Journal of Sports Research and Innovation
ISSN: 2956-980X

Original Research Article

Motor fitness of cadet volleyball players

Monika Vašková[1], Jaroslav Sučka[2], Simona Slivošová[3]

[1] University of Presov, Faculty of Sports, Department of Sports Educology and Humanistics, Presov, 08001 Slovakia
[2] University of Presov, Faculty of Sports, Department of Educology of Sports, Presov, 08001 Slovakia
[3] Independent researcher
*Correspondence: monika.vaskova@unipo.sk

Abstract

Background: Motor fitness is determined by the developmental rate of particular motor abilities. A player's performance is influenced by many factors, but motor abilities remain the primary factor among them. Regular assessment of motor fitness offers insight into the players' physical capabilities and enables evidence-based, individualized training interventions, supporting optimal athletic development and maximizing performance on the court. The purpose of the study was to assess the motor fitness level of cadet volleyball players. **Methods**: A total of 15 volleyball players participated in the study. The following six physical fitness tests were administered to determine their motor fitness level: standing long jump, 4 x 10 shuttle run, 2 kg medicine ball throw, sit-and-reach, sit-ups in 1 minute, and 20m multi-stage shuttle run. The descriptive statistics were used to compute the mean and standard deviations for somatic parameters and physical fitness tests. The test scores were classified based on established performance standards for cadet volleyball players. **Results**: The results revealed that the mean test scores for 4x10 shuttle run and sit-and-reach met performance standards. However, the scores on standing long jump, 2 kg medicine ball throw, and sit-ups in 1 minute indicated a low level of motor fitness. **Conclusions**: The results confirmed the necessity to enhance motor fitness in young players and develop, especially, the explosive power of lower and upper limbs and dynamic core endurance. Improving these specific areas is crucial for maximizing sports performance and meeting the physical requirements at this developmental stage.

Keywords: motor abilities, sports training, performance standards, volleyball

Introduction

Changes in world volleyball, such as maximizing content, structure, and increasing demands on players in physical, mental, and technical-tactical areas, highlight the need to find the most effective ways to optimize and support players' performance [1].

To meet the high demands of the game, players should be well prepared not only technically and tactically but also physically [2]. Motor fitness level is crucial for players' effectiveness [3,4,5,6]. Volleyball is characterized by short, explosive movements, agile and quick positioning, jumps, and blocks [7]. Therefore, a volleyball player´s "kinanthropometric" profile includes height, muscular power, speed, and coordination. These abilities are essential for a game that requires power and height for blocking, power and quickness for spiking, endurance to play the sets, and excellent technical skills [8,9].

Received: 12.08.2025

Reviewed: 29.08.2025

Published: 16.09.2025

The goal of the training process is to develop a successful adult athlete at both the national and international levels [10]. Relevant information about issues related to the training process, such as physical characteristics of adolescent players, physiological attributes, and volleyball skills, can be effectively used in strength and conditioning programs specifically developed for young players [11].

Regular assessment of motor fitness provides insight into players' motor abilities and supports evidence-based training programs, encouraging optimal athletic development and maximizing sports performance on the court. Therefore, the purpose of our study was to assess the motor fitness level of cadet volleyball players.

Material and Methods

Sample

The research sample consisted of 15 male cadet volleyball players from the VK Mirad UNIPO Prešov volleyball club. The players take part in a training process that includes four training sessions and one match per week.

Methods

Before administering motor fitness tests, basic somatic parameters were measured. Body height was measured in centimeters to the nearest tenth using a stadiometer SECA 213 (Medical Measuring Systems and Scales, Hamburg, Germany). Body weight was measured in kilograms to the nearest tenth using the multifrequency segmental bioelectrical impedance analysis method with the InBody 230 device and Lookin'Body 3.0 software (Biospace, Seoul, South Korea). Descriptive statistics of the players' somatic parameters are presented in Table 1.

Table 1. Descriptive statistics of somatic parameters

n	Age (years)	Sports age (years)	Body height (cm)	Body weight (kg)	BMI (kg.m^{-2})
			x ± SD		
15	16.71±1.29	5.80±2.94	186.53±5.82	78.56±13.72	22.60±3.71

n – sample size; x – arithmetic mean; SD – standard deviation; cm – centimeter; kg – kilogram; kg.m^{-2} – kilogram per square

The following six tests were administered to determine players´ motor fitness levels: standing long jump, 4x10m shuttle run, 2kg medicine ball throw, sit-and-reach, sit-ups in 1 minute, and 20m multi-stage shuttle run. Test scores were classified using performance standards for the cadet volleyball players [12].

Statistical analysis

The descriptive statistics were used to compute the arithmetic mean and standard deviation for particular somatic parameters and physical fitness tests. Statistical analysis was performed using IBM SPSS Statistics 27 software.

Bioethics committee

Participants received a verbal description of the study procedures before testing, and their legal representatives completed a written informed consent. The research was approved by the Ethics Commission of the University of Presov in Presov (no. ECUP062024PO). Measurements were taken according to the ethical standards of the Declaration of Helsinki [13].

Results

The current motor fitness levels of cadet volleyball players are shown in Table 2. The results revealed that the mean test scores for the standing long jump, 2 kg medicine ball throw, and sit-ups in 1 minute are below the established performance standards for the cadet age category. However, the mean test score for the sit-and-reach test meets the performance standards.

Table 2. Motor fitness levels of cadet volleyball players

Test	x±SD	95% CI	CV%	min/max
standing long jump (cm)	253.40±21.3	241.18-265.62	8.71	214.0/287.0
4x10 shuttle run (s)	9.95±0.35	9.75-10.16	3.66	9.28/10.65
2kg medicine ball throw (m)	12.19±1.64	11.25-13.14	13.97	8.50/14.73
sit-and-reach (cm)	10.26±7.21	6.13-14.4	72.72	-5.0/24.0
sit-ups in 1 minute	49.60±4.25	47.16-52.04	8.88	42.0/59.0
20m multi-stage shuttle run	66.26±17.25	56.37-76.15	26.94	39.0/100.0

x – arithmetic mean; SD – standard deviation; CI - confidence interval; CV – coefficient of variation; min – minimum; max – maximum; cm – centimeter; m – meter; s – second

Discussion

The performance in volleyball depends on many factors; however, conditioning remains one of the key elements, even though it does not directly determine the final result [10].

Volleyball players need a high level of lower body muscular power to perform jumping, spiking, and blocking, which are frequently performed during a match. The standing long jump was administered to test players' lower body muscular power. Standing long jump performance was compared to the standards established for cadet volleyball players [12]. Of the entire sample, only two players met the performance standard. Compared to the study by Pogoni and Lleshi [14], which tested young volleyball players in Albania, our participants achieved a higher mean value by 74.5 cm. However, to compare the results reported by Lidor et al. [15], our participants achieved a lower mean value by 3.6 cm.

Agility and speed are essential for volleyball players. They allow quick responses to the fast and unpredictable game. Rickta et al. [16] used the 4x10 m shuttle run in their research on junior national and academic volleyball players. The results revealed that the average time of volleyball players representing the national team was 9.3 seconds, indicating a higher level of running speed with changes of direction compared to our participants. On the other hand, compared with academic volleyball players, our participants achieved a lower mean value by 0.11 seconds.

The ability to generate a high level of upper body muscular power during spiking and serving is a crucial attribute for a volleyball player [17]. Our results showed that the mean test scores of all players for the medicine ball throw did not meet the performance standards [12]. Of the entire sample, only three players achieved the performance standard of 14 meters. Compared to the mean test scores achieved by 17-year-old volleyball players in Belgrade [18], Slovak volleyball players demonstrated a higher level of upper body muscular power. Our players achieved a higher mean value by 3.7 meters. These findings suggest that, although our players currently outperform their age-matched counterparts, there remains a necessity for further enhancement, particularly through targeted upper-body strength training.

The sit-up test was administered to assess players' abdominal muscle strength and endurance. The performance standard for the cadet category is 60 repetitions in 1 minute [12]. None of the participants met the performance standards. We compared the results of our study with Ghosh [19]. The difference in the mean values was 6.3 repetitions in favor of our volleyball players. This suggests that while our players may have relatively better abdominal strength and endurance, their current level still falls short of the required standards for the cadet category. Therefore, strength and conditioning programs should include core training to enhance abdominal strength and endurance.

An adequate level of flexibility improves motor learning effectiveness, enhances movement efficiency, and reduces the risk of injury. The sit-and-reach test was administered to assess the lower-back and hamstring flexibility of volleyball players. The performance standard for the cadet category is 10.0 cm [12]. However, only 7 out of 15 participants met this standard. Interesting results were reported by Gulati et al. [20], who examined the impact of high and low levels of flexibility on the performance indicators of volleyball players. The mean value of volleyball players was 13.8 cm, which is 3.5 cm better than the mean value of our players. Emphasis should be placed on dynamic and static stretching exercises for the lower back and hamstrings.

Although volleyball is characterized by intermittent play, a high aerobic capacity remains essential, particularly in multiset matches where sustained performance over time is required [21]. The 20 m multi-stage shuttle run was administered to assess players' aerobic endurance and cardiovascular fitness. The VO_2 max mean value of our participants was 39.2 ml/kg/min. Compared with the results reported by Nasuka et al. [22], the endurance level demonstrated by our volleyball players was lower than the endurance level of their peers in the mentioned study (47.76 ml/kg/min). However, in comparison to the results reported by Fauzi et al. [23], our players achieved a higher VO_2 max mean value by 8 ml/kg/min.

Limitations of the study

A limitation of this study is the small sample size (n = 15), which may reduce the statistical power of the analyses and limit the extent to which the findings can be generalized to broader populations. Future studies with larger and more diverse samples are needed to confirm these results.

Conclusions

Regular assessment and monitoring of motor fitness are essential tools for coaches in designing individualized and effective training plans that align with the specific needs of young players and improve their performance on the court.

Our study findings revealed that cadet volleyball players possess certain strengths and areas needing improvement to meet the sport's demands. While agility and flexibility show promising levels, lower and upper body explosive power and core endurance remain below established performance standards. Therefore, training interventions aimed at enhancing explosive power and core stability are necessary to optimize athletic performance and support the physical development of young players.

However, the small sample size remains a limitation of this study. Future research with larger samples is recommended to strengthen the evidence for targeted training interventions in youth volleyball.

Author Contributions: Authors of this article made the following contributions: Conceptualization, M.V. and J.S.; methodology, M.V.; software, J.S.; validation, M.V., J.S., and S.S.; formal analysis, M.V.; investigation, M.V.; resources, M.V.; data curation, S.S.; writing—original draft preparation, M.V.; writing—review and editing, J.S.; visualization, M.V.; supervision, M.V.; project administration, J.S.. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The research was approved by the Ethics Commission of the University of Presov in Presov (no. ECUP062024PO). Measurements were taken according to the ethical standards of the Declaration of Helsinki.

Informed Consent Statement: Written informed consent was obtained from legal representatives of all participants involved in the study.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author.

Conflicts of Interest: The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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