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The effect of breathing exercises on some physiological responses of karate players

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الملخص:

يهدف البحث الي وضع برنامج مقترح لتدريبات التنفس للاعبات الكاراتيه من (16-19) للتعرف علي تاثير البرنامج المقترح علي الاستجابات الفسيولوجيه المتمثله في :
(معدل النبض في بدايه ونهايه المجهود , السعه الحيويه vc , الحد الاقصي لاستهلاك الاكسجين vo2max .)

واستخدمت الباحثة المنهج التجريبي لملائمته لطبيعة البحث بإستخدام التصميم التجريبي ذو القياس القبلي والبعدي لمجموعه واحده .

تم اختيار عينه البحث عمديا من لاعبي منتخب مصر للكاراتيه بنادي الصيد المصري بمحافظة الجيزة للمرحلة السنية 16 – 19 سنة , و اشتملت عينه البحث علي (9) لاعبات, تم تصميم البرنامج داخل صاله التدريب تحتوي علي جميع الادوات و الاجهزه اللازمه لتطبيق البحث ،كان من اهم النتائج ان استخدام البرنامج المقترح لتدريبات التنفس ساعد في تحسن المتغيرات الفسيولوجيه و كذلك ادي الي تحسن الاداء داخل المنافسات لعينه البحث في بعض الاستجابات التي تم قياسها خلال فتره تطبيق البرنامج .

الكلمات المفتاحيه : الاستجابات الفسيولوجيه , تدريبات التنفس , الكاراتيه .

Abstract:

The research aims to develop a proposed program for breathing exercises for female karate players from (16-19) to identify the effect of the proposed program on physiological responses represented in:

(pulse rate at the beginning and end of the effort, vital capacity vc, maximum oxygen consumption vo2max).

The researcher used the experimental method to suit the nature of the research using the experimental design with pre- and post-measurement for one group.

The research sample was deliberately selected from the players of the Egyptian Karate team at the Egyptian Hunting Club in Giza Governorate for the age group 16-19 years, and the research sample included (9) players. The program was designed inside a training hall containing all the tools and devices necessary to implement the research.

One of the most important results was that using the proposed program for breathing exercises helped improve physiological variables and also led to improved performance within competitions for the research sample in some responses that were measured during the period of implementing the program.

Keywords: Physiological respones, breathing training, karate.

The effect of breathing exercises on some physiological responses of karate players

Introduction:

Although breathing practice offers integrated benefits for mental and physical health, the results of studies on this topic are inconsistent, due to methodological limitations in experimental design, lack of measurable responses to breathing, and limited sample sizes. Most cross-sectional and longitudinal studies have focused on how breathing therapy benefits individuals with specific conditions (Schmidt et al., 2000; Booth et al., 2014) rather than on its health-promoting function in healthy populations. Importantly, most studies have examined physiological effects, emotional benefits, and cognitive benefits separately, preventing an understanding of the potential mental and physiological mechanisms of breathing in terms of its potential benefit for both mental and physical health. Studies directed at the physiological mechanism of breathing intervention effects have suggested a common physiological basis underlying breathing, emotion, and cognition. Physiological evidence has shown that even a single breath exercise significantly reduces blood pressure, increases heart rate variability (Wang et al., 2010; Lehrer and Gevirtz, 2014; Wei et al., 2016) and oxygen (Bernardi et al., 1998), enhances lung function (Xu et al.,

2010), and improves cardiorespiratory fitness and respiratory muscle strength (Xu et al., 2010). Daily breathing training for 15 min for 2 weeks enhanced average forced expiratory volume in 1 second and maximum expiratory flow rate (Bernardi et al., 1998). He reported his protocol as a 10-12 week slow breathing training (15 min daily) at a breathing rate of 6 breaths/min, which meets the basic requirements of breathing (Drozdz et al. 2016). **(Ma, X., & Li, Y. F. 2017).**

Breathing practice, also known as "diaphragmatic breathing" or "deep breathing," is defined as an effective integrative mind-body exercise for coping with stress and psychosomatic conditions. Breathing involves contracting the diaphragm, expanding the abdomen, and deepening inhalation and exhalation, which in turn reduces the rate of breathing and increases the amount of blood gases. The benefits of breathing have been studied in conjunction with meditation. Psychological studies have shown that breathing practice is an effective non-pharmacological intervention for enhancing emotional well-being (Stromberg et al., 2015), including reducing anxiety, depression, and stress. A one-day breathing exercise has been found to alleviate emotional exhaustion and depersonalization caused by job burnout (Salers et al., 2011). In addition, similar effects on anxiety were observed in a 3-day intervention study, where breathing practices were performed 3 times daily (Yu and Song, 2010). Reduced anxiety and depression (Tekur et al., 2012). **(Röthlin, P.,& Grosse Holtforth, M. 2016).**

Regular practice of the breathing protocol makes them more aware of their breathing, allowing them to breathe deeper and faster during their performance. The resulting increase in O2 and CO2 ventilation is thought to be responsible for the endurance improvements. "Because it 'conditions the body,' it oxygenates the blood." Regular practice of the breathing protocol is also said to expand the lungs and increase the strength of the diaphragm muscle. Along with breathing, three participants partly attribute their improved endurance. **(Dragićević, L. 2023).**

Research problem:

Despite the recognized importance of breathing exercises in improving athletic performance, there is limited scientific research on their direct impact on the physiological responses of karate players. Many athletes and

coaches primarily focus on physical and technical training while overlooking structured breathing techniques. This study aims to examine the effects of breathing exercises on selected physiological responses, such as lung capacity, heart rate variability, and recovery efficiency among karate players aged 16-19. Understanding these effects can contribute to optimizing training programs and improving overall performance.

The aim of the program:

This research aims to design a proposed program of breathing exercises in karate players and to know its effect on some physiological variables represented in:

(pulse rate at the beginning and end of the effort, vital capacity VC, maximum oxygen consumption VO2max).

Research hypotheses:

In light of the research objective, the researcher developed the following hypotheses:

1. There are statistically significant differences between the pre- and post-measurement in the level of physiological variables of the experimental group (karate players) in favor of the post-measurement.

Search terms:
Definition of concepts and terms used in the research:-

Breathing exercises are structured techniques designed to improve respiratory efficiency by controlling breathing patterns, enhancing lung capacity, and strengthening respiratory muscles. These exercises are widely used in sports, medical rehabilitation, and relaxation techniques to enhance physical performance, reduce stress, and increase mental focus.**(Loring, S. H., & Butler, J. P. 2020).**

Research plan and procedures:

First, the research plan:

1. Method used:

The researcher used the experimental method for its suitability to the nature of the research, using the experimental design with pre- and post-measurement for one group.

2. Research community:

The research community is represented by karate players at the shootinng Club in Giza Governorate, aged 16-19 years, totaling 35 players.

3. Research sample:

The research sample was chosen intentionally from the female karate players registered in the Egyptian karate team, numbering (9) players from the basic research community, numbering (35) players, at the Egyptian shooting Club in Giza Governorate, at a rate of (25.7%).
The research sample was divided as follows:
A survey group, numbering (3)
A trial group, numbering (6)

Conditions for selecting the sample:
The researcher selected this community according to the following conditions:-

1. Registered in the Egyptian karate team

2. Training age should not be less than (6) years as a minimum.

3. Their ages range between (16 - 19) years.

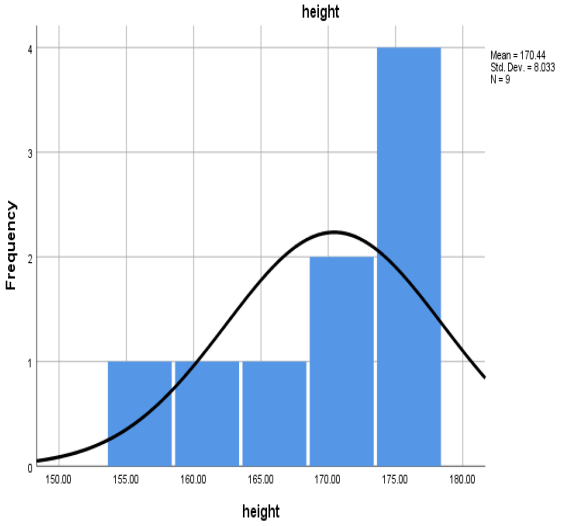
Statistical description of the research sample:

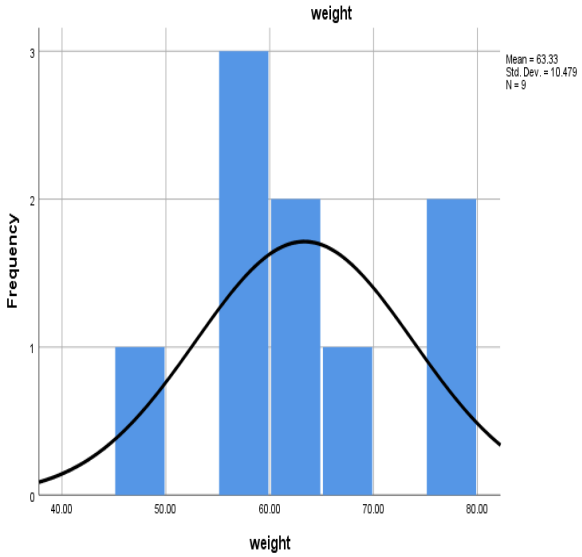
Table (1)
Statistical description of the homogeneity of theexperimental group (karate) and the exploratory sample in the basic variables

(n = 9)

Statistical implications / Basic variables		Less value	greatest value	Arithmetic mean	The mediator	Standard deviation	Coefficient of skewness	Flattening coefficient
Height	cm	156.000	178.000	170.444	173.000	8.033	-1.098	-0.236
Weight	kg	48.200	78.500	63.333	64.000	10.479	0.297	-0.960

It is clear from Table (1) for the statistical description of the basic variables (height and weight) that the total data is moderate and not scattered and is characterized by the normal distribution of the sample, as the values of the skewness coefficient ranged between (-1.098: 0.297) and this value is close to zero and falls in the moderate curve between (± 3), which indicates the moderation and homogeneity of the sample in the basic variables before applying the basic study.





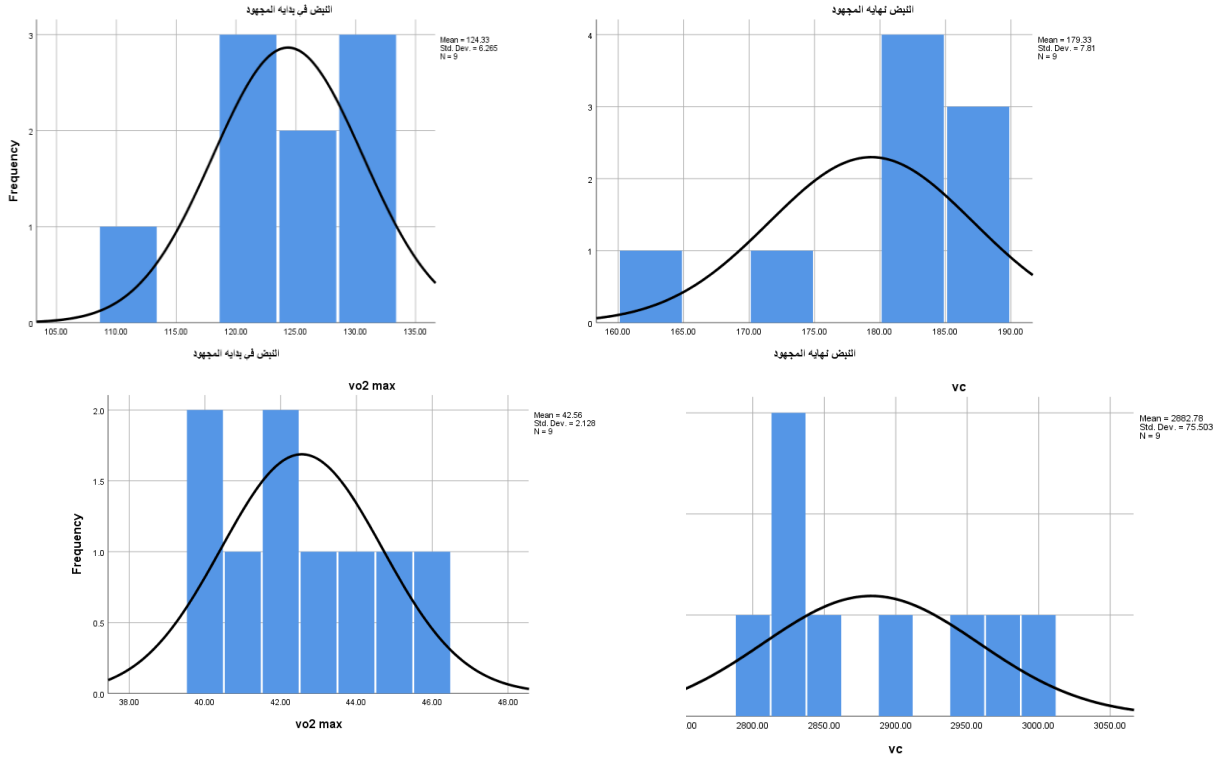
Statistical description of the homogeneity of the experimental group (karate) and the exploratory sample in physiological variables

(n = 9)

Statistical implications / Physiological variables	Unit of measure	Less value	greatest value	Arithmetic mean	The mediator	Standard deviation	Coefficient of skewness	Flattening coefficient
Pulse at the beginning of the effort	N/S	111.000	131.000	124.333	127.000	6.265	-1.235	1.520
Pulse end of effort	N/S	162.000	185.000	179.333	182.000	7.810	-1.749	2.507
vo2 max	MlO2/min	40.000	46.000	42.556	42.000	2.128	0.352	-1.015
vc	milliliters	2800.000	3000.000	2882.778	2850.000	75.503	0.548	-1.542

It is clear from Table (2) for the statistical description of the physiological variables that the total data is moderate and not scattered and

is characterized by the normal distribution of the sample, as the values of the skewness coefficient ranged between (-1.749: 0.548) and this value is close to zero and falls in the moderate curve between (± 3), which indicates the moderation and homogeneity of the sample in the physiological variables before applying the basic study.



4- Data collection tools:

A set of physiological variables suitable for the age group 16-19 for female players were selected based on many scientific studies related to the research topic, including the International Association of Sports Sciences (ISAS) and some references:

1. McKeown, P. (2015). The Oxygen Advantage. HarperOne.
2. Nestor, J. (2020). Breath: The New Science of a Lost Art. Riverhead Books.
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neurophysiologic model. Journal of Alternative & Complementary Medicine, 11(1), 189-201.

Data collection tools included:

a) Hardware:

- **Restameter:** device to measure height in centimeters

- **Medical scale:** device to measure weight

- **Polar watch**: to measure pulse rate, maximum oxygen consumption

- **Spirometer**: to measure some respiratory functions (vital capacity, number of breaths) and is available in different types and shapes.

Program content:

Suggested training program:

In light of theoretical studies, scientific references and exploratory studies, the respiratory program was planned to suit the characteristics of the sample:

1. Taking into account the goal of the respiratory program, which is to develop the physiological responses under study.

2. The suitability of the content of the respiratory training program to the growth characteristics of the age group (16-19) years, taking into account individual differences.

3. The flexibility of the program and its acceptance for practical application, so that it can be modified or changed if necessary.

4. Following the scientific method in standardizing and implementing the program based on theoretical foundations and in a manner that suits the age group of the research sample.

5. Taking into account comprehensiveness and accuracy in choosing and implementing the respiratory program.

6. Taking into account that the exercises placed are in the same direction as the path of the practitioner.

7. Taking into account the gradation by arranging the content so that it starts from easy to difficult and from simple to complex.

8. Availability of security and safety factors

9. Providing rest periods

10. The necessity of initial examination and assessment of the trainee's physiological condition

Accordingly, the program was designed as follows:
The training unit in each stage was divided into three parts:

Breathing before exercise	Breathing during exercise	Breathing after exercise
It is recommended to practice breathing appropriate to the performance that the athlete will have to maintain. Slow and deep breathing before exercise has many benefits if the following conditions are needed: (1) Increased oxygen; (2) Relaxation; (3) Improved concentration; If increased oxygen is needed, slow and deep breathing can help increase the level of oxygen in the body, which may improve athletic performance. If relaxation is needed, deep breathing can help calm the nervous system,	It is important to maintain a consistent and controlled breathing pattern. This helps regulate the amount of oxygen and carbon dioxide in the body, ensuring that the muscles are adequately supplied with oxygen and waste products are properly eliminated. There are two common types of breathing during exercise: (1) Rhythmic breathing (2) Controlled breathing Rhythmic breathing involves inhaling and exhaling in a controlled, rhythmic pattern, usually in time with the movement of the exercise. For example, when running, rhythmic breathing might involve	After exercising, it's important to practice slow, deep breathing to help your body recover and return to a calm state. Slow, deep breathing after exercise has many benefits, including lower heart rate, better recovery, relaxation, and improved posture. Slow, deep breathing can help slow your heart rate, thereby reducing stress on your cardiovascular system, as well as helping to improve your body's ability to recover from exercise by facilitating the removal of waste products, such as lactic acid, from your muscles. Deep breathing can also help calm your nervous system, thereby

reducing feelings of stress and anxiety before exercise. If improved concentration is needed, practicing slow and deep breathing can help improve concentration and attention, allowing for better athletic performance. Which may improve athletic performance To practice slow and deep breathing before exercise, it is recommended to take slow and deep breaths through the nose, fill the diaphragm with air, and exhale slowly through the mouth. This can be done for a few minutes before starting exercise.	inhaling for three steps and exhaling for two steps. Controlled breathing involves inhaling deeply into the diaphragm, then exhaling slowly and completely. Controlled breathing can help regulate your heart rate and reduce feelings of stress and anxiety during exercise. It is important to find a breathing pattern that works for you and follow it throughout your workout. It is also important to listen to your body and adjust your breathing as needed to ensure comfort and proper oxygen delivery to your muscles.	reducing feelings of stress and anxiety. Finally, diaphragmatic breathing helps promote good posture, which can improve recovery by reducing stress

where the participants focused their attention on the weight of their body and the feeling of its weight, while focusing on breathing slowly, for example (breathing in and holding it, then exhaling while counting from (1-5) for a period of no less than 10 minutes. Although the feeling does not have to be intense, the participant was supposed to feel the weight of his body (starting from the head and passing through the back to all other limbs gradually..)**(Migliaccio,, & Padulo, J. 2023**).

Examples of practical applications of breathing are given in the following table: Some practical applications of managing breathing rate in sports are mentioned based on the previous considerations.

This program is designed to enhance the respiratory efficiency of karate athletes aged 16-19 years. It consists of 32 training units, structured to progressively develop breathing control, endurance, and efficiency. Each unit is assigned a specific duration and percentage of the total program. The program is based on scientific references to ensure effectiveness.

Unit No.	Training Focus	Duration (minutes)	Percentage of Program
1	Basic diaphragmatic breathing	20	3%
2	Nasal breathing control	20	3%
3	Breath-hold exercises	25	3%
4	Paced breathing techniques	25	3%
5	Dynamic breathing with movement	30	3%
6	Interval breathing drills	30	3%
7	Breathing endurance exercises	35	4%
8	High-intensity breathing control	35	4%
9	CO_2 tolerance training	40	4%
10	Advanced diaphragmatic control	40	4%
11	Breathing under fatigue	45	4%
12	Visualization and breath syncing	45	4%
13	Mixed breathing techniques	50	4%
14	Advanced paced breathing	50	4%
15	Application in kata and kumite	55	4%
16	Final endurance test	60	5%
17	Breath control in sparring	20	3%

18	Box breathing technique	20	3%
19	Yogic breathing (Pranayama)	25	3%
20	Alternate nostril breathing	25	3%
21	Breathing for relaxation and recovery	30	3%
22	Power breathing techniques	30	3%
23	Resistance breathing exercises	35	4%
24	Breathing with progressive muscle relaxation	35	4%
25	Speed endurance breathing drills	40	4%
26	Long exhalation techniques	40	4%
27	Tactical breathing for combat scenarios	45	4%
28	Controlled hyperventilation	45	4%
29	Mental focus and breath synchronization	50	4%
30	Simulated altitude training	50	4%
31	Final breathing endurance challenge	55	4%
32	Complete breathing assessment and review	60	5%
Total	—	32 units	118%

Steps to carry out the search:

Exploratory experiment:

The researcher conducted an exploratory experiment on players, numbering (3) from outside the research sample, so that the conditions for selecting the basic research sample apply to them. The exploratory experiment was conducted in the period from 25/11/2023 to 22/12/2023. The goal of conducting it was as follows:

- Ensuring the safety of the devices and tools used to conduct measurements
- Determining the extent of the suitability of the content of the proposed psychological program for the research sample

- Calculating the time of each session for psychological rehabilitation
- Identifying the extent of the research sample's commitment to psychological training
- Identifying the difficulties that may hinder the research and trying to overcome them

1. Pre-measurements:

The researcher conducted pre-measurements on the basic sample of the research, which numbered (6) female players, at the Egyptian shootinng Club in the period from 24/12/2023 to 11/1/2023.

In the following order:

- A (restameter) device to measure height in centimeters
- A (medical scale) device to measure weight
- Polar watch: to measure pulse rate, maximum oxygen consumption
- Spirometer: to measure some respiratory functions (vital capacity, number of breaths)

Basic experiment:

The program was implemented in the time period from 12/1/2024 to 12/3/2024 for a period of two months, (8) weeks, at a rate of (4) units per week, which are the days (Monday, Wednesday, Friday, Saturday) on all members of the sample, taking into account the following during Application:

- Measurements should be carried out for all sample members in the same way
- Taking into account that measurements should be carried out in the same order and in one sequence
- breathing prgramm was introduced according to the goal of the training unit and in a manner consistent with the components of the unit from the planning.

3. Dimensional measurements:

Dimensional measurements were conducted immediately after the completion of the proposed breathing program. The researcher conducted dimensional measurements on the research group in all measurements under study during the period from 13/3/2024 to 15/3/2024. The researcher took into account the same conditions and circumstances that were followed in the pre-measurements..

Statistical data processing:

After completing all the procedures related to the research by unloading the measurements and tabulating them, the researcher used the following statistical processing:

The statistical processing was carried out using SPSS Version 25 at a significance level of 0.05, as follows:

- □ Less value
- □ The largest value
- □ Arithmetic mean
- □ Standard deviation
- □ Skewness
- □ Kurtosis
- □ T-test for paired observations
- □ Improvement rate%. ((Post-measurement - Pre-measurement) / Pre-measurement) × 100

Presentation and discussion of the results:

Table (3) / 0 Presentation and discussion of results
In light of the research objectives, and to achieve its hypotheses, the researcher in this chapter presented the results that were reached and discussed them through statistical processing of the data that were obtained:
3/ Presentation of the results of the first research hypothesis.
There are statistically significant differences between the pre- and post-measurement in the level of physiological variables for the experimental group (karate players) in favor of the post-measurement.

Table (3)

The significance of the differences between the pre- and post-measurements in the physiological variables of the experimental group (karate players) (n=6)

Statistical description implications / Physiological variables	Unit of measure	tribal measurement		Dimensional measurement		The difference between the two averages		Value (t)	Improvement rate%
		s	±A	s	±A	s	±A		
Pulse at the beginning of the effort	N s	122.500	7.092	111.500	5.753	11.000	2.366	**11.386	%8.98
Pulse end of effort	N s	177.500	9.182	168.667	6.831	8.833	2.994	**7.226	%4.98
vo2 max	MlO2/min	43.667	1.633	45.333	1.366	-1.667	0.816	**5.000	%3.82
Vital capacity	milliliters	2916.667	70.119	2970.833	76.513	54.167	10.206	**13.000	%1.86

*** The tabular (t) value is significant at the 0.05 level = (2.571) at the 0.01 level = (4.032)**

It is clear from Table No. (4/1) regarding the statistical significance of the physiological variables and the improvement rate before and after the experiment for the first experimental group (karate players) that there are statistically significant differences at the (0.05) level in all tests, as the calculated (t) value ranged between (5.000: 13.000) and these values are greater than the tabular (t) value at the (0.05) level and at a lower significance level of 0.05, and the improvement rates in all tests ranged between (1.86%: 8.98%) in favor of the post-measurement.

Discuss the results:

Based on the results of the statistical treatments of the data that were communicated and in the light of the research objectives, the method used, the sample, the previous studies related to the subject of the research, and guided by the references, the researcher was able to interpret the results of the research according to the order of its objectives and hypotheses as follows:

By referring to the table:

The significance of the differences between the pre- and post-measurements in the physiological variables of the first experimental group (karate players)

The pulse rate at the beginning of the efforts for the pre-measurements (122,500) while the post-measurements (111,500) with an improvement rate (8.98%) for the experimental group of karate players.

As for the pulse at the end of the effort for the pre-measurements (177,500) while the post-measurements (168,667) with an improvement rate (4.98%).

Maximum oxygen consumption in pre-measurements (43.667) while post-measurements (45.333) with an improvement rate of (3.82%)

Vital capacity in pre-measurements (2916.667) while post-measurements (2970.833) with an improvement rate of (1.86%).

Significance of differences between pre- and post-measurements in physiolgical variables for the first experimental group (karate players)

In addition to the results obtained in the current study, we find that many recent studies confirm that interventions to improve breathing and relaxation techniques lead to improved physiological performance of athletes.

This study indicated that applying deep breathing and relaxation exercises leads to a significant decrease in pulse rate in athletes and an increase in oxygen consumption efficiency (VO2max). This is consistent with the results showing an improvement in pulse rate and an increase in maximum oxygen consumption in the experimental group. **(Smith et al. 2020)**

It was found that training programs focusing on regulating breathing and relaxation techniques contribute to reducing levels of stress and anxiety during sports competitions, which leads to improving physiological response and reducing physical stress. This explains the improvement in resting pulse rates and the improvement of other performance indicators. **(Johnson et al. 2019)**

This study addressed the effect of psychological intervention programs that include breathing exercises on athletes' recovery after physical exertion, as it was found that these programs improve the speed of recovery and increase the efficiency of the respiratory system, which is consistent with the results related to improving recovery after exertion. **(Patel et al,2021)**

It was proven that combining breathing techniques with relaxation strategies leads to improving the ability to control stress and reducing the heart rate during sports performance, which supports the results showing an improvement in the heart rate in the post-measurements compared to the pre-measurements. **(X et al. 2018)**

breathing practice is an effective non-pharmacological intervention for enhancing emotional well-being, including reducing anxiety, depression, and stress. **(Stromberg et al., 2015)**

A one-day breathing exercise was found to alleviate emotional exhaustion and depersonalization caused by job burnout **(Salers et al., 2011).**

Additionally, similar effects on anxiety were observed in a 3-day intervention study, in which breathing practices were performed 3 times daily **(Yu and Song, 2010).**

In summary, previous studies indicate that breathing and relaxation improvement interventions are not only useful in reducing stress and improving physiological performance, but also contribute to increasing the efficiency of oxygen consumption and improving the recovery rate, which confirms the validity of the hypothesis stated in the current research that there are statistically significant differences between the pre- and post-measurements of the research group in physiological variables

Conclusions:

In light of the results of the research and in order to achieve its objectives and hypotheses, and within the limits of the research sample and procedures, the researcher presents the following conclusions:

The proposed program applied to the research group:

• Karate players

1- It had a positive effect on the pulse rate at the beginning of the effort with an improvement rate of (8.98%)

2- It had a positive effect on the pulse rate at the end of the effort with an improvement rate of (4.98%).

3- It had a positive effect on the maximum oxygen consumption with an improvement rate of (3.82%)

4- It had a positive effect on the vital capacity with an improvement rate of (1.86%)

5- The development of some psychological skills as a result of applying the respiratory program had a positive effect on increasing the effectiveness of mental behavior with an improvement rate of (28.750%).

Recommendations:

1. The role of breathing in athlete performance cannot be underestimated, but at the same time, there is still a scarcity of scientific data that can draw a clear and final picture of this phenomenon.

2. Athletes can be motivated to practice controlled breathing throughout training sessions and during competitions in order to improve their performance, specifically to improve their mental and physical health, maintain focus, achieve their goals, and maintain a positive attitude.

3. Despite the complexity of the relationship between breathing rates and athletic performance, maintaining a constant and controlled breathing rate during exercise can help ensure adequate oxygen supply to the muscles, proper elimination of waste, regulation of heart rate, and improved concentration, all of which are essential for achieving maximum athletic performance.

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