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PROFILE AND DIFFERENCES IN ANTHROPOMETRIC DATA AND JUMPING ABILITY PERFORMANCE BETWEEN ELITE AND AMATEUR U16 VOLLEYBALL PLAYERS

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

Research purpose. The purpose of this study is to verify if there are significant differences between different anthropometric and jumping ability variables by testing two groups of elite and amateur volleyball players (under 16) after having submitted the two groups to the same training protocol performed 4 times a week for 4 months.

Materials and methods. The study was carried out on 24 volleyball players divided into two groups. The following anthropometric and jumping ability parameters were assessed in all subjects: height, weight, body mass index, height with a stretched arm and height with two extended arms. The jumping ability measurement was carried out with the Vertec jump test.

Results. The results of the anthropometric parameters showed significant differences between the two groups on all the variables considered: in height ($p = 0.00$), in weight ($p = 0.00$), in Vertec attack with a stretched arm, AH1 ($p = 0.00$) and in Vertec wall with two outstretched arms, AH2 ($p = 0.01$). The results of the jumping ability parameters showed significant differences between the two groups (elite and amateur): in Vertec Wall, VW ($p = 0.00$) and Vertec Attack with run-up, VA ($p = 0.00$); and a high correlation was shown for both the groups.

Conclusions. Above all, in high-level youth volleyball, the anthropometric and jumping ability profile is directly linked to the evaluation; training and continuous monitoring of physical qualities and jumping ability become an important aspect for the control of performance and the possibility of selecting talented players.

Keywords: anthropometric and conditional skills, training, testing, talent selection.

Introduction

Volleyball is a team sport involving short explosive activity bursts, such as serves, receptions, passes, spikes, short sprints, jumps and high-speed movement (Lidor & Ziv, 2010; Hank et al., 2015). Volleyball is classified as an activity with alternating aerobic and anaerobic engagement (Forte et al., 2019a) with a high percentage of body muscle mass and district demands for high strength (D'Isanto et al., 2018). The limited dimensions of the field determine a performance characterized by technical gestures (jumps, attack shots, etc.) at high intensities (Ferrara et al., 2019). The volleyball is a sport considered of attack (Raiola et al., 2016) with technical and physical characteristics where precision and power are a very important aspect to obtain a winning action (D'Isanto et al., 2017) and is a game-sport that includes some aspects of human sciences and science experimental for descriptively analyzing the movement (Parisi & Raiola, 2014).

In modern volleyball the use of the jump and the speed of play is a clear sign of a greater demand for physical strength and the speed of the technical gesture; the aim is to express the power necessary to gain an advantage over the opponent (steal time or acquire a space, a position), overcome or contain it (Alminni et al., 2019). In fact, the explosive dynamic strength, the elevation, and the speed of displacement are selective and determining (Forte & Altavilla, 2018); while physical demands during a training or the match differ from each playing position (Altavilla et al., 2017). In volleyball, a vertical jump is adopted (Forte et al., 2019b), preceded or not by a movement (run-up), generally aimed at increasing its effectiveness; the aim is to express the necessary power in order to gain an advantage over the opponent (steal time or acquire a space, a position), overcome or contain it. Several research has shown that anthropometric and physical variables are able to discriminate players as starters vs. non-starters or elitè vs. amateur (Gabbett et al., 2007; Smith et al., 1992).

The main objective of athletic training and sports participation has always been to improve the performance of players; therefore, the ability to jump together at the anthropometric parameters represent fundamentals quality (Aquino et al., 2019) in this type of sport. The relationship between the potential strength, power, and anthropometric contributors to vertical jump performances is unknown for young jumping athletes. Therefore, the purpose of this investigation was to examine if there were significant differences between anthropometric variables and jumping ability, by testing two groups of Italian Under 16 volleyball players (elite and amateur).

The purpose of this study is to verify if there are significant differences between different variables anthropometric and jumping ability, by testing two groups: elitè and amateur volleyball players (under 16), after having submitted, for 4 months, the two groups to the same training protocol, for 4 times a week.

Materials and methods

Study participants

The sample of subjects included young male volleyball players (n=24), were divided in two groups of 12 with an age (years) elitè = 16.4 ± 0.6 and amateur = 16.5 ± 0.8; height (cm) elitè = 181.3 ± 6.6 and amateur = 173.2 ± 8.1; weight (kg) elitè = 77.2 ± 3.6 and amateur = 71.6 ± 6.7 and BMI (kg/m²) elitè = 23.4 ± 0.5 and amateur = 23.9 ± 0.5. The players had at least four years of training experience and participated at the Italian volleyball Under-16 Championship. The inclusion criteria considered, for young volleyball players, was four years of training experience and participate on average 4 months training sessions; whereas the exclusion criteria was no history of injuries in the last year (i.e. muscles, tendons, bones).

Study organization

The variables investigated were: height (cm); weight (kg); BMI (kg/m²); height with a stretched arm (AH1, cm); height with two extended arms (AH2, cm); Vertec Wall (VW, cm) and Vertec Attack with run-up (VA, cm). The method of detection and analysis of data required the use of following tests and devices: altimeter, electronic scale and vertec jump test. The tests were carried out after having subjected the two groups to the same training protocol 4 times a week for 4 months (Table 1). Vertec jump test was used to measure the elevation in a specific way (Isaacs, 1998), using the technical action of the attack to net (VA) and the technical action of the wall (VW). Each player simulated the attack action with a run-up step (VA) and the wall action (VW). For each test three trials were performed: from the jumps performed only the best result was considered for the statistical analysis. It was possible to calculate the different elevations (with and without the run-up) obtained by the various players, for each group, by jumping with and without run-up (Table 2). Other data has been obtained by evaluating the results obtained by the difference between the measurement of the attack action with a run-up step (VA) and the maximum measure reached by extending the dominant arm (AH1), between the technical action of the wall from a standstill (VW) and the maximum measure reached by completely extending the upper limbs (AH2). The differences calculated between VA-AH1 and VW-AH2 were obtained two values that represents an evident index to evaluate the elasticity and of power of the extensor muscles (Komi & Bosco, 1978) of the lower limbs between two groups. In table 1 is shown the workload (physical, technical and tactical) provided during the four months of intensive training, specifying the distribution of work in hours.

Statistical analysis

All data are presented as mean and standard deviation (Mean±SD). Prior to the parametric analysis, the normality of data distribution was verified by the using Shapiro-Wilk test. The independent-samples t-test was used to examine significance differences for each anthropometrics and jumping ability variables between two groups (elitè and amateur); while homogeneity of variances was checked with Levene's test. The correlations between all the variables considered were calculated using the Pearson correlation coefficient. Type I error was set at α=5% and all statistical analyses were performed with the software IBM SPSS Statistics 23.

Results

Table 1. Weekly training hours report for both two groups

Type of training	Duration, hours
Physical training	2h 00'
Technique	2h 00'
Phases of game	2h 00'
Total	6h 00'

Table 2. Anthropometric and jumping ability values of all players

Variables Mean ± SD (n = 24)	Group A (Elitè) (N = 12)	Group B (Amateur) (N = 12)	Differences (Gr.A – Gr.B)
Age (years)	16.4 ± 0.6	16.5 ± 0.8	+ 0.2
Height (cm)	181.3 ± 6.6	173.2 ± 8.1	+ 8.1
Weight (kg)	77.2 ± 3.6	71.6 ± 6.7	+ 5,6
BMI (kg/m²)	23.4 ± 0.5	23.9 ± 0.5	+ 0.5
AH1 (cm)	239.6 ± 7.6	221.7 ± 17.4	+ 17.9
AH2 (cm)	234.7 ± 6.3	219.0 ± 17.3	+ 15.7
VW (cm)	270.0 ± 17.8	237.3 ± 16.2	+ 32.7
VA with run-up (cm)	292.6 ± 16.9	254.3 ± 16.5	+ 38.3
Differences VA – AH1	+ 53.0	+ 32.6	+ 20.4
Differences VW – AH2	+ 35.3	+ 18.3	+ 17.0

Table 3. Comparison of anthropometric and jumping ability values between groups

Variables	Group A (N = 12)	Group B (N = 12)	t	p
Height	181.3	173.2	2.847	0.00
Weight	77.2	71.6	4.475	0.00
AH1	239.6	221.7	3.117	0.00
AH2	234.7	219.0	2.825	0.01
VW	270.0	237.3	4.479	0.00
VA with run-up	292.6	254.3	5.366	0.00

Table 4. Correlation matrix (anthropometric and jumping ability values)

Group A (Elitè)	Height	Weight	AH1	AH2	VW	VA with run-up
Height	-					
Weight	0.948	-				
AH1	0.917	0.974	-			
AH2	0.963	0.922	0.938	-		
VW	0.822	0.891	0.932	0.939	-	
VA with run-up	0.844	0.924	0.921	0.908	0.971	-

Table 5. Correlation matrix (anthropometric and jumping ability values)

Group B (Amateur)	Height	Weight	AH1	AH2	VW	VA with run-up
Height	-					
Weight	0.978	-				
AH1	0.989	0.985	-			
AH2	0.982	0.984	0.999	-		
VW	0.976	0.991	0.975	0.972	-	
VA with run-up	0.957	0.977	0.979	0.982	0.954	-

Discussion

Table 2 show the mean and the standard deviation of the anthropometric values and of the jumping ability of all the volleyball players considered, as well as the differences between two groups. The results of the comparison of the anthropometric parameters and of the jumping ability between the two groups (elitè and amateur) are shown in table 3. To detect these differences between the different variables considered between two groups (elitè and amateur) t-test for independent groups was used. Regarding the anthropometric data, we obtained significant results for the Height ($t = 2.847$; $p = 0.00$), Weight ($t = 4.475$; $p = 0.00$), AH1 measured with a stretched arm ($t = 3.117$; $p = 0.00$) and AH2 measured with two outstretched arms ($t = 2.825$; $p = 0.01$). The results of the comparison on the Vertec jump test between the two groups showed significant differences for the VW ($t = 4.479$; $p = 0.00$) and for the VA with run-up ($t = 5.336$, $p = 0.00$).

The results of the correlation matrix of the different variables considered between the two groups are shown in the tables 4 and 5. A high correlation was found between the results of the anthropometric parameters and those of the Vertec Test for both groups. From the statistical analysis of the tests, we can say that group A (elitè), compared to group B (amateur), recorded better values, in fact, both for the anthropometric parameters and jumping ability there was a significant difference on all the variables considered. These analyzes show that different elements such as the arm length, the push of the arms in the attack and block jumps, the strength developed by the lower limbs, the use of an effective run-up in the jump phase and the coordination between the movements of the arms and legs, can be decisive for assessing a talented player. The strong correlation between VA and VW could be an indicator of an athlete's ability to transform the accumulated kinetic energy during the run-up phase into potential energy.

The results of the anthropometric parameters, linked to particular morphological characteristics, are already present in the junior phase and can be used among the selection criteria in the identification of talents. The attackers must decrease the flight time to intercept the attacking actions faster and faster, with the ball hit at higher elevated; a greater extension of the arms decreases the flight time needed to intercept the ball. The correct identification of the morphological characteristics and the close connection of these with the technical role becomes at this point decisive for obtaining excellent results. These results confirm, mostly for regarding the elite group is concerned, the link between the morphological characteristics, the orientation towards specialization and the training of muscular qualities (Sands et al., 2005). These qualities result to be fundamental in the choice of the player of talent (elitè). Finally, the analysis of the correlation matrix (for both the groups) shows that all the anthropometric and jumping ability variables are correlated with each other. In agreement with the findings in the literature, we found that power and jump height increase with age (Taylor et al., 2010). Similar study of Sheppard et al., (2008) examined the potential strength, power, and anthropometric contributors to vertical jump performances that are considered specific to volleyball success. The results of this study clearly demonstrate that in an elite population of volleyball players, stretch-shortening cycle performance and the ability to tolerate high stretch loads, as in the depth jump, is critical to performance in the jumps associated with volleyball performance. Another study of Aouadi et al. (2012) showed that age, weight, standing height and fat-free mass were the predictors of jumping performance.

Thus, the measurement of anthropometric characteristics, such as stature and lower limb length may assist coaches in the early phases of talent identification in volleyball. The results may help in verifying the effectiveness of a specific training program and detecting highly talented athletes. This study present a limited sample, instead with a much more wide sample it is could come to stronger conclusions. Finally a possible future research might be to repeat the study on a female sample and then to compare the data obtained with the male sample to detect performance and abilities differences, in quantitative and qualitative terms.

Conclusions

There are significant differences between the two groups (elitè and amateur) both in the characteristics anthropometric that in the jumping ability. In particular, the group A (elitè) confirms that high-level volleyball players have an anthropometric and conditional profile directly linked to specific variables such as height, neuromotor coordination and jumping ability. Modern volleyball, due to the reduced duration of play and increasing intensity of rhythm; therefore, we increasingly need tall, fast and powerful athletes. In addition, due to the reduced duration of the game actions and the increasing intensity of the pace, we are increasingly in need of tall, fast and powerful athletes. The evaluation, training and continuous monitoring of physical qualities and jumping ability become an important aspect for the control of performance and the possibility of selecting talented players.

Conflict of interest

The authors declare that there is no conflict of interest.

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ПРОФІЛЬ ТА ВІДМІННОСТІ В АНТРОПОМЕТРИЧНИХ ДАНИХ І ПОКАЗНИКАХ СТРИБУЧОСТІ МІЖ ВОЛЕЙБОЛІСТАМИ ВИСОКОГО КЛАСУ ТА АМАТОРСЬКОГО РІВНЯ ВІКОМ ДО 16 РОКІВ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 5 с., 5 табл., 21 джерело.

Мета дослідження. Метою цього дослідження є перевірка наявності суттєвих відмінностей між різними змінними антропометричних даних і показників стрибучості шляхом тестування двох груп волейболістів віком до 16 років: високого класу та аматорського рівня – після виконання обома групами того самого протоколу тренувань по 4 рази на тиждень протягом 4 місяців.

Матеріали та методи. Дослідження проводили на 24 волейболістах, розподілених на дві групи. В усіх учасників оцінювали наступні параметри антропометричних даних і показників стрибучості: зріст, вага, індекс маси тіла, зріст із витягнутою вгору рукою та зріст із витягнутими вгору обома руками. Вимірювання показників стрибучості здійснювали за допомогою тесту на висоту стрибка вгору з використанням пристрою «Vertec».

Результати. Результати вимірювання параметрів антропометричних даних показали суттєві відмінності між обома групами за всіма взятими до уваги змінними: у зрості (p = 0,00), у вазі (p = 0.00), у тесті Vertec «Стрибок з атакою» з однією витягнутою рукою, AH1 (p = 0,00) і в тесті Vertec «Стрибок із блоком» з двома витягнутими руками, AH2 (p = 0,01). Результати вимірювання параметрів показників стрибучості показали суттєві відмінності між обома групами (високого класу та аматорського рівня): у тесті Vertec «Стрибок із блоком», VW (p = 0,00) і в тесті Vertec «Стрибок з атакою» з розбігу, VA (p = 0,00); також результати показали високу кореляцію для обох груп.

Висновки. Перш за все, у юнацькому волейболі високого рівня профіль антропометричних даних і показників стрибучості безпосередньо пов'язаний з оцінкою; тренування та безперервний контроль фізичних якостей і показників стрибучості стають важливим аспектом контролю результативності та можливості відбору талановитих гравців.

Ключові слова: антропометричні та обумовлені навички, навчання, тестування, відбір талантів.

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