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Effect of CrossFit exercises on the prevention of lower extremity injuries and the improvement of physical and biochemical variables in soccer players

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ABSTRACT

Objectives: To prepare CrossFit exercises for the prevention of lower extremity injuries for soccer players and identify the effect of CrossFit exercises on some physical and biochemical variables for soccer players.

Methods: The experimental method in one group style (pre-post) was used. The sample was selected from 20 football players in the youth category at Sulaikh Sports Club, ages ranging from 18 to 22 years old, for the sports season 2021-2022. CrossFit exercises were applied to them for a period of 8 weeks, at the rate of 5 units per week, and after completion, raw data was obtained through pre- and post-tests.

Findings: Significant differences were observed between the pre- and post-tests in physical variables (explosive power, strength characterized by speed, speed, muscular endurance, and efficiency of the circulatory and respiratory systems), with results favoring the post-test ($p<0.05$). Significant differences were also found between the pre- and post-tests for white blood cells and hemoglobin, favoring the post-test ($p<0.05$). Additionally, significant differences were noted between the pre- and post-tests for LDH and CPK enzymes, with the post-test showing better results ($p<0.05$).

Conclusions: CrossFit exercises can be a useful tool to improve explosive power, strength characterized by speed, speed, muscular endurance, and the efficiency of the circulatory and respiratory systems. Furthermore, CrossFit exercises have a positive effect on white blood cells and hemoglobin, and on LDH and CPK enzymes.

KEYWORDS: CrossFit; Prevention; Lower Extremity Injuries; Soccer Players

1. INTRODUCTION

The world has witnessed development and progress in the fields of sports in general and sports medicine in particular. Athletes are exposed to many injuries, so they resort to treatment and rehabilitation programs in order to return to the stadiums, but it is better for the athlete to undergo preventive programs that protect him from injuries. Prevention exercises can provide athletes with a barrier (physical, psychological, skill) that keeps them away from injuries that occur as a result of wrong practices, lack of physical fitness, physical stress, or muscle fatigue.

The lower extremity is an important part of the football player's body, as the player relies heavily on the parts of the lower extremity in most skills. These parts may be exposed to pressure or physical friction and high effort during the match, which is why the foot, knee, lower leg, and thigh are all vulnerable to injury to the football player in particular, in dribbling, deception and during the attack. Therefore, these parts require preventive exercises to protect them from injury and to continue playing until the end without feeling tired or being injured.

The football game is a popular collective game that is characterized by having a relatively long duration, and it requires strength, endurance, speed, flexibility, compatibility and balance. The player is exposed to high physical friction during attack and defense in the match, so they must avoid injury, which is what is required to reach high levels without losses. Modern practices employ CrossFit exercises for prevention, which are a variety of functional exercises aimed at obtaining the body to muscle strength, endurance, and high energy in the body. It is performed by jumping, weights, running, climbing on heights, gymnastic exercises, and cycling.

CrossFit is beneficial for all ages and all levels, but each program differs from the other. CrossFit aims to build muscles, strengthen bones, get rid of excess weight, raise physical fitness significantly, improve breathing, balance the processes of inhalation and exhalation, and preserve the body from injuries. Hence, the importance of research on the use of CrossFit exercises in preventing sports injuries and the lower extremities of football players. Among the most important studies that preceded this one, there is a study and strength training by Smith et al. (2013) that focused on improving maximum aerobic capacity and body composition. These exercises were used for training and maintaining health, and this research used them to prevent injuries. There is also a study by Jassim (2021) on the effect of deep inner feeling exercises on some motor abilities related to the skill of tricks to prevent some knee injuries for young handball players.

The physical preparation is one of the main pillars of sports training and the development of the athlete depends on it, whether he is a beginner or an advanced player. Therefore, the football player

needs physical fitness and high skill to be able to play for two continuous runs, and sometimes additional runs, and any high stress and excessive fatigue will expose the player to injury. This is one of the most important problems that soccer players are exposed to, and to reduce the problem, the researcher sought to use CrossFit exercises because of their importance in developing physical fitness, giving muscle strength and endurance, strengthening bones and muscles, and giving the body health, activity and vitality. Therefore, these exercises were used to prevent injuries, so the researcher resorted to several questions: Will CrossFit exercises affect physical abilities? Will Cross Fit exercises affect biochemical variables? Will CrossFit exercises benefit the players and prevent injury?

The research aims were to preparing CrossFit exercises for the prevention of lower extremity injuries for soccer players and to identify the effect of CrossFit exercises on some physical and biochemical variables for soccer players. The research hypotheses were that there would be statistical differences between the pre- and post-test of the physical variables of the research sample, and that there would be statistical differences between the pre- and post-tests of the biochemical variables of the research group.

2. METHODS

2.1. Design and participants

The researcher used the experimental method in one group (pre-post). The research community consisted of Sulaikh Sports Club players, the youth category in the football game, ages from 18 to 22 years old, for the sports season 2021-2022. There were 24 players, and the sample was 20 players after excluding four players due to various injuries. Therefore, the percentage of the sample was 83.33% of the original population. The researcher proceeded to homogenize the sample with the variables of height, weight, and age, and it was within ±1. This means that the sample is homogeneous, as shown in Table 1.

Table 1. Homogeneity of the sample

Variables	Unit	Arithmetic mean	Standard deviation	Mediam
Height	cm	169.55	3.913	170
Weight	kg	69.20	5.531	69
Age	year	20	1.451	20
Training age	month	30.20	7.194	29

2.2. Procedures and instruments

First, all sample members were presented to a specialized doctor to ensure that they did not suffer from any injury and were completely free of infection.

The physical tests used were: height and weight; vertical jump from stability (Allawi & Radwan, 1999) to measure the explosive strength of the muscles of the two legs; three consecutive jumps (Ali al-Zubaidi, 1999) to measure the strength characteristic of the speed of the muscles of the two legs; run 20 m (Naji & Bastawisi, 1987) to measure the maximum speed; standing inclined prone test (Allawi & Radwan, 2002) to measure the general muscular endurance of the body; and Cooper's test (12 minutes run) (Khater & Al-Beik, 1996) to measure the efficiency of the circulatory and respiratory systems. The biochemical tests were: White blood cells, hemoglobin (Hb), Creatine Phosphokinase (CPK) and lactate dehydrogenase (LDH).

The exploratory experience was conducted on a sample of 3 players, on Thursday 10/14/2021, in order to find out the appropriateness of exercises and tests, the level of the research sample, and to know the appropriate time for the units.

Pre-tests were conducted on the research sample on Wednesday and Thursday corresponding to 20/10/2021 and 21/10/2021 at 10 in the morning, and they consisted of two days, a day for physical tests and a day for biochemical tests. Post-tests were conducted as applied in the pre-tests, on Sunday 19/12/2021 and Monday 20/12/2021.

The intervention took place from 24/10/2021 to 16/12/2021 and was applied to the research sample, consisting of young soccer players. Preventive units were applied in 8 weeks, at the rate of 5 weekly units. The total units consisted of 40 units, with a time of 30 minutes, and with an intensity of 70-100%. The method of high-intensity interval training is with short rest periods. The units are in the form of rounds, for example 100 m running, 10 times jumping on boxes, 2-5 times skipping rope, 5 times climbing on stairs, 30 weighted rings, exercises with a bottle rope, and exercises with a soft box. The preventive unit was given in gradation from easy to more difficult. Also, CrossFit exercises provide an element of suspense, excitement, diversity, and a sense of competition.

2.3. Statistical analyses

Statistical analyses were carried out with SPSS - Statistical Package for Social Sciences, version 25. The following statistical techniques were used: means, standard deviations and t tests. The significance level was $p<0.05$.

3. RESULTS AND DISCUSSION

Table 2 shows the results of the pre- and post-tests in the physical variables of the research group. According to the results, all the physical variables showed significant results in favor of the post-test, and this is due to the use of CrossFit exercises.

Table 2. Results of the pre- and post-tests in the physical variables of the research group

Variables	Unit	Pre-test		Post-test		t	*p*
		M	SD	M	SD		
Explosive power	cm	24.35	2.346	34.25	2.633	21.604	0.000
Strength characterized by speed	cm	6.40	1.142	9.80	1.704	9.902	0.000
Speed	second	3.262	0.645	2.520	0.583	7.376	0.000
Muscular endurance	degree	123.45	9.501	145.90	7.725	9.711	0.000
Efficiency of the circulatory and respiratory systems	m	2390	197.084	2852	102.166	13.257	0.000

They have a clear effect on physical fitness and the level of physical capabilities in particular because of their method of performance, diversity, and organization between jumping, running, resistances, ropes, and weights...etc. Furthermore, they improve muscle strength in all parts of the body, speed, fitness in general, develop the respiratory system through cardio-aerobic fitness, and increase oxygen consumption. This is consistent with a study by Fisher et al. (2017) that CrossFit training contributes to raising and developing physical preparation, as well as building strength and muscles in the body. Strength was achieved through the use of weight exercises, rope resistance, deep jumping, rebound jumping, and training with resistances.

CrossFit training has a great impact on developing strength and endurance because it consists in a continuous performance without stopping for a simple rest. This was confirmed by Maajed (1997) that doing physical effort for a long period increases the ability of the athlete to withstand fatigue and produce the necessary oxygenic and anoxic energy. The ability of the athlete to consume oxygen reaches its maximum at the age of 18-20 years old, and with training and regularity, the oxygen ability is stabilized or increased (Astrand & Rodahl, 1997).

CrossFit develops endurance through the intensity of its exercises and for a long period of time until fatigue, which improves the respiratory circulatory system.

Table 3 shows the results of the pre and post-tests in the biochemical variables of the research group. From Table 3, significant differences appeared in all biochemical tests and in favor of post-tests.

Table 3. Results of the pre and post-tests in the biochemical variables of the research group

Variables	**Pre-test**		**Post-test**		**t**	***p***
	M	SD	M	SD		
White blood cells	5030	660.223	7380	1114.309	8.625	0.000
Blood hemoglobin	13.70	1.129	15.25	1.070	4.971	0.000
CPK	105.40	8.537	137.20	4.607	16.118	0.000
LDH	245.70	28.344	308.20	6.732	10.090	0.000

According to the researcher, the reason for these differences is that white blood cells increase with sports training, within normal limits. This means that the state is healthy so that the body becomes qualified to resist any viruses and becomes a healthy integrated one. This is confirmed by Al-Budairy (2006) that sports training affects the increase in the number of red and white blood cells and the concentration of hemoglobin in relation to blood volume, and that it affects the number, activity, and effectiveness of white blood cells (Salama, 1988). For long periods of time, the concentration of hemoglobin increases, due to the body's need for oxygen, so that the oxidation process and energy release continue.

As for the creatine phosphokinase (CPK) enzyme, the researcher attributes that the intense effort affects the amount of the energy compound adenosine triphosphate (ATP). As a result of repeated muscle contraction, the ratio of the compound will decrease, and with the help of the enzyme (CPK) it activates its work during the intense physical effort. The enzyme transfers a group of phosphates from the high-energy creatine phosphate (CP) complex found in the muscles to the compound d-adenosine phosphate (ADP). And as a result of the high activity of this enzyme after intense physical effort, the researcher agrees with Abbas (2001) that the body’s systems impose requirements on it for muscular work in order to provide energy for the production of work. Therefore, the physical effort helped in the activity of the chemical reaction within the muscle and the production of energy, and among these Interactions catalyzing enzyme activity (CPK).

CrossFit exercises with high intensity and resistance affect the activity of the enzyme (lactate dehydrogenase (LDH). Physical effort helps to increase the rate of the enzyme lactate dehydrogenase (LDH), since sports activity depends on the process of anaerobic glycolysis, through which energy is

produced from the decomposition of adenosine triphosphate in a rapid manner, to secure the requirements of the muscles for the necessary energy to continue physical effort (Majeed, 1991; Faleh, 2009).

4. CONCLUSIONS

CrossFit exercises can be a useful tool to improve explosive power, strength characterized by speed, speed, muscular endurance, and the efficiency of the circulatory and respiratory systems. Also, CrossFit exercises have a positive effect on white blood cells and hemoglobin, and on LDH and CPK enzymes.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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