THE IMPACT OF A PROPOSED CROSS-TRAINING PROGRAM ON ARM MUSCLE DEVELOPMENT FOR ADVANCED SWIMMERS PURSUING WATER RESCUE CERTIFICATION IN JORDAN

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Abstract

This study aimed to investigate the impact of a proposed cross-training program on the development of arm muscle strength for advanced swimmers pursuing water rescue certification in Jordan. The researcher employed an experimental approach, and the study sample consisted of 30 swimmers registered in the water rescue course at the Youth Leadership Development Center in Jordan, within the Faculty of Sports Sciences at Mutah University. They were purposefully selected and randomly assigned to two equal and comparable groups: an experimental group comprising 15 swimmers who underwent the proposed cross-training program for arm muscle strength development, and a control group consisting of 15 swimmers who followed the conventional training program. The implementation of the training program took 8 weeks, with two instructional units per week, totaling 16 instructional units. The study results revealed statistically significant differences at a significance level (≥ α 0.05) in arm muscle strength development among advanced swimmers pursuing water rescue certification between the two groups in the post-measurement, in favor of the experimental group, with an effect size ranging from 13.10% to 17.25%.Based on the study's findings, the researcher recommends the use of cross-training programs that focus on arm muscle strength development in the freestyle swimming stroke, as it can lead to improved swimming speed for advanced swimmers pursuing water rescue certification in Jordan.

Keywords: Cross-training. Lifeguard. Water rescue

Resumen

Este estudio tuvo como objetivo investigar el impacto de un programa de entrenamiento cruzado propuesto en el desarrollo de la fuerza muscular del brazo en nadadores avanzados que buscan la certificación en rescate acuático en Jordania. El investigador empleó un enfoque experimental y la muestra del estudio consistió en 30 nadadores inscritos en el curso de rescate acuático en el Youth Leadership Development Center en Jordania, dentro de la Facultad de Ciencias del Deporte de la Universidad Mutah. Fueron seleccionados de manera intencional y asignados al azar a dos grupos iguales y comparables: un grupo experimental compuesto por 15 nadadores que siguieron el programa de entrenamiento cruzado propuesto para el desarrollo de la fuerza muscular del brazo, y un grupo de control que constaba de 15 nadadores que siguieron el programa de entrenamiento convencional. La implementación del programa de entrenamiento tomó 8 semanas, con dos unidades de instrucción por semana, para un total de 16 unidades de instrucción. Los resultados del estudio revelaron diferencias estadísticamente significativas a un nivel de significancia (≥ α 0.05) en el desarrollo de la fuerza muscular del brazo entre los nadadores avanzados que buscan la certificación en rescate acuático entre los dos grupos en la postmedición, a favor del grupo experimental, con un tamaño de efecto que osciló entre el 13.10% y el 17.25%. Basándose en los hallazgos del estudio, el investigador recomienda el uso de programas de entrenamiento cruzado que se centren en el desarrollo de la fuerza muscular del brazo en el estilo libre de natación, ya que puede llevar a una mejora en la velocidad de nado para los nadadores avanzados que buscan la certificación en rescate acuático en Jordania.

Palabras clave: Entrenamiento cruzado. Salvavidas. Rescate acuático

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Study Introduction and problem:

Physical preparation is one of the key components for success in the sport of swimming, serving as the foundation for achieving high athletic levels. Additionally, physical preparation is vital for swimmers to excel in competitions, focusing on enhancing the necessary physical attributes specific to swimming and striving to develop them to their fullest extent, thereby enabling athletes to reach the highest possible level of technical performance.

Osama Ratib (1992) emphasizes that sports training is a crucial factor for success in swimming competitions in general. Training methods vary, and each coach attempts to use the method that aligns with the nature of the athletes they work with, aiming to develop motor and tactical skills to the highest possible level.

Recently, a modern training approach called "cross-training" has emerged, known for being one of the most debated training methods in the contemporary sports world. Cross-training emphasizes all aspects of physical fitness. There is a significant similarity between cross-training and circuit training, where athletes move from one exercise to another to break the monotony or routine that can result from performing the same exercise for an extended period (Jones, 2015).

Cross-training is considered one of the modern methods in the field of sports training that aims to enhance the skill performance level in the primary activity. It also improves physical, tactical, and mental performance while reducing the likelihood of injuries. Moreover, it stimulates and enhances the athlete's psychological state, motivation, and commitment to practice.

Cross-training, or "fit-Cross," is an approach used by coaches to organize training programs and fitness activities. It involves using a wide range of diverse physical activities and challenges to help swimmers acquire and meet the requirements and goals of comprehensive fitness in a safe manner. This approach leads to improvements in skill performance, thereby enhancing overall results. It also serves as an organizational framework for training methods and means, focusing on diversity in practicing various sports and activities related to the specialized activity to maintain the physical, physiological, and psychological requirements of swimmers (Hassan, 2004).

Brad Walker (2007) mentions that cross-training involves using various activities to achieve comprehensive adaptation in specialized sports. It utilizes activities outside of specialized training to provide relief from the effects of training in the specific sport, allowing muscles, tendons, bones, joints, and ligaments a brief rest. It also works to achieve muscular balance for athletes. Cross-training is an effective method for giving the body a break from routine sports activities while maintaining physical and technical fitness.

Cross-training activities encompass weight training, plyometric exercises such as box jumping, ballistic training, which focus on building overall body strength and developing muscle strength and endurance for both the arms and legs. They also include aerobic endurance activities such as water running, treadmill use, and stationary cycle training. Additionally, non-aerobic endurance activities involve speed training.

The researcher points out that swimmers' performance levels are affected by several different factors, including physical, physiological, and psychological aspects. However, physiological factors take precedence, closely associated with training load and the body's various adaptation processes. It relates to the body's ability to resist fatigue and maintain performance throughout the training session or competition.

Freestyle swimming is one of the competitive swimming styles that heavily relies on achieving ideal performance, starting from maintaining a streamlined body position on the water's surface to generating propulsive forces. Several scientific studies, such as those by Abu Tameh (2016) and Al-Qatt (2004), indicate that approximately 80-85% of the force for freestyle swimming comes from the arms, while the legs contribute a smaller proportion, approximately 15-20%. This emphasizes that the arms are the primary source of propulsive force in freestyle swimming.

Based on the researcher's experience in teaching and coaching swimming, many swimmers and candidates for water rescue certification courses may lack the

ability to sense the level of effort exerted during various training exercises. This can lead to errors in motor technique, with a focus on leg movements rather than arm movements. It is essential to incorporate exercises that develop the required muscular strength, whether for the arms or leg strokes. During skill assessment tests, some candidates may fail to realize the importance of arm movements, their frequency, and the amount of force required for each stroke to cover the required distance within the specified time frame. This can result in premature exhaustion.

The researcher believes that cross-training could provide a valuable opportunity to overcome some of these technical errors that may hinder candidates from achieving the desired goal of passing the water rescue certification tests. Hence, the researcher conducted this study to examine the impact of a proposed cross-training program on the development of arm muscle strength for advanced swimmers pursuing water rescue certification in Jordan.

Study hypotheses:

This study sought to verify the following hypotheses:

1. There are statistically significant differences at a significance level (≤ α 0.05) between pre-test and post-test measurements among individuals in the control group.

2. There are statistically significant differences at a significance level (≤ α 0.05) between pre-test and post-test measurements among individuals in the experimental group.

3. There are statistically significant differences at a significance level (≤ α 0.05) in the impact of the training program on the development of arm muscle strength in freestyle swimming between the experimental and control groups in the post-test measurements.

Study Methodology

Research Approach: A quasi-experimental approach was used due to its suitability for the nature of this study and its problem.

Temporal Parameter: The study was conducted during the period from October 5th to November 17th, 2022.

Study sample: The study sample consisted of 30 students who are swimmers and are applying for a lifeguard certification through the Youth Leadership Training Center. Table 1 provides a description of the study sample (Table 1).

The data in Table 1 indicates that there are no statistically significant differences between the two groups in any of the study variables, including age, weight, and height.

Study variables:

- **Independent variables:**

1. Cross-Training.

2. Swimmers applying for water rescue certification.

- **Dependent variables:**

- Muscular strength of the arms.

Study tools:

The following tools were used in the study:

- Medical scale.
- 25-meter measuring tape.
- Stopwatch.
- Data recording form.
- 25-meter swimming pool.
- Whiteboards.
- Various weights (medicine balls).
- Therapeutic resistance bands.

Tests used in the study:

Three tests for cross-training to develop arm muscular strength were used after reviewing the previous literature and previous studies, including the studies by Yasser (2013), Al-Aghbar (2016), and Abu Tameh (2016). These tests were selected based on their suitability for the study's objectives, the nature of the study, and the targeted age group. The tests were presented to a group of specialized experts for their opinions, Appendix 1 illustrates the tests used in the study.

Survey study:

A survey study was conducted on six swimmers outside the study sample. The aim of the survey study was to ensure the validity of the tests and tools used in the main study and to calculate the scientific coefficients for these tests.

Test reliability:

Test reliability was assessed by administering the tests and re-administering them to the survey sample, with a time interval of six days between the first and second administrations. The correlation coefficient between the two administrations was calculated. Table 2 illustrates this (Table 2).

Table 2 demonstrates that there is a statistically significant correlation at α ≤ 0.05 between the test's initial application and its re-administration. This indicates that the tests exhibit a high level of reliability and objectivity.

Study procedures:

1. The researcher coordinated with the students at the Faculty of Sports Sciences who wished to enroll in the preparatory course for lifeguard certification, held at Mutah University. The number of participants was 30 students, and their names were recorded in lists, and the days on which the course would commence were determined.

2. The study was conducted at the swimming pool of the Faculty of Sports Sciences at Mutah University.

3. Prior to commencing the training program, the training module was divided into segments that aligned with the training content. The program consisted of three parts: the introductory part, the main part, and the concluding part.

4. **Pre-test**: The researcher conducted pre-tests for both the experimental and control groups before the start of the training program. The results of the pre-tests were recorded on dedicated forms.

5. **Program implementation:** The proposed educational program was implemented on the study sample, following the guidelines outlined in the training program. The program spanned a duration of six weeks, comprising 12 training units, starting from October 16, 2021, to November 8, 2021.

Table 1: This table illustrates the mean, standard deviation, minimum, and maximum values for weight, height, and age among the study sample.

Variables	Group	Mean	Standard Deviation	Degrees of Freedom	t-Value	Significance Level
Age	Control	22.53	2.59	28	1.41	0.889
	Experimental	22.80	6.83			
Weight	Control	69.67	13.18	28	0.758	0.455
	Experimental	73.67	15.61			
Height	Control	175.67	5.81	28	0.0082	0.999
	Experimental	175.42	4.72			

Table 2: Test reliability using the test-retest method.

Tests	Correlation Coefficient
Pull-Up Test on the Bar	0.87
Medicine Ball Push Test (Maximum Distance)	0.85
Arm Stroke Frequency in Freestyle Swimming (25 meters)	0.91
Compatibility Swimming Test (Freestyle) (25 meters)	0.93
*Significant at α ≤ 0.05	

6. **Post-tests:** After the completion of the proposed educational program, post-tests were administered to the study sample. The program lasted for six weeks, and the post-tests were conducted on November 13, 2021. The researcher ensured that the post-tests were conducted under the same conditions, criteria, and locations as the pre-tests, in the swimming pool of the Faculty of Sports Sciences at Mutah University. The results of the post-tests were recorded on dedicated data collection forms to facilitate statistical data analysis.

Statistical analyses used in the study:

The following statistical methods were employed:

1. **Mean (Arithmetic Mean):** Calculating the average value of data points.

2. **Standard Deviation:** Measuring the extent of data dispersion or variation.

3. **Pearson Correlation Coefficient:** Determining the strength and direction of the linear relationship between variables.

4. **Independent Samples t-Test:** Used to detect differences between the two groups (control and experimental) in the post-test application and to verify the equality of groups. Additionally, arithmetic means and standard deviations were extracted to describe the performance levels of each group.

5. **Paired Samples t-Test:** Utilized to detect differences between pre-test and post-test measurements.

Presentation and Discussion of Results - Hypothesis 1:

The hypothesis stated, **"There are statistically significant differences at the (α ≤ 0.05) level between the pre-test and post-test measurements for individuals in the control group."**

The researcher calculated the arithmetic means and standard deviations, and performed a paired t-test between the pre-test and post-test measurements for individuals in the control group. The results are as shown in Table 3.

The data in Table 3 reveals statistically significant differences at the (α≤0.05) level between the pre-test and post-test measurements for the control group, as indicated by the t-value and the associated significance level. The effect size, ranging from 13.42% to 23.87%, suggests a substantial impact in favor of the post-test measurements. According to Cohen's classification, this indicates a large effect of the traditional method in improving leg strokes in prone position swimming.

The researcher attributes this improvement in the control group's performance to the influence of traditional teaching methods on skill acquisition and development in swimming. This aligns with the findings of Tarbpojen (1988) and Sasuny (1985), who emphasized the role of education in acquiring motor skills. The researcher also emphasizes the importance of both traditional teaching and physical training, as the body translates education into improved motor techniques, ultimately enhancing performance. The researcher believes that the traditional method is essential for muscle adaptation, strengthening, and harmonious function, which in turn contributes to learning motor skills and sets the stage for proper training. It is important not to overlook the duration of traditional learning programs, as they play a significant role in skill development in swimming.

Results related to the second hypothesis: - Hypothesis 2:

The hypothesis stated: **Statistically significant differences were found at a significance level (≤ α 0.05) between the pre-test and post-test measurements in the experimental group individuals.**

The researcher calculated the mean values and standard deviations and conducted a paired t-test between the pre-test and post-test measurements for individuals in the cross-training group for arm muscle strength development, as shown in Table 4.

The data in Table (4) reveals statistically significant differences at the (α≤0.05) level between the pre-test and post-test measurements for the experimental group, as indicated by the t-values and the accompanying significance level (α). These differences favor the post-test measurements, suggesting substantial improvements.

The calculated effect size, as indicated in the table, falls within the range of 18.89% to 28.79%. According to Cohen's classification, this signifies a large effect of the cross-training method used in developing arm muscle strength for the freestyle swimming stroke (front crawl).

The researcher attributes these results to the fact that physical and motor abilities are closely related to the development of muscle work in athletes as a result of exercise and training. This is achieved by creating an effective training environment that relies on diverse training environments and the application of adaptation principles through carefully designed exercises. These exercises

Table 3: Paired t-test for related samples to detect differences between pre-test and post-test measurements in the control group.

Test Category	Subtest	Application	Mean	Standard Deviation	t-value	Significance Level	Effect Size
Swimming Tests	Frequency of Arm Movements in Freestyle (25m)	Pre-test	10.20	5.88	4.39	0.00*	23.87%
		Post-test	12.06	5.15			
	Swimming Compatibility Test (Freestyle 25m)	Pre-test	12.18	6.84	3.52	0.00*	20.09%
		Post-test	14.59	5.05			
Arm Muscle Strength Tests	Pull-Up Test on the Bar	Pre-test	1.56	0.25	3.46	0.00*	19.82%
		Post-test	1.73	0.21			
	Medicine Ball Push for Maximum Distance	Pre-test	2.61	0.3	2.17	0.00*	13.42%
		Post-test	2.78	0.18			
*Statistically significant at the (α≤0.05) level.							

Table 4: Paired t-test for dependent samples to detect differences between pre-test and post-test applications for the experimental group.

Test Subtype	Application	Mean	Standard Deviation	t-value	Significance Level (α)
Swimming Tests	Freestyle Arm Stroke Frequency (25 meters)	Pre-test	10.20	5.88	4.39
		Post-test	12.06	5.15	
Swimming Compatibility Test (Freestyle, 25 meters)	Pre-test	12.18	6.84	3.52	0.00*
		Post-test	14.59	5.05	
Arm Muscle Strength Tests	Pull-up Test	Pre-test	1.56	0.25	3.46
		Post-test	1.73	0.21	
Medicine Ball Throw Test (Maximum Distance)	Pre-test	2.61	0.3	2.17	0.00*
		Post-test	2.78	0.18	
*Statistically significant at α≤0.05 level.					

Table 5: T-test for related samples to detect differences between the control and experimental groups in dimensional measurement.

Test	Subtest Application	Mean Standard	Arithmetic Mean	Deviation	t-value	Significance Level	Effect Size
Swimming Tests	Arm Stroke Frequency in Freestyle Swimming (25 meters	Control	12.06	5.15	3.55	0.00*	17.25%
		Experimental	13.06	5.80			
	Synchronized Swimming Test (Freestyle Swimming) for 25 meters	Control	14.59	5.05	3.26	0.00*	16.43%
		Experimental	15.30	5.70			
Arm Muscle Strength	Tests Pull-Up	Control	1.73	0.21	2.14	0.00*	13.10%
		Experimental	1.98	0.29			
	Medicine Ball Throw for Maximum Distance	Control	2.78	0.18	2.96	0.00*	15.56%
		Experimental	3.15	0.33			

*Statistically significant at a significance level (α ≤ 0.05).

aim to improve the performance of the working muscles, thus creating the desired adaptations to achieve the desired goal.

Furthermore, the researcher emphasizes that the use of cross-training and diverse exercises in the proposed training program for developing arm muscle strength had the greatest impact. This is because cross-training allows for various training exercises, both in and out of the water, which positively affected the development of these abilities. Cross-training is considered one of the effective training methods that lead to the improvement and development of various forms of muscle strength, as well as motor speed. These improvements can serve as the foundation for physical abilities and create a new level of adaptation, as confirmed by previous studies such as those by Mohamed (2002) and Almutaimi (2009).

Results related to the third hypothesis- Hypothesis 3:

The hypothesis stated: **indicate the presence of statistically significant differences at the significance level (≤ α 0.05) between the control group and the experimental group in the post-test measurement.**

The researcher calculated the means and standard deviations and conducted an independent samples t-test to examine the differences between the two groups in the post-test measurement, as shown in Table No. (5) (Table 5).

The data in Table 5 indicate statistically significant differences at a significance level (α ≤ 0.05) between the control group and the experimental group in dimensional measurements, as evidenced by the t-value and its associated significance level. The effect size, calculated and ranging from 13.10% to 17.25%, suggests a substantial impact in favor of the experimental group. According to Cohen's classification, these results suggest a large effect for the training method (cross-training) in developing arm muscle strength for freestyle swimming compared to the traditional method.

The researcher believes that these results are logical due to the nature of the cross-training exercises provided to the experimental group. These exercises were based on scientific principles and were tailored to the specific muscle skills required for freestyle swimming. The training regimen aimed to enhance muscle functionality, improve muscle strength, speed, and endurance, using various forms of resistance, including body weight, iron, and water resistance. A wide range of tools and equipment were used to achieve these goals, including exercises performed in the pool and weightlifting hall.

This comprehensive training program had a positive and effective impact on improving specific physical abilities. This result aligns with Jowett's (2004) study, which emphasized that cross-training is an organizational form of training methods and techniques that relies on diversity in practicing various sports and activities related to the specialized activity being pursued. It aims to develop motor, physiological, and skill-related capabilities through the use of modern devices, tools, and techniques in the field of sports training.

Conclusions and Recommendations:

Conclusions:

1. Traditional training programs develop arm muscle strength but may not do so as effectively as cross-training programs.

2. Cross-training programs enhance arm muscle strength for freestyle swimming, leading to improvements in the speed of advanced swimmers pursuing water rescue certification.

Recommendations:

1. Emphasize the importance of training programs and implement cross-training programs to improve arm muscle strength for freestyle swimming.

2. Design training programs and incorporate a set of cross-training exercises to enhance and develop freestyle swimming and other swim styles.

Annex 1:

Tests used in the program

1. **Pull-up test**

- Test Objective: To measure arm muscle strength.
- Equipment: Pull-up bar with a diameter of 2.5 cm and height of 2.20 m.
- Test Procedure: The subject, while hanging from the pull-up bar (holding from above), bends their arms until their chin is higher than the level of the bar. Then, they extend their arms fully and repeat this motion for the specified number of times.
- Recording: The number of correct repetitions is recorded.
- Evaluation: The subject is allowed two attempts, and the better of the two attempts is used (Hassanein, 2003).

2. **Medicine ball throw for maximum distance**

- Test Objective: To measure muscle strength in the arm and shoulder areas.
- Equipment Used: Level ground, small rope, medicine balls weighing 3 kg each, a chair, an appropriate number of flags, a measuring tape.

Test specifications:

- The subject sits on the chair, holding the medicine ball with both hands in front of their chest, below chin level, and with the trunk against the edge of the chair.
- A rope is placed around the subject's chest from behind to prevent any forward movement during the ball push.
- The ball is pushed using only the hands.
- Recording: The subject is given three consecutive attempts, preceded by one training attempt. The best attempt is recorded.

3. **Arm Stroke Frequency Test in Freestyle Swimming (25 meters)**

- Test Objective: To measure arm muscle strength.
- Equipment Used: A 25-meter semi-Olympic pool, a whistle, a stopwatch.
- Test Procedure: The subject stands halfway, facing the pool wall, tilts the trunk forward on the water surface, extends both arms, and starts performing alternating arm strokes.
- Measurement Unit: Meters.
- Recording: The distance covered from the moment the subject leaves the pool floor until they stop performing arm strokes is measured in meters.

4. **Synchronized Swimming Test (Freestyle Swimming) for 25 meters**

- Test Objective: To measure arm muscle strength.
- Equipment Used: A 25-meter semi-Olympic pool, a whistle.

• Test Procedure: The subject stands halfway, facing the pool wall, tilts the trunk forward, extends both arms, pushes off the pool floor with their feet for horizontal gliding, and begins performing synchronized alternating arm strokes (freestyle swimming).

• Measurement Unit: Meters (25m).

• Recording: The distance covered from the moment the subject leaves the pool floor until they stop performing strokes is recorded (Abu Tamim, 2016).

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