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A COMPARATIVE STUDY BETWEEN ARMS AND LEGS IN SOME FUNCTIONAL VARIABLES AFTER PERFORMING AEROBIC EFFORT

Hakam Salem Elias
hkmalbasy67@gmail.com
Nineveh Education Directorate General / Bashiqa Education Department

Abstract

The research aims to identify the response of some respiratory functional variables (pulmonary ventilation, breathing volume, and respiratory rate) and heart rate after performing an aerobic effort for the arms. Identify the response of some respiratory functional variables (pulmonary ventilation, breathing volume, and respiratory rate) and heart rate after performing aerobic effort for the legs. Identify the differences between the aerobic potential tests of the arms and legs in terms of some functional variables and the extension of the circulatory and respiratory systems.

The researcher hypothesizes significant differences in the response of some respiratory functional variables (pulmonary ventilation, breathing volume, and respiratory rate) and heart rate after performing aerobic effort in the arms. And there were significant differences in the response of some respiratory functional variables (pulmonary ventilation, breathing volume and respiratory rate), and heart rate after performing aerobic effort for the legs.

The study found significant differences between aerobic potential tests for arms and legs regarding some functional aspects and the circulatory and respiratory systems. The researcher used a descriptive approach, selecting 13 healthy students from the Physical Education Department at Mosul University. Two tests were conducted, one for arms and one for legs, using a Monark stationary bike.

The intensity was adopted based on watts and a turnover rate (70-75 cycles), and using the intensity (50%) for the arms and legs (100%)

The study used the coefficient of variation and t-tests for related and unrelated samples. The researcher found that leg effort took longer than arm effort, and neither affected the physiological measurements. It is recommended that the physical loads from arms and legs be used in training and that further studies with new resistors and different speeds be conducted.

Keywords: arms, legs, aerobic effort, pulmonary ventilation, breathing

1.1 Introduction

The respiratory circulatory system is important in the body during the response to physical exercise. The muscles involved require a large amount of oxygen and fuel to produce the energy needed for performance. Hence, the cardiovascular and respiratory systems are essential to ensure the requirements of the muscles working during exercise (Saltin & Rowell, 1980).

When comparing large muscle groups (e.g., legs) and small muscles (e.g., arms) during physical exercise, functional responses are often greater in the legs than in the arms (Alis et al., 2015). This may be due to the large muscles in the legs needing large amounts of blood and oxygen to meet their metabolic requirements during exercise.

Interest is still in the study of aerobic endurance and its impact on team and individual sports and its reflection on the functional variables of the body about the circulatory and respiratory systems, and these

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variables addressed by this research are: pulmonary ventilation, respiratory rate, breathing volume, heart rate, where this research highlights the identification of comparisons between these variables of the arms and legs and find differences and similarities when performing an aerobic effort for the arms and legs, as studies of this type that attracted the attention of many Researchers in the field of sports physiology, which can be observed in the direction of the field of recent studies in this area, such as the study (Azab, 2007) that dealt with blood pressure responses and some heart functions for some training loads of the arms and legs on adult males. And a study (Aminoff, et al, 1997), which dealt with cardiorespiratory responses to exercises of arms and legs as a comparison between a group of healthy youth, where the importance of this topic lies in its application, as it helps to provide sports coaches in general and sports coaches in particular in terms of the focus of these sports on the use of body limbs: arms and legs in particular, such as weight lifting, cycling, rowing, throwing and jumping a large part of the information regarding the response of some of the above functional variables to perform an effort for the exercises of the limbs of the body, which helps in the scientific rationing of training loads to bring about the necessary functional changes and ensure the availability of a health protection factor to avoid the harmful effects that result from overload training.

1.2 Research problem:

Any effort involves muscular strength, muscular endurance, muscle fatigue, range of motion, and functional and anatomical performance to generate kinetic energy and then translate it into mechanical movement such as jogging, cycling or rowing.

Studies have often been conducted to understand how the body responds to aerobic effort and this study can provide valuable insights into the functional effects of aerobic exercise on different body organs and compare this response between the arms and legs to better ration exercises, units, exercise, rehabilitation and treatment programs, as there is a study that indicated that the muscles of the arms are more resistant to fatigue and faster recovery compared to the legs (Bogdanis. et al., 1996)?

From this point of view, the research problem can be summarized in the following questions:

What are the functional responses associated with the performance of aerobic effort in the arms? What are the functional responses related to the performance of an effort for the legs? Are there differences in the functional responses of the arms and legs when performing aerobic effort? Is the stretching of the arms when performing an air effort equal to the stretching of the legs when performing an air effort?

1.3 Research Objectives:

1-3-1Identify the response of some respiratory functional variables (pulmonary ventilation, breathing volume, and respiratory rate) and heart rate after performing aerobic effort in the arms

1.3.2 Identify the response of some respiratory functional variables (pulmonary ventilation, breathing volume and respiratory rate) and heart rate after performing aerobic stress for the legs.

1.3.3 Identify the differences between the aerobic potential tests of the arms and legs in terms of some functional variables and the extension of the circulatory and respiratory systems.

1-4 Research Hypotheses:

1.4.1 There were significant differences in the response of some respiratory functional variables (pulmonary ventilation, breathing volume and respiratory rate) heart rate after performing aerobic effort to the arms.

1.4.2 There were significant differences in the response of some respiratory functional variables (pulmonary ventilation, breathing volume, and respiratory rate) and heart rate after performing aerobic stress for the legs.

1.4.3 There are significant differences between the aerobic potential tests of the arms and legs regarding some functional variables and the extension of the circulatory and respiratory systems.

1.5 R Results and Discussion

1.5.1 The human field: a sample of students of the Department of Physical Education - College of Basic Education at the University of Mosul, practitioners of sports activity, and those in good health.

1.5.2 Spatial field: Physiology and Biomechanics Laboratory in the Department of Physical Education - College of Basic Education / University of Mosul.

1.5.3 Time Domain: For the period from 1/3/2023 to 26/3/2023.

2- Theoretical framework and similar studies:

2.1 Theoretical framework:

2.1.1 Voltage:

(Tanner) defines stress as the body's general and non-specific response to any factor that confuses or threatens the body's compensatory abilities to maintain its internal balance. . (Dabbagh, 2005, 66)

Where Voltage is divided into two types or two parts (aerobic Voltage and anaerobic Voltage), and the Voltage that will be addressed in the research is an aerobic potential that can be defined as "the load on the body in which the aerobic system is dominant to supply the body with energy." (Mohamed Tawfiq, 2005, 17).

The word aerobic means muscular work, which depends mainly on oxygen in the production of energy, i.e. its output by the muscle in an aerobic way, and in sports activities that require the nature of performance in which the continuation of muscular work for a long period of more than (5) minutes, the production of anaerobic energy is not a source of energy, so the muscle resorts to the use of oxygen to produce the energy necessary for the performance that enables the continuity of muscle work for an extended time before feeling tired and these sports activities are called aerobic endurance activities, and include all competitions with Long distances and others, and that the aerobic capacity is measured by the shortest amount of oxygen that the body can consume during a particular unit of time called the maximum oxygen consumption. (Abdel Fattah and Nasreddin, 2003, 207)

"This system is characterized by the efficiency of work and energy produced with the absence of residues that lead to fatigue, and the sufficiency of the heart and lungs plays a major role in aerobic activities, as it carries oxygen and other sources of energy production to reach the muscles working through the blood." (Al-Kassar et al., 1998, 73)

It can be said that each molecule of glucose can be liberated during chemical reactions (39) molecules (ATP). At the same time, fatty acids can be released twice as much (Qaba, 1989, 43). Where the advantages of the aerobic system can be summarized in several points:

1- It depends on the oxygen element in the release of energy.
2- This system is free from activities that are characterized by light to medium intensity and for some time of approximately (3) minutes and may reach (3) hours
3- Carbohydrates and fats are used as a primary source that is not the product of energy, and sometimes proteins are used
4- The energy released from this system is many times the energy liberated from the previous two systems.
5- To release energy in other systems, we need hundreds of chemical reactions, and yeasts help us do this (Al-Tikriti and Muhammad Ali, 1986,309).

2.1.2 Pulmonary Ventilation Response (VE)

It is defined as "the volume of air that enters or exits the lungs during one minute, and this is done through the processes of inhalation or exhalation" (Abdel Fattah, 2003, 364), and its amount ranges between

6-7 liters per minute in a healthy adult at rest, where the amount is a product of multiplication (the volume of breath at rest× breathing rate The volume of pulmonary ventilation per minute can be calculated from the following equation:
Ventilation volume per minute = (volume of breath per liter)×respiratory rate (time)

0.5 l× 12 breaths/min = 6 l/min

(Master, 2003, 207)

It is noted a rise in the volume of pulmonary ventilation to about seven liters at rest in the average young people to reach 100 liters per minute during maximum physical exertion and the rise in the volume of pulmonary ventilation with high intensity of aerobic effort is attributed to the increase in the rate of respiration and increase the volume of breathing, that the relationship between pulmonary ventilation and oxygen consumption is linear until reaching the anaerobic threshold, When pulmonary ventilation increases more strongly than the increase in oxygen consumption, to try the body to get rid of the rise in the increased production of carbon dioxide, due to the processes of acidity repelling (low pH) resulting from the high concentration of lactic acid in the blood (Hazza, 2009, 326).

2.1.3 Respiratory Rate-RR: It is the number of breathing or exhalation processes that occur during one minute (visual, 1983, 120) The ideal value of the respiratory rate in the rest period is from (15-20) breaths/minute from non-athletes, while for athletes, regardless of their specializations, the respiratory rate is (9-15) breaths/minute (Muslim, 2008, 25-26).

Al-Hajjar points out that the rate of respiration is one of the two main variables in increasing or decreasing pulmonary ventilation as well as the volume of breathing, as the increase of these two factors or the increase of one leads to an increase in pulmonary ventilation (Al-Hajjar, 1994, 46).

2.1.4 Breathing volume (Tidal Volume-TV)

"The volume of breathing is defined as the volume of air inhaled or exhaled at a time ranging between (0.80-0.35) liters with an average of (0.5) liters" (Abdel Fattah and Hassanein, 1997, 116). The amount of normal breathing air volume at rest is an average capacity of (0.5) liters, and this volume doubles as a result of maximum exercise to reach about (3) liters, which is approximately six times the rest values (Master, 2003, 209, 2010).

There is a constant relationship between the amount of air in liters and body weight in kilograms and this relationship is denoted by the following equation: Normal breathing air volume = body weight × 0.0074
If we assume that a person weighs (75) kilograms, for example, the volume of air in this case will be.
75 ×0.0074 = 0,555 (L) Another example 70× 0.0074 = 0,518 (L) (Abdel Fattah, 1988, 155)
Muhammad points out that the increase in normal breath size during rest increases with lung growth, but the value of this increase is coupled with body weight and surface area during childhood, as Cassels & Moves found that the rate of (TV) for ages (6-8), (8-12), (15-17) was (321, 297, 224) ml. m2 of the surface area of the body in females and that (TV) decreases with increasing growth proportionally with the size of the body. The same applies to the number of breathing times that decline with age (Muhammad, 2007, 19).

2-1-5 Heart rate-hr

The heartbeat is the contractions directed to the walls of the arteries that occur due to the contraction of the heart that pushes blood into the arteries." (Al-Ali et al., 2002, 199) It is known that the heart rate rises during physical activity, and the amount of rise depends on the intensity of physical exertion and the quality of physical activity practiced. In activities where a small muscle mass is used (such as arms only), the heartbeat cannot be peaked compared to those in which a significant muscle mass is used (e.g., thighs and legs). Examples of physical activities in which central muscle mass is used (jogging, climbing stairs, riding Bike)

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other, the maximum heartbeat does not reach the level of what it reaches during running and is due to many reasons, the most important of which is the position of the body when swimming, running and riding a bike and thus the ease of return of venous blood to the heart, which makes the heart pump a larger amount of blood in each stroke than its beats (Hazza, 378, 2009-379).

The baby's heart rate at birth ranges from (130-150) beats/minute and this rate drops to (120) beats / minute when the child reaches one year of age until he reaches (90) beats / minute when the child reaches the age of ten, while the heart beats normally in an adult about (70) beats / minute (Slave Opener, 1988, 339-340).

It should also be noted that there are specific sites where the blood pulse can be excited through the arteries when placing two or three fingers of the hand on specific arteries of the body and thus estimate the heart rate per minute, and these sites include the location of the carotid artery located on both sides of the neck,

The radial artery located above the radius bone at the stem joint, where the pulse is measured for six seconds and then multiplied by the result from the number 10 to get the rate per minute (Hazza, 2009, 375).

Heart rate is related to several factors, including age, sex, body size, and human living conditions. The pulse rate of females is higher than that of males, and the pulse rate of children is higher than that of adults (Allawi, slave Opener, 2000, 201).

2.2 Similar studies :

2.2.1 Study of Azab 2007:

"The effect of metered training loads in the arms and legs on blood pressure responses and some heart functions" a comparative study"

The study aims to identify the quality and extent of blood pressure reactions and some heart functions to the effect of metered training loads in the arms and legs and the occurrence of responses in the changes of systolic blood pressure - diastolic blood pressure - pulse pressure - medium arterial pressure - peripheral resistance of the body - cardiac impulse volume - heart rate volume - heart rate hospitalization, and the study was conducted on 18 male students and their average age was 21 years with a standard deviation of three and a half months. The results reached significant effects at the level of (0.05) in most of the physiological variables after performing each training load separately, and the emergence of statistically significant differences in favor of arm exercises in the values of systolic and diastolic blood pressure and peripheral resistance to blood, the indications of the differences in favor of the exercises of the two legs were in the size of the heartbeat and the volume of cardiac thrust and the decrease in the amount of peripheral resistance to the blood, as the results showed a delay in the recovery of the heart rate after Perform a training load for the legs than for the arms at the same intensity.

2-2-2 Study : 1986 Eston et al:

"Static bike test response for arms and legs"

The study aimed to compare two different voltages of the arms and legs in some functional variables, using a resistance of (49), (73.5), and (98) for the arms, legs, and arms and legs together, using the stationary bicycle. The research sample included (19) men with an average age of (25.7 + 5.5) years. The following variables were measured: (maximum value of oxygen consumption, heart rate, pulmonary ventilation) and after processing the statistical data, the researchers concluded that all the previous variables were higher in the arms than the legs.

2.2.3 Study (Bogdanis. et al., 1996):

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"Comparison of muscle fatigue and recovery between arms and legs during isokinitic exercise[1]"
The study aimed to compare the recovery of muscle fatigue between the arms and legs after performing the isokinetic exercise (constant resistance exercise at a specific speed).
The study included a group of healthy male participants and the isokinity exercises were used for the muscles of the arms and legs where the participants performed several repetitions from the exercises until fatigue, followed by a period of recovery. Muscle strength, muscle fatigue, and recovery rate after exercise were measured using measuring tools.
The results of the study found that muscle fatigue of the legs is faster compared to the muscles of the arms during the isokinity exercise, while recovery was a different speed between the arms and legs, as the muscles of the arms showed faster recovery compared to the muscles of the legs and this indicates that there are substantial physiological differences between the large muscles in the legs and the small muscles in the arms in terms of their response to fatigue and recovery.

3- Research Procedures

3.1 Research Methodology:

The researcher used the descriptive approach for its suitability and the nature of the research.

3-2 Research sample:

The research sample included (13) students from the Department of Physical Education at the College of Basic Education from the University of Mosul, who practiced sports activity and those with good health, where the sample was deliberately selected from those who can complete the two tests well, and the coefficient of difference [2] () showed an acceptable homogeneity among the members of the research sample, and table **(1)** shows some information about the members of the sample.

Table 1 Shows the statistical features of some specifications of the research sample

Variables (unit of measurement)	Arithmetic mean (Q)	Standard deviation (+p)	Coefficient of variation (%)
Age(Year)	20.722	1,487	7,178
Length(cm)	174,556	5,903	3.382
Weight (kg)	74,794	9.927	13.298
BMI	24,472	2,431	9,935

3.3 Devices and tools used

• SpirolaBII Spyrometer
• Monark Ergometer
• Medical Scale Detector of American origin.
• Measure length with Monark-type scale.

[1] Isokinetic exercise is characterized by a constant speed of movement throughout the entire range of motion of the joint, with resistance that changes to match the strength of the muscles during that movement. This type of exercise is achieved using special devices capable of controlling speed and providing appropriate resistance, allowing the muscles to be trained safely and effectively.
[2] They do not have chronic diseases or any injury that hinders them from performing the test properly.

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• Polar type pulse sensor.
• Digital thermometer to measure ambient temperature and relative humidity of Chinese origin.

3.4 Means of data collection:

The researcher used tests and measurements as means to collect data, which included the following:

3.4.1 Physical tests:

The researcher used two tests that measure the aerobic potential, one for the arms and the other for the legs, using the Monark Ergometer :

3.4.1.1 Arm test:

- Objective of the test: The test aims to reach fatigue in the laboratory (voluntary fatigue), and this effort is performed on the Ergometer of the arms.

- Tools: Monark arm ergometer

- Preparation for the test: The laboratory warms up for (3) minutes and then gives a rest period of (5) minutes.

- Test specifications: The test begins by sitting in front of the device on a fixed chair and at an appropriate distance from it, and in a comfortable position. The intensity (resistance) is determined depending on the weight of the tester, and then the effort begins, and with it the timing. The number of cycles is between (70-75 cycles) and continues without stopping until voluntary fatigue. The minimum time for the laboratory to perform this test is 4 minutes. To calculate the resistance used, we use the following steps:

1. For the purpose of converting body mass (in kilograms) to (watts), we multiply the body weight by (1.65) watts.
2. We multiply the result by the required intensity for the arms (50%) and for the legs (100%)

If the person weighs 75 kg for example

75 × 1.65 W ~ 125 W Full Body 125 × 0.75 ~ 95W Working intensity

(Adams, 2002, 192)

3.4.1.2 Testing the legs

- Objective of the test: The test aims to assess laboratory fatigue (voluntary fatigue), and this effort is performed on the Ergometer of the legs.

- Tools: Monark Ergometer

- Preparation for the test: The laboratory warms up for (3) minutes and then gives a rest period (5) minutes.

- Test specifications: The test begins by sitting on the device on the Ergometer seat and in a comfortable position. The intensity of the resistance, as mentioned earlier, is determined by relying on the weight of the tester, and then the voltage begins, and with it the timing. The number of cycles is between (70-75 cycles) and continues without stopping until voluntary fatigue. The minimum time it takes for the laboratory to perform this test is 3 minutes.

3.4.2 Physical measurements

3.4.2.1 Measurement of body length and mass:

The mass of the members of the research sample was measured using a device type (Detecto). After turning on and zeroing the device, the tester stands on the device barefoot and after the reading settles on the electronic screen, the figure represents the mass of the laboratory in kilograms. As for the length, it was done using a measure of the length of the type (Monark)

3.4.2.2 Body Mass Index (BMI) calculation:

BMI was calculated by the following equation:

BMI = (mass)/kg:(height)/m (2006,580,Mcardle et al)

3.4.3 Functional variables:

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3.4.3.1 Pulmonary ventilation variables

The functional variables were measured in the laboratory by the (SpirolabII) type, where the data for each laboratory are first entered, which are height, weight, date of birth and sex, and then a special short tube is placed in the mouth of the laboratory, as well as the placement of the nasal plug and breathing is carried out naturally from the tube while maintaining that the mouth is not opened while breathing, so as not to It affects the accuracy of the extracted measurements. When the sound signal is heard, the data is saved to a computer program linked to the spirometer, and the values of the pulmonary ventilation variables, as well as the value of pulmonary ventilation resulting from these variables, are shown on the computer.

The variables of the study included the following
- Normal breath volume (TV) (Tidal Volume) (liters)
- Respiratory rate (RR) (time/minute)
- Pulmonary ventilation (VE) (l/min)
- Heart rate (HR) (beats/minute)

3.4.3.1 Heart rate variables

This variable was measured by a polare sensor that connects on the chest and waves to another sensor linked to the electronic calculator that stores the reading again physically, and through the program prepared for this purpose, the information is stored for the purpose of benefiting from it.

3.5 Exploratory experiment

An exploratory experiment was conducted on (1/3/2032) on three of the testers with the aim of determining the suitability of the test used for the research sample, and the extent to which it achieved the objectives of the research, in addition:

1- Ensure that the timing of both tests is appropriate and can be implemented.
2- Identify errors and obstacles related to implementation and develop solutions to them.
3- Training the team on the steps of sequencing tests
4- Test the suitability of the laboratory hall in terms of temperature and humidity.
5- Identify the approximate time it takes to take the test.

3.6 Final Experiences:

To achieving the research objectives, the researcher conducted the two tests on the members of the research sample individually from 19/3/2023 - 26/3/2023.

1. The two tests were conducted separately, one after another, for a period of not less than three days and not more than a week.
2. Conducting the test at a normal temperature (20-22) °C by controlling it by heating and cooling devices and the relative humidity level was (25% 20%).
3. To ensure that all members of the research sample are exposed to the same period of time between warming up and starting the test, the warm-up process was arranged in an overlapping work method so that the time period between one laboratory and another of (10-5) minutes (the experiment included two Ergometer devices for the arms and another for the two legs type Monark, one for warm-up and the other to perform the test).
4. Give a rest period between the warm-up period and the start of the test.
5. The two tests were taken into account under the same conditions in terms of place and time, the devices and tools used, and the sequence of functional measurement procedures.
6. The researcher was keen that the work team is the same for all functional measurements.
7. The testers performed the two tests in accordance with the scientific conditions of the two tests.

3.7 Statistical treatments

The following statistical methods were used:

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- Coefficient of variation
- T. Test for associated samples
- T. Test for unrelated samples.
- Arithmetic mean
- Standard deviation (Al-Tikriti and Al-Obaidi, 1999, 161)

The data were processed using the statistical package (SPSS), and the extracted values and statistical drawings were processed using the program (Excel, 2007).

4. Presentation and discussion of results

Table 2

Shows the statistical parameters and the calculated and significant value of (T)

Variable	t	+p	Going to	audition	Moral
TV L	-0,22462	4,9542	1,4575	Arms	-0,824
		3,8875	1,4983	Two	
VE L/min	0,17039	15,22880	37,0383	Arms	0,866
		8,34616	36,1842	Two	
RR	0,10968	6,06953	24,8983	Arms	0,914
		4,22592	24,6642	Two	
Time	-6,71856	2,88236	6,3900	Arms	*0,000
		8,04627	22,9667	Two	
Free	1,52017	3,98006	73,2500	Arms	0,143
		2,58785	71,1667	Two	
HREX	1,26899	12,14402	175,2500	Arms	0,218
		11,65768	169,0833	Two	

Table (2) shows the following

- There are significant differences between the aerobic potential test of the arms and legs in the time variable, as the moral value of (T) calculated is (0.000) and it is less than (0.05).
- There were no significant differences between the aerobic potential test of the arms and legs in the variables (TV, HREX, HRR, RR, VE) as the moral value of (T) calculated was greater than (0.05). Through the table, we notice that the time variable has been higher in the test of the legs compared to the arms, and the reason is that the muscles of the legs are adapted to the daily muscular work as well as in carrying body weight during activity, as well as the large muscle masses of the legs. Suppose we review the table and observe the values of the variables in the averages. In that case, we notice that the values for the arms are always higher than the legs, and this means that the accumulation of lactate in the muscles leads to an increase of (VE, HR), according to a study (Mohammed, 2012) that the increase in the variables (TV, RR, VE, HR) occurs as a result of the accumulation of lactate in the muscles.

The value of these variables increases to eliminate carbon dioxide (Mohammed, 2012, 52-53), as a result of the high concentration of CO_2 in the blood, which stimulates the nerve centers continuously through the chemical receptors located on the walls of blood vessels and nerve endings on the lung tissue (Abdel Fattah, 2000, 288). Increased venous return to the right atrium during voltage escalation stimulates a reflex system that sends signals from the sympathetic accelerator nerve to the heart that increase HR (Abdel Fattah, 2003, 407-408). Many old and recent studies that confirmed that the large muscles, including the legs, have a significant role in raising and increasing the functional organs (heart and respiratory), and these studies: a study. Ribeiro et al. (1983) aimed to respond to cardiac output for the arms compared to the two men when performing the exercise in older males. It was found that there was significantly higher cardio output in leg workouts than in arm workouts. The study suggested that large working muscles in the lower limb require more blood, as well as a study (Calbet et al., 2006) that compared the legs and arms during maximum physical exercise in physiological responses, and found that there was an increase in cardiac output, pulmonary ventilation, And oxygen consumption in the legs compared to the arms. He attributed these differences to the difference in the size of working muscles and vascular density between the arms and legs, and also a study (Callegari et al., 2020) when it compared the responses of heart rate and pulmonary ventilation between the arms and legs after an aerobic exercise and showed that the increase in these variables was high in the legs compared to the arms in the elderly, and similar to them A study (Nyberg et al., 2022) where researchers compared the distribution of oxygen supply between large and small muscles after aerobic exercise, which reached that the large muscles in the legs consume a greater amount of oxygen, which is reflected in the responses of the cardiovascular and respiratory systems, and (Salier-Eriksson et al., 2022) compared the distribution of blood flow And the consumption of oxygen in the arms and legs after performing aerobic effort. It found a marked difference in favor of the legs compared to the arms.

5.1 Conclusions:

Through the presentation and discussion of the results, the researcher concluded the following:

5-1-1 That the effort exerted by the feet took longer than the effort exerted by the arms

5-1-2 The response of the two exertions of the arms and legs had no effect on the physiological variables taken in the research.

5-1-3 That the difference in research results with the predictions of a study (Bogdanis. et al., 1996) may be due to the method of applying resistance?

5.2 Recommendations

The researcher recommended the following:

5-2-1 Take advantage of the physical loads of the arms and legs used in research in training as they have the same effect on the physiological variables under study

5-2-2 Conducting other studies using new resistors and other rotational speeds.

5-2-3 Conducting a study comparing the difference in the mass of arms and legs into account

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