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The Effect of a Combined Training of Swimming and Breath Hold On Cardio - Respiratory, Blood and Biochemical Variables of Divers

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Abstract: Aim of The Study: is to determine the effect of a combined training of swimming and breath-Hold on cardio respiratory, Blood variables and biochemical changes of divers. It is hypothized that the combines training (swimming and breath-hold) might affect positively cardio-respiratory, Blood and biochemical variables of divers were determined. Research Method: The experimental method (Pre-Post) measurement of one group of divers, (18) divers were chosen to participate in the study, (15) divers for the main study, Three for the pilot study. Basic characteristics, Together with blood components (HB, RBCS, HEMATOCRIT), and some biochemical variables (Nitrite, LDH, SOD, Lactate). Blood (5ml) was drawn from participants. Results indicated a significant differences of (Pre-Post) training in pulse rate, respiratory rate and vital capacity and blood (RBCS, HB, HEMATOCRIT), Together with (Nitrite, LDH, Lactate, SOD), For the favor Of Post training variables. It might be concluded that the proposed combined training program may affect positively the cardio vascular, Respiratory system together with blood and biochemical variables of divers.
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Key Words: Combined Training, Divers, Swimming and Breath Hold, Biochemical Variables

1. Introduction and Research Problem

Hypoxia may be defined as insufficient oxygen flow to the tissues, Even though blood flow is adequate.

The maintenance of adequate supply of oxygen to aerobic organisms is vital for survival and hypoxia can be caused such as in high altitude, Diving, Extreme exercise or a severe localized ischemia, (Hag gag et al, 2006).

Cellular Hypoxia may induces a wide range of physiological and pathological changes in the organism systems and tissues and cellular Levels (Semenza 2000), and (Fedel et al 2002).

The Responses developed by cells faced with Hypoxic challenge include, ventilation and cardiac changes, Metabolic responses and angiogenesis, These may occurs through the activation of already present proteins and up regulated by genes including the key role of hypoxia inducible factor (HIFI), Semenza 2001, Semenza et al 2006). (Strauss and Aksenov (2004) Reported that the divers are subjected to some stresses while entering the underwater environment, namely physical, physiological and psychological stresses, They also added that the low oxygen concentration and oxygen partial pressure when become low, The diver will become hypoxic, This in turn will affect different organs including the brain, Which is very sensitive to the low oxygen demand. Physiological stresses associated with diving relate primarily to ventilation, meaning the inspiration of oxygen and the expiration of carbon dioxide. As oxygen must be available to the body to remain alive and carry out their functions, or disfunction Must Reveal. Hypoxia may increase several biochemical proteins and products such as hemeoxygenase (HO-1), its increased attenuates endothelial cell apotosis and Decreases Super oxide anisn Formation. Also of important the effect of hypoxia on the increased expression of hypoxia on the increased expression of nitric oxide synthese (NOS) which affect the blood vessel cells. This indicates, That hypoxia induce several regulatory mechanisms affecting metabolism, Regulatory proteins and blood vessels together with the heart and lungs action (Turkseven et al 2005), (GRILLI et al, 2003), (Jernigan and Resta 2002).

Some studies noted that some drugs such as sildenafil may activate protein kinase, Accumulate GMP in myocardium through NOS and help heart protection via opening of mitochondrial ATPK+ channels, which is an important mechanism for a healthy heart (Dasetal 2005).

In the other side, Hypoxia may induce a higher lactic acid accumulation and increased H+ collection in the blood, Leading to the increased muscle fatigue, Central nervous system hinder function and may lead to decreased per formance of the athlete, As fatigue mechanism may affect, Muscle contraction, Hinder cerebral metabolism and the end result is the

expression of Sign of motor hindering and decline performance (Amann and Kayser 2009, Amann et al 2007), (GURSAVEK et al 2012), (Wang et Al 2016).

Adaptation, Means a permanent change that improve performance, In a sense that the body modifies its cells, Tissues and other compartments to meet the requirements of regular exercise.

The circulatory system adapt to training by angiogenesis of blood vessels, Blood cells by increasing in numbers of RBS, Was and platelets, While muscle fibers respond to adaptation by increasing number and size of muscle fibers leading to increasing mass and strength, Also CNS and neurons adapt to training by increasing excitation and neuro mediators levels, Also the heart and pulserate adapt to Training By Decreasing Pulse Rate and Increasing Cardiac Output, The respiratory system adapt to training by increasing vital capacity and ventilation and lung volumes (ROSS and LEVERITT 2001).

In order to experiment the effect of a combined training method of swimming and breath-hold application on divers, The researcher think that the diving field need urgently to experiment more scientific studies aimed at the navigation in the levels of athletes practicing free diving as a prerequisite for reaching a higher rank.

Aim of the study is to determine the effect of a combined training of swimming and breath-hold on:

1- Cardio-respiratory changes.
2- Blood variables changes.
3- Biochemical variables changes of divers.

Research Hypothesis:

It is hypothized that the combined training might affect positively cardio respiratory, Blood and biochemical variables of divers.

Research Procedures:

Research Method: The researcher used the experimental method (Pre-Post) measurement of one group of divers due to the suitability of the study.

Research Sample:

(18) Divers were chosen from divers clubs in HURGADA to participate in the study, (15) divers for the main study and (3) divers for the pilot study.

Table (1) Research Sample

Participants	Main Study	Pilot Study
Divers Club in HURGHADA	(15) Divers of One Group	(3) Divers

Data Collection Tools
Height by using restameter
Weight by using medical scale
BMI by using pulse meter
Pulse rate by using weight / height 2
Respiratory rate by using hands over chest
Vital capacity by using dry spiro meter
Hemato Crit % by using glass pipette, centrifuge
RBCS by using coulter counter
Serum nitrite by using elise technique
LDH by using spectrophotometer
SOD by using elisa technique
Lactate by using accusport

All blood samples were withdrawn by specialist, laboratory measurements at clinical in Cairo

Pilot Study:

(3) Divers Were The Participants Of The Pilot Study, They Were From The Same Group Chosen For The Study For A Period Of (3) Days Before The Main Study to investigate the soundness of the equipment's.

Tools:

- To Know the Problems That Might Face the Study

-Determine the best ways to perform measurements and record data

Main Study:

-Pre measurements were performed at rest
-The training program was applied for (4) weeks
(6) Days training per week,
(36) Training units.
(70) Minutes training unil time
(5) Minutes warming up
(60) Min main parts (Swimming, Breath Hold)
(5) Minutes cooling down
Post measurements occur at rest

Importance of Breathing for Divers:

-It Plays an important role in exercise and relaxation.

-The right breathing is important to strong respiratory muscle.

-By right breathing athlete can get more oxygen for energy production and recovery.

-Stronger respiratory muscle can prevent fatigue and recover faster.

-Respiratory exercises for divers depend on two session, one to exercises the respiratory muscle by swimming program and second by breath-holding for short time several exercise per day.

Respiratory Muscles Include:

-The diaphragm that separate chest from abdomen.

-The accessory respiratory muscles include intercostals' muscles and sternocleido mastoid muscle.

- The respiratory muscles increases lung cavity (Volume and Capacity) by contraction.

-The better way to exercise these muscles through swimming as it influence the muscle positively, and breath-hold for short time (Hatfield, 2013).

Statistical Analysis:

-Data were analyzed with the statistical package for the social sciences (SPSS), and expressed as arithmetic mean, standard deviation, skewness median. And "T" Test.

-Differences between pre post tests were assumed to be significant at $P < 0.05$.

Results and Discussion:

Breath-hold diving means that one uses breath holding to remain under water, it is also named skin diving or free diving.

This technique is the oldest of all techniques for diving, dating back more than 5.000 years ago. This diving can be a highly rewarding activity in personal satisfaction, mobility, conditioning and productivity (Bookspan, 1998).

Its Application Is Very Extended As Scuba Divers, There Are Three Examples of Reputation for Breath – Hold Diving, Us Navy Frogmen, The Pearl Divers in The South Sea Islands, and The Diving Women Of Japan and Korea (AMA) (Bozanic, 2002).

The most recent record was reported to be 525 FSW (160 MSW) by a female diver. the author noted that about one liter of blood shifted into the blood vessels in the thoracic activity during a dive to 90 FSW (27 MSW) and even more during a dive to 130 FSW (40 MSW). This blood displaced a corresponding amount of air in the lung cavity and apparently afforded additional protection against thoracic squeeze.

(Strauss, Aksenov, 2004) (Butler and Jones, 1997)

Table (3) Indicated A Significant Changes In The Physiological Variables Pulse Rate, Respiratory Rate and Vital Capacity After The Proposed Training Program.

The decreased pulse rate together with the decreased respiratory rate with the significant increase vital capacity after the proposed training program of swimming and breath-hold training indicated a positive result due to the action of the program which affect both the cardiac system and the respiratory system through the action of the parasympathetic system and the action on the respiratory muscle and diaphragm leading to decreased cardiac count and respiratory rate and increased vital capacity.

These result are in accordance with the results of (Ferretti, 2001), liner and (Pnnarsson, 1994) and (Williams et al, 2000). They all reported that immersion during breath- hold induced Brady cardia, slowing of the heart rate. This effect appears to be independent of sex, swimming ability or familiarity with the water as heart rates including pulse rates may decrease as much as 40%.

(Gooden, 1994) and (Hayashi et al, 1997) reported that subconscious brain activity may influence the bradicardia reflex. They give example to the baiting from the sight of blood is an example of the subconscious brain activity that influences the heart and blood vessel, although the effect on the blood vessel is the opposite of that observed with the bradycardia reflex.

Also Vega stimuli may decrease heart rate.

As for the action breath-holding on the respiratory system, (Sherlock et al, 2013) and (Gulick, 2010). Reported a decrease action on respiratory rate and an elevated vital capacity which is the amount of air that can be exhaled from the lungs after a maximal inhalation, as it is the largest amount of air that can moved with a single breath and it is the most important measurement made with simple lung function tests. They also added that during breath-hold dives due to the use of the lungs for oxygen storage, as the ambient pressure increases with breath hold diving, Oxygen and CO2 tensions in the lungs and the blood change, there is a shift of CO2 the lungs to the blood stream. The higher pressures increase oxygen partial pressures in the blood so that the breath-hold times tend to increase. The end result of the decreased respiratory rate is an extra increase in inspiration and expiration, hence, the increase vital capacity also reported By (Guth, Roth, 2013).

Table (4) revealed a significant changes blood careening oxygen (RBCS, HB and Le Hematocrit) after training (Swim, With Old Breath) of drivers these adaptation processes are very important for divers in aquatic environment, and further help to extend the breath hold times of drivers. As cells in the body requite oxygen in order to survive and carry out their metabolic functions. There are great variations in the oxygen requirements of various types of tissues.

Brain tissues require a constant uninterrupted supply of oxygen.

A moment`s interruption in the oxygen supply to the brain will result In loss of consciousness. Heart muscles are most sensible to oxygen deficits while, connective tissue, ligaments, tendon and joint capsules have minimal requirements for oxygen and can survive a long periods without oxygen (Colado et al, 2008, Colado et al, 2009, Becker and Cole, 2011).

Hematocrit value of diving human blood is of great importance to be tested as it comprise the

concentration of the solid part of the blood as RBCS in a percentage range with plasma. The More the hematocrit the higher the RBCS content in the blood and the greater the oxygen carrying capacity of the blood. This represents an adaptation process of the blood carrying oxygen of the breath-hold drivers (Guyton and Hall, 2006, Barrett et al, 2010).

Table (5) revealed a significant change in metabolic products (Serum Nitrite, Ldh and Lactate SOD) after the proposed program of Swimming and Breath-Hold Divers.

These metabolic changes were in accordance with those of (Rodriguez and Mader, 2010, MAGLISHO, 2003, and RODRIGUEZ et al, 2003). They added that in swimming and diving as in all forms of locomotion, Muscles generate the energy to propel the body through the water due to transformation of the metabolic power to mechanical power with a given energetic efficiency. As in case of the results of nitric oxide which is a gaseous molecule, Serum nitrite was determine before and after the proposed program.

The data denoted an increased concentration because nitric oxide plays important role, as a vasodilator tone essential for regulation of blood blow in the blood vessels.

Also nitric oxide may act as neuromediator including the formation of memory, Co-Ordination between neuronal activity and blood flow and modulation of pain, and No is generated in large quantities during immunological reaction (NOURA El SAYED, 2005). This immunological reaction was noted in table (5) as an elevation of super oxide dismutase which is an important antioxidant and its increased immunity as reported by (Shaimaa El Said, 2012). She added that SOD is found in the mitochondria and cytoplasm and depend on copper, Zinc and manganese in its action which is mainly antioxidant that elevate the immunity and health of the body.

In Table (5) lactate dehydrogenase enzyme and lactate subjected to decreased concentration after the proposed program of swimming and breath-hold of divers.

This decline in LDH and lactate may happened due to the adaptation process of muscle mitochondria that increase in size and numbers denoting higher level of oxygen deliver to the muscle leading to decreased lactate level accumulation and lower conversion of pyruvate to lactate by the action of LDH.

Mougios (2006) states that LDH is a tetramer composed of a combination of two kinds of similar subunits denited by H for heart and M for muscle, The enzyme reaction changes pyruvate to lactate in anaerobic exercise. In case of training program and due to the composition of increased mitochondria in size and numbers.

The lactate production decrease and also the reaction of LDH and lactate decreased due to the availability of more oxygen produced by the mitochondria. The discussion indicated that hypothesis has been realized.

Table (2) Skewness (+3) Indicating Homogeneity of the Divers.

Table (2) Basic Characteristic of Divers N:15

Variables	Mean	SD	Median	Skewness
Age (Y)	29.5	1.54	29	0.86
Weight (Kg)	76.8	8.6	76.3	0.12
Height (cm)	175.14	5.29	174.8	0.39
BMI	22.86	1.74	22	0.63
Pulse Rate (C/M)	74.7	6.3	74.1	0.28
Respiratory Rate (C/M)	14.2	1.4	14.0	0.74
Vital capacity (L)	4.1	0.5	4	0.46
Hematocrit %	45.1	0.6	45	1.1
Rbcs (Mil/Ml)	4.2	0.4	4	0.65
Hemoglobin (G/Dl)	14.2	3.1	14	0.91
Serum Nitrite (Uul)	43.2	2.9	43	1.3
LDH (Iu 1 L.)	79.3	5.5	79.1	0.21
Lactate (MMOL/L)	1.7	0.7	1.6	0.61
SOD (Mg/L)	36.3	3.5	36	1.1

Table (3) Revealed a Significant Changes in the Variables after Training.

Table (3): Pulse Rate, Respiratory Rate, Vital Capacity Before and After Training

	Before		After		
Variables	**M**	**SD**	**M**	**SD**	**Significance**
Pulse Rate (C./Mi)	**74.4**	**6.3**	**70.1**	**3.1**	**S**
Respiratory Rate (C./Mi)	**14.2**	**1.4**	**12.2**	**0.7**	**S**
Vital capacity (L.)	**4.1**	**0.5**	**4.9**	**0.3**	**S**

Table (4) Revealed a Significant Changes in Blood Variable After Training.

Table (4): Blood Variables Before and After Training

	Before		After		
Variables	**M**	**SD**	**M**	**SD**	**Significance**
Rbcs (Mil/Ml)	**4.2**	**0.4**	**4.8**	**0.2**	**S**
Hematocrit %	**45.1**	**0.6**	**49.2**	**0.4**	**S**
Hemoglobin (G/Dl)	**14.2**	**3.1**	**15.3**	**2.3**	**S**

Table (5) Revealed A Significant Changes After Training.

Table (5): Biochemical Variables Before and After Training

	Before		After		
Variables	**M**	**SD**	**M**	**SD**	**Significance**
Serum Nitrite (M/ ML)	**43.2**	**2.9**	**52.3**	**2.1**	**S**
LDH (Lu/L)	**79.3**	**5.5**	**64.1**	**3.3**	**S**
SOD (Mg/ L.)	**36.3**	**3.5**	**48.7**	**4.4**	**S**
Lactate (MMOL/L)	**1.7**	**0.7**	**1.1**	**0.3**	**S**

Conclusions:

It may be concluded that the proposed combined training program of swimming and breath-hold for divers may affect positively. The cardio respiratory system, Blood variables and the biochemical variables determined in the research leading to better fitness, performance and health of the divers.

Recommendations:

It is recommended to combine swimming training to breathe hold of the divers, to increase the positive effect of training and elevate performance state.

Homogeneity of Equivalence of the Sample.

References

1. Amann, M, Kayser, B (2009) CNS Function during Exercise in Hypoxia High Alt. Med Biol. 10, 149.
2. Amman, M. Romer, L, Dempsey, J (2007) Severity of Hypoxia Affects the Contributions of Muscle Fatigue to Performance in Human J. PHYSIL. 581,389.
3. Barrett, K, Barman, S., Boitona, S (2010) Ganong Review of Medical Physiology Mc Graw Hill, Lange, USA.
4. Becher, Band Cole, A (2011) Comprehensive Aquatic Therapy Pullman, WA: USA.
5. Bookspan, J (1998) Diving Physiology In Plain English Kensington, Undersea, Hyperbaric Medical Society.
6. Bozanic, J (2002) Mastering Re Breathers Flagstaff, AZ, Best Publishing Company.
7. Butter, P and Jones, D, (1997) Physiology of Diving Physiol. REV. 77, 837.
8. Colado, J, Tella, V, Triplett, N (2008) Monitoring Intensity During Aquatic Resistance Exercise J Of Strength and Condicioning Research 22, 2045.
9. Colado, J, Tella, V, Triplett, N (2009) Effects of Short Term Aquatic Resistance Program On Strength and Body Composition In Young Men J Of Strength and Condicioning Research 23, 549.
10. Das, A, Xi, L, Kukreja. R (2005) Sildenafil Perconditions Myocytes against Necrosis and Apoptosis J. Biol. Chem. 280, 12944.
11. Fedele, A, White Law, M, Peet, D (2002) Regulation of Gene Expression by HIF (1) Mol. Gnter V. 2, 229.
12. Ferretti, G (2001) ESTREME Human Breath Hold Diving EUR. J. APPL. Physiol. 84,254.
13. Gooden, B (1994) Mechanism of The Human Diving Response Int. Physiol. Beh. Sci, 6, 16.
14. Grilli, A, Delutis, M, Felaco, M (2003) NOS and HO-1 In Rat Heart ANN. CLIN. Lab Sci. 33,208.

15. Gulick, D (2010) Effects Of Aquatic Intervention On The Cardio Rulmonary System In The Geriatric Population Topics In Geriatris Rehabilitation 26, 93.
16. Gursavek, S, Mishra, P (2012) Relation of Selected Physical Variables To Per Formance Indian J of Mov. Educ. And Exercise Sci. 2, 2249.
17. Guth, L, Roth, M (2013) Genetic Influence on Athletic Performance CUR. OPIN. in Pediatrics, 25, 653.
18. Gygton, A and Hall, J (2006) Text Book Of Medical Physiology Elsevier Saunders, USA.
19. Haggag, A, Hoda, A, Nahla, E, (2006) A Biochemical Study on Cardio Adaptation To Acute Hypoxia EJBMB, 24, 603.
20. Hatfiels, F (2013) Fitness: The Complete Guide ISSA, USA.
21. Hayashi, N, Ishihara, A, Yoshida, T. (1997) Face Immersion Increases Vagal Activity As Assessed By Heart Rate Variability Eur J Appl. Physiol. Occup physiol, 76, 394.
22. Jernigan, N and Resta, T (2002) Hypoxia Attenuates GMP of Pulmorary Vasodilatation Am, J, PHYS. Lung Cell Mol Physiol 281, 1366.
23. Liner, M, Linnarss on, D (1994) Tissue Oxygen and Co2 Stores and Breath Hold Diving In Humans Jappl. Physiol. 77, 542.
24. Maglisho, E (2003) Swimming Fastest Human Kinetics.
25. Mougios, V (2006) Exercise Biochemistry Human Kinetics, USA.
26. Noura, El Sayed (2005) Effect Of Ginseng On Male Reproduction Physiology Dep. Zagazig Univ.
27. Rodriguez, F, Keskinen, K, Malvela, M (2003) Oxygen Uptake Kinetics During Swimming Univ. St Etienne Publications, 379.
28. Rodriguez, F, Mader, A (2010) Energy Systems In Swimming Nova Science Publishers, INC.
29. Ross, A, Leveritt, M (2001) Long Term Metabolic and Muscle Adaptations To Training Sports Medicine 31, 1063.
30. Semenza, G (2001) HIFI in Sports TRINDS Mol Biol. 7, 345.
31. Semenza, G, (2000) HIFI: Mediatory of Physiological and Patho physiological Responses to Hypoxia. Trinds MOK. Biol. 3,102.
32. Semenza, G. Shimoda, L, Prabhakar, N (2006) Regulation of Gene Expression by HIF1 J APPL Physiol. 88, 1474.
33. Shaimaa, El Sayed (2012) EFFECT Of Aerobic and Anaerolic Activities on Gene Expression of SOD Physiology Dep. Alexandria Univ.
34. Sherlock, L., Guyton, H, James, R (2013) The Physiological Effects of A Quatic Exercise INT. J. Of Aquatic Research and Education 7, 266.
35. Strauss, M, Aksenov, I (2004) Diving Science Human Kinetics, USA.
36. Turkseven, S, Krnger, A, Abraham, N (2005) Antioxidant Mechanism of (Ho-1) Increasing SOD and Catalase Am. J. PHYSIOL. Heart, CIRE. PHYSIOL, 289, 701.
37. Wang, G, Tanaka, North, K (2016) The Future of Genomic Research In Athletic Performance and Adaptation to Training Genetics and Sports, 61, 55.
38. Williams, T, Davis, R, Croll, D (2000) Sinkor Swim Science 288.133.

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