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Original research article

A COMPARISON OF THE JUMPING PERFORMANCE OF FEMALE JUNIOR VOLLEYBALL PLAYERS IN TERMS OF THEIR PLAYING POSITIONS

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Abstract. *The aim of this study was to examine the positional differences in jumping performance of female junior volleyball players. Fifty-six female volleyball players (n=56, average age=16.28±1.32) participated in this study. The players were categorized as middle blockers (n = 13), opposite hitters (n = 16), outside hitters (n = 15) and setters (n = 12). The participants performed the Countermovement Jump (CMJ) and Squat jump (SJ) tests using the Myotest and Attack and Block jump tests. The results on the vertical jump tests (CMJ and SJ) show similar values for all the positions in the team and no significant difference (p≥0.05). The same results were determined for the Attack and Block jump tests. The results of this study indicate that there were no significant differences among female junior volleyball players of different playing positions for jumping performance. It cannot be concluded that volleyball players develop distinctive performance characteristics at this age and level.*

Key words: *Countermovement jump, Squat jump, Attack jump test, Block jump test, differences.*

INTRODUCTION

Volleyball is a team sport played at all competitive levels (e.g., youth, Olympic, and professional) and places an emphasis on explosive movements such as jumping, hitting, and blocking (Marques, Gonzalez-Badillo, & Kluka, 2006). It requires players to compete in frequent short bouts of high-intensity exercise, followed by periods of low-inten-

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sity activity (Gabbett & Georgieff, 2007). These high-intensity bouts include both horizontal approach movements (spike jumps, SPJ) and movements without an approach i.e. jump setting, jousts, blocking (Sheppard et al., 2008). Nowadays, elite volleyball players are quicker, stronger and in better physical condition than before, which could be a result of year-round training and developing skills that add strength, power and fitness specific to their sport (Scates & Linn, 2003).

As the number of adolescent girls participating in club sports continues to grow, it is imperative that training requirements and the physical abilities be assessed (Melrose, Spaniol, Bohling, & Bonnette, 2007). Unfortunately, little position- or age-based data exists for adolescent girls who play volleyball. Player profiles created with these types of data are of considerable interest to volleyball coaches because they greatly enhance the recruitment process (Berg & Latin, 1995).

A volleyball squad comprises 12 players with team positions broadly defined as setters, hitters (outside hitter/left side hitter and opposite hitter/right side hitter), middle blockers, and liberos. Each of these positions plays a specific role in a volleyball match (Gabbett & Georgieff, 2006). Considering the specialized role of the various positions in volleyball and the specific tasks involved, it is likely that differences exist in the physiologic characteristics among the playing positions, but this is not well understood (Sheppard, Gabbett, & Stanganelli, 2009). Before the rule changes, positional roles were not so obvious and there were many universal players that could play different roles. High-level competition demands and evolving tactical play strategies have led to an increase in the specialization of player positions (Sheppard et al, 2009). However, there is still only limited information concerning the differentiation of some parameters in volleyball players according to their playing position. If significant differences exist among playing positions, it may provide insight into the physical qualities important for that position. To the authors' knowledge no similar studies that compare jump performance in female junior volleyball players are available. An understanding of the physical profile of junior female volleyball players may be important for talent identification and physical qualities are important for specific positions in the team.

Therefore, the aim of this study was to examine the positional differences in the jumping performance of female junior volleyball players.

THE METHOD

The sample of participants

Fifty-six female volleyball players (n=56, average age=16.28±1.32, Mean±Std.Dev.) participated in this study (see Table 1). The players were members of junior squads from Serbian volleyball clubs that compete in the second division. A few were candidates for the junior female national squad and younger. The players were categorized according to their playing position and role. They were categorized as middle blockers (n = 13), opposite hitters (n = 16), outside hitters (n = 15) and setters (n = 12). All of the participants provided written consent after being informed of the test protocol. All of the volleyball players were subjected to a medical examination to determine their health state, because only healthy athletes could participate in the research along with those whose parents agreed that their children may take part in the research. The protocol of the study was approved by the Ethical Committee of the Faculty of Sport and Physical Education, Univer-

sity of Niš and according to the revised Declaration of Helsinki. Each player had 3-5 years of training experience, corresponding to 2-hour training sessions, and at least 1 competition per week.

Table 1. Group demographics (Mean ± SD).

	Middle blockers	Outside hitters	Opposite hitters	Setters
N	13	15	16	12
Body height	171.9 ±4.5	168.8±3.9	168.0±5.3	167.2±1.6
Body weight	61.6±5.1	60.3±9.2	61.5±8.5	60.5±5.0

Procedures

Testing protocols

The participants were instructed not to be involved in strenuous exercise for at least 48 hours before the fitness testing session and consume their normal pre-training diet before the testing session. Up to 3 trials were given on each jump, with a 1-minute rest between jump test trials. The participants were all tested during the season. Typical practice warm-up was completed before the testing sessions. This warm-up included 10 minutes of general activity (walk, jog, light stretching), followed by 10 minutes of dynamic activity that increased in speed and intensity, followed by 3 to 5 minutes of rest before beginning the testing session.

The players underwent physical tests assessment in an indoor stadium. During the testing, the air temperature ranged from 22°C to 25°C. Testing began at 10 am and finished by 1 pm. Standard anthropometry (height, standing reach height, body mass) and lower-body muscular power were selected for testing. None of the participants had been injured 6 months before the initial testing as well as during the training program. There was no supplement addition to the diet of the players. In addition, the participants were not taking exogenous anabolic-androgenic steroids and other drugs that might be expected to affect physical performance or hormonal balance during this study. Measurements were taken on Monday morning because the athletes had rested during the weekend. The testing session began with anthropometric measurements. The players were then instructed to assess lower-body muscular power. The players were encouraged to perform static stretching between trials.

Body height and body weight were measured according to the instructions of the International Biological Program – IBP.

Body height was measured with a GPM anthropometer (Siber & Hegner, Zurich, Switzerland) to the nearest 0.1cm. Body weight was obtained by TANITA BC 540 (TANITA Corp., Arlington Heights, IL) to the nearest 0.1kg.

Countermovement and Squat Jump Performances

For the purpose of assessing explosive strength, a “Myotest” device was used. The participants performed the vertical jump, Countermovement Jump (CMJ) and Squat jump (SJ). The sample of the variables, processed by the “Myotest” device consisted of the: Height (expressed in cm); Power (expressed in W/kg); Force (expressed in N/kg) and Velocity (expressed in cm/s). The participants carried a belt around their lower trunk, on

which a "Myotest" wireless device was positioned (safely attached to a belt). All of the participants performed three vertical jumps (CMJ), in the following way: from the initial position, i.e., normal standing position and hands placed on hips, through the flexion in the articulations of the knee up to 90º. Following the audio signal of the device, the participants performed the maximum vertical take-off, and landed with affable flexion (up to 110º) in the articulations of the knee and finally, went back to the starting standing position, while waiting for the new sound signal, when the specified jump technique was repeated. In the case when the CMJ was not well performed, a double audio signal informed the participant to properly repeat the specified jumping technique. At the end of the protocol, the software of the "Myotest" device automatically processed the mean values of analyzed variables (Bubanj et al., 2010).

The squat jump (SJ) allows measurement of "non-pliometric" displacement and the ability to develop a great deal of strength within a very short period of time (explosiveness). This test consisted of the person jumping as high as possible with hands on hips from a half-squat position (i.e. 90º bending of the knees). This position was maintained for about 1s. The participants were then instructed to extend the lower limbs, as explosively as possible, with the aim of performing a squat jump. Three attempts were made at this exercise. The best result was retained for analysis.

Attack and block jump performances

For the standing reach, while wearing their normal volleyball footwear, the players were requested to stand with their feet flat on the ground, extend their arm and hand, and mark the standing reach height while standing 90° to a wall. The players were encouraged to fully extend their dominant arm to displace the highest vane possible to determine their maximum standing reach height. The measurement of the standing reach height allowed for a calculation of the relative jump heights on each of the jumping tasks i.e. absolute jump height – standing reach height = relative jump height (Sheppard et al., 2009).

The attack jump (ATJ) and block jump (BLJ) performances for volleyball players depend heavily on the height at which these skills are performed above the net and are determined by not only the ability of the athlete to vertically raise his center of gravity, but also his stature and standing reach. In this particular case, specific tests would provide a further understanding of the training-induced adaptation. For the ATJ, the standing reach was determined as the maximal distance between the fingertip of the attack hand and the ground, while standing laterally next to the wall. The ATJ was measured from a running start (2- or 3-step approach) by using a basketball backboard marked with lines 1 cm apart with a 1-minute rest interval between them. For the BLJ, the standing reach was determined as the maximal distance between the fingertips of the block hands and the ground, while facing the wall. The BLJ jumps started from a standing position with the hands at shoulder level and arms raised from the start position without an extra swing. All of the tests used the same observer who was situated on a volleyball referee stand placed 2 m from the backboard. Both jumps were recorded as the best of 3 attempts (Stanganelli, Dourado, Oncken, Mançan, da Costa, 2008).

The Left foot take-off attack jump (LFAJ) and Right foot take-off attack jump (RFAJ) tests used the same protocol as the Attack jump test. The difference is in the last step and jump which are conducted with the left or right foot, while in the Attack jump the jump is with both feet.

The Left foot take-off block jump (LFBJ) and Right foot take-off block jump (RFBJ) tests used the same protocol as the Block jump test. The difference is in the take-off phase which is conducted with the right or left foot.

The Slide step block jump (SSBJ) test involves moving the lead foot laterally and closing the trailing foot to within 15 cm of the lead foot. The movement is repeated until the desired jumping position is reached.

In the Crossover step block jump (COBJ) test the player crosses one foot in front of the other and begins to move parallel (with running steps, if necessary) in the direction that the initial step was taken. If moving to the left, the player starts with the right foot. From a stationary position, the right foot is crossed over the left; the next step is made with the left foot parallel to and in the same direction as the right. All of the tests used the same observer who was situated on a volleyball referee stand placed 2 m from the back-board. For all the jumps, the best of 3 attempts was recorded and used for analysis. The validity of the RFBJ, LFBJ, RFAJ and LFAJ tests was proven by Milić (2007). The validity of the SSBJ and COBJ tests was proven by Pajić (2011).

Statistical analyses

Data analysis was performed using the Statistical Package for Social Sciences (v13.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for all the experimental data. In addition, the Kolmogorov–Smirnov test of the normality of distribution was calculated for all variables before the analysis. Differences in lower-body muscular power of players were compared using Univariate Analysis of Variance (ANOVA). The statistical significance was set at $p < 0.05$.

RESULTS

The Kolmogorov-Smirnov test has shown that the data were normally distributed. The results for the vertical jump tests (CMJ and SJ) show similar values for all the positions in the team and without significant differences (Table 2). The Outside hitters have shown slightly greater results in the CMJ test (25.59±3.6, Mean±Std.Dev.). In the SJ test Middle blockers and Setters have achieved the smallest values (20.40±5.85 and 20.97±3.43, Mean±Std.Dev.).

Table 2. Positional differences for the tested variables.

	Middle blockers	Outside hitters	Opposite hitters	Setters	p value
N	13	15	16	12	
CMJ	23.49±3.18	25.59±3.6	23.77±4.99	24.32±4.39	.533
SJ	20.40±5.85	23.12±5.66	23.73±5.07	20.97±3.43	.256

CMJ – countermovement jump, SJ – squat jump

The results for Attack jump performance (Table 3) has shown no significant differences between the positions ($p \geq 0.05$). The Outside hitters and Setters have shown slightly greater results in the ATJ test (37.13±7.26 and 39.58±4.35, Mean±Std.Dev.). In the RFAJ test the Middle blockers have shown the smallest values (26.76±4.74, Mean±Std.Dev.).

Table 3. Positional differences for the tested variables.

	Middle blockers	Outside hitters	Opposite hitters	Setters	p value
N	13	15	16	12	
ATJ	35.84±4.68	37.13±7.26	33.31±7.04	39.58±4.35	.068
RFAJ	26.76±4.74	29.6±5.32	29.37±5.52	30.0±5.84	.413
LFAJ	27.84±5.04	30.6±6.29	28.0±5.36	30.75±4.91	.331

ATJ – attack jump, RFAJ – right foot attack jump, LFAJ – left foot attack jump

The results for Block jump performance (Table 4) have shown no significant differences between the positions ($p \geq 0.05$).

Table 4. Positional differences for the tested variables.

	Middle blockers	Outside hitters	Opposite hitters	Setters	p value
N	13	15	16	12	
BLJ	32.53±5.12	31.8±5.44	33.37±4.31	33.83±5.16	.719
RFBJ	23.61±4.29	23.26±3.34	23.81±3.90	22.50±3.75	.826
LFBJ	23.92±4.71	23.13±4.22	23.18±3.37	22.08±4.39	.746
COBJ	32.53±6.78	31.60±6.02	33.31±4.04	34.66±4.53	.523
SSBJ	33.46±5.83	32.46±5.28	32.50±4.53	32.41±4.46	.942

BLJ – block jump, RFBJ – right foot block jump, LFBJ – left foot block jump,
COBJ – crossover block jump, SSBJ – sidestep block jump.

DISCUSSION

Our aim was to examine the positional differences in the jumping performance of female junior volleyball players. This study has shown that there were no positional differences in the jumping performance among female volleyball players. None of the tested variables have shown significant differences between positions on the team. Several studies (Duncan, Woodfield, & Al-Nakeeb, 2006; Sheppard et al., 2009; Marques, van den Tillaar, Gabbett, Reis, & Gonzalez-Badillo, 2009; Trajković, Milanović, Sporiš, & Radisavljević, 2011) have been carried out on positional differences in volleyball, but according to the authors' knowledge, there are no such studies among female junior volleyball players that analyze jumping performance. If significant differences exist, it could be important for training program designs and talent identification for different positions on the team, but as stated above, our results revealed that there were no significant differences in the jumping performance among individual playing positions.

This could be explained by several facts. A possible explanation is the fact that stretch-shortening cycle movement patterns are performed in all volleyball positions similarly (Marques et al., 2009). Moreover, players have similar values for body height and weight, which could contribute to similar results in jumping performance. The players in our research were not elite players, so these results could be expected. In addition, setters have a modest maximal jumping demand compared with middles and outsides, but their total jump demands during match conditions is actually the highest when submaximal jump sets are included in the analysis (Sheppard et al., 2009). For elite players, it should be taken into consideration that a typical match (and therefore match-like train-

ing conditions) likely imposes the greatest stress on middle players when jumping maximally, and that the setter performs a very large volume of sub-maximal jumping (Sheppard et al., 2009). However, the highest physiological stress of the middle player is reduced because the majority of back-court play is done by the defensive specialist - libero.

Previous research has demonstrated the importance of the vertical jump ability in discriminating between national team and non-national team players (Smith, Roberts, & Watson, 1992), but previous research has been inconsistent in establishing the discriminate validity of jumping tests for different playing positions. The closest contribution toward position differentiation in volleyball players came from Viviani & Baldin (1993), who investigated the physical performance of junior players (under 18 years old) and senior players (older than 18 years), compared with those of girls of the same age who did not play volleyball. They found that middle blockers were much taller and heavier than other players, and in general volleyball players were taller and stouter than girls the same age. It is unclear if volleyball players develop distinct physical and performance characteristics even at elite levels. Clearly, more research is needed to illustrate the physical position characteristics in volleyball players.

CONCLUSION

This kind of study could provide practical application for coaches and sport researchers. In-season testing in volleyball can provide coaches with useful information about the players' physical and performance characteristics so that they could place them in specific positions with greater likelihood of high-level performance and team success. The current study provides normative data and performance standards for sub-elite female volleyball players competing in specific individual playing positions. Considering the importance of the jumping ability in volleyball, coaches and sport scientists should aim to develop it as the primary physical components in volleyball players. The results of this study indicate that there were no significant differences among female junior volleyball players of different playing positions for jumping performance. It cannot be concluded that volleyball players develop distinctive performance characteristics at this age and level. Therefore, more studies must be conducted in order to better understand the selection and training process for positional roles and demands.

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POZICIONE RAZLIKE U SKOČNOSTI KOD ODBOJKAŠICA JUNIORSKOG UZRASTA

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Cilj ovog rada je da se ispitaju razlike u skočnosti između pozicija kod odbojkašica juniorskog uzrasta. U istraživanju je učestvovalo 56 odbojkašica (n=56, prosečna starost=16.28±1.32). Igrači su podeljeni na pozicije srednjeg blokera (n = 13), primača servisa (n = 15), korektora (n = 16) i dizača (n = 12). Ispitanici su izvršili testove skočnosti (skok sa počučnjem i skok iz polučučnja) koristeći Myotest i testove skokova za smeč i blok. Rezultati u testovima vertikalnog skoka (CMJ i SJ) pokazuju slične vrednosti za sve pozicije u timu i bez značajne razlike (p ≥ 0,05). Isti rezultati su za testove skok za smeč i blok. Rezultati ovog istraživanja pokazuju da nema značajne razlike u skočnosti između pozicija kod juniorskih odbojkašica. Ne može se zaključiti da odbojkašice razvijaju distinktivne karakteristike uspešnosti u ovom uzrastu i na ovom nivou.

Ključne reči: *skok sa počučnjem, skok iz polučučnja, testovi skok za smeč i blok, razlike.*