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The Effect of Using Preventive Rehabilitation Exercises in Reducing Sports Injuries among Swimmers of Salah Al-Din Sports Club

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Abstract: *This research sought to assess how effective a prehab program of exercise would be at decreasing the incidence/s of sports-related injury and improving the physical and functional efficiency of swimmers from the Salah Al-Din Sports Club as they attempt to deal with the repeated biomechanical loads that swimming places on their bodies, most importantly on their shoulder joint(s). An experimental methodology was utilized that included a one-group design using purposive sampling of six (6) youth swimmers (16-20 years) to participate in a preventive training program over eight (8) weeks with twenty-four (24) training sessions each involving between sixty (60%) percent and eighty (80%) percent intensity based on their maximum effort. The program consisted of specialized strength exercises using weights, elastic resistance bands, and stretching exercises to develop the strength of stabilizing muscles and to improve the dynamic flexibility of the ligaments and tendons. The statistical analysis showed a significant change between the two assessments of the explosive power of arms. Explosive power of arms measured at 8.34 m increased to 10.05 m. There was a significant improvement for the strength endurance of the (shoulder muscles) shoulder with a statistical significant (0.009) increase. The increase in the speed-strength was minimal again with no statistical significance but confirmed that with physical intervention (hypo, hyper) the subject was able to improve their (hyperbola)(i) the range of motion; (ii) stabilize the humeral head; and (iii) reduce chronic inflammatory tissue damage to soft tissue due to the chronic cumulative fatigue. It is recommended that each of the described activities be incorporated into the primary components of all training sessions in order to fix movement patterns. This will also help to eliminate harmful compensatory mechanisms and result in effective muscle development that will decrease water resistance and provide sustained athletic performance in the long-term.*

Keywords: *Preventive Rehabilitation Exercises, Sports Injuries, Shoulder Joint, Explosive Power, Speed-Strength.*

Introduction

Swimming is an extremely competitive sport that requires repetitive biomechanical loading across the body. To perform at your best, you must balance explosive strength with constant endurance; both will provide enough force to overcome the resistance of the water.

The upper limbs of swimming athletes repeatedly execute circular motions over the water's surface; this is especially true in the breaststroke, butterfly and backstroke strokes where the movement patterns are very similar across all three strokes due to the use of both arms to propel oneself through the water. Because of the repetitive nature of these types of movement patterns, the athlete may suffer from movement-related injuries caused by high-intensity torque production. Of these movement-related injuries, the shoulder joint is often regarded as one of the most susceptible sites for injury. Elite level swimmers often have shoulder pain because they often have imbalances of the muscles that assist with rotation of their upper extremities and lack of scapular stability (McMaster, 1999).

To sustain athletic performance, athletes must shift away from conventional methods of recovering after an injury, to pre-operative rehabilitation methods designed to enhance the pre-injury, acute stage of injury (the time at which the athlete has experienced the greatest amount of tissue damage). Weldon and Richardson (2001) indicate that structured prevention programs, when used properly, can prevent the damage done to the ligamentous structures by improving the motion of the joint, which will decrease the amount of load or forces placed on the tendons.

When addressing injuries to the trunk and spine, the necessity for these programs intensifies (Fernández-Galván et al., 2020) because a weakness in stabilizing muscles leads to biomechanical postural imbalances which result in increased resistance to water when swimming, thus increasing the load on the limbs. Therefore, the importance of incorporating functional balance exercises into training units is crucial because of the need for stability in the musculoskeletal system (as the kinematic chain of the body in water relies upon force transfer from the trunk through to the limbs). If there is a disruption in this kinematic chain then there will be an increase in load placed on certain anatomical structures.

Cumulative fatigue is frequently linked to the mechanism of injury as it results in a decrease in neuromuscular coordination and thus, encourages proprioceptive training through improving an athlete's awareness of space, providing the potential to avoid compensatory movement patterns. According to Wanivenhaus (2012) in regards to swimmer injury prevention, achieving a balance between working muscles and stabilizing muscles around the shoulder joint is essential in providing stability for the humeral head in its anatomical position. Hibberd (2012) also highlights this requirement of maintaining the balance to reduce the likelihood of a tendon being impinged.

Preventative measures will help keep the knee joint healthy in swimmers that use a breaststroke style of swimming. The results of Batalha et al. (2013) showed that strengthening the muscles around the knee can reduce the degenerative effects from forceful kicking. If high intakes of training are performed without any preventative actions being taken, chronic tendon inflammation is more likely to occur (Nugent et al., 2017). Therefore, it is critical that rehabilitation components are included in physical conditioning programmes.

Enhancing the knowledge of connective tissue physiology aids in developing exercise programs that will improve the capacity of tendons to resist tensile loads. Chronic pain is frequently linked to minor alterations in tissue structure that could be averted by undertaking an appropriate exercise programme to strengthen the tendon (Weldon & Richardson, 2001). Additionally, Sein et al (2010) showed that the reduced ability of the rib cage and spinal column to flex increases the forces acting upon the shoulder joint while swimming, which results in the need for individualized programmes to increase functional range of motion (McMaster, 1999). Restoring the balance between anterior and posterior trunk muscles will allow an individual to achieve an effective streamlining of his/her body and therefore decrease drag, or water resistance.

Research Problem

Athletes must be closely monitored with respect to their training levels in order to prepare them for competition. For example, an abrupt increase in training results in an increased risk of injury to muscles and joints. The information in this study describes a deficiency in preventive rehabilitation programs for swimmers at Salah Al-Din Sports Club, which are likely contributing to the repetitive interruptions in training due to shoulder and back pain.

As a result, there is an urgent demand for consistent standards for specific preventive exercise programs to reduce injuries and improve functional performance in specialized sports research that meets the academic/professional requirements for sport. By developing and testing both a comprehensive preventative rehabilitation program, suitable for implementation in the water for swimmers, to enhance performance levels at an internationally recognized standard, we will achieve a systematic and scientific approach toward preventing swimmer injuries.

Using certain exercises that develop functional strength while improving dynamic flexibility supplies the soft tissue around the joints with protection against damage associated with high performance activities. This method minimizes the chances that joint capsules will become inflamed or that muscle fibers will tear, thus protecting the long-term athletic careers of swimmers.

Methodology

For this study, an experimental approach was taken, where a one-group design with pre- and post-test measures was used because it is the most appropriate method for addressing the nature of the problem and meeting the study objectives. The researcher used this approach because the reference group of the researcher exposed to an independent variable (the “proposed prevention programme”) and then measured the effects of this independent variable to the dependent variables (physical ability and flexibility).

To achieve accurate results, all possible outside influences were controlled, allowing all results were a function of the program, avoiding any causes of localised fatigue that could interfere with the measurement. This design is considered one of the best designs in specialised sport studies for small and specific populations, such as the swimmers of Salah Al-Din Sports Club. In this design, each athlete serves as a control for himself based on performance levels prior and following exposure to the experimental stimulus. This design allows for a very accurate assessment of the structural and functional development of stabilising muscles and determines whether negative adaptation occurs due to high-intensity training.

Participants

The population sample included swimmers from the Salah Al-Din Sports Club during the 2024-2025 training season, who were selected intentionally based on their age. The sample consisted of 10 swimmers who were in the youth category (16-20) because this age group represents an optimal developmental phase of their life cycle where measurable preventive training outcomes can be achieved to support the long-term competitive careers of athletes, and help prevent the accumulation of repetitive injury related issues over a lifetime. For methodological control purposes, four swimmers were randomly excluded to participate in the pilot experiment, leaving six swimmers as the main experimental sample. Statistical normalizing of dimensions includes height, weight and chronological age for sample homogeneity before conducting a field experiment. The skewness coefficients were all within the acceptable limits (±3).The average height is about 175.20 cm and has a standard deviation of 3.25 with an approximate skewness of -0.006. The average weight is approximately 73.20kg, standard deviation of 3.11 and approximately skewness of 1.031. The average age is approximately 18.50 years with a standard deviation of 1.75 and approximately skewness of 0.068. They also confirm that the research population is accurately represented in subsequent field procedures by being an accurate representation of the sample population with no extreme deviations from the mean/average or normal distribution.

Measurement

The field research employed a standardized protocol of physical assessments designed to measure each of the studied variables as confirmed by expert evaluation methods for both validity and reliability (explosive power of the upper extremities, speed strength, and endurance of upper extremity and shoulder muscles). All experts reached 100% agreement in their assessment of all three types of tests.

The 1 kg medicine ball throw for measuring explosive power was executed over the net for maximum distance. The protocol followed the standardized procedures of Abdul-Qader and Ali (2011) for Construction and Standardization of Special Physical Tests. The throw was executed from a position above the head and included full extension of range of motion for the throwing arm before being thrown in an excessive forward direction. The distance achieved during the test was calculated as either the best attempt among the three attempts made on the test (in meters only) or, if less than a full meter was achieved, in decimals equal to the number of whole and partial millimeters traveled by the thrown ball.

For the speed strength component of this assessment, a push-up test where the participant maintained the front support position for 10 seconds to perform as many push-ups as possible was timed using a stopwatch. This test is scored according to the performance standards established by Amir (1999) in his book "Physiological Tests and Measurements for the Field of Sports."

The maximum number of repetitions of a handstand push-up test with wall support was used to evaluate arm and shoulder muscle endurance. This evaluation took place with strict form (no knee flexing) and correct posture (alignment of body). The methodology used in conducting this test is the same as that described by Al-Robi (2011) in "Specific Physical Measurements and Testing."

In order to confirm the rigor of physical testing used to measure targeted variables, the scientific foundations of scientific validity, reliability, and objectivity have been developed according to accepted statistical guidelines in the area of sport sciences.

The tests were evaluated for their content validity with the help of an expert panel to help determine if the tests were appropriate for measuring both general and specific physical and preventative abilities. The tests were determined to have a 100% agreement among the expert panel, which again is a methodological approach that has been established by Morrow et al. (2015) in the standards related to measurement and evaluation and is necessary in order to demonstrate that a test is representative of what it is intended to measure.

The test–retest method was utilized to establish reliability, which involved giving the test first to a pilot group consisting of four swimmers, and then repeat the same test 7 days later under the same standard conditions. Pearson r was determined between the two test situations using the results from the first test and the results from the second test. The results returned high and statistically significant correlation coefficients that met the levels defined by Baumgartner and Jackson (2015) in "Measurement for Evaluation in Kinesiology", which establishes that the results are stable and minimizes random error factors.

The assessment of the objectivity of the testing procedures included a standardization (with specific instruction to be followed to perform the tests) of all testing conditions. The use of standard measurement devices and electronic timing devices to measure the results of the swimmers helped to ensure that the results were not influenced by evaluator bias. This is in accordance with Maglischo's (2003) scientific protocols for collecting valid/accurate data in swimmers in field tests conducted in a normal environment.

In order to meet the standards outlined above and be reliable instruments for measuring and field-testing instruments and measure results that will serve the purpose of this study, it must be appropriately adopted for use in the present study and to support and verify the conclusions of the present study.

Procedures

On Sunday, August 6th (2024), four swimmers in the research sample participated in a pilot study. The purposes of the pilot study were to assess whether or not the preventative physical exercises were appropriate for the muscles targeted, to measure how long it took to perform each exercise, and to discover if there were any technical errors in how the exercises were performed.

The goal of designing a prevention program is to develop the strength of muscles, along with the flexibility of the ligaments and tendons, that surround and support the joints of the shoulder, arm and elbow in the young athlete who is 16 to 20 years of age. In this way, it is hoped that future injury will be reduced or even prevented. The program was designed according to the principles of sport medicine and training that promote the use of slow, controlled movements so that all muscles are completely stretched and that no tissue is damaged due to over-stretching.

The program was designed around the holsitu approach whereby the group performed all exercises at high intensity (60% - 80% of max capacity for each swimmer). Exercise intensity was determined by the following formula: (best performance x % of intensity)/100. For example, if the best performance was 20 repetitions and the intensity required was 50%, then the actual number of repetitions completed was: (20 x 50)/100 = 10 repetitions.

Additional weights were included in the design for each athlete based on the relative weight of body segments, according to Fisher's anatomical segmentation method.

For an 8 week period, a preventive program was devised that consisted of 24 sessions held three times/week - Sunday, Tuesday, and Thursday. Each session lasted between 90 - 120 mins in length; 30 -50 min of each session was spent on performing preventive exercises as part of the overall training unit.

To create the load pattern utilized in the program, each exercise was performed within a "wave pattern" of 1:3 (i.e., one repetition followed by three repetitions). To do this, a total of 15 exercises with weights and/or elastic resistance bands were carefully selected based on expert judgment (greater than or equal to 90% agreement), while exercises with less than 75% agreement were excluded from use.

In addition to the techniques stated above concerning stretching, they both involved carrying out preventive stretching through maximum joint ranges in a very slow manner, and holding the position between 8–10 seconds before continuing on in order to have complete relaxation of the opposing muscle groups being stretched out. These approaches were consistent with the training procedures established by Bari'a and Muhammad, (1997), which contain the foundation of all sports training and athletic programs/training.

The length of the recovery periods was 15–30 sec between exercises and 30–60 sec between sets; all measurements were made with a goniometer after the last repetition of the exercise, with the angle being held for 30 sec after being measured, using the procedures described by Fahey et al. (2020) for conducting physical fitness tests.

The collection of baseline data began with conducting pre-tests, on July 25, 2024, Thursday, and concluded with conducting post-tests on September 25, 2024, Thursday, under the same standardized time, location, and conditions (assistance from staff) to ensure that the statistical results can be considered valid.

Data Analysis

To analyze the data collected from field measurements, researchers utilized the Statistical Analysis System (SAS). Advanced methods of statistical analysis were used in order to confirm that the conclusions drawn based on the analysis were statistically accurate.

The descriptive statistics calculations included the mean of all of the physical tests for determining the average for each of the physical tests as well as the statistical variability of the individual scores (the standard deviation from the average performance) in relation to each of the physical tests and median as other mean representation. The skewness was calculated in order to verify that the samples were normally distributed and have no outliers. This process was validated via Weir & Vincent (2021) in their work, "Statistics in Kinesiology", that confirmed what characteristics would lead to data meeting the assumptions of parametric statistical analyses.

The percentage method was also used to describe expert agreement and to clarify improvement rates.

A paired sample t-test was utilized as an inferential statistic technique for evaluating whether differences in the pre-test and post-test scores were statistically significant between experimental participants. A significance level ($\alpha \le 0.05$) was established as well as degrees of freedom ($n - 1$) for the criteria of accepting or rejecting the null hypotheses according to the statistical procedures described by Field (2024) in the book "Discovering Statistics Using IBM SPSS."

Statistical methods are used to integrate methodologies in order to achieve quality results. When using statistical methods, random variables are controlled for to generate reliable results, thus providing the best possible study design by meeting academic expectations and requirements

Result and Discussion

Statistical findings based on pre- and post-research group measurements demonstrate how physically responsive a program was for participants within the context of examining a new approach in muscular strength development. Results analysis shows differing levels of improvement in muscle strength depending on how each researched variable was defined and analyzed.

In the dominant arm's explosive power test, the mean value in the pre-test was increased from 8.34 m (SD = 1.28), to 10.05 m (SD = 0.67). This gives us a calculated t-value of 3.121 and a p-value of 0.022. Since the p-value is less than 0.05, we conclude that the mean increase between the two tests was statistically significant, meaning that we reject the null hypothesis.

There was no statistically significant difference found between the results of tests measuring the speed/strength of the arm muscles pre- and post- intervention. The average for the first test (Pre-test) was 12.61 repetitions, with a standard deviation of 2.70. The average of the second test (Post-test) was 13.23 repetitions, with a standard deviation of 3.49. The computed t value was 1.44 with a level of significance of 0.65.

In the strength endurance test performed on the arm and shoulder, there was also a significant improvement. Mean number of repetitions increased from 5.28 (SD=1.49) in the pre-test to 7.42 (SD=1.98) in the post-test, resulting in a t-value of 3.88 at p-level 0.009.

The t-value is a statistically significant value that provides the researcher with information regarding the statistical significance of the data. A significant result means there is a measurable effect of an intervention on physical properties, including joint stability. Comparison of the t-value (2.45) at the significance level (0.05) and df (9) with other variables of interest supports the conclusion that the training and preventative intervention will improve the physical properties of individuals and protect them from fatigue and overuse injuries. Table (1) provides additional information to support the results of this research.

Table (1): Comparison of the Means, Standard Deviations, and Calculated t-values between Pre-test and Post-test Measurements for the Research Group in Upper-Limb Strength Tests

No.	Variable / Measurement Unit	Pre-Test Mean (M)	Pre-Test SD	Post-Test Mean (M)	Post-Test SD	Calculated t-value	Significance Level	Statistical Significance
1	**Explosive power of the arms used (m and parts of meter)**	8.34	1.28	10.05	0.67	3.121	0.022	Significant
2	**Speed-strength of arm muscles (repetitions)**	12.61	2.70	13.33	3.49	1.44	0.650	Not Significant
3	**Strength endurance of the arms and shoulders (repetitions)**	5.28	1.49	7.42	1.98	3.88	0.009	Significant

Note: The tabulated t-value at $\alpha = 0.05$ and df = 45 equals 2.45.

Discussion

Findings reported in Table (1) show that the experimental group had significantly higher mean values on a post-test than the corresponding pre-test values with respect to arm muscle strength as well as arm muscle speed strength; this is attributable to the effectiveness of the training program designed for this purpose (i.e., improvement of physical abilities).

According to the researcher, these results are largely due to the types of exercises that were used as part of the training regimen. The exercises were characterized by their variety, progressive levels of resistance (in terms of both intensity and volume), and their specificity (i.e., targeting the muscles used in the competition) and helped to activate (stimulate) and increase the ability of the working muscles to produce force. Al-Nimr and Al-Khatib (2005) have stated that the development of muscular strength is critical for the success of any training program, as when training is focused on a specific muscle group and that muscle group has been developed appropriately in relation to the demands of competition, motor performance is improved.

The current findings align with the views of Abdel-Khaleq (2005) and Hassanein (2004) who have stated that muscular strength is one of the key physical attributes that contribute to an individual's capacity to perform at an athletic level. It establishes the platform from which many of the other motor skill abilities (e.g. speed, speed-strength, muscular endurance) are developed and maintained. The regular implementation of progressive resistance training (through increased intensity and volume) will allow for the adaptation and advancement of both the muscular and nervous systems, which will enhance the ability to produce force and therefore make muscular contractions do more effectively.

The scientific literature also states that maintaining functional strength requires achieving a state of equilibrium or balance between the primary working muscle group and the opposing muscular groups. Without training the muscular groups that counteract any given muscular group, there will be an imbalance in overall strength levels providing an increased possibility for injury due to improper movements. Cochran and House (2000) specifically mention that being balanced in your strength program across all of the muscles involved in creating a particular motor performance will provide maximum potential for developing strength in a coordinated manner and limit the risk of injury from excessive muscle tension or strain.

In addition, Bompa and Buzzichelli (2019) report that scientifically based strength training programs produce several muscle and neural adaptations, including increased recruitment of motor units and an increase in neuromuscular coordination. These adaptations will increase your ability to create force and produce quick muscular contractions.

Conclusion

Field data were collected to assess the effectiveness of preventive exercise on the level of arm-specific muscular strength and functional stabilizers in young swimmers at the Salah Al-Din Sports Club. The results of the testing following the 24-week training program indicated significant increases in both explosive and endurance strength from pre-test to post-test. Intensity of training sessions was between 60%-80% of maximum capacity.

As a result of implementing this intervention, the average explosive power was raised from 8.34 m to 10.05 m (p = 0.022). As a result of the systematic exercise intervention, the shoulder's range of motion angles and the elasticity of the ligamentous and connective tissues have been increased, which will help decrease the likelihood of localised fatigue and negative physiological changes associated with swimming's overhead arm movement and repetitive arm movement.

This particular field application proves to be effective and demonstrates how critical it is to include additional prevocationally specific exercise(s) into primary components of everyday unit training so that proper muscular development occurs. The use of a standardized supplemental weight is also recommended to prohibit the development of compensatory body motion in conjunction with fatigue.

Additionally, future applications should include extended programs for various age categories, and a greater variety of muscle categories, for achieving complete prevention of injury and minimising the risk of a sudden injury occurring at a sporting event. This will also support the aims of targeted sport-specific research and comply with the need for scientific validity in sport science research.

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