

## A Comparison of the Effects of Aquatic and Non-Aquatic Training on the Level of Stress of Inactive Men

*Seied Sajad Hosseini, Mohammadali Allahyari, Mohammad Hashemi and Mousa Jalili*

Department of Physical Education and Sport Sciences, Faculty of Humanities,  
Abhar Branch, Islamic Azad University, Abhar, Iran

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**Abstract:** Sport exercise, especially aquatic exercise, has recently found increasing application with hygiene and health purposes. The goal of the present research is to compare the effects of aquatic and non-aquatic exercise on the level of stress of inactive men. 60 middle-aged inactive men of Abhar City were randomly chosen and studied. Subjects were randomly divided into three equivalent groups ( $n = 20$ ) of aquatic exercise, non-aquatic exercise and control. The standard Personal Stress Inventory (PSI) was used in order to assess the level of stress in the pretest and posttest. After collecting the pretest data and elucidating to subjects the procedures of performing the exercises, one of the two experimental groups performed aquatic exercise and the other group performed non-aquatic exercise. Descriptive statistics were used to account for subjects' personal characteristics and level of stress in the pretest and posttest levels and One-way ANOVA was used in order to compare data from the three groups in each level. The results showed that there was no significant difference between individual specifications and the level of stress in research groups in the pretest level, indicating homogeneity among subjects. A significant difference was observed between the levels of stress of the experimental groups and the control group in the posttest level, indicating the decreasing effect of conducting a period of sportsexercise on the level of stress of inactive men. A significant difference was also observed between the decreasing effect of conducting aquatic and non-aquatic exercise. The level of stress of the control group did not change significantly from pretest to posttest. The results of the present research were consistent with previous findings suggesting the effect of conducting a period of sports exercise on decreasing the level of stress. Considering the findings of the research, we can recommend the use of sports exercise in order to decrease the level of stress, especially aquatic exercise which due to its effectiveness and lack of negative consequences is sometimes used in medication.

**Key words:** Stress • Aquatic exercise • Non-aquatic exercise

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### INTRODUCTION

Physical activity and sports are of the methods used in various societies in order to prevent, delay, or treat psychological disorders and without doubt, physical education and sports will have a positive impact on enhancing the living quality of individuals. In the contemporary age, people, especially employees and organization personnel, confront various factors internal and external to the organization and their personality, body and mind are constantly influenced by these factors and they gradually become exhausted. Physical exhaustion and tension that impinge on the bodies of an organization's personnel are distinct and can easily be

recognized and treated; yet, tensions impinging on the mind and spirit of the personnel are not noticeable and cannot be measured or treated straightforwardly, thereby having undesirable effects in the exhaustion of the trained workforce of the organization. Therefore, in the modern age stress has greatly affected human life and its various dimensions (working environment, social environment, family environment, etc.).

The modern life is so complex that one's nervous system is constantly stimulated by numerous stressors, so that one's neuromuscular system is constantly in tension. As a result, today stress is the chief difficulty that human is confronted with. Since physical health and physical fitness is of special importance in the lives of

human beings, negative and positive changes in these physical conditions can strongly affect the psychological aspects and other dimensions of human life [1, 2].

Stress consists of mental, emotional and psychological responses to a stimulus that is perceived consciously or unconsciously as an informative or a threatening factor. This response serves as a protective mechanism, making the individual adaptive by adjusting the threatening factor and has various degrees depending on the type, strength and duration of stimulations and it changes with the characteristics of each individual [3].

Social critics regard stress as the offspring of the unnatural, frantic and demanding speed of industrial life and regard human beings as captives in a prison of chaos, economic issues, environmental pollution, technological advancement, mechanization of tasks and inactivity [4].

Behavioral scientists refer to an occurrence that triggers a stressful response as a stressor. Stress is that which an individual experiences in reaction to a stressor. Not all people view common situations as stressful or in other words not all people experience stress in a similar way. For instance, for some people, going to the doctor is regarded as a stressful incident, while it might not be the case for others. Some people feel anger, depression, or anxiety when they are under stress, while some others experience physical symptoms such as headache, tightness in the chest, knot in the stomach, or muscle tension [3].

When one faces a stressful situation, various physiological responses occur in their body. First, senses or sensory organs (eyes, ears, etc.) transmit information to the brain. The outermost layer of the brain, that is the cortex, interprets the information. Cortex is where your opinion or feeling about a situation occurs. If the information is interpreted as stressful, lower parts of the brain trigger a complicated physiological response which includes glands and all body organs. When a stressor activates a "fight or flight" response in the body, heart rate rises. All these incidents prepare the body for a physical response to the stressor; but in the modern society, the physical response is not the general way of dealing with stresses we face. Thus, physiological changes can have a persistent effect of the body [2].

Stress negatively affects the immunity function. Studies have shown that at the time of exams, students are most vulnerable to viruses. Similarly, the possibility of being inflicted with cold is higher when people are under stress. That is because stress weakens cells and antibodies that protect the individual against viruses. Hormonal changes and physical, emotional, psychological

and behavioral-cognitive responses that occur in the body and in response to stress are referred to as subscales of stress [5].

Results of various studies reveal that sports exercise is one of the simplest tools for controlling stress and continuous exercise, if done correctly, can be considered as one of the most important factors for physical and mental preservation and health, welfare and prevention of physical and mental diseases.

Harris *et al.*, (2003) studied the effect of sports on stress variables (cognitive, emotional and physical) among two groups of Olympics champions in the fields of archery and marathon. The results of the research showed that sports has led to a significant decrease in stress variables, but the decrease of physical variables in marathoners was greater than the other group, while the decrease of cognitive and emotional variables was greater in archers [6].

Hudd *et al.*, (2005) studied the effects of strength sports on stress variables among male university student athletes and found that after strengthening activity, physical responses such as heart beat, feeling of pain, etc. had a more significant decrease in comparison with cognitive responses such as concentration, anxiety and so on [7].

The results of the research studies of Humphrey *et al.* (2006), Kimball (2007) and Kohn (2009) using PSI inventory revealed that aerobic sports (endurance) in long-term led to decrease of stress and its subscales among male student athletes, so that physical and cognitive responses to stress had a more significant decrease in comparison with emotional and behavioral responses. They came to the conclusion that sports leads to an increase in blood circulation throughout human body including the brain and discharges stressors from the body, enabling the athlete to think better. Of course they underlined that aerobic and endurance sports such as running or hiking are the best types of activity, for the athlete inhales more oxygen [8-10].

In their research, Martin and Lichtenberger (2002) came to the conclusion that sports in decreases stress the active individuals group by evoking in individuals better awareness regarding their bodily changes such as breath depth, heart rate, muscle strength and so forth; for this new awareness makes the individual feel more quickly the changes that follows confronting a stressful situation and by removing the stressor, they will prevent these stresses from inflicting them with any disease [11].

When under stress, muscles, in particular facial and limb muscles become contracted and tight. By employing muscles and consuming muscle energy sources, sports

decreases these aberrant contractions and plays an important role in restoring muscles to their primary power [6].

Venfi *et al.*, (1993), who studied hormonal changes that occur when individuals are anxious for several years, stated that the most important hormone changed at the time of stress and anxiety is cortisol [5]. The results of the studies of Dall *et al.*, (2009) revealed that the decrease of average blood cortisol during midnight and early morning (when resting) leads to the decrease of psychological tensions and stress in active individuals (athletes) [9].

Secretion of cortisol (the stress marker hormone) occurs at the beginning of activity due to acceleration of fat metabolisms and release of lipids from adipose tissues in order to generate energy sources in muscle cells. In fact, triacylglycerol metabolism in aerobic system, especially in muscle cells, depends on the level of cortisol secretion and release of lipids from adipose tissues depends on cortisol concentration [10].

Ghaderi *et al.*, (2009) concluded that performing an anaerobic exercise session (sprint exercise) decreases blood cortisol level within 5 to 30 minutes post-exercise in male university students [6]. Reid *et al.*, (2005) studied the effect of psychological responses and the level of stress hormone, i.e. cortisol, in an active groups and an inactive group during and after performing short-term aerobic exercise (3 weeks) under two distinct conditions: (1) exercise on ergometer bicycle with the intensity of 50  $VO_2$ Max and (2) studying solely on a comfortable chair in a resting static state. The results showed that after performing exercises, there was a significant increase in blood cortisol level and correct psychological responses in the active group in comparison with the inactive group [10]. Studies of Martin *et al.*, (2009) and Dall (2007) on aged individuals showed that in comparison with anaerobic activity, aerobic activity such as hiking for a period of 4 weeks leads in short-term to a decrease in blood cortisol level during midnight and early morning and consequently decreases stress level of individuals during the day [11, 12]. Taeabe *et al.*, (2006) came to the conclusion that following strenuous physical activity, plasma level of cortisol has decreased in comparison with easy activity [13].

In recent years sports exercise has been introduced as an effective nonmedical method for decreasing stress responses and on this basis various theories have been presented, aiming to somehow account for this psychophysiological relationship. Studies carried out so far have been mainly devoted to examining short-term effects (less than 4 weeks) of aerobic and undemanding activities on decreasing stress through measuring cortisol

level, while the level of secretion of this hormone during and after performing regular exercises can decrease or increase under effects other than those related to psychological stress of subjects. On the other hand, there have not been many extended systematic studies by researchers in our country to examine these theories more meticulously [14]; thus, the present research has examined the effect of aquatic and non-aquatic exercises on the stress level of inactive men in a comparative fashion.

## MATERIALS AND METHODS

**Population:** The present research is semi-empirical. The statistical population of this research consists of middle-aged inactive men living in Abhar City, Iran, of whom 60 were randomly chosen and studied. Subjects were randomly divided into three equivalent groups ( $n = 20$ ) of aquatic exercise, non-aquatic exercise and control, with the average of  $42.66 \pm 5.08$  years of age,  $172.64 \pm 5.41$  cm of height and  $72.45 \pm 8.20$  Kg of weight. In order to assess the homogeneity across subjects and non-interference of influential factors such as having a sporting history, or hormonal and psychological disorders, a researcher-made questionnaire was used which investigated their sporting and medical record, revealing that subjects were totally homogeneous in all the foresaid cases and were not under medical treatment at the time of the research. Each exercise session in and out of water started and ended with 10 minutes of warming-up and 10 minutes of cooling-down respectively. The main exercise level lasted for 30 minutes during which exercises were performed with emphasis on walking sideways, performing strength exercises and exercise along with competition.

**Material:** Personal Stress Inventory (PSI) was used in order to measure the level of stress in the pretest and posttest. This questionnaire was first employed by two American researchers under the names of Caroline Maynard and Anne Newman and the questions are clear, concise and unequivocal [15]. In 2001, Mousavi and Habibian reported the validity and reliability of the foresaid questionnaire to be 91.82 [16]. Cognitive, emotional, physical and behavioral responses to stress were the four measurement subscales which altogether represented the level of stress of the subjects. Descriptive statistics were used to account for subjects' personal characteristics and level of stress in the pretest and posttest levels and One-way ANOVA ( $P < 0.05$ ) as used in order to compare data from the three groups in each level.

Table 1: Mean and standard deviation of the data of the two groups obtained from PSI, broken down according to subscales

Subscale		Group			P	F
		Aquatic Exercise	Non-Aquatic Exercise	Control		
Behavioral Responses	Pretest	28.23±2.03	27.03±3.04	26.89±3.41	0.056	0.66
	Posttest	23.62±1.24	24.09±1.76	27.19±2.62	0.001	4.09
Emotional Responses	Pretest	30.13±2.49	31.42±2.53	30.23±2.29	0.34	1.98
	Posttest	24.23±2.18	26.94±1.73	30.09±2.29	0.004	6.98
Cognitive Responses	Pretest	32.48±2.63	31.82±3.06	31.38±2.38	0.76	2.34
	Posttest	25.23±1.83	26.44±3.39	30.04±1.86	0.006	5.34
Physical Responses	Pretest	32.29±3.09	33.12±3.82	32.04±1.34	0.63	0.98
	Posttest	24.31±2.98	26.12±2.34	31.09±3.98	0.0001	10.84

## RESULTS

Using proper statistical tests revealed that there was no significant difference between the levels of stress of the subjects in the three groups at the pretest level. Moreover, it was revealed there was no significant difference between the four groups' data in the four subscales of the questionnaire.

A significant difference was observed between the levels of stress of the experimental groups and the control group, indicating the positive effect of a period of sports exercise on decreasing the levels of stress of inactive men. The level of stress of the control group did not change significantly from the pretest to posttest (Table 1).

Comparing the percentage decrease of items in the questionnaire, it was revealed that in almost all the items the aquatic exercise group experienced a greater decrease, yet this difference was not significant. Moreover, comparing the percentage decrease of the subscales of PSI inventory revealed that conducting a period of sports exercise (aquatic or non-aquatic) led to the greatest decrease in physical responses in comparison with other subscales.

## DISCUSSION AND CONCLUSION

The purpose of the present research was to compare the effects of aquatic and non-aquatic sports exercise on the level of stress of inactive men. The results showed that there was a significant difference between the levels of stress of the experimental groups and the control group in the posttest level, indicating the positive effect of conducting a period of sports exercise on decreasing the level of stress of inactive men. Also a significant relationship was observed between the decreasing effect of conducting aquatic and non-aquatic exercises. The level of stress of the control group did not change

significantly from pretest to posttest. Our result is consistent with the results of Dall *et al.*, (2009), Cormack *et al.*, (2005) and Salmon (2007) [9, 17, 18]. It is possible that sports exercises lead to a shift of attention from exogenous stimuli such as stressors from the society, education, etc. to pleasant stimuli of physical exercise, recreation, amusement and so forth. On the other hand, high self-confidence and positive self-esteem play important roles in overcoming chronic stress. Sports and physical activity increases self-confidence and self-esteem and consequently increases the ability of the individual to overcome stressors [9]. Moreover, it appears that performing sports exercise increases affinity and social relations and as a result has enhanced subjects' behaviors such as proper eating habit, lack of aggression and irritability and so forth. When under stress, almost 1500 chemical reactions occur in the body during which hormones, neural conductors and toxic and waste products are generated that sum into stimulation of cardiovascular system and decrease in the function of digestive system and consequently prepare the body for confronting the stress and having a proper reaction to the stressor. Unfortunately, in case the physical readiness is not discharged, the waste products generated will disperse in the circulatory system and may cause diseases or weaken the immunity system, making the individual prone to diseases. Sports and physical activity provide the individual with the ability to discharge and consume these waste substances and can put them in the state of responding to the stress, which leads to the discharge of these waste and pathogenic substances and contribute considerably to the individual's health [10].

An investigation into the studies done so far regarding the effects of physical activity on stress and its various indices such as anxiety, depression, agitation, lack of self-esteem and so on, reveals that physical health is directly related to mental health and people who enjoy

high physical activity are less inflicted with emotional stress and its complications and they feel more energetic and healthy in comparison with inactive individuals. Physical exercise is one of the most effective methods of decreasing depression, anxiety and aggression, as well as improving mental states and increasing self-confidence and self-esteem [19]. Halloszy *et al.*, (2009), interpreting the effect of physical activity on reduction of stress, pointed out to the selective attention of central nervous system and stated that when pleasant physical stimuli reach the brain via sensory afferent pathways, undesirable stimuli arising from either central or local factors are to some extent inhibited in other afferent pathways [20].

Nikolaou *et al.*, (2003) acknowledged that in people who engage in regular sports activities, body organs function under optimum conditions and in face of stressors, these individuals can easily counter them due to their optimum physical and mental conditions [21]. On the other hand, some other researches have shown that physical activity is one of the most important stimuli for secretion of cortisol - the most important of stress hormones - which is secreted in response to physical and psychological stresses in order to protect organisms [21].

It appears that prolonged aerobic sports activity is followed by an increase in the cardiovascular and mental readiness and this leads to the secretion of endorphin that causes euphoria and mental peace and these states continue for about 20 minutes after the activity, which ultimately, as the duration of activity increases, will lead to greater reduction of stress and reduction of cortisol secretion in individuals [22]. On the other hand, the studies of Caroline *et al.*, (1999) who examined the effect of cycling and running on the level of cortisol in athletes, considered changes in catecholamine and ACTH as the reasons for the reduction of cortisol level during midnight and early morning. As we said earlier, cortisol secretion at the onset of activity occurs due to acceleration of fat metabolisms and release of lipids from adipose tissues to generate energy sources in muscle cells; thus increasing aerobic exercises in long-term may increase cortisol secretion due to the cardiovascular readiness of the subject for accelerating the process of decomposition of adipose tissues as energy sources [23].

Moreover, regarding the greater effects of aquatic exercise we can argue that performing exercise in water due to its specific features has had a greater effect on the behavioral characteristics of subjects. Neuromuscular coordination increases in the water setting and perhaps since the research was carried out in a rather warm season, i.e. spring, subjects felt more comfortable in water.

Considering the findings of this research, sports exercises, in particular aquatic exercises, can be used in order to reduce stress.

## REFERENCES

1. Ashby, F.G., A.M. Isen and A.U. Turken, 2003. A neuropsychological theory of positive affect and its influence on cognition. *Psychol. Rev.*, 106: 529-550.
2. Ayala, C., K.J. Greenlund, J.B. Croft, L.J. Neff, S. Dai, Z.J. Zheng, M.L. Casper, N.L. Keenan and G.A. Mensah, 2000. State-specific trends in self-reported blood pressure screening and high blood pressure. United States, 1991-1999. *Morb.*
3. Mortal Weekly Rep, 2002. Symptoms of depression, acute myocardial infarction and total mortality in a community sample. *Circulation*, pp: 93.
4. Baron, R.A., 2009. Affect and organizational behavior: When and why feeling good (or bad) matters. In: K. Murnighan, ed. *Social Psychology in Organizations: Advances in Theory*. New York: Prentice Hall, pp: 63-88.
5. Barrios-Choplin, B. and M. Atkinson, 2000. *Personal and Organizational Quality Assessment*. Boulder Creek, CA: Heart- Math Research Center, Institute of HeartMath.
6. Harris, H.L., M.K. Altekruze and D.W. Engels, 2003. Helping freshman student athletes adjust to college life using psychoeducational groups. *J. Specialists in Group Work*, 28: 64-81.
7. Hudd, S., J. Dumlao, D. Erdmann-Sager, D. Murray, E. Phan, N. Soukas and N. Yokozuka, 2005. Stress at college: Effects on health habits, health status and self-esteem. *College Student Journal*, 34: 217-227.
8. Humphrey, J.H., D.A. Yow and W.W. Bowden, 2006. *Stress in college athletics: Causes, consequences, coping*. Binghamton, NY: The Haworth Half-Court Press.
9. Kimball, A. and V.J. Freysinger, 2007. Leisure, stress and coping: The sport participation of collegiate student-athletes. *Leisure Sci.*, 25: 115-141.
10. Kohn, P.M., K. Lafreniere and M. Gurevich, 2009. The inventory of college student's recent life experiences: A decontaminated hassles scale for a special population. *J. Behavioral Medicine*, 13: 619-630.
11. Martin, K.A. and C.M. Lichtenberger, 2009. Fitness enhancement and body image change. In: T.F. Cash and T. Pruzinsky, (Eds.), *Body images: A handbook of theory, research and clinical practice*. New York: Guilford Press.

12. Dall, H.M. and A.H. Goldfarb, 2007. cortisol peroxidation and scavenger enzymes during exercise: adaptative response to training. *J. Psychological Training*, 64: 1333-1336.
13. Taeabe, *et al.*, 2006. physical activity, plasma level of cortisol has decreased in comparison with easy activity. *Stress*, 9: 107-115.
14. Reid, P. and J.L. Lafond, 2005. Measurement of cortisol and plasma sulfhydryl as a possible indicator of protein oxidation. *Analysis of Free Radicals in Biological Systems*. Basel: Birkhäuser Verlag, pp: 237-248.
15. Barrios-Choplin, B., R. McCraty and B. Cryer, 2005. An inner quality approach to reducing stress and improving physical and emotional wellbeing at work. *Stress Med.*, 13: 193-201.
16. Barrios-Choplin, B., R. McCraty, J. Sundram and M. Atkinson, 2006. *The Effect of Employee Self-Management Training on Personal and Organizational Quality*. Boulder Creek.
17. Cormack, Bejma J. and L.L. Ji, 2009. Aging and sport exercise enhance cortisol in rat blood skeletal muscle. *J. Appl. Physiol.*, 87: 465-470.
18. Salmon Bosco, C., J. Tihanyi, P.V. Komi, G. Fekete and P. Apor, 2007. stress pressure in cortisol blood and recoil of elastic energy in slow and fast types of human skeletal muscles. *Acta Physiologica Scandinavica*, 116: 343-349.
19. Kobara, Aebi, H., 2003. Stress pressure in humans. *Asian Journal Psychological*, 105: 121-126.
20. Martinioc, C., P.A. Hasen, J.O. Holloszy and J.W. Heinacke, 2009. Central nervous system and select way for reduce stress in vivo. *American J. Psychol.*, 276: R128-R135.
21. Taeabe, N., K. Madsen and M.S. Djurhuus, 2006. Cortisol in plasma blood lipid peroxidation after short-term maximal exercise in trained and untrained humans. *American J. Physiol.*, 272: R1258-R1263.
22. Noreau, A. and P. Graham, 2005. Plyometric training influence for stress: a review of principles and practice. *Sports, Exercise and Injury*, 2: 24-30.
23. Carolin, M.D., B.P. Yu, R.J.M. McCarter, S.Y. Lee and JT. Herlihy, 2004. Inventory personal stress PSI in article” Exercise and cortisol blood and measuring stress athlete an non athlete. *Free Radical Biology and Medicine*, 20: 83.