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The effectiveness of resistance exercises to improving cardiac performance and the performance level of the 200-meter freestyle swimming distance

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Abstract

The aim of the research is to know the effectiveness of resistance exercises inside the water using rubber ropes, swimming gloves and weighting the feet as a tool to increase the resistance applied to the swimmer and its effect on improving cardiac performance and the level of performance of the 200 m freestyle distance. To achieve the aim of the research, (10) freestyle swimming specialists aged (16-18) years were randomly selected and divided into an experimental group (5), and the second (5) control group. Both groups implemented the trainer's training curriculum, but the experimental group included resistance exercises such as rubber ropes, foot fins, and swimming gloves for the hands (strength) within the capacity and overload training in its daily training components, while the control group followed the trainer's traditional training curriculum. The researcher conducted the test before and after the research period, which lasted for 90 days, with (3) training units per week. The results for the two groups were analyzed, and the researcher found that there was an improvement in cardiac performance in addition to the time of the 200-meter freestyle swimming distance.

Keywords: Bungee Cords, Cardio, 200m Freestyle.

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Introducing the research:

Introduction:

Swimming has received a large amount of scientific research and studies on the basis of which the level of performance is improved and digital achievement is achieved. In the four swimming events (freestyle, backstroke, butterfly, breaststroke), we find that there are multiple means such as rubber ropes, arm sleeves and foot fins used to increase the resistance on the swimmer to develop strength and muscle capacity, and to use them to match the development or improvement of the strength of the muscles of the arms and legs. It also raises the swimmer's physiological capabilities, as it has proven effective in training through its advantage in producing resistance during the body's forward movement, in addition to its use in developing speed when used in the case of its extension and pulling the swimmer towards its contraction, as well as later in developing speed in addition to strength to become resistance and assistance during training. It is also used inside the water environment and others outside the water environment. In addition, these ropes, depending on the swimming method and the trainer's vision, are ropes as resistance or as an aid to training. "Rubber ropes are considered necessary equipment for strength and ability training for the swimmer" . The effect of successive training loads has a clear effect on the internal physiological variables of the body, or what is called the internal load. It is a reflection of the training state that the athlete reaches, and it is also evidence of the development of the athletic level in the activity that he practices. Among those physiological variables are there is no doubt that understanding and interpreting the results of training loads that have a significant impact on achieving the goal of training and cardiac output is one of the important indicators reflecting the swimmer's physical ability through the speed of returning to the normal state. The researcher noted a difference in the swimmers' times in the 200m freestyle swimming event. The researcher believes that the problem in this is due to the lack of use of training aids, especially in developing the swimmer's ability, as well as the lack of use of functional indicators to determine the extent of the impact of training loads in a manner that is consistent with the level of digital development taking place in Olympic swimming events.

Research Problem:

The research problem is summarized in the neglect of the means of assistance in training. And the extent of the impact of increasing training loads on the internal physiological variables of the body or what is called the internal load, which is a reflection of the training state that the athlete reaches and is also evidence of the development of the athletic level in the activity that he practices. Among those physiological variables is cardiac performance, and therefore its estimation and calculation has become essential to know the human ability. Hence, the importance of the research and the need for it is that it is an attempt to provide a set of information that is the basis for developing an appropriate strategy for using auxiliary means, and an attempt to achieve improvement in the digital level. As well as identifying the effectiveness of using rubber resistance ropes as a training method to raise the efficiency of

cardiac performance and the digital level among swimmers aged (16-18 years) in the 200m freestyle swimming distance.

Research objective:

- Identifying the effectiveness of training (resistance) with rubber ropes on the level of cardiac performance.
- Identifying the effectiveness of training (resistance) with rubber ropes on improving the level of achievement in swimming (200 m) freestyle.

Research hypothesis:

1- There are statistically significant differences in the development of the level of cardiac performance in the post-tests in favor of the experimental group in (200m) freestyle swimming.
2- There is a positive effect of exercises using rubber ropes (resistance) on the level of achievement in (200m) freestyle swimming.

Research field:

Human field: Sample. From the 200m freestyle swimming specialty, Al-Furat Al-Awsat Clubs, ages (16-18).
Time field: from (5/5/2022) to 5/8/2022).
Spatial field: Indoor Water City Pool (Marina) (50m) Babylon.

Methodologies for research and field operations:

Research Methodology:

Because the experimental approach was appropriate for the problem, the researcher used it. The approach the researcher takes to investigate the issue and find the truth is known as the method.

Community and sample Research:

The type of sample that the researcher will select depends on the goals he has set for his study and the methods he will employ. The research sample was chosen intentionally, and consisted of (10) swimmers representing the Middle Euphrates clubs for the category (16-18 years) specializing in the 200-meter freestyle swimming distance. The experiment was conducted by dividing them randomly into two equal groups, experimental and control, with (5) for each group. In order to ensure the homogeneity and equivalence of the research sample, homogeneity was conducted for height, weight and age. The results indicated that the sample was homogeneous, as in Table (1).

Table (1) shows the homogeneity of the sample individuals

Variables	Mean	Std. Deviation	Coefficient of difference	Result
Length/Cm	176	1.258	0.766	Homogeneous
Age	19.02	0.175	1.45	Homogeneous
Weight	66.3	0.98	1.6	Homogeneous

Research devices and tools:

1- Electronic watches.
2- Rubber ropes.
3- Medical scale to measure weight and height.
4- Measuring tape to measure lengths.
5- Computer (HP)
6- Physoflow device to measure functional heart variables
7- German-made rubber ropes, with a length of (4 m) and an extension of up to (8 m), connected to two belts at both ends, one of which is tied around the swimmer's waist and the other to the pool wall or held by the coach or assistant for the purpose of resistance and assistance training, number (2).

Research procedures: -

Pre-tests:

The auxiliary work team administered the pre-tests to the members of the research sample. To the greatest extent feasible, the researcher set up the test circumstances and methodology so that the post-tests could be administered under the identical conditions. In order to execute the cardiac performance test (heart rate and stroke volume after rest) and (200) freestyle swimming on Thursday in the Marina Water City indoor pool, the researcher set up the pre-test at precisely eleven a.m. on May 5, 2022. The post-test was administered to the two research groups on May 8, 2022, following a 12-week training period. The identical protocols used for the pre-tests were followed, and the results obtained were documented.

Training Program: -

Rubber ropes are essential equipment for strength and power training for swimmers. The training program was designed to train swimming with rubber ropes and was included in the training curriculum as a means to increase the water resistance that the swimmer encounters while flowing forward or to help him move forward quickly. Some paragraphs of the training curriculum prepared by the research sample trainer were modified in terms of intensity and volume, in addition to exercises using resistance tools such as rubber ropes, swimming gloves, and foot fins, in a manner that suits the nature of the sample and according to Appendix (1). The training curriculum included a method of using rubber ropes to resist the swimmer's speed. The researcher will use rubber ropes with a length of (4 m) and an extension of up to (8 m) tied as a belt to the swimmer from his stomach on one side, and the other side of the rope will be tied to one of the edges of the pool or the starting platform. The swimmer will perform the designated exercise. According to the specified intensity, the exercise is performed by pulling the rope to perform freestyle swimming until it reaches the point of stability, after which the trainer calculates the stability time, the number of repetitions, and the pulling distance. "While maintaining his performance without change at the same time, the goal is to increase the amount of strength in the swimmer. The units included (12) weeks, at a rate of three training units per week, where the training volume ranged from (1600 m) until it reached (2800 m) at the end of the eleventh week, where it begins to decrease in preparation for conducting the post-test for the research sample, where both groups implemented the training

curriculum components in all its details except for one paragraph, which is that the experimental group used ropes, gloves and fins as a training tool implemented within the training repetition group consisting of (400 m) in the form of a repetition group (2 x 6 x 50 m) or (8 x 50 m) using the free swimming method. And with a intensity close to or higher than what the swimmer does in competition, meaning that the swimming speed strategy during the (200m) freestyle swimming competition changes between every 50m (pool), as some swimmers have a faster swimming speed in the first (50m) than in the other pools, and some have equal speed, these strategies also change in the qualifiers and finals according to the physical and tactical ability of the participating swimmers in swimming each pool. In general, the researcher recorded the time of each pool and then extracted its average and took it as a measure of the speed of (50 m) as a training intensity. Therefore, the researcher asked the research individuals to perform the same performance recorded in the pre-test and to emphasize the correct technique. And maintaining the straight, streamlined position of the body, in order to maintain a greater effect when performing the work, while the control group performed the same set of repetitions in terms of volume and intensity, but without using resistance tools and in the traditional method prepared by the trainer. All exercises were performed in the same pool, at the same time and by the same trainer.

- Tests and measurements used in the research:

- Measuring cardiac performance:

Cardiac variables, heart rate and stroke volume were measured at rest using a device (Vizflo). The work with this device involves the swimmer after completing the warm-up that was set for him. Then, the electrodes are connected wirelessly to the swimmer's chest to measure heart variables, heart rate, stroke volume, and cardiac performance using a device that is attached to the swimmer's chest using a belt designed for this purpose. The data is read via a laptop during rest.

- Freestyle swimming (200m) effectiveness test:

The aim of the test: to measure the time of (200l) swimming.

The tools used: a swimming pool (50m), stopwatches, a whistle., registration forms.

- Description of the test performance: The swimmer stands at the standing platform in the designated area and upon hearing the word (take) from the shooter, he takes the starting position. After hearing the shooter's whistle, he jumps from the platform into the water and covers a distance of (200 m) in the freestyle swimming method at maximum speed. After completing the race distance, the time achieved by the swimmer is recorded.

Statistical methods:

The researcher used the following statistical methods to process the results of the research test.

1. Arithmetic mean.
2. Standard deviation.
3. T-test: for samples.

4-T-test for independent samples

Presentation, analysis and discussion of the results:

Presentation of the results:-

Displaying, analyzing and discussing the research results, and in order to achieve the research objectives and hypotheses in knowing the extent of the impact of the training tool used, it was necessary to shed light on the level of improvement in cardiac performance and the nature of the performance level of the research sample individuals in 200m freestyle swimming, in addition to knowing the amount of dispersion of its values from the average performance level in that test "which is the standard deviation that helps the researcher to detect, diagnose and predict" through the following tables: -

Table (2) The arithmetic mean, standard deviation and result of the pre- and post-tests for the experimental and control groups in the variable of 200m freestyle swimming time

Group	Per-Test		Post-Test		Calculated T value	Sig type
	Mean	Std. Deviation	Mean	Std. Deviation		
Experimental	1:55.6	1.2	1:49.32	0.841	4.44	Sig
Control	1:55.7	1.9	1:54.8	1.12	4.74	Sig

The tabular value of (T) is (4.62) with a degree of freedom of (4) and a significance level of (0.05).

The calculated (t) values for the experimental and control groups reached (4.44) and (4.74), respectively, which are greater than the tabular value, indicating a development of the aforementioned variable in the post-test for both groups. Based on Table (2) and statistical treatments, it is evident that there are statistically significant differences between the results of the pre- and post-tests of the two research groups in the variable of 200m freestyle swimming time.

Table (3) shows the post-results between the experimental and control research groups in the variable of 200m freestyle swimming time.

Group	Mean	Std. Deviation	T Calculated value	Sig type
Experimental	1:49.32	0.741	6.27	Sig
Control	1:54.8	1.13		

Under the degree of freedom (8) and the significance level (0.05), the tabular (T) value is (2.31).

The experimental and control research groups' statistical outcomes for the variable of 200-meter freestyle swimming time are displayed in Table (3). While the control group got an arithmetic mean of 1:54.8, the experimental group got an arithmetic mean of 1:49.32 with a standard deviation of 0.741. There is a significant difference between the two groups in the variable of 200-meter freestyle swimming time in favor of the experimental group, as indicated by the standard deviation of 1.13 and the calculated value of (t) between the two groups of 6.27, which is greater than the tabular value of (t). The researcher attributes this difference to the impact of the resistance training that the experimental group underwent.

Table (4) shows the arithmetic means, standard deviations, and the calculated and tabulated (t) value in the heart variables.

Group	Variables	Pre-test		Post-Test		Calculated T Value	Sig Level	Sig Type
		Mean	Std. Deviation	Mean	Std. Deviation			
Experimental	HR	118	1.82	105	2.41	4.501	0.007	Sig
	SV	93.15	2.42	117.9	3.22	3.491	0.000	Sig
	CQ	11.96	0.33	12.15	0.42	3.460	0.041	Sig
Control	HR	120	2.52	116	2.58	4.662	0.007	Sig
	SV	93.12	2.48	98.9	2.41	3.220	0.027	Sig
	CQ	11.17	0.37	11.57	0.34	3.244	0.001	Sig

Under the degree of freedom (4) and the significance level (0.05), the value of the (T) table is (6.41).

Table (4) displays the variations in the values of the variables under study in the pre- and post-tests based on the data that was extracted for the research sample participants. The calculated (t) values for the experimental and control groups reached (4.501) and (4.662), respectively, which are greater than the tabular (T) value, indicating that there are statistically significant differences between the pre- and post-test results in the HR variable, as shown by our observation of Table (4) and subsequent statistical treatments.

Because the calculated (t) values for the experimental and control groups reached (3.491) and (3.220), respectively, which are greater than the tabular (T) value, which indicates that the aforementioned variable has developed in the post-test for both groups, it is evident to us that there are statistically significant differences between the results of the pre- and post-tests with regard to the variable SV after using Table (4) and performing statistical treatments.

As for the CQ variable, through Table (4) and after conducting statistical treatments, it becomes clear to us that there are statistically significant differences between the results of the pre- and post-tests, as the calculated (t) value for the experimental and control groups reached (3.460) and (3.244), respectively, and they are greater than the tabular (T) value, which indicates that the aforementioned variable has developed in the post-test for both groups.

Table No. (5) shows the arithmetic dimensional means, standard deviations, calculated and tabular (t) values for the two research groups

Group	Variables	Post-Test		Calculated T Value	Sig Level	Sig Type
		Mean	Std. Deviation			
Experimental	HR	105	2.41	3.581	0.006	Sig
	SV	117.9	3.22	3.184	0.000	Sig
	CQ	12.15	0.42	3.244	0.041	Sig
Control	HR	116	2.58	2.882	0.007	Sig
	SV	98.9	2.41	2.752	0.027	Sig
	CQ	11.57	0.34	2.505	0.001	Sig

Under the degree of freedom (8) and the error rate (0.05), the table value (t) is (1.65).

Table (5) indicates that the two research groups' post-test results differ from one another. Regarding the HR variable, the experimental group's post-test arithmetic mean was 105 with a standard deviation of 2.41, whereas the control group's post-test arithmetic mean was 116 with a standard deviation of 2.58%. (3.581) and (2.882) were the computed (t) values, respectively. This suggests that there are notable variations between the two post-tests for the experimental group and the research group.

Regarding the SV variable, the experimental group's post-test arithmetic mean was 117.9 with a standard deviation of 3.22, whereas the control group's post-test arithmetic mean was 98.9 with a standard deviation of 2.41. According to the computed (t) value, which was 2.752, there are notable disparities between the experimental and control groups' post-test results, and the experimental group performs the best.

Regarding the CQ variable, the experimental group's post-test arithmetic mean was 11.57 with a standard deviation of 1.41, whereas the control group's post-test arithmetic mean was 11.34 with a standard deviation of 0.34. The corresponding computed (t) values were (3.244) and (2.505). This suggests that there are notable variations between the two post-tests that favor the experimental group.

Discussion of results

By observing tables (4,5) regarding the cardiac performance variables, they are considered among the most important physiological indicators in identifying the swimmer's efficiency and determining his adaptation to sports activity. This importance comes from the importance of delivering oxygen and other sources through the blood to the various other body systems in order to confront the major changes during physical work or during the recovery phase.

Therefore, the researcher was interested in developing these variables for the research group because they are considered an indicator of physical condition. The researcher attributes the increase in the efficiency of the cardiac variables to increasing the intensity of training through resistance ropes, swimming gloves, and foot fins, which created additional physical effort in swimming. This effort led to physical adaptation that played a fundamental role in increasing blood flow to the up or low intensity when reducing the training intensity to the down. This is an indicator of efficiency. The higher the physical efficiency, the lower the heart rate. This gives an advantage to the heart muscle, as it not only produces more, but is more economical. "Physical exercise affects the increase in cardiac output at the beginning of exercise, accompanied by an increase in heart rate (HR) as well as stroke volume (S.V). Most of its causes are hormonal at the beginning of the effort, in which the heart muscle is formed by increasing the volume of blood pumped per stroke (s.v) and heart rate (HR). The amount of nervous and hormonal stimuli adapts to the intensity of the load by providing blood loaded with oxygen and nutrients, which is the period of stability. Regular training also works to adapt the heart to the effort, which leads to a decrease in the heart rate during rest or when giving different loads. This was confirmed by (Sperryn) when he said that the heart adapts during rest and during effort, quickly returning to the normal state, and this is clearly evident in athletes who practice endurance and endurance games.

When the heart rate increases during exercise, this will lead to an increase in cardiac performance, which is the product of stroke volume x heart rate. This means that the dynamics of blood and its flow are subject to physiological changes. This was reflected in the values of these variables during the rest period, which represents a more accurate indicator of the physical and physiological efficiency of the heart muscle of the athlete in general and the research sample individuals in particular. With regard to the time of completing the 200 m freestyle. By observing Tables (2) and (3), it appeared that there was a significant difference in the variable of performance time, which showed a development in the level of achievement in swimming the 200 m freestyle for the experimental group. The calculated value of (t) was greater than the tabular value of (T), which indicates that there is a clear effect of the training methods used when implementing the training curriculum paragraphs. However, the development that occurred in the performance level of the experimental group was more evident than it was in the control group. The researcher attributes this development to the effect of the training method used (rubber ropes, swimming gloves and foot fins), which clearly affected the work of the arms and legs and strengthened their joint muscles, which are very important in producing the driving forces to move the body forward during freestyle swimming. This is consistent with what was indicated by (1975-Miyashita) "that there is a high positive correlation between the pulling force of the arms and the swimming speed," and with what was stated by (Conselman-1980) "that reaching the maximum efficiency of propulsion in the water is through pushing a large amount of water for the longest possible distance," and this is what was achieved by increasing the strength of the movements of the legs. The researcher finds that the increased loading achieved through the use of resistance ropes, hand gloves and foot fins has achieved the goal of its use, and this is consistent with what was indicated by (Beltz, J.D., D.L.Costill.1988) that the increase in aerobic and anaerobic loading causes changes in the concentration of high-energy phosphate in the muscles performing the exercise. This explains the reason for the development of the level of performance of the arms and legs as a result of the loading of the experimental group, by increasing the resistance it faces with the swimming ropes, fins and gloves compared to what is the loading in the control group, and achieving the objectives and hypotheses of the research.

Conclusions and recommendations:

Conclusions:

By presenting, analyzing and discussing the test results, the researcher reached the following conclusion:

1. It was found that training using resistance tools is a good training method to increase water resistance, which works to develop muscle capacity and thus improve the time to complete (200 m) freestyle.
2. The effect of using resistance tools was positive in creating resistance within the aquatic environment and increasing the effort on swimming, thus adapting the swimmer and raising his physiological capabilities, including cardiac performance.

Recommendations:

- Using resistance training methods such as rubber ropes, gloves and fins to develop physical and physiological abilities.
- Giving importance to using physiological indicators when developing training programs because they are a true indicator of the swimmer's physical condition and the training loads.
- Generalizing the use of resistance ropes, gloves and fins in swimming as a training method to strengthen the muscles of the arms and legs and because of their importance in developing the level of achievement in the (200 m) freestyle swimming event.

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Appendix
Training units

Sunday		
Curriculum Content And Objective	**Organization**	**Training Method**
Warm up	200m freestyle + 100m + 4×25m 15 s)	Heart rate 120-150 f/min
Endurance swimming	4 x 100m (25m right + 25m left) arm pull + 50m Rubber ropes swimming	4 minutes (work + rest) 80% intensity*
Lactate production exercises	8 x 50 + 50m between each repetition, light swimming foot fins	Repeat 100 seconds (work + rest), intensity up to 90%
Bearing swimming is a topical basis	6 x 100m swimming gloves	4.5 min (performance + rest) 75% intensity
Overload exercises	(8 x 50 m) using resistance ropes swimming m.experimental	Maximum intensity 90 seconds (rest + performance) maximum
Recovery	200m light swim	Continuous swimming time 6 minutes, moderate to light intensity
Size	2500 m	
Tuesday		
Curriculum Content And Objective	**Organization**	**Training Method**
Warm up	800m (400m medley + 200m freestyle + 200m medley)	Continuous swimming time 12 minutes pulse up to 150
Endurance swimming	8 x 50m (25m right + 25m left) Pull-up arms palms	90 sec interval (performance + rest) 80% intensity
Capacity development exercises	2(8 x 25m) using resistance bands	Maximum intensity 60 seconds (performance + rest) 95% intensity
Endurance swimming is a topical basis	4 x 100m 2 men only (fins)	2.5 min (work + rest) 80% intensity
Anaerobic threshold training	6 x 100m Zkof Fins	90 sec reps (performance + rest) 90% intensity
Recovery	4×100m descending	8 minutes 75% intensity
Size	3500 m	
Thursday		
Curriculum Content And Objective	**Organization**	**Training Method**
Warm up	600 m (50 m freestyle + 50 m butterfly + 50 m backstroke + 50 m breaststroke x 2...)	Continuous swimming time 12 minutes pulse up to 140
Endurance swimming	8 x 100m (25m) arm pull + 75m full body swimming gloves	Period – 2 minutes (performance + rest) 80% intensity
Lactate production exercises	4 (8x25m) Swimming Resistance Bungee Ropes	90 sec (work + rest) + 4 intensity 90%
Bearing swimming is a topical basis	4 x 100 m 2 leg fins	2.5 min (work + rest) 80% intensity
Overload exercises	(8 x 50m)	Maximum intensity 90 seconds (performance + work) 100% intensity
Recovery	400m light descent	Continuous swimming time 8 min
Size	3200 m	