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ORIGINAL STUDY

Effect of Rehabilitation Exercises and Antioxidants on Patients with Stable Heart Failure

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The research aims to find out the effect of rehabilitation exercises and antioxidants in some physical and physiological abilities, free radicals and the degree of pain for patients with stable heart failure, and the research sample was selected randomly and whose ages ranged between 40–45 years and their number is 30 female patients with this disease, and the researcher used the experimental approach as the most appropriate approach to solve the research problem, as the sample was divided into two groups equal in number, each of which (15) patients (experimental and control), and the tribal tests were carried out after That the procedures were explained to the participants and their approval was obtained officially on 15/9/2024 and the post-tests were on 1/12/2024 at the Kings Hall for Women in Babylon Governorate, It included physical tests (heart stress test) and the physiological tests included cholesterol test, which included (benign and harmful cholesterol), heart rate, pulmonary ventilation, high and low blood pressure, free radicals and the degree of pain and the researcher concluded that rehabilitation exercises and antioxidants that are given regularly in sports halls and under the supervision of specialists affect the above variables.

Keywords: Rehabilitation exercises, Antioxidants, Physical and physiological abilities, Free radicals, Degree of pain, Stable heart failure

1. Introduction

Sports is no longer a hobby practiced by individuals to spend leisure, but has become a science in itself that contains many other sciences, whether medical, engineering or educational, as the interaction of knowledge in those sciences and their overlap among them has achieved qualitative progress in all sports fields, including rehabilitation and physical therapy, which was interested in studying the therapeutic and life aspects for the patient, and this includes the function of the body and its various parts alike as an integrated unit that cannot be studied independently and from the branches The task in rehabilitation and physical therapy is physiology and biochemistry, which are interested in studying the chemical changes that occur before, during and after muscular work,

and as it is known, rehabilitation leads to the events of many changes, whether physical changes from the development of the general physical characteristics of the patient or internal changes, which include functional or chemical changes for different body systems and according to the type of rehabilitation, and sports rehabilitation has become an important auxiliary treatment in both the prevention and management of heart failure.

Organized analytical studies have shown that sports rehabilitation in patients with heart failure leads to a consistent and clinically significant improvement in lipids such as cholesterol, body mass index, heart rate, pulmonary ventilation, blood pressure, physical ability, degree of pain and reduction of free radicals, which is one of the most important indicators that express the cause of death in patients with heart failure

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[7, 23], in addition to that sports rehabilitation with high organization and sufficient duration is one of the important and effective requirements in improving and managing heart failure, as one study showed that sports rehabilitation with a duration of at least 1 month is one of the requirements that help to show greater effects in heart failure disease [6].

Recently, modern concepts have emerged that affect patients with heart failure, and one of these concepts is free radicals associated with harm and damage to patients as a result of sports rehabilitation for long periods, and because sports rehabilitation has become a scientific research based on facts, theories and foundations, the rehabilitation processes, whatever they are, must be based on the continuous physiological evaluation of performance under safe limits and not expose the patient to damage to his living cells as a result of oxidation, which causes chemical changes within the body. The patient, including changes in enzymes, and these changes express the presence of damage or ulceration in the muscle that makes the patient unable to continue moving.

Damage may appear after hours of strenuous exercise, and for this reason, the athlete must be familiar with the correct rehabilitation methods and according to the capabilities of patients, and he must also be familiar with nutritional programs that help patients get rid of free radicals, and these programs are called antioxidants, as antioxidants are an important requirement for healing from diseases, because they provide the body with fluids and energy, but the choice of antidotes (food) must be appropriate to the nature of the disease.

The goal of this food is to increase the body's ability to possess antioxidants to get rid of free radicals (muscle ulcers), and through the above lies the importance of research in clarifying the importance of antioxidants (nutrition) in late-onset muscle pain resulting from free radicals.

Heart failure is one of the chronic diseases that spread around the world, especially in Iraq, as it is one of the diseases that occur due to genetic or environmental factors, which are greatly affected by exercise, diet and not eating overeat, a number of studies found that walking for 30 minutes a day on a regular basis leads to reducing blood cholesterol and blood pressure and maintaining heart health, the International Association of European Community confirmed in 2008 that regular sports rehabilitation leads to improved physical ability. One study of 673 patients from 4 European countries indicated that only 63% of heart failure patients contribute to heart failure treatment programs [15].

Rehabilitation programs improve the work of the heart and develop the health status of patients with stable heart failure, as the European Organization for the treatment of heart failure patients recommends to follow organized aerobic training that helps improve functional ability [16], and others believe that treatment approaches that include drug therapy and implanted electronic devices still fail to improve the work of the heart, because the special goal of sports rehabilitation is to treat defects that drugs cannot treat. Athletic rehabilitation is an effective method for improving the condition (Catherine et al., 2013). Hence the importance of research in identifying the effect of rehabilitation exercises and antioxidants in some physical abilities, physiology, free radicals and the degree of pain for patients with stable heart failure, the goal of the research is to find out the effect of rehabilitation exercises and antioxidants in some physical abilities such as running on the treadmill and physiological such as cholesterol, blood pressure, pulmonary ventilation, heart rate, free radicals and the degree of pain for patients with stable heart failure.

2. Research methodology and field procedures

2.1. Research methodology

The researcher used the experimental method by designing equivalent groups in the pre- and post-test because it is more suitable for the current study, as the pre- and post-tests are compared to ensure that the improvement is obtained for one group with the specified tests, and then the two groups are compared with the post-tests, as shown in Table 1.

2.2. Research community and sample

The research community included (50) women with heart failure who were officially registered in Al-Turki Hospital/Babylon Governorate, and the research sample included (30) women with stable heart failure only at the age of 40–45 years, they were randomly selected from the research community after reading their drums by the specialist doctor to confirm the type of disease represented by stable heart failure.

The research sample was also identified with patients who are not practicing rehabilitation programs prior to their disease while continuing to treat with medicine, which is unified for all members of the two groups, and the patients were given all the information related to their disease and were registered and referred to when needed, and official

Table 1. Shows the experimental design of the research.

The group	Pre-tests	Pilot Program	Post-tests
Experimental group	Cholesterol, blood pressure, pulmonary ventilation, heart rate, heart stress test, free radicals, pain	Use of rehabilitation exercises and antioxidants	The same tests are tribal and are compared with the control group.
Control group	Same as previous tests	Dependence on the drug only	Same pre-tests

Table 2. Shows the homogeneity of the sample.

Variables	Unit of Measurement	Arithmetic Mean	Median	Standard Deviation	Coefficient of Skewness
Age	Year	42	41	3.41	0.77
Weight	kg	83.04	81	5.03	0.93
Body Mass Index	kg	24.26	23	3.35	0.75

approval was obtained by the patients for the purpose of participating in the rehabilitation exercises prepared by the researcher, and the homogeneity of the research sample was calculated as shown in Table 2.

Table 2 shows the values of the arithmetic media, standard deviations, median and torsion coefficient values for the homogeneity of the sample, and since all the values of the torsion coefficient are less than (-1 to $+1$), this indicates that the distribution was moderate and that the sample members are homogeneous.

After the homogeneity was done, the researcher worked to divide the research sample into two experimental and control groups, and by (15) individuals for each group and for the purpose of conducting equivalence between the two groups in the research variables, the researcher used the T-test test for independent samples and the results were as in Table 3.

The value of T at significance level (0.05) and degree of freedom (28) is 2.07.

2.3. Field procedures for research

2.3.1. Determining the research variables

The research variables were determined based on some experts and the researcher's experience, and the variables are: (blood cholesterol, high and low blood pressure, pulmonary ventilation, heart rate, SGPT, SGOT, lactic acid, and the degree of pain).

2.3.2. Determining and characterizing measurements and tests

After determining the research variables, the measurements and tests that suit the research variables were determined, and Table 4 shows the tests and measurements.

In order to identify how to perform and how to record and the steps of implementing measurements and tests, it was necessary to present them in the form of steps as follows:

First: Pulmonary ventilation measurement [3]

–**Method of measurement:** Pulmonary ventilation was measured by sitting the patient on a chair with

Table 3. Shows the equivalence of the sample in the research variables.

Variables	Experimental group		Control group		T value	Significant
	S	A	S	A		
Cholesterol	4.33	2.36	4.75	2.78	1.99	Non-moral
HDL	1.27	0.31	1.12	0.54	0.91	Non-moral
LDL	2.55	0.52	2.45	0.60	0.56	Non-moral
Heart rate before treadmill	80	14.2	79	13.7	2.0	Non-moral
Heart rate after treadmill	156	18.6	154	18.1	1.47	Non-moral
Pulmonary ventilation	29.7	2.01	28.9	1.9	1.7	Non-moral
High blood pressure before treadmill	14	2.4	13.5	2.1	1.2	Non-moral
Low blood pressure before treadmill	9	1.3	8.5	1	0.79	Non-moral
High blood pressure after treadmill	15	3.4	14.8	3.01	1.02	Non-moral
Low blood pressure after treadmill	10	2.71	9.7	2.03	0.96	Non-moral
SGOT	10.02	0.50	10.07	0.53	0.54	Non-moral
SGPT	7.3	0.42	7.1	0.39	0.44	Non-moral
Lactic acid	19.7	1.89	19.5	1.87	0.38	Non-moral
Pain score	6	0.24	6.8	0.33	1.48	Non-moral

Table 4. Shows tests and measurements.

	Variables	Measurement/Testing
.1	Pulmonary ventilation	Spirometer
.2	Blood cholesterol	Laboratory Equipment
.3	High and low blood pressure	Blood Pressure Gauge
.4	Heart rate	Pulse Oximeter
.5	Essential stress test	Treadmill
.6	SGOT and SGPT enzymes	Laboratory Equipment
.7	Lactic acid	Lap 2
.8	Pain score	Optical Analogue Gauge

a height of (40) cm as the feet are in contact with the ground and the back is straight and supported on the back of the chair, the researcher begins to teach the patient the technique of testing by taking a deep inhale and then exhaling strongly and quickly until the feeling of not The presence of air in the lungs to excrete it. The patient places the lips around the breathing tube attached to a computer and inhales the air deeply, then exhales the air forcefully and quickly from the chest (exhalation) until the lungs are empty of air.

–**How to record:** The exhalation must continue until the air is completely exhaled and the patient's inability to continue, and it must be at least a time of (6) seconds and lasts to 15 seconds or more, the test was performed with two attempts, provided that the rest period between the test and the last one minute and records the best performance, knowing that the reading of the attempt appears directly in the display screen and then it is printed to become a graph sheet and that the unit of measurement is the percentage (%).

Second: Blood cholesterol

–**Measurement method:** A quantity of venous blood is withdrawn by specialists to know the percentage of high and low density cholesterol, and the percentage of total cholesterol, where the patient participating in the study is asked to write a report on the type of medicine he is taking before starting the implementation of the pre-tests, and the blood is taken to the laboratory for the analysis process and give the final result.

Third: The ratio of SGOT and SGPT:

The two enzymes were measured by drawing blood from the patient's arm and from a vein exclusively, and the patient is at rest, that is, after performing physical effort for 15 minutes with the Treadmill treadmill in order to know the work of the two enzymes, and then the blood was taken to the laboratory for the purpose of conducting the examination process using blood analysis devices.

Fourth: Measuring lactic acid:

The percentage of lactic acid was measured using the Lap 2 device, which is a device whose results are approved in research, and the measurement was made after 7 minutes of effort given on the stationary bike for 15 minutes.

Fifth: Measuring high and low blood pressure

–**Method of measuring:** A blood pressure gauge is a device used to measure blood pressure, which consists of an inflatable cuff to limit blood flow, a mechanical mercury pressure gauge, an inflator, and a control valve. Manual blood pressure monitors are used in conjunction with a stethoscope in humans. The cuff is placed smoothly and comfortably around the arm at approximately the same vertical height as the heart while the patient sits with her arm relaxed and supported. It is important to choose the correct size of the cuff for the patient. A very small size gives very high blood pressure results, while a very large size gives very low blood pressure results. The cuff is inflated until the artery is completely closed and the arm artery is heard at the elbow joint with the stethoscope. Then the pressure is slowly reduced. As soon as the pressure in the cuff drops, intermittent sounds (Krotkoff sounds) are heard. When blood begins to flow again in the artery, the pressure recorded when this sound begins is the systolic pressure and the pressure is reduced further until the sounds disappear and is then called the diastolic pressure. The measurement was performed with the patient sitting with the arm relaxed to give accurate results. Note that the unit of measurement is mm/Hg.

–**Recording:** By monitoring the mercury in the column and while depressurizing the air by the control valve, blood pressure values (mm/Hg) can be read. The peak pressure in the arteries during [the cardiac cycle] is the systolic pressure, and the minimum pressure (in the resting phase of the cardiac cycle) is the diastolic pressure. The stethoscope is used in the auscultatory method, the systolic pressure (first phase) is determined with the first sound of the continuous Krotkoff sounds, and the diastolic

pressure is determined at the moment when the Krotkoff sounds disappear (fifth phase) (<http://ar.wikipedia.org/wiki>).

Sixth: Cardiac stress test and heart rate [20]

It is a test that is performed by performing physical effort on a stationary treadmill and its goal is to increase the effort on the heart muscle and to know the effect of effort on blood pressure and heart rate, i.e. the amount of blood leaving the heart to the body, in addition to explaining some important tests for the doctor.

–**How to measure:** The heart rate was measured before and after the heart effort using a treadmill that contains sensors placed directly on the heart and gives us the reading of the heart rate.

–**Recording:** The values that appear on the device screen are recorded.

Seventh: Measuring the degree of pain [10]

The purpose of the measurement is to know the degree of pain in the patient after the high effort performed in the rehabilitation units, which is a subjective measure that depends on the patient and her answer and consists of 10 degrees, each degree means a specific degree of pain.

2.3.3. Pre-tests

The pre-tests were conducted on 15/9/2024 after the researcher was given some general guidance to the sample about the importance of the research and the tests were carried out in front of the research sample and the correct performance mechanism for each test was emphasized, after which the tests began at ten in the morning and lasted for two days and as follows: The first day: measurements of physical ability, cholesterol and SGOUT ratio were made, SGPT, lactic acid ratio and degree of pain. The second day: pulmonary ventilation, high and low blood pressure, heart rate and cardiac stress test were measured.

2.3.4. Main experiment

The researcher prepared a rehabilitation program for patients with stable heart failure using rehabilitation exercises and the exercises included (spreading the arms to the side and then above the head, spreading the arms to the side to shoulder level, rotating the shoulders, pulling the arms from the front of the body to the back, moving the interlocking arms in front of the body, raising and lowering the shoulders, moving the interlocking arms behind the head, moving the head to the side, running on a fixed treadmill, riding a stationary bike, walking a distance of 100 m) and the goal is to improve the strength and endurance of the heart.

The main experiment of the experimental group began on 9/18/2024, and the patients attended for an hour for the introductory course that was conducted in the Kings Hall for women, in which they talked about the rehabilitation exercises and the necessary devices that must be available, and a special calendar was prepared to write everything related to the daily rehabilitation carried out by the participants in the experimental group, and the members of the experimental group completed (30) minutes of rehabilitation and (16) repetitions per group, then gradually escalate depending on the severity, and the repetitions were determined depending on the patient's ability to During the recording of the total number of repetitions until the exhaustion of effort, which is the intensity of (100%) and the time period of the total repetitions was also recorded to benefit from it in knowing the time of each repetition, and the arithmetic mean was extracted to find out the number of repetitions that correspond to the intensity with which the patient begins, (3–5) sets per exercise, and the rest period between one exercise and another (2–3) minutes and a group and another (4–5) minutes The researcher has adopted the patient's feeling of fatigue as an indicator to determine the periods of rest between them, and for 3 days a week, and the total duration of the program was (8) A week and the total number of rehabilitation units (27) units.

As for antioxidants, doses of vitamins (A, E, C) were given in the form of tablets to the experimental group for a period of (30) days before the pre-test, while the control group was not given vitamins and then the research sample (experimental and control) was given a training unit of high intensity using a treadmill and a stationary bike.

2.3.5. Post-tests

The post-tests were conducted on 20/11/2024 at the Kings Hall for women in Babylon Governorate in the same way as the tribal tests, which are as follows: The first day: Measurements of physical ability, blood cholesterol, SGOT, SGPT, lactic acid and pain degree were made. The second day: pulmonary ventilation, high and low blood pressure, heart rate and cardiac stress test were measured.

2.4. Statistical analysis

In the current research, the researcher used the following laws: -

T-test for correlated and incoherent samples, - arithmetic mean, - standard deviation, - median, - torsion coefficient.

Table 5. Shows the arithmetic media, standard deviations, T value of correlated samples in physical and physiological aptitude tests and degree of pain for the experimental group.

Variables	Pre-tests		Post-tests		T value	Significant
	A	s	A	s		
Cholesterol	5.78	2.36	4.55	1.78	3.8	moral
HDL	1.27	0.31	3.98	0.6	6.2	moral
LDL	2.55	0.52	1.45	0.62	5.4	moral
SGOT	10.07	0.53	12.6	0.52	2.87	moral
SGPT	7.1	0.39	6.9	0.21	2.67	moral
Lactic acid	19.5	1.87	14.6	0.95	2.75	moral
Pre-exercise heart rate	80	14.2	78	11.7	3.9	moral
Post-exercise heart rate	156	18.6	149	12.1	2.91	moral
Pulmonary ventilation	29.7	2.01	32.9	2.4	3.09	moral
High blood pressure	14	2.4	12.3	1.8	3.46	moral
Low blood pressure	9	1.3	7.7	0.85	4.20	moral
6-minute walk	640	24.8	745	27.1	2.98	moral
Pain score	6.4	0.28	3.2	0.15	2.87	moral

3. Presentation and discussion of the results

The results obtained by the researcher were presented through the implementation of rehabilitation exercises and antioxidants and treated statistically and arranged the results in the form of tables for all research variables and for both experimental and control groups in the pre- and post-tests, and to find out the truth of the differences, the researcher used the T test for non-independent samples between the experimental and control groups, and the T test for independent samples to find out the difference between the pre- and post-tests for one group.

3.1. Presentation, analysis and discussion of the results of the pre- and post-tests of the experimental group

The value of T at significance level (0.05) and degree of freedom (14) is 2.57.

Table 5 of the experimental group showed significant improvement and significant differences in all study variables.

3.2. Presentation, analysis and discussion of the results of the pre- and post-tests of the control group

The value of T at significance level (0.05) and degree of freedom (14) is 2.57.

Table 6 of the control group did not show improvement and significant differences in all study variables.

3.3. Presentation, analysis and discussion of the results of the post-tests of the experimental and control groups

The value of T at significance level (0.05) and degree of freedom (28) is 2.57.

Table 7 showed that there are significant differences between the post-tests for both groups and in favor of the experimental group, as it was found that the T values of the research variables represented in (total cholesterol, high and low density cholesterol, SGPT enzyme, SGOT, lactic acid, heart rate before and after exertion, pulmonary ventilation, high and low blood pressure, physical ability and degree of pain) respectively are greater than the tabular value of 2.57 at 28 degrees of freedom.

3.4. Discussion of the results

The members of the experimental group showed a high commitment to rehabilitation, as they completed 3 rehabilitation units per week, i.e. approximately 90 minutes, so the rehabilitation exercises led to the development and improvement of the health status of patients with stable heart failure, as the commitment to rehabilitation leads to improving the physical and physiological variables of patients with heart failure [13], and previous studies have shown that sports rehabilitation may offer additional benefits to the circulatory heart system (Boule et al., Some studies found that the follow-up of patients and the practice of sports rehabilitation leads to good results, which is consistent with what the researcher found in the current study, and the reason for this is the interest of patients in sports as a therapeutic aspect [21].

Sports rehabilitation increases the heart rate during exertion and decreases it at rest, and the reason for this is the improvement in the strength of the heart muscles, which contributed at least partially to improving cardiac output, Ades et al. [2] showed that people aged 55–65 years adapt to rehabilitation exercises by improving the movement of venous and arterial blood, in the physical ability test (6 minutes walking) there was a significant difference in favor of

Table 6. Shows the arithmetic media, standard deviations, T value of correlated samples in physical and physiological aptitude tests and the degree of pain of the control group.

Variables	Pre-tests		Post-tests		T value	Significant
	A	s	A	s		
Cholesterol	4.75	2.78	4.0	1.10	2.09	Non-moral
HDL	1.12	0.54	1.67	0.78	1.91	Non-moral
LDL	2.45	0.60	2.23	0.35	1.56	Non-moral
SGOT	10.02	0.50	8.3	0.67	1.17	Non-moral
SGPT	7.3	0.42	7.01	0.45	0.94	Non-moral
Lactic acid	19.7	1.89	21.7	2.02	1.21	Non-moral
Pre-exercise heart rate	79	13.7	78.8	12.3	2.1	Non-moral
Post-exercise heart rate	154	18.1	153	16.7	1.97	Non-moral
Pulmonary ventilation	28.9	1.9	29.2	2.8	2.07	Non-moral
High blood pressure	13.5	2.1	13	1.46	2.2	Non-moral
Low blood pressure	8.5	1	8.2	0.56	1.79	Non-moral
6-minute walk	645	25.1	650	26.4	2.01	Non-moral
Pain score	6	0.24	6.8	0.33	1.48	Non-moral

Table 7. Shows the arithmetic means, standard deviations, T value for uncorrelated samples in physical and physiological aptitude tests and the degree of pain for the two groups.

Variables	Experimental group		Control group		T value	Significant
	A	s	A	s		
Cholesterol	4.55	1.78	4.0	1.10	3.09	moral
HDL	3.98	0.6	1.67	0.78	2.91	moral
LDL	1.45	0.62	2.23	0.35	3.56	moral
SGOT	12.6	0.52	8.3	0.67	3.01	moral
SGPT	6.9	0.21	7.01	0.45	2.98	moral
Lactic acid	14.6	0.95	21.7	2.02	3.23	moral
Pre-exercise heart rate	78	11.7	78.8	12.3	4.1	moral
Post-exercise heart rate	149	12.1	153	16.7	2.97	moral
Pulmonary ventilation	32.9	2.4	29.2	2.8	3.07	moral
High blood pressure	12.3	1.8	13	1.46	3.2	moral
Low blood pressure	7.7	0.85	8.2	0.56	2.79	moral
6-minute walk	745	27.1	650	26.4	5.01	moral
Pain score	3.2	0.15	6.8	0.33	3.05	moral

the experimental group due to the increased interest by the sample and commitment to rehabilitation led to This increase is important as well as due to the type of therapeutic exercises prepared by the researcher accurately to affect more on the research sample and previous studies have shown a significant increase in physical ability in patients with heart failure after organized therapeutic exercises [8].

In fact, the data we obtained in our current study are consistent with what was announced by the American Organization for Heart Health, where it was suggested that rehabilitation for 30 minutes to 90 minutes leads to improved heart work, in one study it appeared that exercise leads to an improvement in the heart muscle [14], and the data of our study confirms that 90 minutes of rehabilitation per week with low intensity is required to improve the work of the heart, previous studies have shown the importance of mixing between Rehabilitation and nutritional programs to control cholesterol in the blood [9], but in the variables of the other study, repre-

sented by blood pressure and ventilation, we find an improvement in the experimental group more than the control group in the post-tests and attributed by the researcher to the great commitment in the vocabulary of the curriculum and not to leave the rehabilitation units for long periods, which was the direct cause of the lack of development of the control group.

As for the improvement in the variables of free radicals in the experimental group at the expense of the control, the researcher attributes it to antioxidants consisting of vitamins A, C, E, which had a clear effect in raising the activity of enzymes, including SGOT, and thus avoiding the risk of free radicals (tissue damage) and not feeling muscle fatigue after exertion, and this is what Dekkers [5] pointed out in one of the studies conducted on the slopes “It was found that delayed muscle pain and oxidative stress resulting from physical training may Significantly decreased when taking a dose of antioxidants containing vitamin” (E), as for the activity of the enzyme SGPT, it appeared that

the difference is significant between the post-tests, and this indicates that vitamins and physical effort affect the activity of this enzyme, which indicates the participation of the enzyme in energy processes and thus contributes directly to the reduction of free radicals.

While a difference appeared in the arithmetic circles of the post-tests of the two research groups in the measurement of lactic acid, which indicates that the difference is significant and in favor of the experimental group, which the researcher attributes to the adaptation as a result of rehabilitation exercises and taking antioxidants consisting of vitamins A, C, E, which had a clear effect on maintaining lactic acid and this is what Hassan pointed out in his translation of the book Mayo Clinic (2005) "Researchers discovered that a diet rich in vitamins and low in fat helps to reduce acid accumulation lactic in the muscles after exertion."

4. Conclusions

Through the results obtained, the researcher concluded that performing rehabilitation exercises and taking antioxidants regularly in sports halls affects the percentage of fats such as cholesterol, SGPT, SGOT, lactic acid, high and low blood pressure, pulmonary ventilation, heart rate, physical ability and degree of pain.

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