

The effect of physical exercises to improve muscle strength to reduce recurrent injuries of the ankle joint in men's high jump

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ABSTRACT

Sports injuries represent a significant threat to athletes' futures. This study aimed to develop preventive physical exercises focused on enhancing muscular strength within the ankle joint among the research participants. Additionally, it sought to evaluate the effectiveness of these exercises on the muscular strength of the muscles involved in the ankle joint. The study used the experimental method by using the pre and post-experimental design for one experimental group for the research sample. The researcher deliberately selected male high jumpers in the advanced category as the research community, with a sample size of 10 players. SPSS was used for statistical analysis. The results of our study showed significant differences between the pre-test and post-test measurements, highlighting particular interest in the post-tests. The study findings underscore the effectiveness of preventive exercises in averting ankle joint injuries, as evidenced by their positive impact on muscular strength within the ankle joint. Additionally, the results reveal a notable improvement in muscular strength following the implementation of these exercises.

KEYWORDS

Physical Exercises; Muscle Strength; Ankle Joint Injury; High Jump

1. INTRODUCTION

Injury is a dangerous handicap for sports practitioners in general and for high jumping sports in particular, as this activity requires changes in body directions and therefore requires the coach to use preventive exercises to reduce injury. The ankle joint is one of the joints most exposed to injuries in high jumps as a result of the effort that falls on the performance through the change in directions when performing as the foot moves in changes, which moves in a rotation with a range more than normal and may sometimes lead to injury. Therefore, the importance of the research comes in the use

of a set of preventive physical exercises, which leads to an increase in the strength of the muscles and ligaments of the ankle joint through the use of a set of physical exercises, which in turn leads to strengthening the ligaments and muscles and preventing them from repeating the injury that occurs in the same joint.

Through the researcher's review of previous research and studies, it was found that most highly jumpers are exposed to injuries in the ankle joint for several factors that may be subjective and external factors. We have noticed that the occurrence of injury signifies the loss of continuity in the member's performance of its functions in its natural form due to tissue damage. This damage can affect a group of tissues, muscles, or nerves, resulting in the disruption of their natural function and causing pain at the site of injury. Therefore, trainers must recognize the risk of injury and prioritize preventive measures within the training regimen. The researcher believes it is essential to investigate the scientific causes of injuries and seek methods to limit or reduce their frequency, as they often lead to premature retirement for players. Consequently, the researcher has decided to develop physical exercises aimed at improving muscle strength in the ankle joint to reduce the occurrence of frequent injuries and enhance players' performance levels.

The study aims to prepare preventive physical exercises aimed at improving the muscular strength of the ankle joint in the research sample. Additionally, it aims to assess the impact of these exercises on the muscular strength of the muscles involved in the ankle joint among the research participants. The research hypothesis was that there would be significant differences in the rate of change between the pre- and post-measurements within the research sample.

2. METHODS

2.1. Study design and participants

The study used the experimental method by using the pre and post-experimental design for one experimental group for the research sample. The researcher deliberately selected male high jumpers in the advanced category as the research community, with a sample size of 10 players. The study was conducted from March 2, 2021, to March 20, 2021, at the Athletics Stadium of the Ministry of Youth and Sports. Table 1 shows the homogeneity of the research sample. As Table 1 illustrates, the skew coefficient values for all research variables remained within the range of $+1$. This suggests that the research sample adheres to a normal distribution in the variables being studied (Bahi, 1999).

Table 1. Sample homogeneity

Variables	Unit	Mean	Median	SD	Skewness
Height	Cm	175.468	176.001	2.387	1.263-
Weight	Kg	72.068	72.001	1.224	0.128
Age	Year	19.000	19.000	0.378	1.000
Explosive power of the legs	Sec	21.047	21.200	0.678	0.104-
Fixed balance	Cm	3.774	3.700	0.381	0.389
Ankle extensor muscle extend	Kg	87.827	87.900	0.618	0.037-
Ankle muscle grip	Kg	86.567	86.700	0.758	0.255-

2.2. Procedures

The instruments used in this research were: one laptop computer, a stadiometer to measure height in centimeters, a medical scale for measuring weight in kilograms, measuring tape and sticky marks, rubber ropes, iron bar and assorted weights, and high jump materials. The tests implemented were: Explosive power of the legs (Al-Janabi, 2019); Fixed balance (Jawad, 2004); Ankle extensor muscle extend (Raouf, 2005); Ankle muscle grip.

The pre-tests of the research sample were conducted on 5/2/2021 and on the playgrounds of the Ministry of Youth and Sports in the province of Baghdad and on the power games courts at exactly ten o'clock by conducting the tests. The conditions for the tests and how they were performed were confirmed by the research sample.

The researcher developed preventive training exercises gradual in the use of exercises from easy to difficult, and also developed these exercises according to the physical and functional abilities and capabilities of each player, including as well the use of rubber ropes. The preventive program consisted of 25 preventive units, and the duration of each exercise unit was 20 minutes. They were implemented on Monday, Tuesday and Thursday.

After completing the implementation of the units of preventive exercises, post-tests were conducted on the members of the research sample, which numbered 10 players, with the same tests and conditions and under the direct supervision of the researcher, on 20/3/2021 at exactly ten o'clock in the morning.

2.3. Statistical analyses

The statistical analyses were carried out with the Statistical Package for the Social Sciences (SPSS), version 24. With SPSS, the researchers calculated means, standard deviations and t tests. Statistical significance was set at $p < 0.05$.

3. RESULTS

The purpose of the study analysis was to compare the test results and discern differences in muscle strength within the ankle joint by examining both pre-test and post-test outcomes among the study sample, as depicted in Table 2.

Table 2. Differences in muscle strength within the ankle joint by examining both pre-test and post-test outcomes

Variables	Pre-test		Post-tests		t	p
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation		
Explosive power of the legs	21.730	0.667	30.300	0.457	33.412	Sig
Fixed balance	3.020	0.268	6.400	0.274	20.457	Sig
Ankle extensor muscle extend	88.080	0.505	97.480	1.553	22.535	Sig
Ankle muscle grip	86.190	0.777	94.030	0.680	23.634	Sig

The table above clearly indicates significant statistical differences between the averages of the pre-test and post-tests in the physical variables.

Table 3 presents the rate of change observed between the means of pre-test and post-test measurements within the sample, focusing on the variables under study.

Table 3. Differences between the means of pre-test and post-test measurements

Variables	Pre-test	Post-tests	Difference between the two averages	Rate of change
Explosive power of the legs	21.730	30.300	8.57	39.4%
Fixed balance	3.020	6.400	3.38	111.9%
Ankle extensor muscle extend	88.080	97.480	9.4	10.7%
Ankle muscle grip	86.190	94.030	7.84	9.1%

4. DISCUSSION

It is evident from Tables 2 and 3 that significant differences exist between the pre-test and post-test measurements, highlighting particular interest in the post-tests. The researcher attributes this improvement in the ankle joint to the specific physical exercises employed, which primarily target the muscular groups, particularly the muscles surrounding the ankle. The strength exercises directly impacted the muscle group by targeting weak muscles, tendons, and ligaments surrounding the ankle. These exercises, such as wall exercises, floor exercises, and weight-bearing exercises, aided in improving and strengthening the muscles of the ankle joint. Moreover, the utilization of strength exercises induced physiological effects on the athlete's body, including morphological changes such as an increase in muscle mass, enlargement of fast-twitch fibers, heightened capillary density, and enhanced size and strength of tendons and ligaments (Abdel-Fattah & El-Din, 2003).

In addition to correctly implementing strength exercises, adhering to the principle of gradual loading, and ensuring adequate rest based on established scientific principles has been instrumental in strengthening the muscles surrounding the ankle joint. This, in turn, serves as a protective measure against potential injuries. The incorporation of weight training can further bolster this safeguard, acting as a robust preventative measure against exercise-related injuries (El-Din et al., 1997).

The gradient rule is a protection against internal disturbances in the muscles (Al-Mandalawi & Al-Shati, 1997). High-efficiency balance exercises play a crucial role in enhancing the condition of postural receptors at the ankle joint. These exercises have significantly contributed to strengthening the ankle joint during contractions. Through these exercises, there has been evident enhancement in joint stability, along with improvements in the overall performance and strength of the ankle joint across all its movements (Qader, 2016).

In addition to balance exercises, the incorporation of strength exercises utilizing weights and resistance bands has played a pivotal role in enhancing muscle strength. These exercises engage a larger number of motor units, thereby activating the muscles more effectively. By engaging a greater number of motor units, athletes can generate higher contractile forces during muscle work, leading to significant improvements in muscle strength and overall performance (Al-Asmy, 2015).

The torque generated during muscle work is crucial in facilitating the processes of contraction and relaxation within the ankle joint. During this process, torque typically ranges from 30 degrees to 70 degrees during contraction, reaching 90 degrees at the point of maximum contraction, and spanning from 130 to 180 degrees during relaxation. It's important to note that there are variations in torque among different muscles, influenced by their training regimen and resistance levels during

contraction and relaxation phases. Consequently, a significant correlation exists between the muscles throughout the entire muscle contraction process during basic movements (Mahmoud & Karak, 2007; Maaboud, 2010).

The exercises must be appropriate for the athletes' ages and their physical abilities in order to meet the purpose and achieve the goal (Ahmed & Hussein, 1979). Therefore, the researcher believes that the prepared preventive exercises have led to the improvement and development of muscle strength in the ankle joint, and thus the results are logical.

5. CONCLUSIONS

The study findings underscore the effectiveness of preventive exercises in averting ankle joint injuries, as evidenced by their positive impact on muscular strength within the ankle joint. Additionally, the results reveal a notable improvement in muscular strength following the implementation of these exercises. Moreover, there is a discernible positive correlation observed between the pre-test and post-test outcomes, indicating enhanced development and performance in the ankle joint as a result of the post-tests.

Based on the study results, we recommend the following: Firstly, it is crucial to avoid overtraining and utilize training methods tailored to the specific activity, taking into account the physical and physiological capabilities of the players. Secondly, it's essential to ensure that warm-up routines are adequate and appropriate to the nature of physical exertion, as this contributes significantly to injury prevention. Lastly, trainers should prioritize the preventive aspect of training, allocating a portion of training sessions to activities aimed at reducing injury incidence. This proactive approach not only has a positive effect on shortening recovery time and minimizing effort, but also aids in decreasing the overall risk of injury among players.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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