ORIGINAL ARTICLE

Volleyball as a means to develop speed endurance in girls aged 16-18

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

Abstract

Background and Study Aim There is an increasing interest in using volleyball as a means of physical activity among high school students and a need to assess its impact on speed endurance. The purpose of the study is to identify effective volleyball means for developing speed endurance in high school students in the context of distance and in-person learning.

Material and Methods The study involved 16 senior high school girls aged 16-18 from Ternovskiy Lyceum No. 1 in Dnipro, Ukraine. The girls performed special exercises over a period of 12 weeks. The weekly schedule included physical education lessons in a format of 1 online lesson/1 offline lesson and 2 additional sessions.

Results A significant improvement was observed in almost all test exercises: the running time in the "Fir-tree" test decreased by 2.16 seconds ($t=3.01$, $p < 0.05$); the running time for 6x6 m decreased by 0.92 seconds ($t=3.77$, $p < 0.05$); the number of squats in 20 seconds increased by 4.31 times ($t=4.46$, $p < 0.05$); the number of leg raises to a 90° angle in a hanging position increased by 1.13 times ($t=3.02$, $p < 0.05$), and the number of torso raises from a lying on the back position increased by 1.81 times ($t=4.49$, $p < 0.05$).

Conclusions The proposed exercises positively affected the development of speed endurance in girls. The obtained results allow recommending these exercises as means for developing speed endurance in physical education classes within the volleyball module.

Keywords: schoolchildren, volleyball, high-speed endurance, special exercises

Introduction

The modern educational process presents physical education teachers with complex challenges, especially in the context of distance and blended learning. Adaptation to new conditions (martial law in Ukraine) requires not only a revision of traditional teaching methodologies but also the search for innovative approaches to developing students' physical qualities.

This approach to organizing physical education in the context of distance learning is emphasized in the works of many researchers [1, 2, 3, 4]. Authors recommend paying special attention to the safety of online learning participants who live in areas of military conflict. Another study discusses the importance of integrating digital technologies into the educational process to ensure the accessibility and quality of physical education [5]. Attention is also paid to the development and implementation of general principles and tools for remote learning that contribute to increasing student motivation and engagement [6]. The variety of suggestions includes recommendations for organizing extracurricular physical activity, using aerobic exercises and sports games as means to increase students' physical activity [7, 8, 9].

The distinctiveness of volleyball as a means of physical education lies in its comprehensive impact on various physical qualities of students. Studies confirm that systematic volleyball practice not only improves speed-strength qualities and coordination of movements but also contributes to the overall physical development [10]. This makes volleyball particularly valuable in the context of the educational program for high school students, where the goal is not only specialized training but also the formation of a healthy lifestyle foundation.

The importance of a comprehensive approach to training is emphasized by many specialists [11, 12, 13, 14]. Authors believe that enhancing endurance should occur in parallel with the development of other motor abilities, including technical-tactical preparation. Such an approach not only allows achieving higher results but also significantly improves the overall physical condition of students. The level of speed-strength preparedness affects the success in team games, including volleyball [15]. Systematic measurement of strength qualities, speed, endurance, and flexibility is an integral part of the training process and allows for an adequate

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doi:10.15561/physcult.2024.0104

assessment of the effectiveness of the used methodologies [16]. Therefore, it is important to pay attention to the development of speed-strength motor characteristics in female volleyball players of this age. The use of objective tools to assess differences will provide reliable data on the dynamics of physical development in volleyball players [17].

In other studies, age-related changes in physical fitness, the impact of combined aerobic and strength training, as well as the specific effects of volleyball sessions on physical form and body composition across different age groups were analyzed [17, 18, 19, 20]. These data highlight the multifaceted impact of volleyball and confirm its significance in the physical education of high school students. The purpose of the study is to determine effective volleyball means for developing speed endurance in high school students in the context of distance and in-person learning.

Material and Methods

Participants

The study involved 16 senior high school girls aged 16-18 from Ternovskiy Lyceum No. 1 in Dnipro, Ukraine. The research was conducted starting from February 24, 2024. Parents gave their consent for their children to participate in this experiment.

Research Design

It is worth noting that before participating in the study and the introduction of martial law in Ukraine, the girls were involved in a volleyball section. Therefore, they are familiar with its basic techniques, and this is precisely why volleyball means were chosen to develop their physical fitness. The girls performed special volleyball exercises over 12 weeks. The weekly load included physical education lessons in a format of 1 lesson online/1 lesson offline and 2 additional sessions. The girls were offered sets of special exercises specific to volleyball, conducive to the development of speed endurance. These exercises can be performed at home as part of the online format work and in the gym during offline classes conducted by the teacher (Fig. 1).

For the completion of the exercise sets, 10 to 20 minutes were allocated at the end of the main part of the lessons. The exercises were performed at a fast pace, in amounts ranging from 8 to 12 repetitions per set. The number of sets increased by one set every 2 weeks.

Battery of tests (fig. 2):

1. Test 1 – 92-Meter Multi-Directional Shuttle Sprint Test: Duration measured in seconds (fig. 2a); [21];
2. Test 2 – 36-Meter Back-and-Forth Shuttle Run (6x6m): Time to complete measured in seconds (fig. 2b);
3. Test 3 – Max Squats in 20 Seconds: Count of squats performed on signal within 20 seconds (fig. 2c);
4. Test 4 – L-Hang Leg Raise Duration: Count of 90° leg raises held for 10 seconds each on a pull-up bar (fig. 2d);
5. Test 5 – Eurofit Sit-Up Performance in 10 Seconds: Number of correct sit-ups performed with a 90° torso raise from the floor, hands behind head, within 10 seconds (fig. 2e);
6. Test 6 – 20-Second Max Jump Squats: Number of jump squats performed from a semi-squat position on signal within 20 seconds (fig. 2f).

Special volleyball exercises for developing speed endurance

1. Side-to-side shuffle with floor touch left/right in the direction of movement
2. Squatting with a ball in hands, positioned above the forehead (imitating an overhead pass)

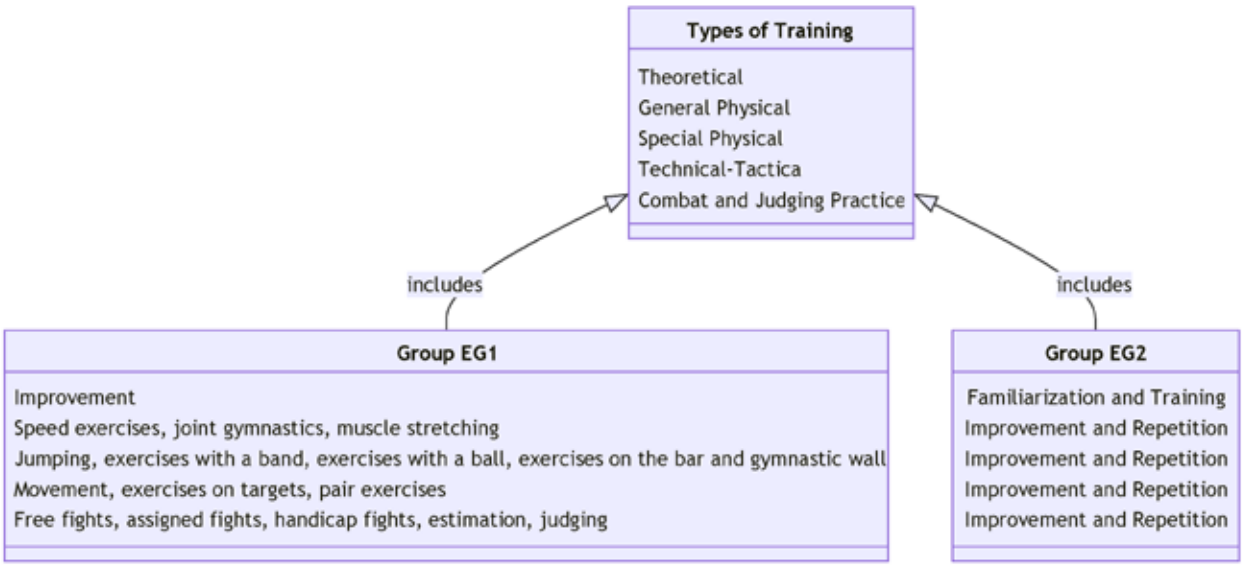

Figure 1. Special volleyball exercises for developing speed endurance

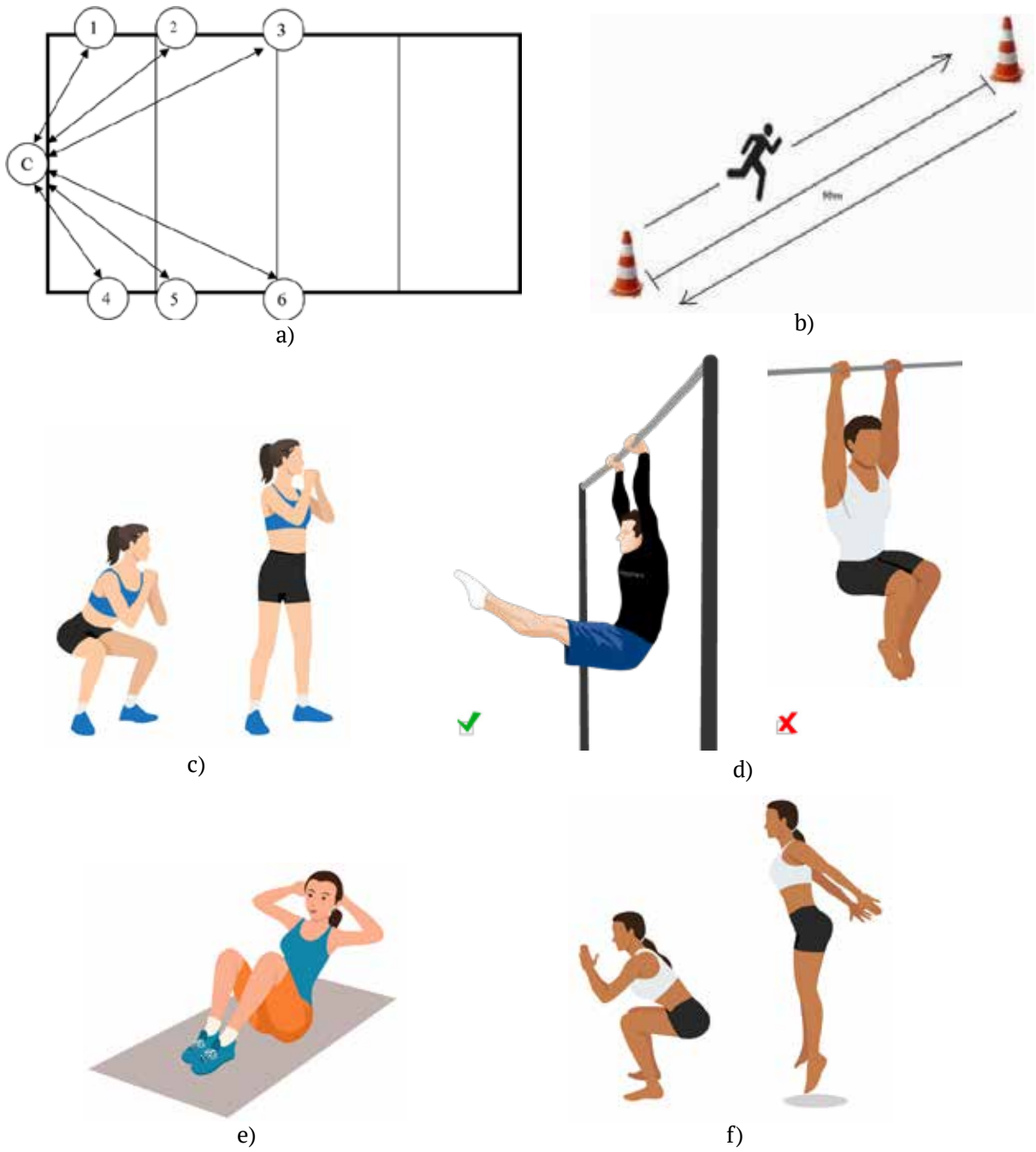

Figure 2. Battery of Tests (image: VectorStock)

3. Performing a ball toss above oneself during an abdominal crunch exercise
4. From a squatting position to a prone position, back to a squatting position, then jumping up with hands raised (imitating a block)
5. Jumping up with a turn to the left, right imitating a spike
6. Jumping from a full squat, raising hands up (imitating a block)
7. Moving the ball right/left during an abdominal crunch exercise
8. Running in place with high knee lifts
9. Running in place with a heel flick
10. Performing the "plank" exercise from a handstand to an elbow stand position
11. Acceleration for distances of 6-3-9 meters Acceleration for distances of 9-3-6-6-3-9 meters
12. Acceleration for distances of 9-3-3-3-3-9 meters
13. Running with high knee lifts against partner resistance, 9 meters
14. Moving along the net with jumps for blocks in zones 2, 3, and 4
15. Running around the court with acceleration from the front to the 3-meter lines
16. Jumping over a gymnastic bench followed by a 3-meter sprint

Statistical Analysis

The statistical analysis of the data was conducted using SPSS software (Statistical Package for the

Social Sciences), version 25. To assess changes in the physical fitness indicators of participants before the start and after the completion of the experiment, the following statistical measures and criteria were used: mean value ($\bar{X}$) and standard deviation (SD), and the Student's t-test for paired samples. The level of significance (p) was set at 0.05. Results where the p-value was less than 0.05 were interpreted as statistically significant, indicating reliable changes in the studied parameters.

Results

The study assessed changes in the speed endurance indicators of the experiment participants. For this purpose, participants underwent a series of tests aimed at measuring their physical capabilities at the beginning and at the end of the experimental period. Comparative analysis of the obtained data revealed statistically significant differences in the indicators (Fig. 3).

Results of Figure 3 indicate a significant improvement in all speed endurance indicators, except for the last one, where the improvement was not statistically significant.

This confirms the effectiveness of the training program implemented within the experiment. After incorporating volleyball-specific exercise complexes into the training process, a retest was conducted, the data of which are provided in Figure 2. The results of all tests, except for Test 6, indicate a significant improvement in indicators. However, there is also a trend towards improvement in Test 6. Thus, the running time in Test 1 significantly decreased, the running time in Test 2 decreased, the number of squats in 20 seconds significantly increased, as did the number of leg raises to a 90° angle in a hang and the number of torso raises from lying on the back position.

Discussion

The aim of the study is to identify effective volleyball means for developing speed endurance among high school students in the context of remote and face-to-face learning. The results of our research indicate a significant improvement in speed endurance and other physical qualities in high school students thanks to volleyball activities. This aligns with the findings of other researchers [6], emphasizing the importance of refining the methodological component of the training process. Our results also resonate with the works of [7, 8, 9], where the use of various means of physical education and directions of sports activities is recommended to increase the level of motor activity among students.

Also, our results correlate with the data of other authors [12, 13, 14, 23, 24], emphasizing the significance of motor readiness as an important component of children and adolescents' health.

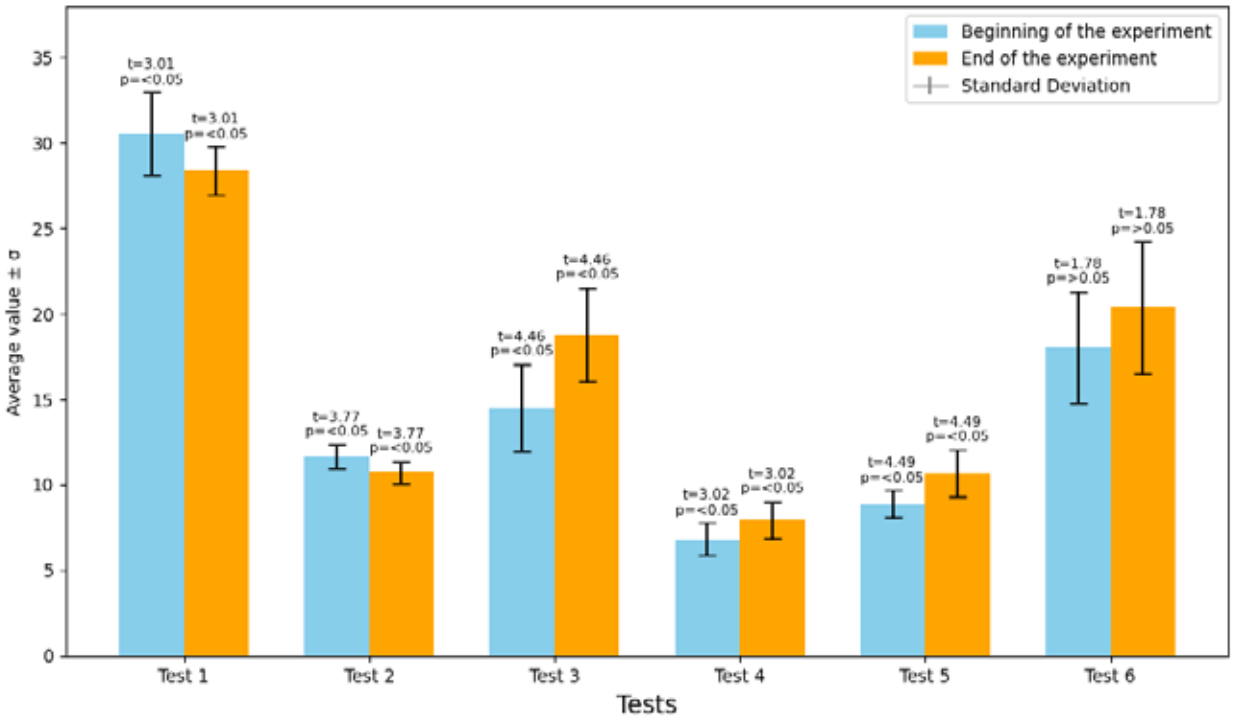

Figure 3. Speed endurance indicators at the beginning of the experiment and at the end of the experiment (n=16). Test 1 - 92-Meter Multi-Directional Shuttle Sprint: Duration, s (seconds); Test 2 - 36-Meter Back-and-Forth Shuttle Run (6x6m): Time to complete, s (seconds); Test 3 - Maximum Squats in 20 Seconds: Count, (times performed); Test 4 - L-Hang Leg Raise Duration: Count, (cycles completed); Test 5 - Eurofit Sit-Up Performance in 10 Seconds: Number, (sit-ups); Test 6 - 20-Second Maximum Jump Squats: Number, (jumps)

Similar to the improvements in our study, other works have also noted the positive impact of physical activity on various aspects of physical fitness, including improvements in standing long jump results and shuttle run [10].

Thus, our findings highlight the value of integrated approaches in physical education lessons, where volleyball is used not only as a means to improve speed endurance but also as an effective tool for developing overall physical fitness and health of students. It is important to continue research in this area, expanding the range of physical qualities studied and including the analysis of the long-term impact of regular volleyball practice on the physical development of adolescents.

Our results seamlessly integrate into the overall picture created by previous research on the positive impact of volleyball activities on the physical development of students. As noted in studies [10, 12, 13, 14], volleyball has a comprehensive effect on various physical qualities, which confirms our observations of improvements in speed-strength qualities and coordination of movements. This underscores the significance of volleyball as a tool for overall physical development and the formation of a healthy lifestyle among high school students.

According to other studies [11, 15, 16, 17], the need for a comprehensive approach to training is reflected in the positive dynamics of indicators among students engaged in volleyball. Research [17] and subsequent works [18, 19, 20], emphasizing the importance of systematic measurement of physical qualities and the impact of various training approaches, including combined aerobic and strength training, on physical fitness, further confirm the effectiveness of our methods.

Thus, the synthesis of our results and the analysis of existing scientific data indicate a significant contribution of volleyball to improving the physical fitness and health of adolescents, highlighting the need for further study and development of optimized training programs.

Conclusions

The study has shown that the use of volleyball as a means of physical education significantly contributes to the development of speed endurance and other physical qualities in high school students. Systematic volleyball practice not only improves speed-strength indicators and coordination of movements but also has a positive effect on the overall physical development of students, highlighting the importance of integrating such activities into the educational process.

Our results confirm the effectiveness of volleyball as a tool for enhancing the level of physical fitness and contribute to the formation of a healthy lifestyle foundation among adolescents. At the same time, the data obtained emphasize the need for further research in this area, aimed at optimizing training processes and expanding the use of volleyball in the educational sphere.

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Cite this article as:
Kryventsova I, Strelnykova Y, Boichuk R, Wnorowski K. Volleyball as a means to develop speed endurance in girls aged 16-18. *Physical Culture, Recreation and Rehabilitation*, 2024;3(1):22–27. https://doi.org/10.15561/physcult.2024.0104

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Received: 02.02.2024
Accepted: 07.03.2024; Published: 30.06.2024