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# The Impact of Exercises Using Different Resistances on Developing the Explosive Power of the Arms, Some Kinematic Aspects, and the Performance in the 50-Meter Freestyle Swimming Event

**Tabark Mohammed Salman**

**Al-Mustansiriyah University, College of Pharmacy, Sports Activities Unit – Iraq**

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**Abstract**

This research aims to design exercises using different resistances for 50-meter freestyle swimmers and to investigate the impact of these exercises on arm explosive power, momentum transfer between body parts, motion fluidity, and the 50-meter freestyle swimming performance. The experimental method was adopted, involving both an experimental and a control group, with a sample of 11 swimmers deliberately selected using a comprehensive survey method (100%) from the Iraqi national junior swimming team, specializing in the 50-meter freestyle, and actively training for the 2023-2024 season. The participants, aged 15-17 years, were then divided into experimental and control groups. After determining the tests for the dependent variables, training programs were designed to target the main phase of the 50-meter freestyle swimmers' training unit, focusing on out-of-water exercises over a six-week period with five training sessions per week. A variety of training styles were employed, including plyometric and ballistic methods, utilizing high-intensity interval and repetitive training approaches. Various resistances, such as resistance bands, wooden boxes, medicine balls, dumbbells, and barbells, were used. The movements aimed to simulate the arm strokes in the 50-meter freestyle by focusing on eccentric muscle contractions. After the trial, the results were analyzed using the SPSS software.The conclusions and recommendations highlight that exercises using different resistances are suitable for the Iraqi national junior swimming team and contribute to the development of arm explosive power, improve the kinematic aspects of momentum transfer between body parts, enhance motion fluidity, and reduce the 50-meter freestyle completion time. It is crucial to apply the principle of variation in modern sports training to suit the specific needs of athletes, taking into account individual differences by optimally combining resistance training and methods for improving muscle elasticity, which plays a positive role in enhancing the physical performance and achievement of arm movements for 50-meter freestyle swimmers. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Good Health).

**Keywords** **Exercises using different resistances, explosive arm power, kinematic aspects, 50-meter freestyle swimming.**

## Introduction:

Swimming is a sport that relies heavily on numerical achievement, where swimmers face the challenge of genetic factors related to muscle contraction speed during repetitive movements. Swimming holds a unique position among sports due to the water environment, which applies continuous resistance to the swimmer's body throughout performance. As such, variation and diversity in training are considered positive factors in the development of swimming skills. The water's constant resistance requires specialized training methods to optimize performance, making it crucial to focus on



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exercises that enhance strength, agility, and speed under such conditions. This allows swimmers to not only overcome natural resistance but also to achieve competitive results in a sport where even milliseconds matter. **Introduction (continued)**:

Swimming drives coaches to focus on the mechanical factors associated with enhancing physical and physiological performance to achieve improvements in speed. One of the most significant aspects of speed and transition training in freestyle swimming is muscular strength training, which, when developed, improves the maximum speed of swimmers. According to researchers and sports coaches, “athletes, coaches, and sports scientists are constantly searching for methods, approaches, and exercises in modern training to improve physical capabilities. Muscular strength plays a critical role in improving performance and preventing sports injuries” (11). Muscular strength is of great importance, serving as the fundamental basis and key requirement for nearly all sports (3).

When combining strength with speed (explosive power) (13) as a fundamental requirement in swimming, it becomes clear that performance depends on the amount of force the body can generate in the shortest possible time. This makes it essential to focus on training that develops explosive power, which, in turn, enhances swimmers' physical performance. Additionally, the use of the term "muscle elongation," synonymous with flexibility, highlights the importance of providing a full range of motion for joints and muscle elasticity in the arms, as this contributes to fluid motion and efficient momentum transfer from the torso to the shoulders and then to the arms.

The researcher believes that allowing room for variation and innovation in training plans and exercises is a form of renewal, moving beyond rigidly defined training methods. This flexibility in muscular strength training is particularly important for improving performance in short-distance freestyle swimming, such as the 50-meter freestyle event. The significance of the research lies in the fact that muscular strength is particularly evident in the 50-meter freestyle, where the rapid arm strokes must overcome water resistance and the drag on the body, allowing swimmers to complete the race distance as quickly as possible, according to their abilities. Therefore, it is crucial to focus on identifying the type of muscular strength targeted for development before designing exercises aimed at explosive power, which results from the combination of fast strength and high arm speed in the 50-meter freestyle.

The theoretical importance of this research lies in its potential to enhance coaches' knowledge by incorporating various resistances to develop muscle elasticity, which, in turn, improves physical performance and results. The practical importance lies in helping swimmers use these resistance exercises to improve their ability to break personal records by enhancing their arms' explosive power.

The research problem stems from the fact that resistance exercises significantly affect muscle elongation and contraction, similar to other body muscles, which require high energy to release the maximum muscle power during elongation and contraction. This indicates that these exercises fall under high-intensity training, imposing significant stress on the body within the phosphagen system. As such, the exercises should be performed quickly and with high intensity, without compromising the technical movements required in the 50-meter freestyle. The biomechanical values, especially those related to the descriptive mechanics, ensure the safety and appropriateness of these exercises for the technical and skill requirements of this type of fast swimming.

Furthermore, the researcher, through her academic experience in swimming training, observed that young swimmers on the Iraqi national team need more variety in the methods used to develop their arms' explosive power,

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which is essential for improving their performance. Research Objectives are as follows:
1. Design exercises using different resistances for 50-meter freestyle swimmers.
2. Identify the impact of exercises using different resistances on developing the explosive power of the arms, momentum transfer between body parts, motion fluidity, and 50-meter freestyle swimming performance.

The Research paper hypothesize the following:

1. There are statistically significant differences between the pre-test and post-test results of the experimental and control groups in terms of arm explosive power, momentum transfer between body parts, motion fluidity, and the 50-meter freestyle swimming performance.
2. There are statistically significant differences between the post-test results of the experimental and control groups in terms of arm explosive power, momentum transfer between body parts, motion fluidity, and the 50-meter freestyle swimming performance.

And the scope of the research paper are Human Scope: The research population consists of the swimmers from the Iraqi national junior swimming team specializing in the 50-meter freestyle, who continued their training during the 2023-2024 sports season and Time Scope : The study period was from October 6, 2023, to November 17, 2023, conducted at the Shaab Central Pool in Baghdad, Rusafa, Zayouna.

**Research Population and Sample**: The research population was represented by the 11 swimmers of the Iraqi national junior team specializing in the 50-meter freestyle, aged 15-17 years, all of whom were purposefully selected using a comprehensive survey method, constituting 100% of the population. Given that the research problem centers around this specific group, they were divided randomly into two groups—5 swimmers in the experimental group and 6 in the control group—according to the experimental design of the current research. Homogeneity in some anthropometric variables was ensured to maintain the internal validity of the experimental design, as shown in Table 1:

**Table 1**: Homogeneity of the research sample in some extraneous variables

| Variable and Units of measurements | Sample size | mean | Standard deviation | Skewness coefficient | Coefficient of Variation |
|---|---|---|---|---|---|
| Training Age (years) | 11 | 4.67 | 0.651 | 0.439 | 13.94 % |
| Chronological Age (years) | 11 | 17.33 | 0.888 | 0.139 | 5.124% |
| Body Height (cm) | 11 | 169.58 | 1.564 | 0.328 | 0.922% |
| Weight – Body Mass (kg) | 11 | 72 | 1.702 | 0.56 | 2.363% |

The normal distribution skewness coefficient is limited to (+1), and the coefficient of variation is less than (39%).

**Research Methods, Equipment, and Tools Used:**

1. Arabic and foreign sources.
2. The Internet.
3. Observation and experimentation.
4. Testing and measurement.
5. A pool with official dimensions.
6. Various resistances (rubber bands, wooden boxes, medicine balls, dumbbells, and iron bars).
7. One wooden chair.
8. One medicine ball weighing 2 kg.
9. One height and weight measurement device (Rustmameer) made in China.
10. One high-speed video camera (Casio-Exilim Pro) made in Japan with variable frame rates (300, 600, 1200 frames per second).
11. Dartfish Team Pro 5 full version software with 2 CDs.

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Field Research Procedures

To measure arm explosive power, the test involved sitting on a chair with the torso strapped with a belt and throwing a 2 kg medicine ball, measured in centimeters (Appendix 1).

To measure momentum, transfer between body parts and motion fluidity, motion analysis software was used alongside underwater high-speed video recording with a Japanese-made Casio-Exilim Pro camera, operating at variable frame rates (300, 600, 1200 frames per second). For this research, 300 fps video footage was used, with three recordings using camera mounts with water scales. These recordings were analyzed with Dartfish Team Pro 5 software in parallel with the first 10 meters of the 50-meter freestyle swim. The performance test utilized the 50-meter freestyle race, conducted individually for each swimmer to enable the analysis of momentum transfer and motion fluidity.

The researcher developed training exercises using various resistances, alternating between plyometric and ballistic training methods. The resistances included rubber bands, wooden boxes, medicine balls, dumbbells, and iron bars, focusing on eccentric muscle movements that simulate arm strokes in the 50-meter freestyle. These resistance exercises were tailored with high-intensity loads using interval and repetitive training methods, based on the specific muscle elongation needed to maximize arm explosive power. This was designed to suit the elite levels of the swimmers.

The exercises using different resistances were implemented at the beginning of the main section of the 50-meter freestyle training unit, conducted outside the water as outlined in the training load schedule in Appendix 2.

The exercises using different resistances were applied over six consecutive training weeks, with five sessions per week, according to the national swimming team's training schedule, implemented on Saturdays. **Sunday, Monday, Wednesday, and Thursday** of each week, making a total of 30 sessions, as it is designed for elite-level training.

The progression and variation in training loads were carefully considered, ranging from intensities of **90-100%**, with repetitions of **2-3** and sets of **1-2,** and with rest periods of **2-5 minutes** between exercises, following the anaerobic (phosphagen) energy system for the **50-meter freestyle** swim.

The experiment commenced with the pre-tests conducted at the **Al-Shaab Central Pool** on **Friday, October 6, 2023**, as shown in the results of the equivalence of the two research groups to verify the starting point, presented in **Table 2:**

| Variables | Group | Mean | St.deviation | Levene's ) test | (Sig) | (t) | (Sig) | Difference | |
|---|---|---|---|---|---|---|---|---|---|
| Explosive power of arms (cm) | Experiential | 5 | 326.8 | 5.404 | 0.028 | 0.87 | 0.414 | 0.689 | Non significant |
| | Control | 6 | 328.17 | 5.492 | | | | | |
| Motor coordination between body parts | experiential | 5 | 187 | 16.432 | 0.033 | 0.86 | 0.149 | 0.885 | Non significant |
| | Control | 6 | 188.5 | 16.873 | | | | | |
| Motor agility for hand-eye coordination | experiential | 5 | 176.65 | 1.118 | 4.286 | 0.068 | 0.093 | 0.928 | Non significant |
| | Control | 6 | 176.697 | 0.48 | | | | | |
| Swimming performance (50m free) | experiential | 5 | 44.2 | 0.837 | 0.44 | 0.524 | 1.204 | 0.259 | Non significant |
| | Control | 6 | 43.5 | 1.049 | | | | | |

The statistical difference is non-significant, indicating equivalence and baseline similarity when the Sig value is greater than (0.05) with a degree of freedom (9).

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Following this, the exercises using different resistances were applied to the experimental group of swimmers starting on Saturday, 7th October 2023, and continued until Thursday, 16th November 2023. The control group swimmers continued with their usual training regimen.
Post-tests were conducted for both research groups on Friday, 17th November 2023.

The results of the pre- and post-tests for the dependent variables were analyzed using the SPSS system to obtain values for the percentage, mean, standard deviation, Levene's test for homogeneity of variance, independent samples t-test, and paired samples t-test.

**Table 3** shows the pre and post test for each group:

| Variables | Group (n) | Comparison | M (Mean) | SD (Standard Deviation) | Diff. | T-Value | Significance |
|---|---|---|---|---|---|---|---|
| Explosive Power of the Arms (cm) | Experimental | Pre-test | 326.8 | 5.404 | 37.2 | 13.547 | 0 |
| | | Post-test | 364 | 1 | | | Significant |
| | Control | Pre-test | 328.17 | 5.492 | 16.5 | 4.381 | 0.007 |
| | | Post-test | 344.67 | 6.47 | | | Significant |
| Body Transfer Parts Between | Experimental | Pre-test | 187 | 16.432 | 36.4 | 4.823 | 0.009 |
| | | Post-test | 223.4 | 2.074 | | | Significant |
| | Control | Pre-test | 188.5 | 16.873 | 11.83 | 2.857 | 0.036 |
| | | Post-test | 200.33 | 14.404 | | | Non-significant |
| Fluidity of Movement (Momentum Shift) | Experimental | Pre-test | 176.65 | 1.118 | 40.42 | 42.983 | 0 |
| | | Post-test | 217.47 | 0.822 | | | Significant |
| | Control | Pre-test | 176.697 | 0.48 | 22.93 | 14 | 0 |
| | | Post-test | 199.63 | 1.294 | | | Significant |
| 50m Freestyle Swimming Time (sec) | Experimental | Pre-test | 44.2 | 0.837 | 3 | 5.477 | 0.005 |
| | | Post-test | 41.2 | 0.447 | | | Significant |
| | Control | Pre-test | 43.5 | 1.049 | 0.667 | 3.162 | 0.025 |
| | | Post-test | 42.83 | 0.753 | | | Non-significant |

The statistical difference is considered significant when the (Sig) value is less than 0.05, with degrees of freedom equal to n-1 for each group.

**Table (4)** shows the results of the post-tests for each group

| Variables | Group (n) | Comparison | M (Mean) | SD (Standard Deviation) | Diff. | T-Value | Significance |
|---|---|---|---|---|---|---|---|

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Explosive Power of the Arms (cm) | Experimental | Pre-test | 326.8 | 5.404 | 37.2 | 13.547 | 0 |
| | | Post-test | 364 | 1 | | | Significant |
| | Control | Pre-test | 328.17 | 5.492 | 16.5 | 4.381 | 0.007 |
| | | Post-test | 344.67 | 6.47 | | | Significant |
| Body Transfer Parts Between | Experimental | Pre-test | 187 | 16.432 | 36.4 | 4.823 | 0.009 |
| | | Post-test | 223.4 | 2.074 | | | Significant |
| | Control | Pre-test | 188.5 | 16.873 | 11.833 | 2.857 | 0.036 |
| | | Post-test | 200.33 | 14.404 | | | Non-significant |
| Fluidity of Movement (Momentum Shift) | Experimental | Pre-test | 176.65 | 1.118 | 40.42 | 42.983 | 0 |
| | | Post-test | 217.47 | 0.822 | | | Significant |
| | Control | Pre-test | 176.697 | 0.48 | 22.933 | 14 | 0 |
| | | Post-test | 199.63 | 1.294 | | | Significant |
| 50m Freestyle Swimming Time (sec) | Experimental | Pre-test | 44.2 | 0.837 | 3 | 5.477 | 0.005 |
| | | Post-test | 41.2 | 0.447 | | | Significant |
| | Control | Pre-test | 43.5 | 1.049 | 0.667 | 3.162 | 0.025 |
| | | Post-test | 42.83 | 0.753 | | | Non-significant |

**The statistical difference is significant when the (Sig) value is less than (0.05), with degrees of freedom equal to n-1 for each group.**

## Discussion:

The results from the pre- and post-tests presented in Table (3) show a clear improvement in the dependent variables for the swimmers in both research groups, except for the motor transfer between body parts and performance in the control group swimmers. The post-test results shown in Table (4) reveal that the experimental group swimmers outperformed the control group swimmers in explosive arm power, motor transfer between body parts, fluidity of movement, and 50-meter freestyle swim performance. The researcher attributes these results to the positive impact of varied resistance training on improving muscular contraction by incorporating different types of resistance in both the stretching and shortening phases, using plyometric and ballistic training methods for repetitive movements in this fast-paced swimming discipline.

Additionally, using light resistance to match muscular stretching and to avoid exposing swimmers to sports injuries is crucial. As noted, "When athletes vary their muscle contraction exercises, they stimulate a range of muscles in the arms, including the biceps and triceps. This helps balance muscle development and prevents neglecting certain muscles at the expense of others" (10). The researcher also attributes this development to the effective adaptation of this variety, aligning with the difficulty of each exercise to suit the number of repetitions and sets without compromising muscle coordination. This adaptation is particularly beneficial for the explosive power of the arm muscles, as confirmed by the improvements in kinematic variables such as motor transfer and fluidity of movement. The enhancement in these variables reflects an improvement in the execution of swimming strokes, which positively impacts the reduction of the time taken to complete the race in freestyle swimming. Therefore, the varied resistance training focusing on muscular stretching

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represents an effective training approach. The meticulously designed training program was tailored to fit the specific needs of the national team swimmers of higher levels, considering their age, gender, and training status to improve both their physical capacity and performance. As noted, "Stimulation plays a role in activating nerves, and consequently, the strength and speed of muscular mechanical work affected by or resulting from this stimulation require energy to continue. Thus, the cessation of stimulation leads to the stopping of the chemical processes responsible for releasing energy in these muscles" (12). Additionally, "In most movements, the limbs are relied upon as a source of driving force or as auxiliary power. The transfer of movement from the limbs to the torso is clearly visible in most sports movements and can also be categorized into: transfer of movement from the arms to the torso, from the legs to the torso, and from the head to the torso" (1). The researcher attributes these results to the fact that the varied resistance exercises helped increase neuromuscular control, improving the explosive capacity of the muscles by effectively aligning the high-intensity interval training and repetitive training methods with the anaerobic energy system.

According to the researcher, "Changes in momentum can be measured by keeping the athlete's mass constant and noting changes in velocity to indicate the smoothness of the movement, whether performed well or poorly. This is a quantitative measure of a movement aspect that, until now, was assessed descriptively through visual observation (qualitatively). Therefore, it can be stated that movement smoothness equals changes in momentum, as effective force application means good smoothness according to Newton's second law" (7). "Several studies have indicated that resistance training strengthens muscles, increases their size and firmness, improves blood circulation and heart function, enhances lung vital capacity, and strengthens tendons, joints, and connective tissues, in addition to increasing bone mass and density" (5). Moreover, "Stretching exercises are movements that depend on coordinated work between the nervous and muscular systems. When this coordination is good, the movement becomes harmonious, which is referred to as 'neuromuscular coordination.' This allows individuals to perform well, and coordination exercises may require tools or be performed without them. The primary goal of these exercises is to develop physical and skill-related attributes correctly and balanced, with specific exercises for each body part to avoid sudden sports injuries" (14)."Muscle elasticity (stretching) is influenced by the amount of effort applied, and the morphological structure of the muscles plays a significant role in determining the type of flexibility. It has been shown that transverse muscles are more elastic than longitudinal muscles" (9). Furthermore, "Factors affecting muscle strength production include the number of muscle fibers activated, the cross-sectional area of the muscle or muscles involved in performance, the muscle fiber type, the angle of muscle force production, muscle length and relaxation before contraction, the duration of the muscle contraction, the degree of coordination among the muscles involved in performance, the athlete's emotional state before and during force production, age, gender, and warm-up" (2). The researcher attributes the improvement in the experimental group swimmers to the diversity and interchange in muscular work due to different types of exercises and resistance variations. This approach effectively impacts the direction of muscular contraction work and muscle stretching in both plyometric and ballistic exercises, enhancing the flexibility of arm muscles. "Regardless of the diversity in methods for developing muscle strength and their various techniques, what is required falls within the limitations of properly planning and applying these methods and techniques. These often focus on plyometric and ballistic exercises in cycles of muscle elongation and contraction for high-speed,

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high-output contractions affecting the resulting force" (11)."Among the reasons for performance improvement are the correct balance between load and rest, the relationship between load and adaptation, continuity in training, gradual increase in load, specificity of training, individualization in training, and regular evaluation and monitoring. These factors significantly impact the increase in muscular strength and effectiveness of skill performance" (6). "Exceptional skill performance cannot be achieved in a distinguished manner unless it undergoes research and analysis from multiple perspectives, based on the laws and principles of biomechanics, to achieve the best results" (8)."The effect of training on the efficiency of the motor system includes strengthening neural signals to the muscles, stimulating movement centers in the cerebral cortex, suppressing emotional centers, improving muscle circulation, reducing muscle viscosity, enhancing metabolic processes, and increasing the elasticity of connective tissues" (4) "All of an athlete's physical activities lead to numerous bodily changes. However, when these activities are applied scientifically and systematically, they subsequently result in improved performance" (3).

## Conclusions:

The exercises using different resistances are suitable for the Iraqi national youth swimmers in the 50-meter freestyle.

Exercises using different resistances help in developing explosive strength in the arms, improving kinematic aspects of momentum transfer between body parts, and enhancing movement smoothness among the Iraqi national youth swimmers in the 50-meter freestyle, surpassing swimmers who train without them.

Exercises using different resistances also improve the performance time for the 50-meter freestyle among the Iraqi national youth swimmers, exceeding swimmers who train without them.

## Recommendations:

It is essential to adopt the principle of variety in modern sports training to match the specificity of the athletes and their sport while considering individual differences. Proper alignment between methods for muscle elongation development is crucial for positively impacting physical and skill-related factors and achievement for the arms of the Iraqi national youth swimmers in the 50-meter freestyle.

It is crucial to focus on training that helps develop explosive strength in the arms and improve the kinematic aspects of momentum transfer between body parts among the Iraqi national youth swimmers.

## Author's declaration:

**Conflicts of interest**: None

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

**Ethical-Clearance**: this manuscript approved by local ethical committee of physical education and sport sciences college for women on (June /2024)

## Author's contributions:

All contributions of this study were done by the researcher (T.M.) who get the main idea and work on writing and concluding also with number of experts, Aid Al-Nusairy (Al-Mustansyria University) in Statistics, Huda Shihab in revision, Nibal Ahmed in translating, Khitam Mousa in proofreading

**Facilitate the task:** this study was supported by Iraqi youth national team swimmers – Iraq.

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## Appendix (1)

### Test for Explosive Power of the Arm and Shoulder Muscles

**Test Name:** Medicine Ball Throw (2 kg) from a Seated Position

**Purpose of the Test:** To measure the explosive power of the arm and shoulder muscles.

**Equipment:**

- Flat area
- Leather strap
- Chair
- 2 kg medicine ball
- Measuring tape

**Performance Specifications:**

- The subject sits on the chair, holding the medicine ball with both hands above the head, ensuring the torso is close to the edge of the chair.
- A leather strap is placed around the chest to stabilize the subject.
- The subject is held from behind by an assistant to prevent forward movement during the throw.
- The ball is thrown using only the arms, without involving the torso.

**Conditions:**

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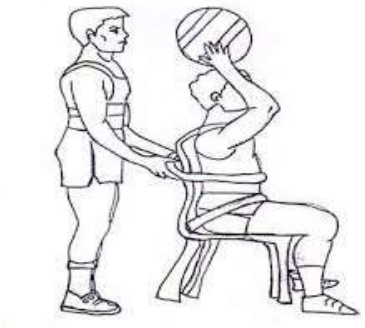
1. The subject is given three attempts.
2. An independent trial is given at the beginning of the test as a practice.
3. If the chair shakes or moves during the performance, the result is not counted, and another attempt is given.

**Recording:** The best distance achieved in the attempts is recorded, measured from the chair to the furthest point reached by the ball.

**Measurement Unit:** (cm)



## Appendix (2)
## Example of Planning Details for Resistance Exercises in 50 Meter Freestyle Swimming

| Exercise | Intensity | Sets | Reps | Rest Between Sets | Transitional Rest | Work (Time) |
|---|---|---|---|---|---|---|
| **Dumbbell Bicep Curl** | | | | | | |
| **(Standing with feet shoulder-width apart)** | **90%** | **2** | **12** | **60 sec** | **120 sec** | **250 sec** |
| **Barbell Bicep Curl** | | | | | | |
| **(Standing with feet shoulder-width apart)** | **95%** | **2** | **10** | **120 sec** | **180 sec** | **281 sec** |
| **Cable Bicep Curl** | | | | | | |
| **(Standing with feet shoulder-width apart)** | **95%** | **2** | **15** | **80 sec** | **180 sec** | **281 sec** |
| **Reverse Bicep Curl** | | | | | | |
| **(Standing with arms extended and palms facing down)** | **90%** | **3** | **10** | **60 sec** | **120 sec** | **250 sec** |
| **Hammer Curl** | | | | | | |
| **(Holding dumbbells with palms facing each other)** | **90%** | **3** | **10** | **60 sec** | **120 sec** | **250 sec** |
| **Dumbbell Bicep Curl** | | | | | | |
| **(From a seated position or standing with feet shoulder-width apart, holding dumbbells at sides, curl the weights up to shoulder level)** | **90%** | **3** | **10** | **60 sec** | **120 sec** | **250 sec** |
| **Barbell Bicep Curl** | | | | | | |
| **(Standing with feet shoulder-width apart, hold a 20 kg barbell with arms extended down. Curl the barbell to shoulder level, then return slowly to start.)** | **90%** | **3** | **10** | **60 sec** | **120 sec** | **250 sec** |
| **Cable Bicep Curl** | | | | | | |

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| **(Standing with feet shoulder-width apart, use a cable machine to curl the handle up to shoulder level.)** | **95%** | **2** | **15** | **80 sec** | **180 sec** | **281 sec** |
| **Reverse Bicep Curl** | | | | | | |
| **(Standing with arms extended and palms facing down, curl dumbbells or barbell to shoulder level, then return slowly.)** | **90%** | **3** | **10** | **60 sec** | **120 sec** | **250 sec** |
| **Hammer Curl** | | | | | | |
| **(Holding dumbbells with palms facing each other, curl the weights to shoulder level, focusing on the front and side arm muscles.** | **90%** | **3** | **10** | **60 sec** | **120sec** | **250 sec** |

Total Time of Resistance Training Exercises: 21.35 minutes

# تأثير تمرينات بإستخدام مقاومات مختلفة لتطوير القدرة الإنفجارية للذراعين وبعض المظاهر الكينماتيكية وإنجاز سباحة (50) متر حرة

**تبارك محمد سلمان**
**الجامعة المستنصرية/كلية الصيدلة/وحدة النشاطات الرياضية**

**مستخلص البحث**

هدف البحث إلى إعداد تمرينات بإستخدام مقاومات مختلفة لسباحي (50) متر حرة، والتعرف على تأثير التمرينات بإستخدام المقاومات مختلفة في القدرة الإنفجارية للذراعين، وإنتقال الزخوم بين اجزاء الجسم، والانسيابية الحركية، وزمن إنجاز سباحة (50) متر حرة، وأعتمد المنهج التجريبي بتصميم المجموعتين التجريبية والضابطة على عينة بلغت (11) سباح أختيروا عمدياً بإسلوب الحصر الشامل بنسبة (100%) من مجتمعهم المتمثل بسباحي منتخب العراق للشباب لمسافة (50) متر حرة المستمرين في تدريباتهم للموسوم الرياضي (2023-2024) بعمر (15-17) عام ومن ثم قسموا إلى مجموعتين تجريبية وضابطة، وبعد تحديد أختبارات المتغيرات التابعة، تم إعداد هذهِ التدريبات لتستهدف بداية القسم الرئيس للوحدة التدريبية لسباحي (50) متر حرة ويكون تطبيقها خارج الماء لمدة (6) اسابيع تدريبية متتالية وبمعدل (5) وحدات تدريبية في الاسبوع الواحد، يتم التنويع ما بين أسلوبي التدريب البلايومتري والبالستي بإعتماد طريقتي التدريب الفتري المرتفع الشدة والتدريب التكراري، وبإستعمال مختلف المقاومات المتمثلة الحبال المطاطية، والصناديق الخشب، والكرات الطبية، والدمبلصات، والشفتات الحديد، وتوجيه الحركات الإنقباضية للإستطالة العضلية بطريقة مشابهه لحركات ضربات الذراعين في سباحة (50) متر حرة، وبعد انتهاء التجربة تمت معالجة النتائج بنظام (**SPSS**)، وكانت الاستنتاجات والتوصيات بإن التمرينات بإستخدام المقاومات مختلفة تلائم سباحي منتخب العراق للشباب لمسافة (50) متر حرة وتساعد في تطوير القدرة الإنفجارية للذراعين، وفي تحسين المظاهر الكينماتيكية لإنتقال الزخوم بين اجزاء الجسم، والانسيابية الحركية لدى سباحي منتخب العراق للشباب لمسافة (50) متر حرة، وفي تحسين زمن إنجاز سباحة (50) متر حرة لدى سباحي منتخب العراق للشباب، ومن الضروري أعتماد مبدأ التنويع في التدريب الرياضي الحديث ليلائم خصوصية اللاعبين وريضتهم بمراعاة الفروق الفردية بإعتماد حسن الموائمة ما بين التمرينات بإستخدام المقاومات مختلفة وأساليب تطوير استطالة العضلات لِما لها من دور إيجابي للعامل البدني والإنجاز للذراعين لسباحي منتخب العراق للشباب لمسافة (50) متر حرة. وهذا ما يحقق احد اهداف التنمية المستدامة للامم المتحدة في العراق (الصحة الجيدة).

**الكلمات المفتاحية** | **تمرينات بإستخدام مقاومات مختلفة، القدرة الإنفجارية للذراعين، المظاهر الكينماتيكية، سباحة (50) متر حرة**