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EFFECT OF TSH HORMONES AND CIRCULATORY SYSTEM VARIABLES AFTER 50 METERS FREE SWIMMING FOR MALES

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Abstract

All the major metabolic pathways are influenced by the thyroid hormone (TH) and the thyroid glands are responsible to secret these thyroid hormones (THs) which are very essential to maintain the normal metabolism **(Park and Song, 2016)**. Vital role is played by these thyroid hormones in neural development, metabolism of carbohydrate, lipid and protein, growth and maturation of bones and cardiovascular and renal functions as well **(Mondal et al., 2016) and (Samy, Ismail and Nassra, 2015)**. The physical exercise or swimming is known to increase the activity of thyroid glands and also increases the blood level of melatonin which is associated to raise the level of TSH (Thyroid Stimulating Hormone). Swimming exercise improves different nerve growth factors and angiogenesis and this encourages the researchers to study the effect of swimming exercise on function of thyroid stimulating hormones (TSHs). The effect of exercise on circulating thyroid hormones is still not clear through the studies and it is assumed that load of physical exercise shows effect on THs level and serum lipid profile in swimmers.

Keywords: TSH (Thyroid Stimulating Hormone), Circulatory System, Swimming, T4 (thyroxine), T3 (triiodothyronine).

抽象的

所有主要的代谢途径都受到甲状腺激素 (TH) 的影响，甲状腺负责分泌这些甲状腺激素 (THs)，这对于维持正常的新陈代谢非常重要（Park 和 Song，2016 年）。这些甲状腺激素在神经发育、碳水化合物、脂质和蛋白质的代谢、骨骼的生长和成熟以及心血管和肾功能中发挥着重要作用（Mondal 等人，2016 年）和（Samy、Ismail 和 Nassra，2015 年）.众所周知，体育锻炼或游泳会增加甲状腺的活动，也会增加血液中褪黑激素的水平，这与提高 TSH（促甲状腺激素）的水平有关。游泳运动可以改善不同的神经生长因子和血管生成，这鼓励研究人员研究游泳运动对促甲状腺激素 (TSH) 功能的影响。运动对循环甲状腺激素的影响尚不清楚，研究表明运动负荷对游泳者的 THs 水平和血脂水平有影响。

关键词：TSH（促甲状腺激素）、循环系统、游泳、T4（甲状腺素）、T3（三碘甲状腺原氨酸）。

Introduction

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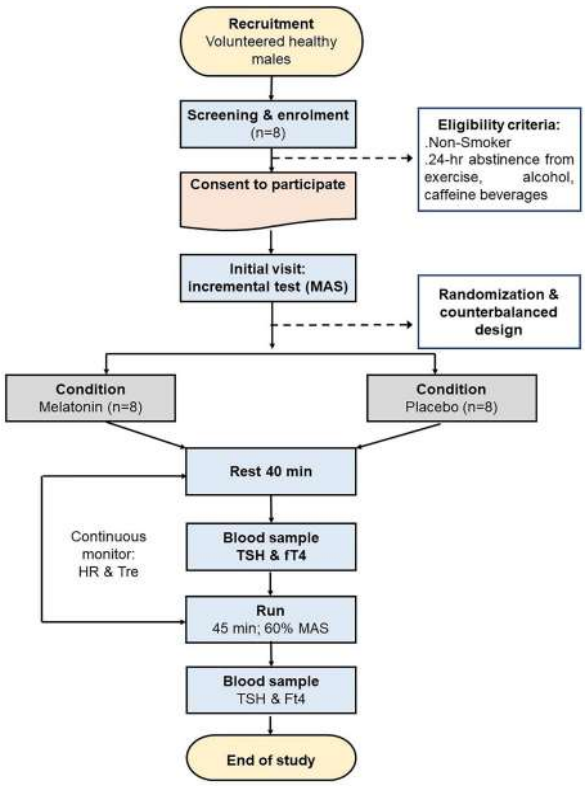
Thyroid stimulating hormone (TSH) is a glycoprotein hormone consist of 2 peptide chain (an α-chain, which is nearly identical in all, and a β-chain, which is responsible for immunological and biological specificity) joined with non-covalent bond. There is no virtual cross reactivity with other peptide hormones when there is access hyper sensitive thyroid stimulating hormone (hTSH). The interaction of specific receptors of thyroid cell surface are stimulated by TSH to produce and secret T4 (thyroxine) and T3 (triiodothyronine), the metabolically active THs. Thyroxine and triiodothyronine regulate various biochemical processes all through the body that are important for normal metabolism and neural activities. There is a sensitive negative feedback control on the pituitary gland that maintains the level of thyroid hormone in blood of a normal individual in dynamic equilibrium. Secretion of T3 and T4 is regulated by the pituitary and TSH which occupies the central position in negative feedback scheme. The low level of circulating THs give rise to synthesis and secretion of thyroid stimulating hormone (TSH) with the help of TRH (hypothalamic tripeptide thyrotropin-releasing hormone) and on the other hand the production of TSH is supressed when the level of T3 and T4 is increased.

Effect of TSH Hormones after Swimming

The thyroid hormones (THs) and physical exercises together elevates the basal metabolism which brings in more consumption of oxygen in the tissues **(Souza et al., 2014)**. It is well known fact that the thyroid gland activities and melatonin level in blood increases with physical exercise and this increased melatonin level leads to increase in TSH



It is found through the studies that increase and decrease in plasma thyroid stimulating hormone (TSH) and free thyroxine (F.T4) is shown on the basis of the water temperature while swimming and there is no significant effect of exercise on different temperature is found in T3. The heart rate is also monitored at regular intervals all through the exercise which shows that heart rate increases at high temperature and decreases at low temperature of water during swimming. A significant increase in level of plasma TSH and F.T4 is found after swimming at twenty degree which show no change in level at 260C but decreases at 320C. In addition,

Swimming in cold water triggers the secretion of TSH is activated by peripheral and central cold receptors and this exposure of the body to acute cold water during elevates the thyroid releasing hormone (TRH) level in plasma. The studies highlight the point that these hormones respond to cold water and increase the level of

epinephrine and norepinephrine in blood which is considered to be very important for thermoregulations during swimming exercise. Previous studies support to the viewpoint that the changes that are induced in the level of thyroid hormone due to exercise can be secondary to "altered blood flow, plasma binding, fluid shifts or other effects of exercise" with no noticeable difference in T3 level before and after exercise. The studies also report that moderate level of prolonged exercise increase rT3 and T4 level and decrease the level of T3 due to changes in concentration of "plasma free fatty acids, glucose and other fuels." The secretion of THs (thyroid hormones) is suppressed by glucocorticoids which to changes in concentration of cortisol, plasma TSH and thyroxine during swimming at different temperatures.

Physical exercises represent one of the important non-pharmacological methods to have control on metabolic disorders generally encountered **(Baltaci et al., 2017)**. A co-ordinated series of physiological responses that are triggered by exercise that also changes the metabolism and provide outstanding ways to explore the neuroendocrine relation amid hormones, energy balance and help to select and utilize the metabolic substrates **(Soria, Anson & Escanero, 2016)**. The studies show conflicts in results related to stress on level of THs which is induced due to exercise and it is found that it mainly depends on the type of exercise, duration, intensity and physiological conditions as well. Yet, the credit is given to advantageous effects of exercise on cholesterol transport function of high-density lipoprotein and low-density lipoprotein **(Valimaki et al., 2016).**

Effect of Circulatory System

Swimming is considered as the most commonly accepted exercise by majority of people for its health benefits. It is found to improve the efficiency of "respiratory and circulatory" systems along with other functional systems of human body. Swimming helps in increasing the productivity, provides fitness and also helps in maintaining the body weight. It also has some other benefits like "mental, psychological and spiritual aspects, it gives an atmosphere of entertainment, fun and happiness" which can be achieved at any age and suits both men and women and motivates them to exercise **(Bani Melhem, 2003)**. A significant improvement is found between after and before "heart pulse rate, vital capacity, systolic blood pressure, body fat, and performance of (50m, 200m) freestyle swimming" and this the treason why the investigators suggest to generalize the usage of training programs which is suggested by the study which can help to improve the physiology and swimming performance parameters.

The above figure shows the changes of heart rate during swimming at different water temperatures like 20^0C, 26^0C and 32^0c. It is observed that Thyroid Stimulating Hormone (TSH) is increased after swimming at water temperature of 20 degree C by 90.4% and was changed at 26 degree C but it was decreased at 32 degree C by 22.3%.

The work intensity and temperature of water are both related to heat production while swimming and it is studied that there is a close relation with "water temperature during swimming" and "changes of rectal, oesophageal and muscle temperatures." This is due to the reason that heat is saved by the body while swimming in warm water which loses while swimming in cold water and this heat flux are determined by two key factors "subcutaneous fat and thermoregulatory control."

The figure is showing the heart rates which was recorded during swimming at three different water temperature. It is observed that the heart rate recorded was 4.9 beats min^{-1} at 20^0C which decreased to 4.6 beats min^{-1} at 32^0C and on 30 minutes the heart beat was 3.7 beats min^{-1} at 20^0C and was increased to 4.8 beats min^{-1} at 32^0C. It is also found that after 30 minutes of swimming the heart beat recorded was 4.1 beats min^{-1} at 20^0C and was deceased to 3.8 beats min^{-1} at 32^0C.

During swimming, contraction is found in lungs in first few seconds which is followed by hyperventilating and loss of breathing control which is tough to control. Along with peripheral vasoconstriction, increase in heart rate, and blood pressure and cardiac output is observed. The peripheral cold receptors initiate a dynamic response which shows its peak for nearly 30 seconds after its exposure and adaptation for nearly 2 minutes. The initial shock and loss of breathing controls shows the risk of drowning and death of the swimmers and this requires very small amount of aspirated water to start the process of drowning. The body of winter swimmers becomes resistant to cold shocks as they had adapted the conditions of cold conditions, increasing frequencies and gradual lowering of temperatures.

Problem Statement

In the present time, all the activities related to sports has their own requirements at functional and physical levels. To reach to a high level in any specific sports activity majorly depend on the development of those requirements that help in progress of training program and its completion as well. It is important for medical distance swimmers to have some properties that cam help them to increase their "aerobic abilities" and this increase in capacity will help them to improve their achievements. It is found through the studies that the swimmers are having low levels and fluctuating performance and capabilities and they show results which are not satisfactory it is suggested through the study that it is important to provide proper training programs to developing swimmers and improve their functional and physical performance.

Research Questions

1. What be the Effect of TSH hormones after 50 meters free swimming for males?
2. What will be the effect of 50 meters free swimming for males on the circulatory system variables?

Research Aims

The aim of the research is to the effect of TSH hormones and circulatory system variables after 50 meters free swimming for males. The study had aimed to review previous studies to know the changes occurs in the kevel of TSH, T4 and T3 hormones after physical exercises and swimming. The research also studies the effect of cold and warm water during exercise on the increase and decrease of level of these hormones. The study also focus on the circulatory system (heart, lungs etc.) and their functions all through the exercise and even after the swimming and physical exercises.

Significance of the Study

The present study is important as it provides the information of the circulatory system and level of hormones that increases and decreases after and even during the physical exercise and swimming. The swimmers and even normal people are able to know that rise in thyroid activities have a close relation with high efficiency of mechanical work which is performed by the muscle exercise. The study talks about the effect of cold and hot water swimming on secretion, stimulation and even reduction of hormone levels and the function of

circulatory systems. It is important to conduct study on related topic so that one can know the benefits of swimming along with the functioning of different body organs at the same time.

Literature Review

According to **Chatzitomaris et al. (2017)** exercise stimulates different kinds of responses from thyroid stimulating hormone (THs) and previous studies that had investigated on thyroid hormones all through training and even after training have found that the concentration of TSH, T4 and T3 is increased but on the other hand through some studies it is also found that the concentration of TSH, T4 and T3 reduces on long training sessions with repeated heavy strains. The serum TSH, T3 and T4 levels are significantly affected by acute swimming exercise and it is assumed that rise in thyroid activities may have a close relation with high efficiency of mechanical work which is performed by the muscle exercise.

Effect of swimming or any other exercise on THs is still not very clear but there are studies which reports that thyroid hormone levels are not affected by exercise **(Onsori and Galedari, 2015)** and on other hand there are some investigators and their studies reports that the level of THs is significantly reduced by exercise. It is assumed that there is a difference in results of various studies since they had followed of exercise of different intensities and evaluation of time after exercise in humans.

There is beneficial training of swimming exercise that causes very less damage to muscles and this is the reason why it is chosen as the treatment indicator **(Veskoukis et al., 2018)**. It is found that swimming training programs provides significant ameliorate to "depression parameters, stress, cognitive flexibility, selective attention and motor coordination in children with attention deficit hyperactivity disorder" **(Silva et al., 2020)**.

Park et al. (2020) found in their study that increased serotonin expression and suppressed apoptosis which reduces the anxiety and memory disorders after certain age is seen in a 30 minutes exercise for four weeks programs. The study also examines the effects of swimming exercise on "cAMP and DUOX2 levels" of the similar thyroid gland and on the synthesis of FT4 in rats that had thyroid dysfunction due to PTU administration.

T4, T3 and TSH levels, pituitary TSHβ mRNA expression and TRH PVN are increased in blood after forced swimming of 10 minutes in rats that had undergone "adrenalectomy" and on the hand a normal rat show no significant difference in any of these hormone levels after forced swimming for ten minutes **(Sun et al., 2016)**.

It is found that individuals with obvious or yet diagnosed "cardiovascular pathologies" are more likely to have negative effects as they cause arrhythmias and acute cardiovascular events that leads to significant healthy risks and this is the reason why it is suggested to follow step by step strategy to initiate and expand these activities in order to maintain to adaptations and adjustments, get protection against conceivable risks when exposed to cold water and also to get all the advantages of health benefits that are promised by the exercise **(Manolis et al., 2019)**.

Yuan et al. (2016) found in their study that a swimming training of moderate intensity of about eight weeks shows beneficial effects on "systolic blood pressure, arterial stiffness and blood supply to the brain" in an adult who is overweight. In addition, an individual also faces "maximal and mean wall shear stress" after training but it is good that that these

hemodynamic changes did not last more than 4 weeks.

Discussion

The loads of different exercises may show a positive impact on physical health of the swimmers with the help of their lipid profiles and thyroid hormones (THs) level. Moreover, exercise is one of the most effective methods that has the ability to lower the lipid levels which is proved to be very harmful to the organism. Framingham Heart Study had originally introduced the concept of "risk factors for cardiovascular disease" and at present is served as the corner stone to prevent the coronary heart disease (CHD). The land based regular physical exercises like walking and running as proved to have health benefits that reduces the risk of CHD and stroke and is taken as first line approach to prevent and treat different CHD risk factors. It is still not clear that water-based exercise like swimming also have same cardiovascular benefits or not.

In this section, we review and evaluate the previous studies, including our own, conducted in the area of regular swimming and Effect of thyroid stimulating hormones (TSHs) and circulatory system variables after free swimming for males. It is found through the studies that increase and decrease in plasma thyroid stimulating hormone (TSH) and free thyroxine (F.T4) depends on water temperature during swimming and there is no significant effect of exercise on different temperature is found in T3. The heart rate increases at high temperature and decreases at low temperature of water during swimming. Hypotensive (lowering of blood pressure) effects of similar magnitude are produced by other physical exercise training like cycling and walking but no direct comparison for effects of TSH and circulatory system is done for swim training and other physical exercises. Moreover, very few studies have been conducted to evaluate the effects of TSH, T4 and T3 along with circulatory variables after regular swimming.

Conclusion

Thyroid gland and thyroid stimulating hormones are responsible to conduct all the important metabolic process of a human body and this is reason why it is very important to know the effects of human activities on these hormones and glands that secrets these glands. The circulatory system of the body is vital system that circulates the blood and oxygen all through the body and it is found that swimming has significant effects on blood pressure even after the exercise.

It is found through the study that blood pressure and level of hormones increase and decrease during the physical exercise and swimming. Rise in thyroid gland activities is associated with high efficiency of mechanical work which is performed by the muscle exercise. It is also found that there is an effect of cold and hot water swimming on secretion, stimulation and even reduction of hormone levels and the function of circulatory systems. The study says that increase and decrease in TSH and free thyroxine depends on water temperature during swimming and there is no significant effect of exercise on different temperature is found in T3. The heart rate increases at high temperature and decreases at low water temperature.

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