Proximus Journal of Sports Science and Physical Education
Volume 3, Issue 06, June, 2026
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

THE EFFECT OF PHYSICAL-SKILL EXERCISES ACCORDING TO TARGETED TIMES ON DEVELOPING EXPLOSIVE POWER, STRENGTH-SPEED FOR THE LEGS, AND SOME BIOCHEMICAL INDICATORS FOR SERVING AND SPIKING SKILLS AMONG VOLLEYBALL PLAYERS

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Abstract
The research aimed to: prepare special physical exercises according to targeted times for volleyball players, identify the effect of these exercises on developing the explosive power and strength-speed of the legs, alongside some biochemical indicators for the serving and spiking skills in volleyball, and identify the differences between the control and experimental groups in explosive power, strength-speed of the legs, and some biochemical indicators for the serving and spiking skills. The researchers hypothesized that there are no statistically significant differences between the pre-tests and post-tests in explosive power, strength-speed, and some biochemical indicators for the serving and spiking skills, and that there are no statistically significant differences between the post-tests in explosive power, strength-speed, and some biochemical indicators. The researchers adopted the experimental approach using the equivalent groups design with pre-tests and post-tests. The research sample consisted of (32) players from the specialized volleyball school, and the researchers distributed them equally into a control group and an experimental group, each consisting of (16) players. The researchers prepared physical exercises according to targeted times for the experimental group, as the implementation of the curriculum began on October 25, 2024, and continued for (8) weeks, with two training units per week, equivalent to 16 training units. The researchers concluded: The exercises prepared by them have a positive impact on developing the explosive power and strength-speed among volleyball players, and the prepared exercises have a positive impact on developing some biochemical indicators for the serving and spiking skills. Accordingly, the researchers recommended the necessity of using the exercises they prepared in the game of volleyball, and adopting the utilized exercises in various sports games and events.
Keywords: Physical-skill exercises, targeted times, explosive power, strength-speed, biochemical indicators, serving skill, spiking, volleyball.

Chapter One

1. Introduction

The game of volleyball receives great care and attention everywhere as it is one of the most popular games in the world, which young and old from different social and cultural levels desire to play and watch. This is due to the various capabilities players present, relying on basic skills that align with their physical, psychological, and health abilities. Given the development of sciences and knowledge in many sports fields, including the

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game of volleyball, the game has received a large share of researchers' attention, which was reflected in the development of playing styles, tactics, and rules that contributed to providing aesthetic value to the players' performance and increasing the crowd's enthusiasm. Physical exercises are the primary tool for maintaining physical and mental health, as well as achieving high levels of physical fitness.

In order to advance the athletic level, it was necessary to adopt the best methods and means in sports training; therefore, the direction was taken toward preparing exercises that suit the required goal. Thus, the researchers deemed it appropriate to prepare exercises according to precise time intervals for each exercise, which ensures the body's efficiency and its capacity for endurance, speed, and strength, where specific times were determined for each ability. Therefore, the importance of the research lies in achieving the desired goal of the training process and providing a precise scientific methodology that plans for every aspect of preparation according to a tight schedule, in addition to improving physical fitness, recovery, and reducing the burden on the muscles, thus avoiding injury.

2. Research Problem: Through the researchers' experience in the field of sports training and after reviewing the training of specialized volleyball schools, and despite the broad interest in volleyball training in general, there is a lack in the training of most coaches, or their focus is directed solely on the skill aspect or the physical aspect, which may not achieve maximum benefit. Furthermore, measuring biochemical indicators remains absent in most training programs, which is considered one of the main obstacles facing players and coaches. Therefore, the researchers clarified a set of reasons that motivated them to study such a problem, including: Does the prepared training curriculum account for the balance between intensity, the targeted time for the exercise, and the ability intended to be developed? Moreover, do exercises prepared according to targeted times have an impact on the training and development process for physical abilities (strength, speed...)? Additionally, is the training process conducted according to studied scientific foundations in which physical, skill, and biochemical aspects are considered? According to these reasons, and possibly other unknown reasons, the researchers decided to conduct a scientific study to identify the effect of time-restricted exercises on physical performance and biochemical indicators.

3. Research Objectives:

- Preparing physical-skill exercises according to targeted times for volleyball players.
- Identifying the effect of physical-skill exercises according to targeted times on developing the explosive power and strength-speed of the legs for volleyball players.
- Identifying the effect of physical-skill exercises according to targeted times on developing some biochemical indicators for volleyball players.
- Identifying the differences between the control and experimental groups in explosive power, strength-speed of the legs, and some biochemical indicators for volleyball players.

4. Research Hypotheses:

- There are no statistically significant differences between the pre-tests and post-tests in explosive power, strength-speed, and some biochemical indicators for the experimental and control groups.
- There are no statistically significant differences between the post-tests in explosive power, strength-speed, and some biochemical indicators.

5. Research Domains:

- **Human Domain:** Players of the specialized volleyball school, numbering 32 players.
- **Spatial Domain:** The indoor hall for specialized schools.
- **Temporal Domain:** For the period from October 25, 2024, to December 20, 2024.

Chapter Two:

2.Research Methodology

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1. Research Methodology: The researchers adopted the experimental approach as it suits the resolution of the targeted problem and because it is one of the important means to reach reliable knowledge. The researchers used the equivalent experimental groups design, considering that (the approach is the path leading to the discovery of truth in sciences through a set of rules that dominate the course of work and determine its operations until the researcher reaches a known result).
2. Research Population and Sample: The researchers determined the research population as the players of the specialized volleyball school, totaling (38) players, and the researchers divided them equally into two groups, one control and the other experimental, with (16) players for each group.
3. Equivalence of the Two Research Groups: Before starting the implementation of the exercises, the researchers resorted to verifying the equivalence of the two research groups in the variables under study, as shown in Table 1.

Table (1) *Illustrates the equivalence of the sample in the pre-tests for the control and experimental groups.*

Treatments	**Tests**	**Control Pre-test (M ± SD)**	**Experimental Pre-test (M ± SD)**	**Calculated t-value**	**Sig**	**Difference Significance**
Explosive Power (Legs)	-	2.32 ± 0.5	2.15 ± 0.34	0.76	0.1654	Non-significant
Strength-Speed (Legs)	-	11.5 ± 1.34	10.75 ± 2.15	1.21	0.625	Non-significant
Lactic Acid Concentration	Post-effort (mmol/L)	14 ± 0.756	14.0333 ± 0.3272	1.20	0.362	Non-significant
Creatine Kinase Concentration	Post-effort (mEq/L)	184.54 ± 54.516	182.892 ± 2.0684	1.568	0.536	Non-significant
Troponin Concentration	Post-effort (mEq/L)	4.725 ± 0.504	4.514 ± 0.2530	0.985	0.125	Non-significant

Significant at the significance level ≤ 0.05 and degrees of freedom (30).

4. Means, Devices, and Tools Used: The researchers utilized the following research means:

- Arabic and foreign sources.
- Data collection form.
- Data extraction form.
- Legal volleyballs (16).
- Legal volleyball court.
- Cones and flags at various heights.
- Chalk for planning and defining test areas.
- Measuring tape (leather) (meter and its fractions) 30 meters long.
- Stopwatches (2) Japanese (Casio) brand and a whistle.
- Electronic scale, Japanese (Sanyo) brand, measuring in (kg).
- Electronic computer, Dell brand.

5. Selection of Physical Tests and Biochemical Indicators Used in the Research:

Explosive Power (for the legs)

- **Test Name:** Standing broad jump.
- **Test Purpose:** Measuring the explosive power of the legs.
- **Tools Required:** A suitable jumping area 1 cm wide and 3.5 cm long, ensuring the area is level and free of chalk, a measuring tape, and colored pieces of chalk.

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- **Test Description:** The subject stands behind the starting line with feet slightly apart and parallel so that the toes touch the starting line from the outside. The subject begins by swinging the arms backward while bending the knees and leaning slightly forward, then jumps forward to the maximum possible distance by extending the knees and pushing off with the feet while swinging the arms forward.
- **Scoring Method:** Measurement is taken from the starting line to the last body part touching the ground towards the line; the best of three attempts is recorded for the subject.

Strength-Speed (for the legs)

- **Test Name:** Maximum upward jump for (10) seconds from a full squat position.
- **Test Purpose:** Measuring the strength-speed of the legs.
- **Tools Required:** Stopwatch.
- **Test Description:** The subject takes the ready position, and upon hearing the start signal, the subject jumps upwards with full knee flexion.
- **Scoring Method:** The number of flexion and extension repetitions within 10 seconds.

Concentration Measurement Test (CPK & Troponin):

- **Test Purpose:** To determine the concentration level of (Creatine kinase, Troponin) in the blood after performing a 50-meter run.
- **Tools Used:** Laboratory analytical equipment (cobas e411) to determine (Creatine kinase, Troponin) concentration, assisting work team, and a recording form.
- **Performance Description:** The assisting work team measures the concentration level of (Creatine kinase, Troponin) in the blood after performing a 50-meter run.
- **Scoring:** Recording the concentration ratios of (Creatine kinase, Troponin) as read by the analytical laboratory equipment (cobas e411) after performing a 50-meter run.

Blood Lactic Acid Concentration Measurement Test post-performance (50 meters) of running:

- **Test Purpose:** To determine the level of lactic acid concentration after a 50-meter run.
- **Tools Used:** A device type (Cobas e411) manufactured by (ROCHE) company was used, employing the electrochemiluminescence method (CLIA technology), which is a closed analysis system using a computer to display blood sample analysis results.
- **Performance Description:** The assisting work team measures the level of lactic acid concentration in the blood post-performance. Blood was drawn (5) minutes after completing the 50-meter run, and this duration is considered appropriate to ensure the transfer of lactic acid from the muscles to the blood.

6. Pilot Study: It is a miniaturized experiment for the main experiment, aimed at identifying the obstacles that the researchers might face when applying the main experiment, determining the time required to conduct the tests, the suitability of the exercises or training prepared by the researchers, the efficiency of the assisting work team, and arranging the sequence of exercises and rationing the rest periods between them.

7. Pre-tests: On October 25, 2025, the pre-tests were conducted, and all temporal and spatial conditions were standardized for the purpose of unifying them with the post-tests, where specific tests (explosive power of legs, strength-speed of legs) and the tests specific to biochemical indicators (measuring CPK & troponin concentration, measuring blood lactic acid concentration post-performance) were conducted.

8. Preparation of Exercises Used in the Training Curriculum: The researchers prepared physical-skill exercises according to targeted times for the members of the experimental group to develop some variables specific to the research, as the implementation of the curriculum began on October 27, 2024, and the curriculum continued for (8) weeks, comprising (16) training units, at a rate of two training units per week. The time distribution for the prepared exercises is as follows:

- Number of weeks: (8) weeks.

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- Number of training units per week: Two training units.
- The sequence of exercises must support the achievement of objectives.
- Determining the times allocated for each exercise.
- The training method used is the high-intensity interval training method.
- The proposed exercises in their content must be commensurate with the set objectives and the nature of the age stage.
- Considering individual differences among players.
- Determining the time of the training unit.
- Taking into account the progression from easy to difficult within the training unit.

9. Post-tests: The post-tests were conducted for the control and experimental groups under the same conditions as the pre-tests for the variables under study. The post-tests (explosive power of legs, strength-speed of legs) and the tests specific to biochemical indicators (measuring CPK & troponin concentration, measuring blood lactic acid concentration post-performance) were conducted on Saturday, December 20, 2025.
10. Statistical Means: SPSS statistical package.

Chapter Four: Presentation and Discussion of Results

Table (2) *Shows the arithmetic means, standard deviations, and the significance of differences between the pre- and post-tests for the control group.*

Variables	Pre-test (M ± SD)	Post-test (M ± SD)	Calculated t-value	Sig	Significance
Explosive Power (Legs)	2.15 ± 0.3	2.45 ± 0.02	4.2	0.001	Significant
Strength-Speed (Legs)	10.75 ± 1.25	12 ± 0.3	4.62	0.002	Significant
Lactic Acid Concentration (Post-effort, mmol/L)	14 ± 0.756	15.88 ± 0.835	6.355	0.000	Significant
Creatine Kinase Concentration (Post-effort, mEq/L)	184.54 ± 15.88	192.75 ± 57.018	6.318	0.000	Significant
Troponin Concentration (Post-effort, mEq/L)	4.725 ± 0.504	5.054 ± 0.454	4.638	0.00	Significant

Significant at the significance level ≤ (0.05) and degrees of freedom (15).

Table (3) *Illustrates the significant differences between the pre- and post-tests for the experimental group in the researched variables.*

Variables	Pre-test (M ± SD)	Post-test (M ± SD)	Calculated t-value	Sig	Significance
Explosive Power (Legs)	2.35 ± 0.19	2.51 ± 0.02	4.75	0.002	Significant
Strength-Speed (Legs)	11.5 ± 2.75	13.75 ± 0.22	12.5	0.001	Significant
Lactic Acid Concentration (Post-effort, mmol/L)	14.332 ± 0.327	15.571 ± 0.5329	8.462	0.000	Significant
Creatine Kinase Concentration (Post-effort, mEq/L)	182.892 ± 2.0684	190.733 ± 3.473	9.113	0.00	Significant
Troponin Concentration (Post-effort, mEq/L)	4.514 ± 0.253	5.5804 ± 0.3719	9.663	0.00	Significant

Significant at the significance level ≤ (0.05) and degrees of freedom (15).

Table (4) *Shows the significance of the differences between the post-tests of the two research groups for the researched variables.*

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Variables	Control Group (M ± SD)	Experimental Group (M ± SD)	Calculated t-value	Sig	Difference Significance
Explosive Power (Legs)	2.45 ± 0.48	2.51 ± 0.26	3.45	0.000	Significant
Strength-Speed (Legs)	12 ± 1.35	13.75 ± 0.89	3.82	0.002	Significant
Lactic Acid Concentration (Post-effort, mmol/L)	15.88 ± 0.835	15.571 ± 0.5329	2.879	0.00	Significant
Creatine Kinase Concentration (Post-effort, mEq/L)	192.75 ± 57.018	190.733 ± 3.473	1.987	0.00	Significant
Troponin Concentration (Post-effort, mEq/L)	5.054 ± 0.454	5.5804 ± 0.3719	2.659	0.00	Significant

Reached at a significance level of 0.05 and degrees of freedom (30).

Results Discussion: Sports exercises of all types are the only tool that has a clear role in the sports training process and translating it to serve the desired goal. The coach becomes an artist in choosing the style, training equipment, and means suitable for the type of sport they work in, which can be used alongside other methods to develop and improve any element of physical fitness to achieve what needs to be achieved (Marzouk & Shabib, 2023, p. 1115). Therefore, the exercises with targeted times to develop physical traits prepared by the researchers had a clear impact on developing the physical aspects, which was clearly reflected in the performance of the serving and spiking skills in volleyball.

The increase in the muscles' ability to recover at a faster rate occurs when performing consecutive movements due to specific muscular strength exercises. It also relies on the adaptation of specific motor nerves in reducing the contraction time, in addition to producing higher amounts of force and speed (Shabib, 2020, p. 123).

Furthermore, the exercises prepared by the researchers were formulated according to precise scientific foundations that align with the characteristics of the game. These are exercises aimed at developing the active muscle groups in the game, and more importantly, ensuring and preparing groups with motor skills similar to the technical performance of the serving and spiking skills in volleyball (Shbeeb et al., 2023, p. 134).

Explosive power, strength-speed, and other physical and motor traits are effective abilities that affect the physical and skill preparation of players. Therefore, it has become necessary to conduct research and studies in this field directly regarding skill and tactical performance (Naama & Shabib, n.d., p. 36).

The exercises prepared by the researchers had a clear impact on improving performance, especially in the skills under study, as these exercises work to develop explosive power, in addition to increasing the level of excitement and competition among players and achieving the desired goal (Hasan & Shbeeb, 2021).

This type of exercise works to (match the motor performance to the performance requirements, which contributes to making a positive change in skill performance) (Ajam & Mubarak, 2023, p. 76).

Additionally, strength improves as a result of regular training, especially if this training includes varying resistances that are commensurate with the players' abilities (Mubarak et al., 2020, p. 2348).

Regarding biochemical effects, they "are summarized in improving the processes of anaerobic energy production as a result of strength training, increasing the activity of enzymes specific to energy release, in addition to increasing the storage of chemical energy sources such as (ATP) and (PC) and hormonal responses." Also, "training intervals must be of high intensity to increase the need for enzymes involved in the production of anaerobic energy responsible for the splitting of phosphocreatine and glycogen." Likewise, "specialized training causes specific adaptations in muscle biochemistry that are directly proportional to the

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difficulty placed upon the athlete (Tudor, 2012, p. 240)" (Tudor, 2012). As it is "one of the principles of specificity and cellular chemical changes that working with anaerobic system training and its intensity increases the anaerobic energy stores in the cells (Guyton, 2011, p. 315)." "And that players need to increase their ability to tolerate fatigue resulting from the increase in lactic acid or to dispose of it or reduce its accumulation."

Conclusions:

- The physical and skill exercises prepared by the researchers had a positive impact on improving the explosive power and strength-speed of the legs for volleyball players.
- The exercises prepared by the researchers had a positive impact on improving the biochemical variables selected by the researchers.

Recommendations and Proposals: Through the results that emerged in the research, the researchers recommend the following:

- Using physical-skill exercises according to targeted times in volleyball training.
- Conducting similar studies on different events and on a female sample instead of males.
- Conducting similar studies to investigate the impact of this type of exercise on skill abilities and determining their effects.

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Training Unit Model

Table (5)

Exercise	**Targeted Time**	**Number of Repetitions**	**Rest between Repetitions**	**Rest between Sets**
Maximum upward jump for 10s from a full squat position	10 s	4	40 s	2 min
High-speed jump rope	20 s	3	30 s	1.5 min
Repeated jumping for a distance of 10m	15 s	3	45 s	2 min
Overhand serve performance	30 s	5	45 s	-
Spiking skill performance	20 s	4	40 s	-