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# The Impact Of Compound Exercises Utilizing Intensity Concentration Techniques On Strength Development And Its Correlation With Shooting Accuracy In Young Handball Players

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**Abstract**:
*Sports training constitutes a fundamental and essential aspect of the training process. Elevating athletic performance requires a foundation based on sound scientific principles and the development of interconnected and integrated training elements. Athletes cannot achieve advanced positions without integration in physical fitness elements. Therefore, focusing on sports training elements through physical preparation, a crucial stage for reaching higher levels, is essential. This stage relies on physical and motor qualities.*

*The current study seeks to investigate the effects of compound exercises combined with intensity concentration techniques on muscle strength and shooting accuracy in young handball players. The researcher used an experimental methodology with an experimental group (pre-test and post-test) that was appropriate for the nature of the research.*

*The research population comprised young players from the Sulaymaniyah Handball Club aged between 16 and 18 in Sulaymaniyah province. This choice was due to the availability of all experiment requirements, the researcher's ability to follow up with them, and the researcher's intention to address the issue present in this sample.*

*The researcher used a constrained purposive sampling method, and the research sample consisted of seven handball players registered with the Kurdistan Region Handball Federation in Sulaymaniyah Club.*

*Compound exercises with intensity concentration for strength showed a significant improvement in muscle strength training, particularly in muscle strength tests of the muscles used in handball shooting. This emphasizes the importance of incorporating compound exercises with intensity concentration for strength into the training programs of young handball players.*

**Keywords**: Compound exercises, high intensity concentration for strength, and handball shooting accuracy.

## 1-1 Introduction and Research Importance:

Sports training constitutes a fu[1]ndamental and essential aspect of the training process. Therefore, elevating athletic performance must be grounded in accurate scientific principles. Those involved in the training process must develop training plans and curricula based on scientific foundations to enhance the training process. This involves the development of interconnected and integrated elements of sports training, as an athlete cannot reach advanced positions without integration in physical fitness elements. Thus,

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there is a need to focus on sports training elements through physical preparation, a crucial stage for reaching higher levels, relying on physical and motor qualities.

The research topic centers on the attribute of strength, which is one of the most important elements of physical preparation and a crucial physical trait in both general daily life and sports training. Strength is the most impactful trait in all sports activities, and athletes must possess it to reach higher levels and achieve optimal results. As stated by Qasim Hasan Hussein (1998), "An athlete distinguished by muscular strength can achieve a high level of overall physical ability and capability."

In recent years, the practice of compound exercises has become a significant cultural phenomenon, emphasizing the importance of sound scientific foundations. These exercises offer substantial benefits in various life domains, becoming an important science with established principles and foundations. Exercise, in general, has become essential for both regular individuals and athletes, promoting a healthy life free from diseases and physical deformities. Moreover, exercise serves as a means of psychological relaxation and enjoyment, contributing to the achievement of milestones for athletes (Akram Youssef Anad, 2017).

Compound exercises, as defined by Sami Al-Saffar and others (1987), are exercises closely resembling competitive situations, subject to the rules of the game. They serve as complements to physical, skill-based, and psychological preparation, facilitating the athlete's entry into the realm of real competition.

**1-2 Research Problem:**

Through personal observation of several matches held at youth centers and interviews conducted with present coaches, the researcher noticed a clear weakness in the maximum strength of the upper limbs of young players. Consequently, this weakness has an impact on certain skills required by players, including the striking force and its accuracy. The development of this strength is influenced by the concentration of intensity used in enhancing the maximum strength of players.

Therefore, the researchers deemed it essential to address and study this problem using a form of concentrated intensity. This is an attempt to understand the effectiveness of this approach in developing the maximum strength of the upper limbs and, consequently, enhancing the striking force and accuracy of young handball players.

**1-3 Study Objectives:**

1. To investigate the effect of compound exercises with intensity concentration techniques on the development of maximum upper-limb strength and handball shooting accuracy.

2. To investigate the relationship between maximum upper-limb strength and handball shooting accuracy among the research participants.

3. To compare shooting accuracy at distances of 7m and 9m in handball.

**1-4 Study Hypotheses:**

1. Compound exercises with intensity concentration techniques have a significant impact on the development of maximum upper-limb strength and handball shooting accuracy.

2. There are statistically significant differences in maximum upper-limb strength and handball shooting accuracy among the research participants.

3. There are differences in shooting accuracy between 7m and 9m in handball.

**1-5 Research Scope:**

1-5-1 Human Scope: Young handball players from Sulaymaniyah Handball Club.

1-5-2 Temporal Scope: From April 22, 2023, to June 22, 2023.

1-5-3 Spatial Scope: Sulaymaniyah Club Hall - Sulaymaniyah Governorate.

**2- Research Methodology and Procedures:**

**2-1 Research Methodology:**

To reflect the nature of the research, the researchers used an experimental approach with an equivalent experimental group (pre-test and post-test).

**2-2 Research Sample:**

The researcher selected the research sample using a constrained purposive sampling method. The sample consisted of seven young Sulaymaniyah Club players. Table (1) describes the characteristics of the research sample.

Table (1) Specifications of the Research Sample in the Fundamental and Anthropometric Tests

| No. | The Fundamental and Anthropometric Tests | Unit | The arithmetic mean | The median | Range | The standard deviation ± n | Coefficient | Coefficient of kurtosis | Higher | Lower |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | The chronological age | Yr | 18.56 | 18.65 | 19.20 | 0.66 | -0.66 | 0.31 | 17.10 | 19.50 |
| 2 | Training age | Yr | 9.50 | 9.00 | 8.00 | 2.62 | 0.82 | 0.81 | 5.00 | 15.00 |
| 3 | Height | Meter | 1.78 | 1.77 | 1.73 | 0.06 | 0.33 | -0.97 | 1.69 | 1.88 |
| 4 | Mass | KG | 76.00 | 70.00 | 70.00 | 11.10 | 0.79 | -0.75 | 64.00 | 98.00 |
| 5 | ulnar length | CM | 31.21 | 32.00 | 32.00 | 3.19 | -1.21 | 2.48 | 23.00 | 36.00 |
| 6 | length of the forearm bone | CM | 28.00 | 28.00 | 28.00 | 1.36 | 0.00 | 2.19 | 25.00 | 31.00 |
| 7 | length of the palm bone | CM | 19.14 | 19.00 | 17 | 1.57 | 0.14 | -0.72 | 17.00 | 22.00 |
| 8 | radius center of mass distance | CM | 18.02 | 18.47 | 18.47 | 1.84 | -1.20 | 2.48 | 13.28 | 20.78 |
| 9 | forearm center of mass distance | CM | 12.81 | 12.81 | 12.81 | 0.62 | 0.01 | 2.21 | 11.44 | 14.18 |
| 10 | palm center of mass distance | CM | 15.12 | 15.01 | 13.43 | 1.24 | 0.14 | -0.72 | 13.43 | 17.38 |
| 11 | forearm circumference | CM | 29.29 | 28.50 | 26.00 | 2.89 | 0.45 | -1.20 | 26.00 | 34.00 |

| No. | The Fundamental and Anthropometric Tests | Unit | The arithmetic mean | The median | Range | The standard deviation ± n | Coefficient | Coefficient of kurtosis | Higher | Lower |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Forearm circumference | CM | 27.04 | 27.00 | 26.00 | 2.13 | 0.16 | 0.08 | 23.00 | 31.00 |
| 13 | Chest circumference | CM | 87.29 | 88.00 | 86.00 | 7.83 | -0.99 | 1.72 | 68.00 | 99.00 |
| 14 | Relative weight of the forearm | KG | 2.06 | 1.90 | 1.90 | 0.30 | 0.78 | -0.74 | 1.73 | 2.66 |
| 15 | Relative weight of the forearm | KG | 1.23 | 1.13 | 1.13 | 0.18 | 0.79 | -0.75 | 1.04 | 1.59 |
| 16 | Relative weight of the trunk | KG | 33.03 | 30.42 | 30.42 | 4.82 | 0.79 | -0.75 | 27.81 | 42.59 |
| 17 | Relative weight of the palm | KG | 0.47 | 0.43 | 0.43 | 0.07 | 0.82 | -0.63 | 0.39 | 0.60 |

Table (2) Equivalence of Maximum Strength, Accuracy Measurements, and Supplementary Tests for the Pre-test of the Research Group Before Experiment Implementation

| No. | Tests | Unit | Concentration Group (n=7) | | Distribution Group (n=7) | | The difference between the means | The calculated value (t-value) | The probability of error (p-value) |
|---|---|---|---|---|---|---|---|---|---|
| | | | SD | P | SD | P | | | |
| 1 | The maximum force of the muscles involved during shooting | KG | 15.56 | 4.28 | 15.42 | 4.53 | 0.14 | 0.06 | 0.79 |
| 2 | The maximum force of the shoulder flexor muscles | KG | 14.17 | 1.30 | 14.79 | 2.07 | -0.62 | 0.67 | 0.21 |
| 3 | The maximum force of the wrist | KG | 11.80 | 2.92 | 11.94 | 3.14 | -0.14 | 0.08 | 0.65 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | flexor muscles | | | | | | | | |
| 4 | Accura" cy shooting test from a distance of 7 meters to the "goal | Deg | 22.57 | 4.24 | 22.29 | 5.09 | 0.29 | 0.11 | 0.52 |
| 5 | Accuracy shooting test from 9 meters to the goal | Deg | 22.29 | 3.77 | 22.86 | 4.98 | -0.57 | -0.24 | 0.43 |
| 6 | Two-footed long jump test | Met | 1.82 | 0.18 | 2.00 | 0.15 | -0.18 | 2.00 | 0.52 |
| 7 | Two-footed vertical jump test | Met | 53.51 | 9.22 | 56.88 | 7.95 | -3.36 | 0.73 | 0.87 |
| 8 | Balance test | Sec | 46.14 | 15.03 | 37.71 | 19.11 | 8.43 | 0.92 | 0.59 |
| 9 | Elasticity test | CM | 5.86 | 6.72 | 1.86 | 2.04 | 4.00 | 1.51 | 0.05 |
| 10 | Agility test | Sec | 11.08 | 0.47 | 10.43 | 0.91 | 0.65 | 1.68 | 0.36 |
| 11 | Speed test | Sec | 5.45 | 0.38 | 5.13 | 0.28 | 0.32 | 1.75 | 0.41 |
| 12 | Strength endurance test | Sec | 70.29 | 12.94 | 67.29 | 12.51 | 3.00 | 0.44 | 0.86 |
| **13** | Recovery test | Standard | 1.13 | 0.37 | 0.95 | 0.14 | 0.19 | 1.23 | 0.24 |

**2-3 Data Collection Methods:**

The researchers used the following data collection methods:

- Arabic and foreign sources.

- Personal interviews.

- Physical and skill tests.

2-4 Research Tools:

The tools used in the research include:

- Regulation-size handballs (size 3), quantity (7).

- Stopwatch, quantity (2).

- Whistle (40/fox).

- Regulation handball court.

**2-5 Research Procedures:**

The training program at Al-Sulaymaniyah Club was implemented on the research group over a six-week period, with two weeks at the end of general preparation and four weeks of specific preparation. The program considered a relative focus on the weights placed on the arm link (forearm) for the training group according to the proportional distribution shown in Table (2).

Table (3) Relative Weights and Loads Placed on Arm Links During Compound Exercises

| No. | Body Parts | Relative (%) Weight | Actual Weight (KG) | Weight of the load (%10) |
|---|---|---|---|---|
| 1 | Ulnar | 2.71 | 1.90 | 0.190 |

*The average weight used for calculating the loads is 70 kg.

**2 – 6 The Tests Used:**

Physical, skill, and compound exercises were chosen after consulting with handball training experts. The selection resulted in three physical exercises, two skill exercises, and two compound exercises, which are as follows:

**2-6-1 Physical Tests:**

• Maximum Muscle Force during Shooting:

Test Purpose: To measure the maximum muscle force during shooting.

Performance Description: The tester stands with the feet shoulder-width apart, holding the dynamometer grip firmly. The dynamometer is positioned behind the player and at the same level as the shoulder, about 2 meters away from the shoulder. It is securely fixed to a column to prevent any movement under pressure. The player grips the dynamometer handle and performs the shooting and pulling movement with maximum force, as shown in Figure (1). The tester is given 3 attempts.

Result Calculation: The maximum reading recorded by the device during the pull is used, displayed on the dynamometer screen.

Measurement Unit: Newton.

Used Tools:

- Dynamometer.

Figure 1: Direction of Tension in the Maximum Muscle Force Test during Shooting Using the Dynamometer. (Couto, D., Cunha , 2022 , 24(2), 52-58).

• Maximum Muscle Force Test for Shoulder Flexors:

Test Purpose: To measure the maximum muscle force of the shoulder flexor muscles.

Performance Description: The participant stands with the feet shoulder-width apart, holding the dynamometer grip positioned and securely fixed next to the player at the shoulder level. The dynamometer is located about 2 meters away from the shoulder, securely attached to a column to prevent movement under pressure. The player performs a flexion and approximation movement of the arm, starting from a 45-degree position for the shoulder, with the angles of the arm (elbow and wrist) extended to the maximum force possible. See Figure (2). The participant is given 3 attempts.

Result Calculation: The maximum reading recorded by the player on the dynamometer screen is calculated.

Measurement Unit: Newton.

Used Tools:

- Dynamometer.

Figure (2) Direction of Tension in the Maximum Muscle Force Test for Shoulder Flexors during Shooting Using the Dynamometer. ( Couto, D., Cunha , 2022 , . 24(2), 52-58)

• Maximum force of the wrist flexor muscles:

Purpose of the test: Measuring the maximum force of the wrist flexor muscles.

Performance description: The subject stands with the distance between the feet, chest width apart, holding the handle of the dynamometer placed and well-fixed beside the player and at the same level as the shoulder. The player moves from a 45-degree shoulder position,

with the angles of the arm (shoulder and elbow) extended and exerts the maximum possible force by performing a wrist flexion movement (Figure 3). The subject is given 3 attempts.

Calculating the result: The maximum reading recorded by the player on the dynamometer screen is calculated.

Measurement unit: Newton.

Figure 3: Direction of pulling in the test of maximum strength of the flexor muscles of the wrist during shooting using the dynamometer. (Couto, D., Cunha , 2022 , . 24(2), 52-58)

**2-6-2 Skill Tests:**

• Accuracy Test of Shooting from the 9-Meter Line in Front Jump:

Purpose of the Test:

Measuring shooting accuracy.

Test Description:

The subject stands holding the ball just before the specified 9-meter line (shooting distance). Upon the start signal, the subject begins shooting with a total of 6 balls, three of which are directed to each corner of the upper goal angles within the designated square (60×60 cm), ensuring that their feet do not touch the starting line.

Result Calculation:

The result is based on the number of goals scored in both squares.

Tools:

Official handballs (8), square target (2) for shooting accuracy (60×60 cm) with clips installed at the upper goal angles (Khaled Hamouda, 116, 2015; Diaa Al-Khayyat and Nofal Mohammad Al-Hilali, 2001, p. 209).

1- Accuracy Test of Shooting from the 7-Meter Line by High Jump:

Purpose of the Test:

Measuring shooting skill.

Test Description:

The player starts by taking a step, then jumps from the 7-meter line and shoots at the shooting accuracy squares from a high jump. Three balls are consecutively sent to each square in the shooting accuracy squares.

Result Calculation:

The player records the number of successful attempts at shooting, where the ball fully enters the shooting accuracy squares.

Tools:

Handball court, shooting accuracy squares (60×60 cm, 2) suspended at the upper corners of the goal, handballs (6) (Diaa Al-Khayyat and Nofal Mohammad Al-Hilali, 2001, p. 210).

1- Change with Shooting:

Two players stand on the center line. Player (1) runs, bounces the medicine ball until he reaches it, and then passes it to player (2) behind him. Player (2) shoots while putting weight on the shooting arm joints, upper arm, and forearm (3-10% of the weight of the segment), as shown in figure (4).

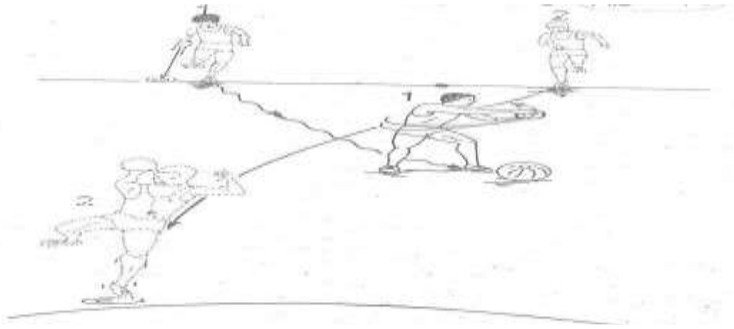


Figure (4) Change with Passing with Weights on the Shoulder and Arm (Majdi Sabah Hassan; 1995, 19)

2- Compound Change with Shooting:

Three players stand at the centre line. Player (1) begins by dribbling the medicine ball until it reaches the other medicine ball, then cuts behind player (3) to receive a back pass. He continues to dribble the ball until he reaches the second medicine ball, at which point he passes it to player (2), who cuts behind and receives it. Player (2) then shoots while placing weight on the joints of the throwing arm and forearm (3-10% of the segment's weight), as shown in Figure (5).

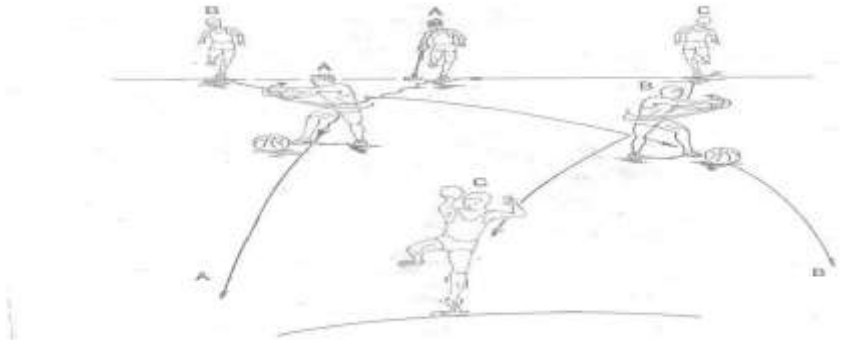


Figure (5) Compound Change with Shooting with Weights on the Forearm and Wrist (Mohamed Tawfik Al-Waleeli, 2007, 97)

**2 – 7 Survey Experiment:**

The survey experiment was carried out on Wednesday, January 10, 2023, with a sample of four players and assistance from the auxiliary team in the Sulaymaniyah Club's indoor hall. The experimental objectives were as follows:

- Educate the auxiliary team on the testing procedures.

- Determine the scientific basis for the tests.

- Identify any difficulties encountered by the researcher.

- Assess the tools' validity.

**2 – 8 Main Experiment:**

The researcher carried out the exercises on the experimental group from Sunday, April 22, 2023, to Wednesday, June 22, 2023. The following considerations were made during the implementation of the exercises:

- Each training unit began with general warm-ups, followed by specific warm-ups.

- The researchers used high-intensity interval training (HIIT) for the exercises.

- The exercises were performed three times per week for a total of 24 training units over eight weeks.

- Exercise repetitions were fixed, and training intensity was controlled using the HIIT method.

- The intensity used ranged from 80 to 90 percent.

- Exercise durations were determined using the survey experiment results.

**3- Presentation, Analysis, and Discussion of Results:**

**3-1 Presentation and Analysis of Results:**

Table (4) Statistical Features for Maximum Muscle Strength Tests for the Pre and Post Tests of the Intensity Concentration Group

| **No.** | **The tests related to maximum strength** | **Unit** | **Pre-test (N=7)** | | **Post-test (N=7)** | | **The difference between the means** | **Calculated T value** | **Improvement ratio (%)** | **Probability of Error** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | **SD** | **P** | **SD** | **P** | | | | |
| **1** | The maximum force of the muscles involve | KG | 15.56 | 4.28 | 18.26 | 4.11 | 2.69 | 2.22 | 15% | 0.07 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | d during shooting | | | | | | | | | |
| **2** | The maximum force of the shoulder flexor muscles | KG | 14.17 | 1.30 | 14.63 | 1.59 | 0.46 | ***2.78** | 3% | 0.03 |
| **3** | The maximum force of the wrist flexor muscles | KG | 11.80 | 2.92 | 12.60 | 2.99 | 0.80 | ***3.72** | 6% | 0.01 |

*Significant at a probability error rate of ≤ (0.05), where the critical (t) value is 2.447.

Table (4), which shows the statistical features for maximum muscle strength tests for the pre and post-tests of the intensity concentration group, clearly shows that there are significant differences in the maximum strength tests for the shoulder flexor muscles and in measuring the maximum strength of the wrist flexor muscles in favor of the post-test. The calculated t-values were 2.78 and 3.72, which are greater than the critical t-value at a probability error rate of ≤ 0.05, which is 2.447.

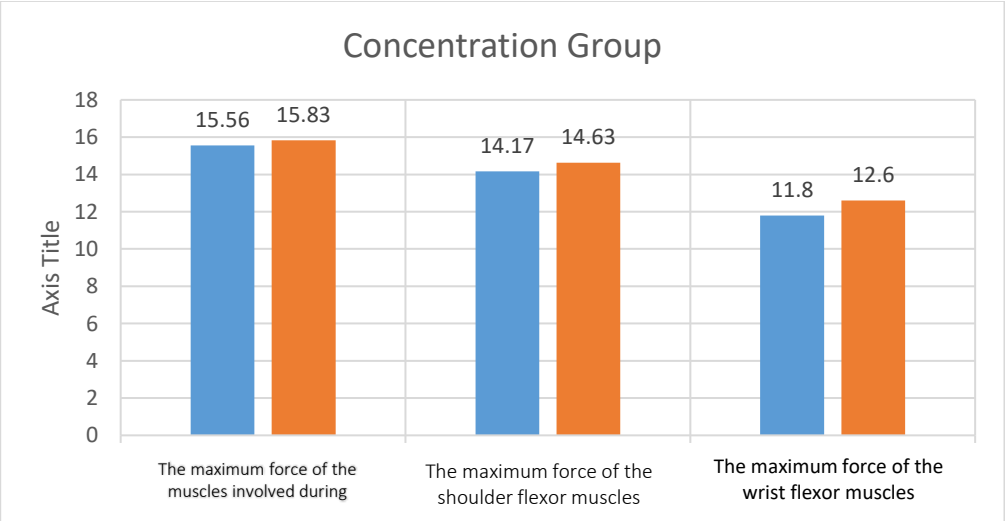
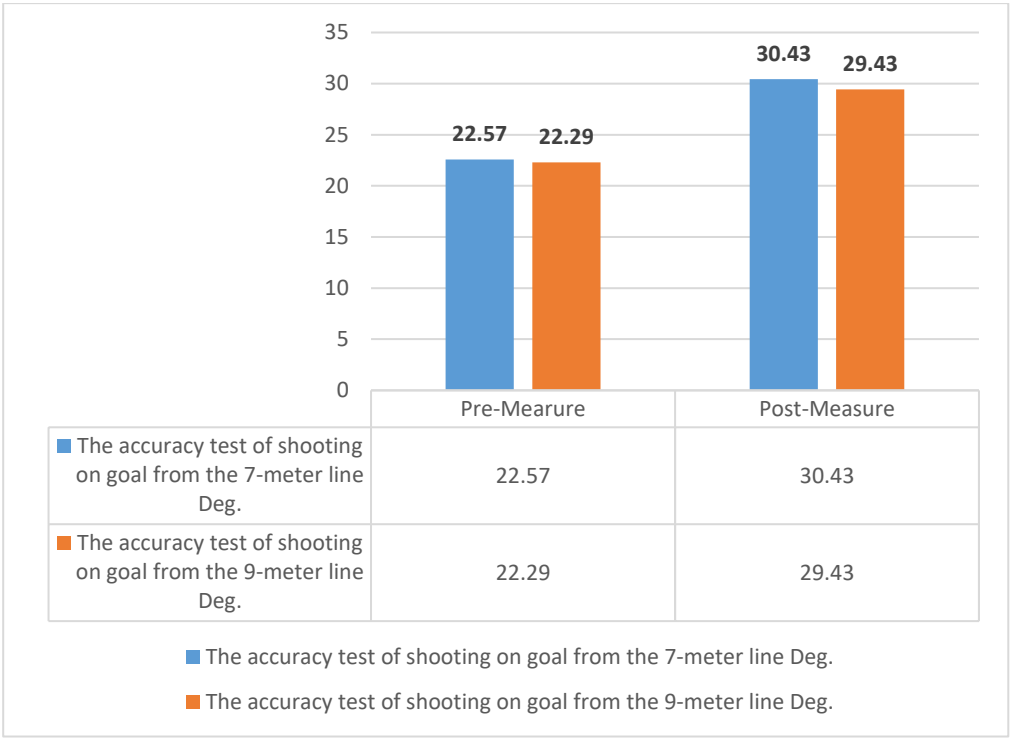



Table (5) Statistical Features for Marksmanship Tests for the Pre and Post Tests of the Concentration Group

| No. | The tests related to accuracy | Unit | Pre-test (N=7) | | Post-test (N=7) | | The difference between the means | Calculated T value | Improvement ratio (%) | Probability of Error |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | SD | P | SD | P | | | | |
| **1** | The accuracy test of shooting on goal from the 7-meter line | Deg. | 22.57 | 4.24 | 30.43 | 7.41 | 7.86 | ***4.45** | 26% | 0.00 |
| **2** | The accuracy test of shooting on goal from the 9-meter line | Deg. | 22.29 | 3.77 | 29.43 | 6.16 | 7.14 | ***4.61** | 24% | 0.00 |

*Significant at a probability error rate ≤ (0.05) where the tabulated t-value is 2.447.

Table (4/2) shows that the statistical features of the accuracy tests for the concentration group's pre and posttests differ significantly in measuring shooting accuracy at the goal from the 7-meter and 9-meter lines, favoring the post-test measurement. The calculated t-values were 4.45 and 4.61, respectively, which are greater than the tabulated t-value at a probability error rate of ≤ 0.05 (2.447).




### 3-1-1 Impact of the Program for the Concentration and Distribution Groups:

Table (6) Statistical Features of Maximum Muscle Strength Tests for the Post-Tests of the Concentration and Distribution Groups.

| No. | The tests related to maximum strength | Unit | Concentration Group (N=7) | | The difference between the means | Calculated T value | Improvement ratio (%) | Probability of Error |
|---|---|---|---|---|---|---|---|---|
| | | | SD | P | | | | |
| **1** | The maximum force of the muscles involved during shooting | KG | 18.26 | 4.11 | 1.49 | -0.67 | 8% | 0.85 |
| **2** | The maximum force of the shoulder flexor muscles | KG | 14.63 | 1.59 | 2.32 | ***2.59** | 14% | 0470. |
| **3** | The maximum force | KG | 12.60 | 2.99 | 1.91 | 1.13 | 13% | 0.649 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | of the wrist flexor muscles | | | | | | | |

*Significant at a probability error rate ≤ (0.05) as the tabulated (t) value equals 2.197.

Table (6) displays the statistical characteristics of the maximum muscle strength tests for the post-tests of the concentration group, indicating significant differences in the maximum strength tests for the shoulder muscles in favour of the concentration group. The calculated t-value is 1.59, which is higher than the tabulated t-value at a probability error rate of ≤ 0.05 (2.197).

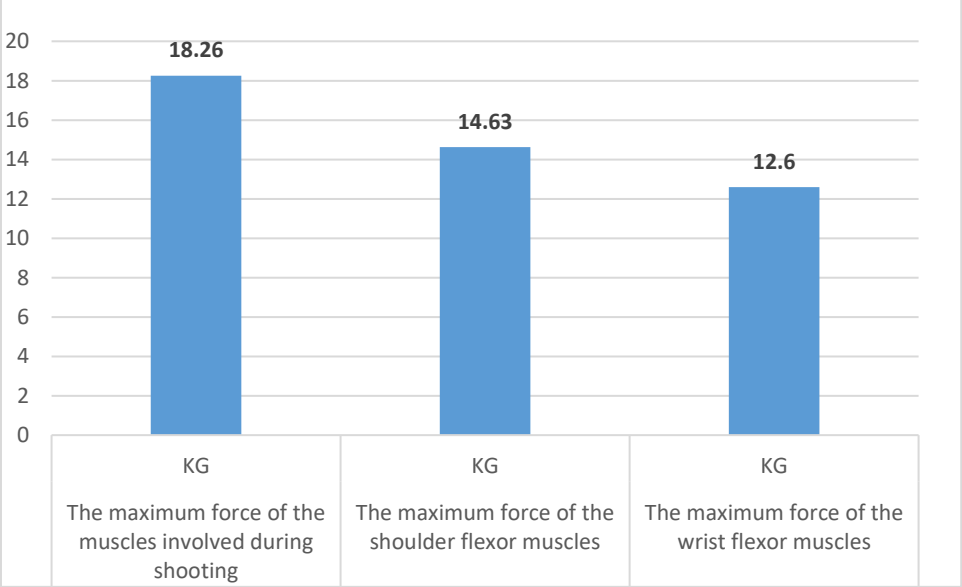



Table (8): Maximum Muscle Force for the Two-Dimensional Concentric Tests

Table (7): Statistical Features of Accuracy Tests for the Two-Dimensional Concentric Test

| **No.** | **The tests related to accuracy** | **Unit** | **Concentration Group (N=7)** | | **The difference between the means** | **Calculated T value** | **Improvement ratio (%)** | **Probability of Error** |
|---|---|---|---|---|---|---|---|---|
| | | | **SD** | **P** | | | | |
| **1** | The accuracy test of shooting on goal from the 7-meter line | Deg. | 30.43 | 7.41 | 5.71 | 1.96 | 16% | 0.01 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **2** | The accuracy test of shooting on goal from the 9-meter line | Deg. | 29.43 | 6.16 | 5.71 | ***2.34** | 16% | 0.02 |

Significant at a probability error rate ≤ (0.05) if the critical (t) value equals 2.197.

Table (7) shows that there are significant differences in measuring the accuracy of shooting at the goal from 9 metres in favour of the concentration group. The calculated t-value of 2.34 exceeds the tabulated t-value at a probability error rate ≤ 0.05, which is 2.197.

Table 4/19 shows the statistical features for the correlation relationships between maximum strength tests for the upper limbs and shooting accuracy on the goal for the concentration group.

| **No.** | **Maximum power & accuracy measurements** | **Unit** | The accuracy test of shooting on goal from the 7-meter line | The accuracy test of shooting on goal from the 9-meter line | The maximum force of the muscles involved during shooting | The maximum force of the shoulder flexor muscles | The maximum force of the wrist flexor muscles |
|---|---|---|---|---|---|---|---|
| 4 | The accuracy test of shooting on goal from the 7-meter line | Deg | 1 | | | | |
| 5 | The accuracy test of shooting on goal from the 9-meter line | Deg | **.992**** | 1 | | | |
| 1 | The maximum force of the muscles involved during shooting | KG | **.690*** | 0.636 | 1 | | |
| 2 | The maximum force of the shoulder flexor muscles | KG | 0.473 | 0.462 | 0.351 | 1 | |
| 3 | The maximum force of the wrist flexor muscles | KG | 0.203 | 0.214 | -0.030 | **.859**** | 1 |

- *Statistically significant at a probability error rate ≤ 0.005 in the positive direction.

- **Statistically significant at a probability error rate ≤ 0.01 in the positive direction.

It is evident from Table 4/19, which deals with statistical features concerning the correlation relationships for maximum strength tests for the upper limbs and shooting accuracy on the goal for the concentration group, that there are statistically significant relationships at a probability error rate ≤ 0.01 in the positive direction.

There are relationships between the accuracy test for shooting on goal from the 7-meter line and the shooting accuracy test from the 9-meter line, with a correlation coefficient (r) value of 0.992**. There is a significant positive correlation (r = 0.690) between shooting accuracy from the 7-meter line and maximum muscle strength (p-value ≤ 0.05).

Furthermore, there is a statistically significant correlation at a probability error rate ≤ 0.01 in the positive direction between the maximum strength of the shoulder flexor muscles and the maximum strength test for the wrist flexor muscles, with a correlation coefficient (r) value of 0.859**.

## 4 - Conclusions and Recommendations:

### 4.1 - Conclusions:

1. Concentration strength exercises increased the maximum strength of the muscles used for shooting in handball by up to 15%.

2. Concentration strength exercises increased the peak strength of the shoulder flexor muscles in handball by up to 3%.

3. Concentration strength exercises increased the maximal strength of the wrist flexor muscles in handball by up to 6%.

4. Concentration strength exercises increased shooting accuracy from the 7-meter line by 26%.

5. Concentration strength exercises increased shooting accuracy from the 9-meter line by 24%.

### 4.2 - Recommendations:

Based on the research results and conclusions, the researcher recommends the following:

1. Use concentration strength exercises with youth and young handball players to improve maximum muscle strength in the muscle groups involved in shooting and passing.

2. Use concentration strength exercises with youth and young handball players to increase maximum strength in the shoulder flexor muscle groups.

3. Include concentration strength exercises for youth and young handball players to improve maximum strength for the wrist flexor muscle groups in handball.

4. Incorporate concentration strength exercises for youth and young handball players to improve shooting accuracy from the 9-meter line.

5. Include concentration training for youth and young handball players to enhance shooting accuracy from the 7-meter line.

6. Utilize concentration strength training methodologies within youth handball training programs as an approved training method to develop passing and shooting accuracy from various distances, as well as to enhance maximum muscle strength for specific muscle groups.

7. Conduct future studies to investigate the impact of concentration strength training using different weights on different body joints in handball.

8. Conduct future studies on the use of artificial intelligence tools to regulate concentration strength training methods with different weights on various body joints in handball.

9. Address other aspects of strength in similar studies, such as speed-specific strength, explosive strength, and strength endurance for youth handball players.

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