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RESEARCH ARTICLE

The Use of Specific Resistance Exercises in Developing Explosive Strength and Its Effect on the Jump Shot in Under-17 (U17) Handball Player; A Field Study Conducted on the Boukadir Team

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Abstract

The research aims to identify the effect of specific resistance exercises on developing explosive strength and its subsequent influence on the jump shot performance in handball players. The study addresses the problem defined by a clear weakness in vertical jumping during the shooting process. A core objective was to develop specific resistance exercises for enhancing the explosive strength of both the legs and arms in the Boukadir U17 players.

The researchers employed the experimental method due to its suitability for the study's nature and its efficacy in solving the research problem and achieving the study objectives. The EXL statistical program was used to analyze the study results. A comparison of the post-test results showed statistically significant differences, leading to the conclusion that the specific resistance exercises successfully developed explosive strength and positively affected the jump shot in the handball players.

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1-Introduction and Research Problem

Explosive strength is a vital component of physical fitness during the training process, helping players achieve integrated sports performance to meet the objective outlined in the training program. To develop explosive strength using resistance exercises, the focus must be on movements that require a fast reaction and high power, such as plyometric training, vertical jumping, or drop jumping, due to the nature of the sport practiced, as they relate to the balance between strength and speed. This requires the coach to elevate the athlete to the highest level physically, tactically, technically, and psychologically.

The goal of sports training is to enable the player to reach ideal performance, especially during matches. For a player to achieve this, their training state (or "sports form") must be excellent. The training state signifies the player's optimal readiness to execute the required performance at an excellent level (Hanafi Mahmoud Mokhtar, 1998, p. 16). Consequently, to increase the muscular power of handball players, specific abilities related to the game must be developed. One of the most important physical fitness elements is speed-strength (or power), which is supported by numerous research, studies, and scientifically based experiments. Mohamed Hassan Allawi defined muscular strength as the muscle's ability to overcome or face an external resistance (Hadoush Aissa et al., 2020, p. 91).

Handball is currently considered one of the most prominent and popular sports, comparable to others, due to its significant development across various fields, both scientific and cognitive. It is a team sport with a wide fan base, leading national authorities to invest in it by establishing specialized schools to seek out modern, scientific methods, techniques, and standardized training curricula to develop its physical and technical characteristics throughout the training season. Coaches strive to select the best training methods and utilize the most suitable means according to the specific specialization.

Explosive strength in handball is defined by the player's ability to generate maximum force in the shortest possible time. It is developed through plyometric exercises and quick-strength exercises.

Among the methods used to develop explosive strength, specific resistance exercises are widely utilized to enhance physical qualities like speed, maximum strength, and speed-strength. They can sometimes be used to develop certain types of specific endurance, such as maximum speed endurance (Hadoush Aissa et al., 2020, p. 225).

Defense in handball relies on muscular power, which allows for a sudden and rapid transition into attack. This sudden change from defense to offense requires optimal efficiency in muscular power and is characterized by proficiency in catching the ball, jumping, and shooting at the goal.

To prepare the player for these situations, physical capabilities such as speed and strength—which are essential for a handball player—must be developed through structured training, especially during specific preparation phases. Many scientists and researchers assert that muscular strength is crucial for an athlete to reach the highest level in sports

competitions, as it significantly influences the development of other physical qualities according to the nature of the activity and the sport (Qasim Hassan Hussein, 1998, p. 317).

Repetitive training (or interval training) is considered one of the best methods for raising physical, technical, tactical, and psychological levels by repeating multiple qualities within a single training session.

The research problem is thus crystallized in the effect of using a training program, specifically employing the repetitive training method, on developing muscular strength in handball players.

Based on this, the following question was posed.

2-Research Questions

2-1- General Question

-Does the use of specific resistance exercises in developing explosive strength have an effect on the jump shot performance in Under-17 (U17) handball players?

2-2- Specific Questions

-Are there statistically significant differences between the pre-test and post-test measurements in the explosive strength tests for the legs and arms of U17 handball players?

-Are there statistically significant differences between the pre-test and post-test measurements in the power and accuracy of the high jump shot for U17 handball players?

3- Research Hypotheses

3-1- General Hypothesis

-The use of specific resistance exercises in developing explosive strength will positively affect the jump shot performance in U17 handball players.

3-2- Specific Hypotheses

-There are statistically significant differences between the pre-test and post-test measurements in the explosive strength tests for the legs and arms of U17 handball players.

-There are statistically significant differences between the pre-test and post-test measurements in the power and accuracy of the high jump shot for U17 handball players.

4-Importance of Study

-Practical and Applied Significance: the importance of this research lies in demonstrating the use of specific resistance exercises in developing explosive strength and its effect on the jump shot performance in U17 handball players. This is particularly relevant as modern interpretations of contemporary training have introduced new concepts for the methods, techniques, and curricula used to design training programs.

-Scientific and Theoretical Significance: the current research represents a new addition for handball team coaches, as these specialized scientific references serve as a primary source for improving the coaches' cognitive competence and, consequently, facilitate the process of designing effective training programs.

5-Objectives of the Study

-To develop a set of exercises using specific resistance to enhance explosive strength for the purpose of improving the jump shot in handball players.

-To identify the effect of specific resistance exercises on developing the explosive strength of the leg muscles and the shooting hand in handball players.

6-Rationale for Choosing Research

-The reasons for selecting this specific research topic include:

-The failure of some coaches to rely on the use of specific resistance to develop muscular strength.

-The lack of high-quality players in this age category who demonstrate excellent vertical jump ability and accurate long-distance shooting.

-The desire to promote and disseminate this sport among youth.

I. Theoretical Framework

1. **Explosive Strength:** explosive strength is defined as the highest dynamic force a muscle or muscle group can produce a single time (Bastwisi Ahmed, 2008, p. 116).
2. **Handball:** handball is a team sport involving two teams. Sabri Ahmed defined it as a game of speed and excitement simultaneously, combining running, jumping, receiving the ball, and passing it in the shortest possible time (Sobhi Ahmed Qablan, 2012, p. 09).
3. **Age Category U17:** the U17 age category spans the period following the onset of the growth spurt that accompanies puberty, continuing through early adolescence until all the physiological and physical changes that characterize adolescence finally stabilize (Mohamed Hassan Ghanem, Khalid Mohamed Qalyoubi, 2011, p. 256).

II. Applied Aspect

1- Research Methodology and Field Procedures

1-1- Exploratory Study (Pilot Study)

An exploratory study was conducted at the Chlef Province Handball League. The purpose was to gather specific information regarding the research population to help accurately select and define the research sample.

1-2- Scientific Foundations of the Test (Psychometric Properties)

1-1-2- Test Reliability (Consistency)

Reliability is the condition where an instrument yields the same results if the test is repeated on the same individuals under the same conditions. We applied the tests to the sample and then reapplied them to the same sample one week later.

1-2-2- Test Validity

To confirm the validity of the test, the researchers used the Self-Validity Coefficient (Intrinsic Validity), which is calculated by finding the square root of the test's reliability coefficient:

$$Self\ Validity = \sqrt{Reliability\ cofficient}$$

Statistical Measures / Tests	Research Sample	Reliability Coefficient	Validity Coefficient
Sargent Jump Test	06	0.99	0.99
3 Steps Jump Test Right Leg		0.67	0.81
3 Steps Jump Test Left Leg		730	850
Arm Flexion and Extension Test 10s		0.95	0.97

Jumping Shot Power Test		580	920
Jumping Shot Accuracy Test		0.75	860
3 Kg Medicine Ball Throw Test		0.92	950

Table No. (01): Represents the Reliability and Validity Coefficients of the Physical Tests.

2- Study Variables

2-1- Independent Variable (IV): the independent variable is the specific resistance (Exercises).

2-2- Dependent Variable (DV): the dependent variable is the explosive Strength.

3- Methodology

The researchers selected the Experimental Method as it is the most appropriate approach for solving the research problem. Since the nature of the research requires identifying the effect of specific resistance on explosive strength, the use of an Experimental Design with One Group utilizing a Pre-test and Post-test is considered the optimal choice.

4- Research Population

The research population for this study consisted of the handball players from the municipality of Boukadir, totaling 35 players.

5- Research Sample

The research sample was selected using the Purposive Sampling method from the original population. The sample for this study consisted of the Boukadir team: 16 players belonging to the Chlef Province Handball League. Six (06) players who were used in the Exploratory Study (Pilot Study) were excluded, thus making the final sample size 10 players.

6- Sample Homogeneity

Statistical Measures / Tests	Arithmetic Mean	Standard Deviation	Median	Skewness Coefficient
Height Test	175.5	5.45	175	0.09
Weight Test	72.10	2.85	73	-0.31

Table No. (02): Shows the Homogeneity of the Sample using the Coefficient of Skewness.

7- Equivalence of the Sample Members in Physical Abilities

Statistical Measures / Tests	Arithmetic Mean	Standard Deviation	Median	Skewness Coefficient
Sargent Jump Test	0.33	0.08	0.38	-0.62
3 Steps Jump Test Right Leg	5.52	0.54	5.58	-0.61
3 Steps Jump Test Left Leg	5.47	0.78	5.46	0.01
Arm Flexion and Extension Test 10s	8.58	1.08	8.9	-0.29

Jumping Shot Power Test	4.97	0.83	4.97	0
Jumping Shot Accuracy Test	2.21	0.48	2.02	0.39
3 Kg Medicine Ball Throw Test	4.02	0.77	3.7	0.41

Table No. (03): Shows the Equivalence of the Sample using the Coefficient of Skewness.

8- Research Scope

8-1- Human Domain

The research sample targeted U17 handball players with an average age of 16 years, totaling 10 players.

8-2- Spatial Domain

The location was the "5 July 1962 Multi-Sports Hall," Boukadir Municipality.

8-3- Temporal Domain

The study of this subject began on 06/12/2024 and concluded on 01/05/2025.

9- Tools, Instruments, and Equipment Used in Research

9-1- Physical Fitness Tests

- ✓ Test of Explosive Strength (Unit: cm).
- ✓ Test of the 3-Steps Jump (Right and Left) (Unit: m).
- ✓ Test of 3 kg Medicine Ball Throw (Unit: m).
- ✓ Test of Arm Flexion and Extension (10 seconds) (Unit: repetitions).
- ✓ Test of Jumping Shot Power (Unit: degrees/score).
- ✓ Test of Jumping Shot Accuracy (Unit: degrees/score).

9-2- Pedagogical Tools:

Studies and research materials, test definition form, specific and regulation-sized balls for the category, medical scale, a graduated wooden vertical pole marked in centimeters (2 meters long), whistle, measuring tape, and adhesive tapes for drawing lines.

9-3- Proposed Training Units

Based on the researchers' monitoring of various junior competitions and training methods at regional, national, and international levels, the researchers designed training units that align with the study's objective, ensuring careful consideration of the content of the exercises presented.

9-4- Training Program

The researchers prepared a training program using the Specific Resistance Exercise method to develop shooting skill. Considering the time constraints, the program was implemented within the training units, involving three (03) training units per week during the Special Physical Preparation phase. The program lasted for eight (08) weeks, comprising a total of 24 training units. The application of the training program on the experimental group began on 18/12/2025 immediately following the pre-tests and was completed on 19/02/2025.

9-5- Statistical Processing

The Statistical Package for the Social Sciences (SPSS) Version 25 was used for statistical analysis.

2- Presentation, Analysis, and Discussion of Results

2-1- Presentation and Analysis of the Results for Muscular Power of the Arms and Legs between the Pre-test and Post-test for the Experimental Group.

Statistical Measures / Tests	Research Sample	Pre-test		Post-test		Calculated t value	Critical t value	Degrees of Freedom	Level of Significance	Significance of Differences
		X1	SD1	X2	SD2					
Sargent Test	10	0.33	0.08	0.41	0.08	3.81	2.26	09	0.05	Significant
3 Kg Medicine Ball Throw Test	10	4.02	0.77	4.34	0.75	1.64	2.26	09	0.05	Significant
3 Steps Jump Test Right Leg	10	5.52	0.54	5.81	0.53	0.000	2.26	09	0.05	Significant
3 Steps Jump Test Left Leg	10	5.47	0.78	5.82	0.84	2.81	2.26	09	0.05	Significant
Arm Flexion and Extension Test 10s	10	9.6	2.22	13.1	3.07	6.01	2.26	09	0.05	Significant

Table No. (04): Illustrates the results of the Pre-test and Post-test for the Experimental Group regarding the Muscular Power variables.

NB:

X: Arithmetic Mean: The average value (X)

SD: Standard Deviation: A measure of data variability (σ)

Analysis and Discussion of Results

Observation of Table (04) reveals that the arithmetic means (average scores) between the pre-tests and post-tests for the research sample's physical abilities show a development in the players' performance regarding their muscular capabilities. This progress is attributed to the use of specific resistance exercises in developing explosive strength and its effect on the jump shot in U17 handball players. These exercises helped the players enhance their explosive strength and speed-strength (power), which consequently led to the development of the jump shot skill.

The results confirm that the research sample achieved a statistically significant difference in the explosive strength test. The difference is clearly visible in the arithmetic mean scores, where the group achieved a better average score in the post-test. The researcher thus concludes that the sample's results demonstrated statistically significant differences in the measurement of explosive strength, specifically for the lower extremities.

The researcher attributes this development in the specific physical quality to the effectiveness of the program implemented using the resistance exercise method. The researcher also suggests that this progress is due to the program being appropriate for the players' capabilities and included progressive loading tailored to their improving performance. This is corroborated by Hadoush Aissa et al., who states that explosive strength is highly important in handball, and its

improvement can be achieved through more effective training methods; the higher a player's explosive strength, the better and faster they can execute the skill (Hadoush Aissa et al., 2020, p. 211).

Furthermore, the table indicates an improvement in the speed-strength of both the leg and arm muscles using resistance exercises, which significantly impacted the development of muscular power, as it is a key component of physical fitness. These findings align with the 2015 study by the researcher Al-Eidani Hakim, which found a relationship between speed-strength, explosive strength, and their impact on improving the accuracy of the jump shot for handball players. They also align with the 2017 study by Saad Dhari Hamel Al-Delfi, which concluded that specific resistance exercises led to the development of muscular power and the improvement of vertical jump performance and the maximum distance throw of the medicine ball.

The author Issam El-Din states that power is a composite of muscular strength and speed (Power=Strength × Speed) and is referred to by the term "power" (in Arabic "El qodra"). Larson and Yocom define it as "the ability to perform with maximum force in the shortest possible time," and it is also defined as "the individual's efficiency in overcoming various resistances with high, increasing acceleration and high movement speed," or "the individual's efficiency in overcoming various resistances in the shortest possible time." Naturally, an individual who excels in power possesses great muscular strength, a high degree of speed, and a high degree of integration of both strength and speed, while considering the inverse relationship between them. It is also referred to as explosive strength when speed is increased and resistance is reduced. Speed-strength is important in sports involving repetitive movements (running, cycling, swimming), as well as in sports requiring a single, rapid movement like pushing, jumping (take-off), or rapid initiation (throwing, jumping, and leaping events), and in field sports such as football, basketball, volleyball, handball, and tennis (Issam El-Din Abdel-Khaleq Mustafa, 2003, p. 138).

The researcher attributes the development of the explosive strength and speed-strength qualities in the legs and arms to the specific resistance exercises, as evident in the achieved post-test results. The development observed in the muscles of the lower extremities is a result of using appropriate training intensity, as most references indicate that movement always occurs against a resistance to be overcome. When the muscle becomes stronger, the effect of resistances lessens due to the increased strength of the muscle, which works to increase the speed of movement for executing the power and accuracy of the standing shot.

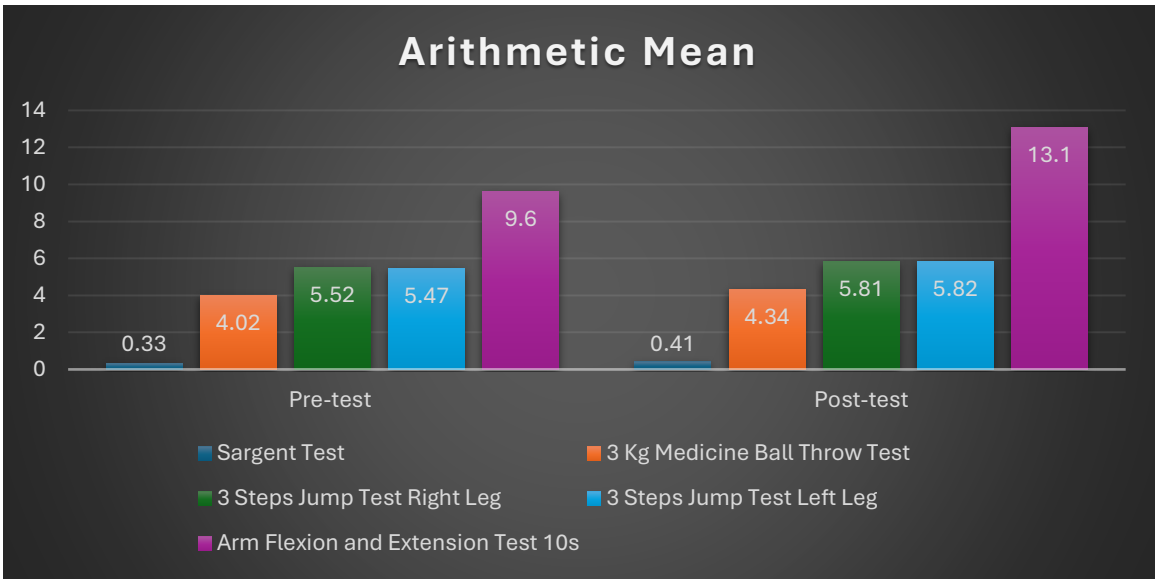

Figure No. (01): Shows the Arithmetic Means of the Research Sample for the Pre-test and Post-test.

Analysis of Figure No. (01)

From Graphical Figure No. (01), it is observed that the research sample achieved superior results in the Post-test for the explosive strength test of both the lower and upper extremities. Consequently, there are differences between the arithmetic means that are significant in favor of the Post-tests at a significance level of 0.05.

2-2 Presentation and Analysis of Results for the Accuracy and Power of the Jump Shot Skill Performance between the Pre-test and Post-test for the Research Sample

Statistical Measures / Tests	Research Sample	Pre-test		Post-test		Calculated t value	Critical t value	Degrees of Freedom	Level of Significance	Significance of Differences
		X1	SD1	X2	SD2					
Shooting Power Test	10	4.97	0.83	5.05	0.82	0.32	2.26	09	0.05	Significant
Shooting Accuracy Test	10	2.15	0.52	2.7	0.53	1.60		09	0.05	Significant

Table No. (05): Illustrates the results of the Pre-test and Post-test for the Accuracy and Power of the Jump Shot Skill Performance.

Analysis and Discussion of Results

Observation of Table (05) shows that the arithmetic mean for the power and accuracy of the shooting test in the research sample demonstrated a very noticeable development in the players' level regarding their skill capabilities. This indicates that the differences between the pre-test and post-test are statistically significant and in favor of the post-test, suggesting a clear development in the high jump shot skill.

This finding aligns with the 2017 study by Saad Dhari, titled "The Use of Specific Resistance Exercises to Develop Muscular Capabilities and Their Effect on the Index of Long-Distance Jump Shooting," which also concluded that there was a development in both the index of physical efficiency and the power and accuracy of the high jump shot.

The researcher attributes this development to the use of specific resistance exercises within the training units, which contributed to the adaptation between the accuracy and power of the shooting skill performance. This is further supported by the study of Hajji Hamada and Mortat Mohamed (2017), who investigated the effect of plyometric training on improving speed-strength and explosive strength and their relationship to jump shot performance in handball, and concluded that there were statistically significant differences.

Ahmed Oraibi Awda (2016) emphasizes the need to focus on developing the strength of the leg muscles, given the handball player's requirement to jump forward and upward to execute the shot. He further advises coaches, when training strength, to observe certain crucial points—neglecting them may lead to player injury and absence from the court—including: thorough warm-up for all body muscles, attention to the rest period between exercises, incorporating relaxation exercises, and ensuring the exercises are commensurate with the players' actual capabilities (Ahmed Oraibi Awda, 2016, p. 203).

The researcher suggests that the regulation of training load in terms of intensity, volume, and density also plays a role in developing these physical qualities, highlighting the necessity of controlling the degree of training load provided to juniors, as this constitutes the scientific basis of training. Saad Dhari et al., on the other hand, believe that the nature of the exercises used within the training curriculum—which contained specific exercises for developing both the explosive strength and speed-strength of the legs and arms—contributed to the process of coordination and balance in movement performance (Saad Dhari Hamel Al-Delfi, 2017, p. 10).

The researcher concludes that the research sample results showed statistically significant differences in the development of explosive strength and its effect on the jump shot in U17 handball players, specifically improvement in the lower extremities. The researcher interprets this development in the quality as resulting from the effectiveness of the specific resistance exercises.

Harré suggests that exercises should contain part of the actual movement path in terms of force, time, and trajectory (Harré, translated by Abd Ali Naseef, 1991, p. 95).

This led to the program used by the researcher influencing the development of speed-strength quality. The development achieved in the lower limb muscles is a result of using appropriate training intensity, which is characteristic of the repetitive training method; this method aims to develop transitional speed, maximum strength, speed-strength, and speed endurance over short to medium distances.

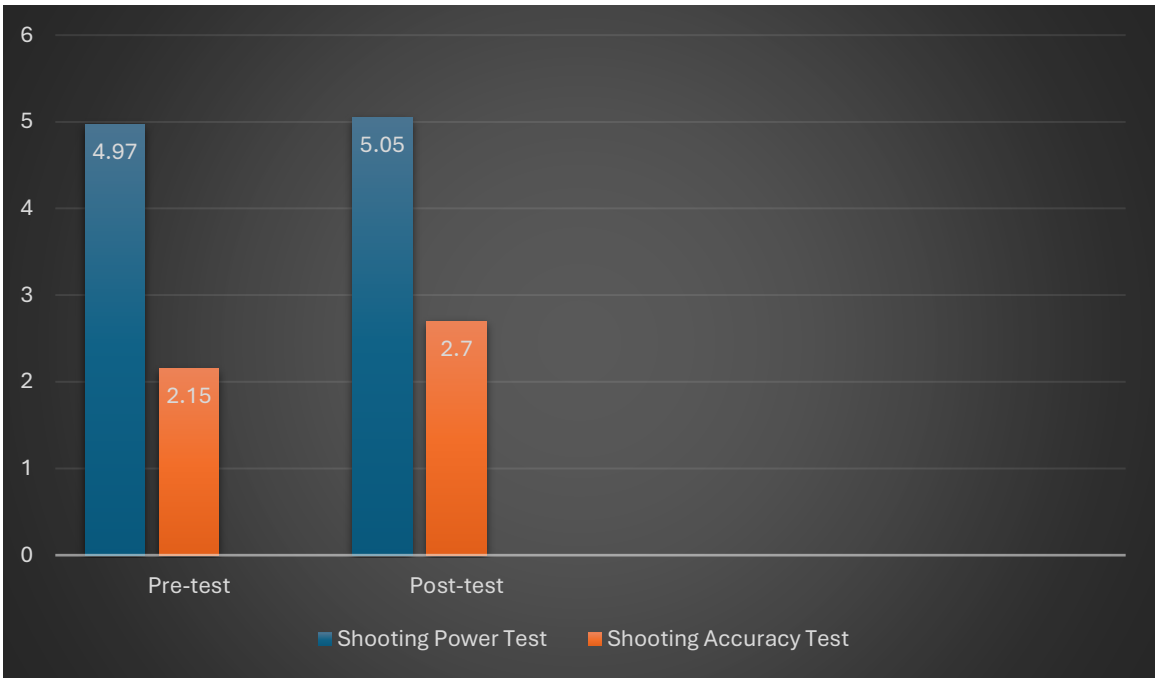

Figure No. (02): Shows the Arithmetic Means of the Research Sample in the Shooting Accuracy and Power Test.

Analysis of Figure No. (02)

From Figure No. (02), it is observed that the research sample achieved superior results in the Post-test for the shooting power and accuracy test. This indicates the existence of statistically significant differences between the arithmetic means in favor of the Post-tests for the research group at the 0.05 significance level.

3- Findings

Based on the foregoing presentation, and within the limits of the methodology employed, the specific resistance exercise program used, and the sample to which the study was applied, the following conclusions were reached:

- The results of the statistical processing related to the physical fitness tests showed that the research sample achieved statistically significant differences between the pre-test and post-test results, in favor of the post-test.
- The results of the statistical processing related to the specific tests for the skill of shooting accuracy and power showed that the research sample achieved statistically significant differences between the pre-test and post-test results, in favor of the post-test.
- The research sample achieved the best, fastest, and most effective development and enhancement of the essential physical qualities for the handball jump shot skill, thanks to the specific resistance exercises used to develop explosive strength.

4- Recommendations

Based on the data collected by the researcher and the conclusions drawn, and within the framework of this study, the researcher submits the following recommendations:

- The use of specific resistance exercises leads to the improvement of explosive strength in handball players.
- The use of specific resistance exercises leads to the improvement of the jump shot skill in handball players.

- The importance of conducting physical and physiological measurements before the start of the sports season and again afterward to determine the extent of the training program's impact (i.e., assessment and evaluation to facilitate the process of load regulation).
- We recommend that team officials, specialists, and coaches emphasize the importance of junior categories by providing the necessary resources for training and planning standardized training programs for youth.

5. Conclusion

Through the analysis of the results above, the researcher concluded that the specific resistance exercises led to the development of explosive strength and the improvement of the jump shot skill in handball players. The researcher relied on vertical jumping exercises and plyometric exercises to develop muscular power and enhance the effectiveness of the skill performance (shooting accuracy and power). This is clearly demonstrated by the post-test results of the research sample.

The researcher recommends relying on specific resistance exercises using boxes and hurdles of various heights to develop the physical capabilities (explosive strength and speed-strength) of both the legs and arms concurrently for handball players. This will help create a harmonious motor and skill performance to master the shooting skill. This should be achieved by designing a structured training program containing training units aimed at developing the power and accuracy of the jump shot, without neglecting other skills, and always creating conditions like matches during training. Finally, the researcher recommends conducting similar research and studies using specific resistance exercises for different handball age groups (male or female) as well as for other team or individual sports.

Ethical Considerations

This study was conducted in accordance with internationally accepted ethical standards for research involving human participants. Prior to data collection, permission was obtained from the Boukadir Handball Club administration and the coaching staff. All participating players and their legal guardians were fully informed about the objectives, procedures, potential benefits, and risks of the study, and written informed consent was obtained. Participation was entirely voluntary, and players were free to withdraw at any stage without any negative consequences. The confidentiality and anonymity of all participants were strictly maintained, and the collected data were used solely for scientific research purposes.

Author Contributions

- Dr. Saber Khaled: Conceptualization of the study, research design, development of the specific resistance exercise program, supervision of data collection, and manuscript drafting.
- Dr. Meddah Rachid: Methodology development, statistical analysis, interpretation of results, and critical revision of the manuscript.
- Dr. Belkacemi Brahim: Technical expertise in motor performance, contribution to training protocol design, and validation of performance tests.
- Dr. Ziani Zakaria: Field implementation of the experimental program, data collection, and assistance in data processing.
- Dr. Louati Abdesselam: Scientific consultation, review of health-related aspects of training, and final proofreading of the manuscript.

All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication **of this article.**

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