The effect of using cluster training on indicators of muscle fatigue and improving the level of some harmonic abilities and the skill level of butterfly swimmers

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Introduction and research problem:

Swimming is one of the sports activities that develop its motor performance in recent times at rapid rates, and this is clearly expressed through what is seen in the world championships and the Olympic Games of upgrading and progress in the beauty of skill performance, and if this indicates something, it indicates the extent of the ability to employ scientific facts to serve this sport, but swimming in Egypt suffers from many problems in order to catch up with the global sports development, not only for For high levels, but also at the level of the broad base of juniors.

Sports coaches and sports scientists are constantly looking for modern training methods in order to improve sports performance, and gain a competitive advantage, and cluster exercises are considered one of these modern training methods in the sports field. (9:14)

Tufano et al .(2017) that the term cluster training was first used in scientific studies in (**2003**) by researcher **Gregory Haff**.(37:464)

Oliver**, et., al (2019)** state **that cluster combinations should be used with the aim of maintaining speed and capacity**, increasing the size of the total load within the training unit, increasing vertical jump performance, reducing estimates of observed effort of the athlete, maintaining the level of technical performance of the exercise, and reducing pressure and acute respiratory periodic stress during resistance exercises (30 : 235 (235)

Cluster training is an effective way to counter low speed and productive capacity as cluster exercises include short breaks between individual repetitions or sets of repetitions, and it has been hypothesized that 15-30 seconds of recovery between repetitions allows partial replenishment of creatine phosphate stocks, thus facilitating full recovery to perform the exercise in the next repetitions.(849:36)

Morales, et., Al (2018) state that **cluster training are groups of** interrelated exercises belonging to a series with a single goal that is divided into small groups of repetitions including breaks (a rest period after each repetition – after a number of repetitions), and short breaks between groups "usually between 10 to 30 seconds" in order to help us do more repetitions. 932:27)

Abu Ela Ahmed Abdel Fattah (2002) **believes that the phenomenon of fatigue of the** basic physiological processes closely related to sports training processes, and when physical performance associated with loads, and appears in the form of a temporary decrease in the player's ability to continue to perform physical exertion, followed by the recovery process, which is the return of the body's systems to its normal state, and therefore they are two processes inseparable during the effort. (1: 14-15)

Exhaustion **is a late stage of muscle fatigue, the result of** excessive fatigue, and often appears as a result of performing training loads or carrying competition without eliminating the energy production residues resulting from these loads.(1: 32)

High intensity physical training is also accompanied by the emergence of muscle pain, which is one of the factors that lead to low access to advanced stages of physical and physiological efficiency in athletes, and that not getting rid of muscle pain directly, through various means of recovery, before starting to implement the new training dose may lead to some sports injuries, and delayed muscle pain for athletes. (33: 86)

Beta-endorphins are secreted from the anterior lobe of the pituitary gland in times of stress, severe stress, and pain sensations where beta-endorphins combine with pain receptors in neurotransmitter, and this is done when pain and psychological and nervous pressure begin to increase, so the brain begins to send its commands chemically and electrically to nerve cells, especially in the cerebral cortex and spinal cord. It urges it to secrete beta-endorphins to work with receptors, especially in pain sensation centers, and beta-endorphins are secreted in response to stress, stress and muscle pain, and the work of beta-endorphins is to reduce the feeling of pain, improve emotional moods, and contribute to reducing pain resulting from high-intensity physical

exercises, and works to relax muscles and reduce the degree of muscle tension. (4 : 81 (19:361) (24:159)

Troup **(2002), Jones (2010), Saad Kamal and Ibrahim Yahya (2014) agree** that lactic acid is one of the main causes of muscle stress, and this is associated with the phenomenon of fatigue, so the measurement of blood lactate is an important indicator of muscle stress because the level of blood lactate is a good indicator of performance tolerance, and because the response to blood lactate for training is very sensitive, training programs need more specialized planning, and linked to the response to blood lactate. 11: 35)(172:23)(10:89)

Gold **, et., Al (2003**) add that the dehydrogenizing enzyme (**LDH) contributes to the elimination of lactic acid, and the increase in the** concentration of this enzyme is accompanied by an increase in the elimination of lactic acid as it is a dehydrogenizer, and thus converts lactic acid to pyruvic acid, and beta-endorphins (blood morphine) acts as a chemical transporter, and enters into many physiological processes. 357: 20)

Butterfly swimming is one of the most exciting and exciting swimming devices for viewers because it contains common elements, such as strength parts, stability and flexibility, and changing direction, all of which are installed in the form of a kinetic sentence with a harmonious rhythm.

The researcher reviews many scientific studies in the field of cluster training, such as: **Keir Hansen, et., al (2018)(25**), ***Abbas Asadi et al*** **.(2019)(**18**), Juma Mohammed (2020)(7), Khaled Naim and Mustafa Hassan (2020)(8), Mohammed** Al-Husseini and Khaled **Ahmed (2020)(16), Howayda Abdel Hamid (2021) (17), Sameh Mohammed** (2022**)**(9), whose results indicated the importance of using the cluster training method in the development of physical, physiological and technical aspects of individual and team sports players, as well as within the limits of the researcher's access to previous scientific studies did not find the researcher any scientific study dealt with the impact of the use of cluster training method on the indicators of muscle fatigue and the level of performance of some somersaults on the butterfly for junior swimming under (11) years.

Also, through the work of the researcher in the field of training juniors and swimming players, he noticed the low **level of technical performance** of butterfly swimming, and the appearance of signs of fatigue and stress on junior swimming under (11) years, and this may be due to the implementation of training units in the traditional form, which

is characterized by rigidity and stereotype, and lack of change, which affects young people in a state of boredom and apathy , which causes a lack of enthusiasm to continue training with high efficiency, and this results in poor functional and skill abilities for junior swimming under (11) years.

Hence the idea of this research in an attempt to identify the effect of using cluster training on indicators of muscle fatigue and improve the level of some harmonic abilities and skill level for butterfly swimmers under (11) years.

Research Objective:

The research aims to design a training program using cluster training for junior swimming under (11) years and to know its impact on:

1- Indicators of muscle fatigue (beta-endorphins - lactic acid - hydrogenizing dehydrogenase enzyme).

2- The level of some harmonic abilities and the skill level of butterfly swimming for junior swimming under (11) years.

Research hypotheses:

1- The use of cluster training positively affects the indicators of muscle fatigue (beta-endorphins - lactic acid - hydrogenizing enzyme) for junior swimming under (11) years.

2- The use of cluster training positively affects the level of performance of some harmonic abilities and the skill level of butterfly swimming for junior swimming under (11) years.

Search terms:

Cluster Training:

It is a "training system consisting of groups of interrelated exercises belonging to a series with a single goal divided into small groups of repetitions, including breaks "a rest period after each repetition – after a number of repetitions" and short breaks between groups "usually between 10 to 30 seconds". 34: 2857)

Muscle Fatigue:

It is "a condition that appears sharply after the execution of the training load or the maximum one-time competition load". (1: 32)

Beta-Endorphin:

It is "one of the most important natural painkillers, and it works to reduce the degree of muscle pain resulting from high physical loads, as well as improving and enhancing the efficiency of the immune system and improving moods." (2 : 165)

Search Procedure:

Research Methodology:

The researcher used the experimental approach through the experimental design of one group using the pre- and post-measurements, due to its suitability to the nature of the current research.

Research population and sample:

The researcher selected the research sample in a deliberate way from junior swimming under (11) years old in the following sports clubs: Al-Gezira Sports Club - Vanguards of the Army Club, affiliated with the Cairo region, and registered in the Egyptian Swimming Federation in the training season 2021/2022, and their number is (21) youngsters, and (10) juniors have been excluded to conduct the exploratory study on them, thus becoming the basic research sample (11) Emerging swimming used cluster training.

The moderation of the distribution of the members of the research sample was calculated in the growth rates (age - height - weight - training age), and the indicators of muscle fatigue (beta-endorphins - lactic acid - dehydrogenizing enzyme) and the level of performance of some somersaults on the butterfly in the swimming under research, and tables (1) and (2) show that:

Table (1)

Moderation of the distribution of the members of the research sample in growth rates

(age - height - weight - training age) n = 21

Torsion coefficient	Broker	Standard deviation	Arithmetic mean	Unit of measurement	Variables
0.59	10.10	0.51	10.20	year	Age
0.73	133.00	6.27	134.52	poison	Length
0.66	29.00	4.12	29.91	kg	Weight
0.98	4.60	0.80	4.86	*year*	*Training age*

It is clear from Table (1) that all the values of the torsion coefficients were limited between (±3) in the growth rates (age - height - weight - training age), which indicates the moderation of the distribution of the members of the research sample, and free from the defects of non-moderate distributions.

Table (2)

Moderation of the distribution of the research sample members in the indicators of muscle fatigue In swimming butterfly n = 21

Torsion coefficient	Broker	Standard deviation	Arithmetic mean	Unit of measurement	Variables
0.66	9.35	0.73	9.51	Beko Mall/Liter	Beta-endorphins
0.78	6.11	0.46	6.23	mmol/L	Lactic acid
0.73	541.20	31.49	548.85	unit/liter	Dehydrogenase enzyme

It is clear from Table (2) that all the values of the torsion coefficients were limited between (±3) in the indicators of muscle fatigue, which indicates the moderation of the distribution of the members of the research sample.

Data collection tools:

They are divided into the following:

First: Measuring the indicators of muscle fatigue under research:

A blood sample of (5) cm3 of each emerging Swimming under (11) years From the members of the basic research sample after performing somersaults On the butterfly By a doctor specializing in medical analysis, where what has been withdrawn from each emerging Swimming (10) cm3 during the application of pre- and post-measurements, and the samples were unloaded into clean and sterile plastic tubes where they were numbered by the inking pen ،Each plastic tube took a specific number, and blood samples were transferred to the laboratory to separate the serum (blood serum) from the cells by the centrifuge at a speed of 3000 cycles / s, for a period of (5) minutes, and the tubes were placed in a balanced manner inside the device, in preparation for measuring the concentration of beta-endorphins, lactic acid and dehydrogenizing enzyme in the blood.

Proposed cluster training program:

First: Objectives of the training program:

1- Improving muscle fatigue indicators (beta-endorphins - lactic acid - hydrogen dehydrogenizing enzyme) for junior swimming under (11)

years.

Second: The foundations of developing the proposed training program:

When developing the content of the training program, the researcher took into account the following scientific foundations and standards:

1- Taking into account the individual differences between juniors during the application of the training program.

2- Explain the exercises used and their rules in a simplified manner before the beginning of the training unit.

3- The intensity of the pregnancy during the stages of the training program ranges between (60% - 90%).

4- The number of groups ranges between (3-5) groups, and the number of repetitions between (8-15) repetitions, provided that the repetitions are divided into smaller repetitions.26: 2856)

5- The method of low and high intensity interval training was used during the application of the content of the training program.

repetitions ranges (5-2) The rest period after the cluster groups -6 seconds, and after the main groups (90) seconds, and (30-between (15 .this procedure is for performance speed exercises

(29: 1876)

7- The rest period after the cluster groups (2-5) repetitions ranges between (15-30) seconds, and after the main groups (60-120) seconds, and this procedure is for muscular ability exercises for the legs and arms.31:217)

8- Taking into account security and safety factors during the application of the program.

Pre-measurements:

The researcher made tribal measurements of the members of the basic research sample in the indicators of muscle fatigue (beta-endorphins - lactic acid - hydrogenizing enzyme) and the level of performance of some somersaults (front somersault on the hands - side somersault on the hands

with a quarter lap - back somersault on the hands) on the butterfly in swimming during the period from 15/9/2021 to 17/9/2021.

Application of the proposed training program:

The researcher applied the content of the proposed training program using cluster training on the members of the basic research sample for a period of (8) consecutive weeks by (3) training units per week at Al-Jazeera Sports Club, from 19/9/2021 to 13/11/2021.

Dimensional measurements:

The dimensional measurements of the members of the basic research sample were conducted in the indicators of muscle fatigue and the level of performance of some somersaults on the butterfly in swimming, in the same order and conditions as the pre-measurements, from 15/ 11/2021 to 17/11/2021.

Statistical methods under consideration:

The statistical coefficients that suit the search were performed using the statistical program **SPSS** to extract the following processors:

- Arithmetic average. - Mediator. - Standard deviation.

- Torsion coefficient. - Simple correlation coefficient. - Test "T".

- % improvement rates.

Presentation and discussion of results:

First: Presentation of results :

Table (3)

The significance of the differences between the pre- and post-measurements of the members of the research sample Basic indicators of muscle fatigue under research n = 11

Value "T"	Telemetry		Pre-measurement		Unit of measurement	Variables
	on	M	on	M		
4.91*	0.31	8.84	0.48	9.64	Beko Liter/Mall	Beta-endorphins
4.37*	0.29	5.72	0.36	6.31	mmol/L	Lactic acid
3.02*	22.46	521.96	27.12	553.50	unit/liter	Dehydrogenase enzyme

The tabular value of "T" at 0.05=2.228 * D at 0.05 level

It is clear from Table (3) that there are statistically significant differences at the level of 0.05 between the pre- and post-measurements of the members of the basic research sample in the indicators of muscle fatigue (beta-endorphins - lactic acid - dehydrogenizing enzyme) in favor of the post-measurement.

Table (4)

Rates of improvement of telemetry from the tribal for the members of the research sample Basic in the indicators of muscle fatigue under consideration

Members of the basic research sample n = 11			Variables
Improvement rates	you go away	before me	
9.05٪	8.84	9.64	endorphins-Beta
10.31٪	5.72	6.31	Lactic acid
6.04٪	521.96	553.50	Dehydrogenase enzyme

It is clear from Table (4) that there are improvement rates in the dimensional measurement of the tribal for the members of the basic research sample in the indicators of muscle fatigue (beta-endorphins - lactic acid - dehydrogenizing enzyme) with a percentage ranging between (6.04% - 10.31%).

Table (5)

The significance of the differences between the pre- and post-measurements of the members of the basic research sample at the level of Performance of some somersaults on the butterfly in swimming n = 11

Value "T"	Telemetry		Pre-measurement		Unit of measurement	Variables
	on	M	on	M		
3.27*	0.53	9.40	0.94	8.35	Grade	Front somersault on the hands
3.51*	0.61	9.60	0.98	8.50	Grade	Side somersault on the hands with a quarter roll
4.19*	0.58	8.90	1.03	7.45	Grade	Backflip on the hands

The tabular value of "T" at the level of 0.05=2.228 * D at 0.05 level

It is clear from Table (5) that there are statistically significant differences at the level of 0.05 between the pre- and post-measurements of the members of the basic research sample in the level of performance of some somersaults on the butterfly in swimming in favor of the post-measurement.

Second: Discussion of the results:

A- Discussing the results of the first hypothesis, which states: "The use of cluster training positively affects the indicators of muscle fatigue (beta-endorphins - lactic acid - dehydrogenizing enzyme) for junior swimming under (11) years."

The results of Table (3) and Figure (1) indicated that there were statistically significant differences at the level of 0.05 between the pre- and post-measurements of the members of the basic research sample in the indicators of muscle fatigue (beta-endorphins - lactic acid - dehydrogenizing enzyme) in favor of the post-measurement.

the improvement in the indicators of muscle The researcher attributed endorphins in the blood -fatigue, where the rate of concentration of beta

decreased to the positive effect of the use of cluster training, which led to g under the development of physiological abilities for junior swimmin years, which contributed positively to delaying the signs of the (11) endorphin, -appearance of fatigue, and thus decreased the secretion of beta which is associated with fatigue, stress and tension, and this result is **Morales** ،(32) **(Samson (2018** :ated byconsistent with what was indic that the inclusion of short breaks (27)(**2018**) **.et al. Morales, et., al** between small groups of repetitions was called cluster training or cluster the training, and that exercises performed according to clusters lead to development of transitional speed, performance speed, muscular ability of athletes with a lower level of metabolic stress, and the ability to eliminate .energy production wastes

The researcher also attributes the improvement in the ability to get rid of lactic acid to the improvement of the training situation as a result of the use of cluster training with junior swimming under (11) year, and thus improve the functional condition, which positively affected the reduction of the rate of accumulation of lactic acid in the blood, in addition to increasing the efficiency of the enzyme dehydrogenase, which converts lactic acid to pyruvic acid, which gives the emerging the ability to resist muscle fatigue, and this result is consistent with what was pointed out by:

Nicholson et al Nicholson, et al., Al (2016)(29)، **Mora et al Mora, and last, Al. (2018**)(26)، **Oliver et al Oliver, et al, Al (2019**)(30) that there are many positive physiological effects of the use of cluster exercises, including decreased concentrations of lactic acid in the blood, increased concentrations of triadenosine phosphate and creatine phosphate during performance, reduced metabolic requirements for resistance training, and reduction of decreases resulting from muscle fatigue.

This result is also consistent with the results **of the study of: Howayda Abdel Hamid** (2021)**(**17) on the effectiveness of cluster training in improving the functional status and reducing the concentration of lactic acid in the blood of athletes.

The results of Table No. (4) showed that there are improvement rates in the dimensional measurement of the tribal members of the basic research sample in the indicators of muscle fatigue (beta-endorphin - lactic acid - dehydrogenizing enzyme) by a percentage ranging between (6.04% - 10.31%), and this result is consistent with what was pointed out by **Iglesias, et., al. (2018)(21**) that training athletes in an **integrated manner leads to an increase in the ability to tolerate lactic during the use of various exercises that accumulate in their muscles during physical exertion, which makes them able to continue to perform at a high speed rate for as long as possible, these physiological adaptations allow the production of more anaerobic energy as lactic tolerance is developed and the activity of the enzyme** (LDH) **in the muscles of the** athletes increases.

Thus, the validity of the first research hypothesis is verified.

Conclusions:

In light of the objectives of the research, the procedures followed and the statistical method used, the researcher was able to reach the following conclusions:

1- The cluster training program has a positive effect statistically at the level of 0.05 on the indicators of muscle fatigue (beta-endorphin - lactic acid - dehydrogenizing enzyme) for junior swimming under (11) years.

2- There are improvement rates in the dimensional measurement of the tribal members of the basic research sample in the indicators of muscle fatigue (beta-endorphins - lactic acid - hydrogen dehydrogenizing enzyme) with a percentage ranging between (6.04% - 10.31%).

Recommendations:

In light of the results of the research, the researcher recommends the following:

1- Using the cluster training program because of its effective positive effect in improving the indicators of muscle fatigue (beta-endorphins - lactic acid - hydrogenizing enzyme) and the level of performance of some somersaults on the butterfly for junior swimming under (11) years.

2- The need to use measurements of muscle fatigue indicators when evaluating the functional aspects of junior swimming under (11) years.

3- Interest in integrating cluster training with weight training and plyometric exercises to develop the physical and technical abilities of junior swimming under (11) years.

4- Holding refinement courses for trainers on how to develop training programs using cluster training for junior gymnastics.

5- Conducting similar studies on different dental stages and other devices, using cluster training programs.

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