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RESEARCH ARTICLE

The Effect of a Hydrotherapy Program Accompanied by an Ultrasound Device and Massage in Improving Pain and Restriction of the Cervical Region in Female Tennis Players in Basra Governorate

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Abstract

The importance of this research lies in developing a hydrotherapy program to treat cervical pain, strengthen neck muscles, and improve the range of motion in the cervical region for female tennis players. Water-based training contributes to the improvement of key physical variables such as balance, flexibility, and muscular strength. The problem of the research is that athletes generally engage in high-intensity training and competitive matches. Whether they suffer from injuries or not, they require rehabilitation programs for recovery and returning to peak physical condition. The research aims to develop a hydrotherapy program incorporating ultrasound therapy and massage to enhance the muscular strength of the cervical region and improve its range of motion. The experimental method was applied to a sample of female tennis players from Al-Shabab Basra Club. Key Findings: The proposed hydrotherapy program, as part of an integrated rehabilitation approach, had a positive impact on pain reduction, increased cervical muscle strength, and improved range of motion. The researchers emphasize the importance of adopting hydrotherapy programs for the rehabilitation of the upper body in athletes. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education)

Keywords: Hydrotherapy, Ultrasound therapy, Massage

1. Introduction

Physical therapy relies on natural therapeutic methods, with water-based therapy being one of the most effective due to its physiological and psychological benefits. The aquatic environment provides a recreational effect, promotes muscle relaxation, reduces tension and stress, and alleviates pressure in general. Ragheb pointed out that “swimming skills are not required, and anyone interested in aquatic training can find a suitable place to perform water-based fitness exercises” [3, p. 20]. Aquatic training is considered one of the most modern and effective methods in both training and rehabilitation, serving as a preventive and natural therapeutic approach for various injuries and cases of physical fatigue.

Sardah and Abu Eid stated that “it consists of a set of movements performed in the aquatic environment for either recreational or therapeutic purposes” [2, p. 64]. The use of water-based exercises dates back to ancient times, as they were employed in treating muscle weakness and paralyzed limbs due to water’s ability to support body weight and provide resistance. Floating on water allows the body to move more freely and effortlessly compared to movement on land. High-performance athletes and those undergoing rehabilitation can greatly benefit from aquatic exercises. Individuals with pain, muscle spasms, limited mobility, or other conditions are prime candidates for hydrotherapy. The rehabilitation process begins with assessing the athlete’s fitness and suitability

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for hydrotherapy, ensuring they can safely and independently perform exercises in a rehabilitation pool to aid recovery and return to normal function. Additionally, water-based training can be integrated into daily routines, gradually increasing session duration and enhancing motor abilities such as strength, speed, flexibility, and endurance. Athletes frequently experience pain and injuries due to intense training and competitions. Neck pain is one of the most common complaints, often caused by poor posture, overuse of neck muscles, or injury. If neck pain is accompanied by numbness, weakness in the arms or hands, or radiating pain in the shoulder or down the arm, medical attention is necessary. The cervical region is particularly prone to injury due to its wide range of motion and high susceptibility to twisting forces, which may lead to ligament tears and other injuries. Athletes often fear being sidelined due to injuries, making safe and comfortable treatment methods essential for a faster return to play. Based on this, the significance of this research lies in developing a hydrotherapy program to relieve cervical pain, strengthen neck muscles, and improve the range of motion in female tennis players. It may be noted that “aquatic training contributes to improving certain physical variables such as balance, flexibility, and muscular strength” [9, p. 19]. Research Problem: Athletes generally engage in high-intensity training and intense competitions. Regardless of whether they sustain injuries, they require rehabilitation programs for recovery and returning to their optimal physical condition. Through the researcher’s experience as an instructor and coach at the University of Basra in various sports, it was observed that many injured athletes in Basra’s sports clubs tend to avoid simple exercises post-injury due to the strain they place on the affected area. Instead, they prefer aquatic training because of its positive effects on physical fitness, physiological well-being, and psychological relaxation. Based on this, the researchers conducted a study and proposed an aquatic training program aimed at enhancing the functional performance of muscles and joints in injured athletes participating in individual sports. The objectives of the research: develop a hydrotherapy program incorporating ultrasound therapy and massage to enhance the muscular strength of the cervical region and assess the impact of the hydrotherapy program, combined with ultrasound therapy and massage, on the range of motion in the cervical region. Research Hypotheses: There are statistically significant differences between the pre-test and post-test measurements in the improvement of muscle strength of the muscles acting on the cervical vertebrae in favor of the post-test measurement.

2. Research scope and methodology

1. **Human Scope:** Female tennis players from Basra Youth Club in Basra Governorate.
2. **Time Scope:** From July 1, 2024, to September 1, 2024.
3. **Place Scope:** Gym Fit Express swimming pool.

2.1. Methods and procedures

2.1.1. Research methodology

The researchers used the experimental method, as it aligns with the nature of the study.

2.1.2. Research population and sample

The research sample was purposively selected and consisted of four female tennis players from Al-Shabab Basra Club in Basra Governorate. These athletes were chosen based on their cervical pain and restricted neck movement. The details of the study sample are presented in [Table 1](#):

Table 1. Describes the sample characteristics.

Case	Length cm	Weight kg	Age year	Training age year
1	169	72	25	4
2	168	71	23	5
3	169	69	24	4
4	170	71	25	4

2.2. Sample homogeneity

In order to ensure the homogeneity of the sample, the researchers extracted the skewness coefficient for all research variables in order to know the skewness of the sample distribution, as shown in [Table 2](#).

2.2.1. Tools and equipment used

The researchers collected data for this study using the following tools and methods:

1. **Reference Survey:** The researchers reviewed specialized scientific references in sports medicine, injuries, and rehabilitation to establish a theoretical background on the key variables for managing the rehabilitation process of the cervical region. This included understanding the cervical vertebrae, deep and superficial muscles, and ligaments, as well as identifying the primary rehabilitation variables and functional tests used to measure these variables to guide the rehabilitation program effectively through its various stages.
2. **Medical Examination Tests:** The cause of neck pain on either the right or left side was confirmed

Table 2. Presents the normal distribution of the sample across the research variables, ensuring the homogeneity of the participants in the study.

Variables	Measurement Unit	Arithmetic Mean	Standard Deviation	Median	Skewness Coefficient
Age	year	24	0.95	24	0.85
Mass	kg	70	0.95	70	0.85
Length	cm	168	0.95	0.85	0.85
Right side muscular strength	kg	3.96	0.20	3.92	1.00
Left side muscular strength	kg	3.92	0.11	3.92	1.00
Forward muscular strength	kg	3.50	0.35	3.47	1.41
Backward muscular strength	kg	3.78	0.21	3.809	0.83
Range of motion right fixation	degree	27.97	0.41	27.95	0.35
Range of motion left fixation	degree	28.47	0.41	28.50	0.33
Range of motion forward fixation	degree	28.35	0.50	28.25	0.73
Range of motion backward fixation	degree	28.47	0.41	28.30	0.71

Between (± 3), this indicates that the distributions approximate normality in all variables.

to result from muscle spasms in the cervical region through MRI examination.

2.2.2. Devices and tools used in the study

Rest Meter for measuring height in centimeters and weight in kilograms, Electrical Frequency Device, Dynamometer, Goniometer for measuring cervical joint range of motion, swimming pool, Measuring tape and adhesive marker, Swiss balls, Floats, Neck pillows, Chair, Resistance bands and elastic bands.

2.3. Field research procedures

After completing the medical examinations and accurately diagnosing the injury, the required tests were conducted, which included:

1. Measuring the muscle strength of the muscles working on the cervical region.
2. Testing the range of motion of the cervical joint.

2.4. Pre-test measurements

Pre-test measurements were conducted on the research sample on July 1, 2024, for the study variables (height, weight, chronological age, and training age). Additionally, the cervical joint range of motion and the strength of the muscles working on the cervical joint were assessed in a swimming pool and at Gym Fit Express in Basra for four injured female athletes.

2.5. Main experiment

The researchers conducted the study on a sample of four injured participants focusing on the cervical region while organizing exercises. The rehabilitation program was applied to athletes suffering from neck pain localized on either the right or left side. Program Duration lasts for 8 weeks. And as for the

Frequency: 2 sessions per week. Session Duration lasts for 30–45 minutes, depending on progress through program stages. Implementation Period: July 2, 2024–September 2, 2024. Each rehabilitation session was divided into three main parts: Warm-up, Main session, cool-down. Each session started with ultrasound therapy on the cervical region for 10 minutes, followed by a treadmill warm-up. The main rehabilitation program was then performed in the swimming pool ([Appendix Table A.1](#)), where the water temperature ranged between 34–37.5°C, and the water level covered the shoulders. The sessions began with water adaptation exercises, followed by upper body movements aimed at improving blood circulation, increasing joint range of motion, and strengthening muscles. The exercises included static and dynamic strength training, with 10–15 repetitions for the muscles working on the cervical region, as well as resistance exercises, where resistance was increased by increasing movement speed. Specialized exercises were also included, following the principle of gradual progression from easy to difficult. At the end of each session, relaxation techniques and cervical region massage movements were performed.

2.5.1. Post-test measurements for the research sample

The post-measurement for the study sample was conducted under the same conditions and procedures as the pre-measurement. The range of motion of the neck joint and the strength of the muscles acting on the neck joint were reassessed at Fit Express Gym & Pool in Basra for the four injured female players on September 4, 2024.

2.6. Statistical analysis

The researchers used the SPSS software (version 19) for statistical analysis.

3. Results

Table 3. Presents the means, standard deviations, calculated T-values, significance values (SIG), and significance levels for the variables related to muscle strength and range of motion in both the pre-test and post-test measurements.

Variables	Measurement Unit	Pre-Test		Post-Test		Calculated T-Value	SIG Value	Significance Level
		Mean	Standard Deviation	Mean	Standard Deviation			
Neck Muscle Strength (Right Side)	kg	3.69	0.20	5.87	0.32	10.72	0.002	Significant
Neck Muscle Strength (Left Side)	kg	3.92	0.11	5.81	0.23	28.70	0.000	Significant
Neck Muscle Strength (Forward)	kg	3.50	0.35	6.22	0.32	25.90	0.000	Significant
Neck Muscle Strength (Backward)	kg	3.78	0.21	5.37	0.25	10.17	0.001	Significant
Range of Motion – Neck Flexion to the Right	Degrees	27.97	0.42	29.89	0.45	8.80	0.003	Significant
Range of Motion – Neck Flexion to the Left	Degrees	28.47	0.41	30.93	0.31	15.15	0.001	Significant
Range of Motion – Neck Flexion Forward	Degrees	28.35	0.50	31.72	0.48	13.01	0.001	Significant
Range of Motion – Neck Extension Backward	Degrees	28.47	0.41	31.31	0.55	5.95	0.010	Significant

4. Discussion

The results in Table 3 indicate statistically significant differences at a 0.05 significance level between the pre-test and post-test measurements for the muscle strength of the cervical region. There were also statistically significant differences between the pre-test and post-test for all range of motion variables, favoring the post-test measurements. This suggests that movement restriction was reduced, and pain during motion was alleviated. The researchers attribute this improvement to the effectiveness of the proposed rehabilitation program, which successfully progressed toward its primary goal: restoring the normal functional capacity of the cervical region. Additionally, the well-designed structure of the rehabilitation program positively impacted pain reduction speed. Since pain management is the first goal of rehabilitation, this aligns with Rashdi's findings, which state that: "Water exercises increase surface skin temperature and expand superficial blood vessels, enhancing blood circulation to deeper tissues. This results in muscle relaxation, pain relief, increased range of motion, and muscle strength, as well as an overall improvement in daily activity performance after hydrotherapy sessions" [4, p. 95]. The values of the muscle strength variable for the muscles working on the cervical region showed improvement in all variables. The reason for this is that the selection of aquatic exercises, which rely on water resistance, had a positive effect on improving muscle strength. Additionally, rehabilitation exercises in the aquatic environment offer numerous benefits due to the difference in water density compared to air. Water supports body weight, reducing pressure on the joints, while also increasing resistance when moving the arms, legs, and all body muscles, which helps enhance muscle strength. This has been confirmed by many researchers, including Othman, who stated that "the process of improving strength levels requires working with weights or us-

ing body weight" [5, p. 40]. The focus of the injured person on performing exercises targeting the relevant muscles without putting pressure on the joints is due to the fact that water reduces body weight and also increases resistance within the water due to its viscosity. This was confirmed by Gajer who emphasized "the importance of focusing on the core working muscles during training to shorten time and effort and to develop them in the shortest period with the highest efficiency" [7, p. 25]. The connection between strength and flexibility in the exercises used resulted in significant improvement, contributing to recovery and the restoration of the natural range of motion in the cervical joint. Hussam El-Din pointed out, "Using flexibility exercises aimed at reconditioning is one of the important processes to compensate for the decrease in flexibility in a specific joint after an injury" [6, p. 71]. The rehabilitation exercises used in the program had a clear impact on increasing muscle strength in the injured, as they included both static and dynamic exercises. In dynamic exercises, the contraction and relaxation cycles increase blood circulation and the expansion of blood vessels. Performance is influenced by muscle strength, so improving performance depends on contraction exercises, especially those targeting the muscle capable of producing strength and improving energy production systems. The researcher believes that the rehabilitation exercises, which progressed from easy to difficult, were designed to begin with static strength exercises from a seated position with simple repetitions, enabling the injured player to perform them, especially in the presence of pain. Additionally, the variety of exercises achieved the desired benefits of reducing pressure, which in turn alleviates pain. It also increased blood circulation to facilitate the removal of waste and injury by-products. This was also emphasized by Mackenzie, who stated, "Exercises should be performed carefully to include the level that prevents pain, especially in the first

phase of performance” [8, p. 33]. Furthermore, the final section included cervical area massage, which significantly contributed to the speed of recovery and the return of function to the injured area. Muhammed stated, “Massage expands blood vessels, which leads to the activation of circulation, the rapid removal of waste and harmful substances that hinder normal functional activity, and improves tissue nutrition and muscle energy production for restoring the organ’s function and speeding up recovery” [1, p. 238].

5. Conclusions

1. The proposed hydrotherapy program, based on integrated treatment, had a positive effect on pain relief.
2. The hydrotherapy program contributed to the improvement of muscle strength in the cervical region.
3. The hydrotherapy program had a positive role in improving the range of motion and eliminating stiffness in the cervical region.

6. Recommendations

The researchers recommend the following:

1. To consider following the hydrotherapy program for rehabilitating the upper body region.
2. To focus on hydrotherapy programs and their development due to their benefits in accelerating recovery.
3. To conduct similar studies on different injuries to develop programs and accelerate return to sports after an injury.

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 (January/2024).

Author’s contributions

All contributions of this study were done by the researchers (S.T. and W.H) who get the main idea and work on writing and concluding also with number of experts, Suhair Taha in Statistics, Khitam Mousa in revision, Nibal in translating, Batoul Ahmed Salim in proofreading.

Facilitate the task: This study was supported by four female tennis players from Al-Shabab Basra Club in Basra Governorate.

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Appendix

Table A.1. Aquatic therapy unit model.

Weeks	Time	Rest between repetitions	Rest between sets	Exercises	Notes
	30 min.	10 sec.	20 sec.	<ul style="list-style-type: none"> • 10-Minute Preparatory Exercises in Water (In the shallow area – forward walking with movement transitioning from heel to toe – backward walking with movement shifting from toe to heel – tandem walking forward and backward (walking along an imaginary line) – walking on tiptoes – walking on heels.) • Standing Facing the Pool Wall: Hold the bar with arms extended, lower the head downward, and hold the position for 10 seconds before raising it back up. Ensure the head submerges in the water and emerges. Repeat for 3 sets. • Standing with Arms Extended: Rotate the head to the right and left alternately. Perform 10 repetitions per set for 3 sets. • Back Floating: Maintain a floating position on the back for 15 seconds per repetition. Perform 3 sets. • Knee Bend with Lateral Neck Stretch: While bending the knees so that the shoulders and neck are submerged underwater, place the right hand on the right ear and tilt the head to the right while gently pushing it toward the left using the right hand. Hold for 10 seconds, then switch sides. Perform 3 sets. • Neck Muscle Stretch: Tilt the head to the right and hold for 10 seconds, then switch to the left side. Perform 3 sets. • Forward Neck Stretch: Place both hands in front of the face, grasp the back of the head, and gently pull it forward. Hold for 10 seconds. Perform 3 sets. • Resistance-Based Neck Extension: Place both hands on the forehead and push the head backward while resisting the movement by tucking the chin toward the chest. Hold for 10 seconds. Perform 3 sets. • Final section: Perform massage on the front, back, and sides of the neck for 5 minutes. 	<p>Ensuring water sanitation.</p> <p>Exercises are performed in the shallow area, with water level reaching the shoulders.</p> <p>Water temperature: 37°C.</p> <p>Treatment is conducted near individuals with injuries to enhance their sense of security in the water.</p>