Journal of Advanced Sport Technology *7(4):1-10.*

Received: September, 29, 2023 *Accepted: December, 24, 2023*

Original Research

Investigate the Most Important Characteristics of Elite Volleyball Players for Sports Talent Identification

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ABSTRACT

This research aimed to investigate the most important characteristics of elite volleyball players to identify sports talents. 150 elite and 150 non-elite volleyball players were selected by random sampling and accessible to perform the tests. The measured variables included anthropometric indices, physiological abilities, psychological characteristics, and skill abilities. Independent t-test and the Mann-Whitney statistical test were used to compare the variables of the two groups. Principal component analysis was used to determine the main variables. The significance level of 0.05 was considered. The result showed the variables of height, arm span index, brachial index, leg cororal index, aerobic power, anaerobic power, vigor, hand grip strength, Sargent's jump, spike jump, overhead serve, forearm, and overhead pass in elite volleyball players were significantly higher than in non-elite players. Variables of weight, body mass index, sitting height index, waist-to-hip circumference index, tension, and anger were significantly higher in non-elite players than in elite players. By using principal component analysis, the most important variables in the research to identify elite volleyball players were obtained, respectively: height, overhead serve and forearm pass, vigor, sitting height index, brachial index, spike jump, and anaerobic power. In the current research, the differences between the elite and non-elite groups, along with the most important variables from the anthropometric, physiological, psychological, and skill areas of the elite volleyball players, were obtained, and the main variables for the identification of sports talent were determined.

Keywords: Anthropometry, Sports talent identification, Volleyball

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INTRODUCTION

Volleyball is one of the most popular and attractive sports among different communities. Therefore, to be among the top 10 in the world, the national teams of different countries need to develop talent identification programs to discover and nurture elite athletes in this sport. Unfortunately, despite the importance of talent identification and identifying elite players in volleyball, there are very few documents and studies related to talent identification in volleyball [1]. For the development of championship sports, talent identification is a key element that aims to evaluate and recognize players with specific skills and competencies to achieve success [2, 3].

Sports talent identification represents our judgment about people's future performance based on their current skills and abilities [4]. Various studies have tried to identify a wide range of variables that have the greatest impact on volleyball players' sports success. Despite this, there is no specific set of variables for sports talent identification in volleyball [5–7]. In recent years, talent identification programs have become very popular and are considered a fundamental solution to maximize the potential of athletes to achieve success [8]. Since the successful performance of a volleyball player depends on several factors for excellence, many researchers have tried to use different variables to predict and identify sports talents [5, 7, 9]. Therefore, coaches must be fully familiar with the necessary variables for identifying sports talent, and a lack of knowledge about anthropometric differences, physiological abilities, psychological characteristics, and skill abilities in athletes, specialists, coaches, parents, and even the athlete will lead him in the wrong direction, which causes huge financial and time costs, frustration for the athlete himself, and most importantly, a sharp drop in the championships of the countries' sports teams [10, 11]. Therefore, knowing these characteristics not only gives the coaches of the national team enough confidence in terms of choosing volleyball players for short-term planning but also enables them to design long-term strategies [12, 13].

Most of the research that has been conducted in the field of sports talent identification, especially in the field of volleyball, has examined a small number of anthropometric or physiological variables with a low number of statistical samples, and other important talent identification factors such as skill abilities and psychological characteristics have been neglected [5, 7, 14, 15]. Milić et al. (2016) investigated the anthropometric and physiological characteristics of female volleyball players according to different game positions. Their results showed that volleyball players in different positions of the game do not differ in mass, body mass index, or physical performance variables, but only libero players were shorter than others [16]. Tsoukos et al. (2019) investigated movement and anthropometric performance variables to determine the main factors in the selection of the Greek women's national volleyball team. This study showed that height, body mass index, speed, and agility were critical in choosing volleyball players [16]. Rubajczyk and Rokita (2020) investigated the effect of relative age on the talent factors of volleyball players in Poland. The results showed that the chronological age and level of maturity of players can affect physical characteristics as well as movement abilities [17]. As mentioned, most studies have investigated anthropometric variables in volleyball players. Gabbett & Georgieff (2007) stated that successful players should have a high level of physical, physiological, psychological, and anthropometric variables [10].

Therefore, for intelligent and scientific talent identification, we need to investigate and recognize the most important anthropometric indices, physiological abilities, psychological characteristics, and skill abilities of elite volleyball players. By using the review and analysing these characteristics, elite volleyball players can be distinguished from non-elite players. Therefore, the purpose of this research was to investigate the difference between elite and non-elite players in different physical and psychological characteristics and to use the principal component analysis method to identify the characteristics of elite volleyball players for sports talent identification.

MATERIAL AND METHODS

Participants

The statistical population of the present study included all elite and non-elite juvenile male volleyball players in Iran. The subjects attended the laboratory on two different days. Once for anthropometric and skill tests, and once for physiological and psychological tests. 150 elite juvenile male volleyball players

were selected to perform the tests. The criteria for their entry into the research was to have at least a national championship or membership in the national team or club teams in the A or B volleyball league. Also, another group was formed by 150 non-elite juvenile males who were selected from the non-elite volleyball athletes who participated in school competitions.

The criteria for their entry into the research were not having professional sports experience in the field of volleyball and not having sports experience of more than 2 years. All the subjects were selected by random and accessible sampling. Exclusion criteria were having a neuromuscular disorder or injury in the past 6 months. An elite refers to players who have achieved an ideal level of skill [18]. In this study, players who had a history of membership in clubs and national teams were considered elite [19].

Procedures

Measurement of anthropometric variables

Body height and mass were measured using a Sahand BS100 digital device made in Iran with an accuracy of 0.1 cm and 0.1 kg. Body mass index, sitting height index (ratio the height of the upper body to the standing height), arm span index (ratio of the length of the open hands to the total standing height, the distance between the tips of the middle fingers of both hands in the open position to the total height), forearm brachial index (ratio of the open length of the forearm, from the elbow marker to the tip of the middle finger, to the length of the whole hand, from the acromion process marker of the shoulder to the tip of the middle finger), leg cororal index (ratio of leg length, from the medial epicondyle tibia marker to the sole of the foot, to the total length of the lower extremity, from the greater trochanter marker to the sole of the foot), Pelvic/Shoulder-width index (the ratio of pelvic width from the location of the iliac crest markers on the left and right sides to shoulder width from the location of the two acromion process markers on the left and right sides), Waist/Shoulder circumference index (the ratio of the largest buttock circumference to the shoulder girdle circumference from the location of the two acromion process markers on the left and right sides) and Waist/Hip index (ratio of the narrowest part of the waist circumference to the largest part of buttock circumference were measured. From the set of anthropometric measurement tools model KDS made in Iran, including a Lufkin meter was used to measure circumferences with an accuracy of 0.1 cm, a Segmentometer was used to measure lengths with an accuracy of 0.1 cm, and a Caliper was used to measure widths with an accuracy of 0.1 cm. Each variable was measured three times, and the average data was used for analysis [20, 21, 22].

Measurement of physiological variables

Aerobic power was measured by Bruce's test, and anaerobic power was measured by Wingate's test. A treadmill (American Horizon Fitness treadmill, Omega GT) was used to measure aerobic power. Bruce's seven-step test was such that by increasing the running speed and incline of the treadmill, the subject became extremely tired, and finally, the activity time was recorded and used to estimate the maximum oxygen consumption [23]. A Monark Ergomedic 894E made in Germany was used to measure anaerobic power. First, the subject should pedal as fast as possible with zero resistance, and then the training load should reach the maximum rhythm for 3 to 4 seconds, or about 1 Newton per kilogram of body weight. After adding the test load, it continued to operate for 30 seconds. The peak power calculation was obtained in the first 5 seconds [24]. A digital hand grip strength model (DSI) made in Iran with an accuracy of 0.1 kg was obtained using a digital hand dynamometer. This test was performed three times, and then the strength of each person was measured with his weight [25]. For Sargent's jump test, the subject raised his dominant hand as high as he could while the soles of his feet were on the ground, and that point was marked. This point was considered the base point, or the point reached by the subject while standing. Then he jumped up and touched the measuring board with his dominant hand, which was covered in powder. The average of three jump times was calculated. The method of scoring was the difference between the maximum height of the hand in the standing position and the score obtained from the peak of the jump [26]. To measure the spike jump test, the subject, after taking three steps, jumps up one foot or two feet. Then he jumped up and touched the measuring board with his dominant hand, which was covered in powder. The average of three jumps will be calculated. The method of scoring was the difference between the maximum height of the hand in the standing position and the peak of the jump [27].

Measurement of skill variables

All participants performed the overhead serve, forearm pass, and overhead pass exercises from the AAHPERD Volleyball Skills Test [28]. The subject had to stand on the baseline, halfway between the two end corners, for the overhead serving test. Depending on where the ball landed on the opposing court after it was served, a point value was assigned. This point value was predetermined from marked areas within the court, ranging from 1-4 points. If the ball lands outside the designated area or hits the net, zero points are assigned. Each examinee was served twice and 10 times each time, and the sum of the best scores in the region was recorded. The forearm pass test required the participant to stand rear-midcourt, receive the ball from midcourt, and send the ball over an 8-foot-high rope into a target area in the right and left front corners, which were 10 feet from the net. The average of 20 attempts from each side will be calculated. The participant in the overhead pass test had to stand on either the right or left front court, receive the ball from midcourt, and send it over a 10-foot-high net [four feet from the net) and into a target area at the center front court. 10 repetitions will be done from the right side and 10 repetitions from the left side. Each repetition will have one point, and the average of the repetitions from the left and right sides will be recorded as a score. For both the forearm pass and the overhead pass, participants received 1 point if the ball went over the net and into the target area, while all other ball placements received a zero [29, 30].

Measurement of psychological variables

The profile questionnaire of mood states (tension, anger, fatigue, depression, confusion, and vigor, which included a total of 65 questions) was used. The scoring of the questionnaire was of the Likert type. There were 5 options for each question: not at all, a little, medium, almost a lot, and a lot. Each option was awarded from zero to four points, respectively [31].

Statistical Analysis

In this study, the Kolmogorov-Smirnov test (K-S) was used to determine the normality of the data distribution. To compare the data obtained from two elite and non-elite groups, an independent t-test was used for parametric data, and a Mann-Whitney U test (U) was used for non-parametric data. Principal component analysis (PCA) was used to determine the main variables. A significance level of 0.05 was considered.

RESULTS

The mean and standard deviation of the measured variables for two elite and non-elite groups are shown in Table 1. The data relating to mass, body mass index, arm span, leg cororal, pelvic/shoulder width, waist/shoulder circumference, and anaerobic power had a normal distribution, while other research variables did not have a normal distribution. The variables of height, arm span, brachial index, leg cororal, aerobic power, anaerobic power, vigor, hand grip strength, Sargent's jump, spike jump, overhead service, forearm pass, and overhead pass in elite players were significantly higher than in non-elite players. The variables, weight, body mass index, sitting height index, pelvic /shoulder width, tension, and anger, were significantly higher in non-elite players than in elite players. The variables age, and waist/shoulder circumference index did not show significant differences between the two groups.

Table 1: Comparison of mean and standard deviation of measured variables in elite and non-elite volleyball players.

Variables	*Mean ± SD*		*P-Value*		
	Elite	*Non-elite*	*t-test*	*U*	*K-S*
Age (years)	18.6±0.6	18.2±1.9		0.15	0.001
Height (Cm)	180.5±6.3	177.8±3.7		0.001	0.11
Mass (Kg)	61.9±2.2	65.8±3.7	0.001		0.2
BMI (Kg/m2)	21.2±1.6	22.5±1.2	0.021		0.081
Sitting height index	51.6±1.5	52.3±1.4		0.011	0.04
Arm span	183.9±3.6	178.5±2.7	0.001		0.02
Brachial index	37.6±3.1	35.7±1.8		0.04	0.043
Leg cororal index	83.9±5.7	82.4±7.1	0.012		0.2
Pelvic /Shoulder-width index	72.7±6.1	77.1±5.3	0.001		0.68
Waist/Shoulder circumference index	67.3±2.5	66.9±3.2	0.14		0.15
Waist/Hip index	0.76±0.06	0.82±0.03		0.015	0.001
Aerobic power (ml/kg/min)	44.5±2.8	42.8±3.4		0.016	0.007
Anaerobic power (W/kg)	7.4±1.9	6.1±1.5	0.011		0.2
Tension	12±2.7	15±3.1		0.001	0.001
Anger	13±4.2	14±3.8		0.001	0.001
Fatigue	6±2.9	6±3.2		0.165	0.001
Depression	12±4.3	13±3.5		0.294	0.001
Confusion	7±2.3	8±4.5		0.081	0.001
Vigor	24.9±5.2	15.9±3.6		0.001	0.001
Hand grip strength test (Kg)	27.3±2.8	24.1±3.2		0.001	0.001
Sargent jump test (Cm)	48.7±5.8	35.6±4.5		0.023	0.001
Spike jump test (Cm)	52.7±4.2	40.9±7.1		0.014	0.029
AAHPERD overhead serve test	22±4	15±6		0.001	0.001
AAHPERD forearm pass test	10±3	6±3		0.001	0.001
AAHPERD overhead pass test	11±3	9±3		0.001	0.001

The PCA method was used to identify the most important measured variables. In this research, any variable that had a factor loading of less than 0.6 was removed [32, 33]. According to the results obtained from elite juvenile volleyball players, eight factors were highlighted, which included 92.58% of the variance of the total data. According to Table 2, the most important research variables of elite volleyball players were determined in order: height, overhead service, forearm pass, vigor, sitting height index, brachial index, spike jump, and anaerobic power.

Variables	*Factor1*	*Factor 2*	*Factor 3*	*Factor 4*	*Factor 5*	*Factor 6*	*Factor 7*	*Factor 8*
Height (Cm)	0.939							
AAHPERD overhead serve		0.909						
AAHPERD forearm pass			0.902					
Vigor		0.868						
Sitting height index					0.827			
Brachial index					0.825			
Spike jump test (Cm)							0.822	
Anaerobic power (W/kg)								80.6

Table 2: Factor loading of the description of Principal Component Analysis (PCA) with varimax rotation.

DISCUSSION

Knowing the different characteristics of each sport is one of the most important and fundamental factors in the performance of athletes and a prerequisite for sports talent identification. As stated in the results, significant differences were observed in various variables between the two elite and non-elite players, which can be used to formulate a scientific approach to sports talent identification. Past studies also stated a significant difference in the anthropometric characteristics of volleyball athletes to identify sports talent [5, 16]. In this study, anthropometric variables, including height, arm span, brachial index, and leg coronal, were more common in elite players than non-elite players. In the analysis of the principal components, it was found that the height, sitting height index, and brachial index of elite players were important variables in the measured characteristics of elite players. The sitting height index of elite players was lower than that of non-elite players, which is an advantage for volleyball players. A smaller upper body makes the center of gravity for these players higher than others, which is considered an advantage for jumping, and they will perform better in jumping skills [34]. The brachial index also shows that elite players have longer forearm lengths and will perform better in receiving the ball, which will be an advantage for volleyball players. Therefore, it is recommended to pay more attention to the two indexes of sitting height and brachial index in talent identification programs. Due to the nature of volleyball, which involves alternating jumping and landing, the players must have relatively high anaerobic power. Anaerobic power is one of the most important physiological characteristics of volleyball players [35]. The main energy systems in volleyball consist of phosphagen and glycolysis [36]. In this study, the aerobic and non-aerobic power of elite players was higher than that of non-elite players. Also, in the analysis of the results of the principal component analysis, it was found that anaerobic power was one of the main factors among the measured variables. Therefore, according to the nature of volleyball, it seems that anaerobic capacity is a suitable variable for sports talent identification. Psychological characteristics are considered to be the most important part of athletes' success, and in team sports, psychological interactions between team members can be effective in improving team performance [37]. Despite the importance of psychological characteristics in the sports performance of athletes, unfortunately, this has not been seriously considered by researchers, and there were few studies in this field. In this study, we saw a significant difference between elite and non-elite volleyball players in various variables, which shows that these characteristics should be considered an important and fundamental variable for sports talent identification. Players may get a high score in anthropometric and physiological characteristics, but due to a low score in psychological skills, a lack of ability in team activities, and a lack of control over their emotions, they cannot succeed in volleyball [38]. Musa et al. (2022) showed in their study that elite players have higher mental performance than individuals and that psychological characteristics can affect team tactics and team performance during matches [37]. In this study, tension and anger in non-elite players were significantly higher than in elite players, and vigor in elite players was significantly higher than in non-elite players. In the analysis of the principal components, the vigor variable was recognized as one of the principal components. Therefore, it is suggested that psychological variables be taken into consideration to identify and discover talent. Volleyball players perform frequent jumps in five-game sets, and this feature is one of the important factors in the progress and success of volleyball athletes. Players who are more capable of jumping will perform better in volleyball. Trajković et al. (2011) and Lidor et al. (2007) showed that spike jumping skill was a suitable characteristic to determine elite and non-elite players [6, 39]. Gabbett and Georgieff (2007), in their study on the anthropometric and physiological characteristics of teenage volleyball players, stated that skill variables were also very important for talent identification and should be considered in the talent discovery program [10]. In this study, a significant difference in jump, pass, and spike skills was observed between elite and non-elite volleyball players, and in the examination of the basic components, service, spike, and jump spike skills were identified as principal components for elite players, and therefore, these skills are suggested to be considered for scientific talent identification.

CONCLUSION

According to the results of the present study, psychological and skill variables should also be taken into consideration to scientifically identify sports talent, in addition to anthropometric and physiological variables. Anthropometric variables, including the sitting height index and brachial index, are useful variables for talent identification and can be considered by sports coaches. Anaerobic capacity was identified as the most important physiological ability of elite volleyball players. The most important psychological variable of elite volleyball players, vigor, and the most important skill variables, overhead serve, forearm pass, and spike jump, were obtained. Using this information, you can design a sports talent search model for volleyball and reduce the time for sports talent identification.

Author Contributions: BH has done the initial idea of reading and writing the article, and laboratory work has done the coding process of the data. MA has written and prepared the initial and final draft, supervised the data collection, and revised the article.

Funding: This research received no external funding.

Institutional Review Board Statement: The design of this study has been registered with the Ethics Committee of Bu Ali Sina University with the unique identifier IR.BASU.REC.1402.027.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data will be available at request.

Acknowledgments:

The authors are grateful to the subjects who participated in this study. This article is an extract from the post-doctoral project with a memorandum of understanding of the Iran National Science Foundation and Bu Ali Sina University, entitled "Designing an artificial neural network for detecting talent indicators in volleyball" with project code 4000781.

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بررسی مهم ترین ویژگی های والیبالیست های نخبه جهت استعدادیابی ورزشی

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چکیده:
این پژوهش با هدف بررسی مهم‌ترین ویژگی‌های والیبالیست‌های نخبه برای شناسایی استعدادهای ورزشی انجام شد. ۱۵۰ والیبالیست نخبه و ۱۵۰ والیبالیست غیر نخبه به روش نمونه گیری تصادفی و در دسترس برای انجام آزمون انتخاب شدند. متغیرهای اندازه‌گیری شده شامل شاخص‌های آنتروپومتریک، توانایی‌های فیزیولوژیکی، ویژگی‌های روان‌شناختی و توانایی‌های مهارتی بودند. برای مقایسه متغیرهای دو گروه از آزمون t مستقل و آزمون آماری من ویتنی استفاده شد. سطح معنی داری ۰،۰۵ در نظر گرفته شد. برای تعیین متغیرهای اصلی از تحلیل مؤلفه های اصلی استفاده شد. نتایج نشان داد که متغیرهای قد، شاخص طول دست باز، شاخص براکیال ساعد، شاخص کرورال ساق، توان هوازی، توان بی هوازی، قدرت، قدرت گرفتن دست، پرش سارجنت، پرش اسپک، سرویس بالای سر، پاس ساعد و پاس بالای سر در والیبالیست‌های نخبه به طور معنی داری بیشتر از بازیکنان غیر نخبه بود. متغیرهای وزن، شاخص توده بدنی، شاخص قد نشستن، شاخص دور کمر به باسن، تنش و خشم در بازیکنان غیر نخبه به طور معنی داری بیشتر از بازیکنان نخبه بود. با استفاده از تحلیل مؤلفه‌های اصلی، مهم‌ترین متغیرهای تحقیق برای شناسایی والیبالیست‌های نخبه به‌ترتیب قد، سرویس بالای سر و پاس ساعد، قدرت، شاخص قد نشسته، شاخص براکیال ساعد، پرش اسپک و توان بی‌هوازی به‌دست آمد. در پژوهش حاضر، تفاوت بین گروه های نخبه و غیرنخبه همراه با مهم ترین متغیرها از حوزه های آنتروپومتری، فیزیولوژی، روان شناختی و مهارتی والیبالیست های نخبه به دست آمد و متغیرهای اصلی برای شناسایی استعدادهای ورزشی. مشخص شدند.
واژگان کلیدی: آنتروپومتری، استعدادیابی ورزشی، والیبال