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The Effect of Heat Stress on A Number of Thyroid Gland Functions Among Workers in A Number of Occupations

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Abstract:
This study was conducted to investigate the effect of heat stress on thyroid gland functions among workers in some occupations exposed to heat stress. The study included 100 males working in occupations exposed to heat stress in the city of Kirkuk, and they were distributed into four groups according to the profession in which they work by 25 males for each group (Group A: It included bakers , group B: included isogam workers , group C: included blacksmiths and group D: included construction workers), in addition to the control group, which included 20 males who do not work in the field of occupations exposed to heat stress. The study included estimation of the concentrations of Thyroid-Stimulating Hormone (TSH), Triiodothyronine (T3) and Tetraiodothyronine (T4). The results showed There were no significant differences ($p \leq 0.05$) in the concentration of TSH, T3 and T4, in the four groups compared to the control group.
Keywords: Heat stress, Thyroid gland, TSH, T3, T4

Introduction

Heat stress effects the health of humans who are mammals through its direct or indirect impact on normal physiology, metabolism, metabolic processes, hormones, as well as the immune system. Moreover, the problem of heat stress is expected to be an increasing problem in the near future due to the development of global warming [1].

On average, it is estimated that more than 25,000 deaths due to high temperatures occur in European countries each year. However, heat diseases and heat stress not only arise when ambient temperatures are high, but physical exertion has a clear effect in increasing heat production within the organism several times [2]. The effects of heat stress are varied, ranging from discomfort to death in extreme conditions [3].

The thyroid is one of the glands that form an endocrine device, produces, and stores, and launches hormones across the blood stream and directly affect the body [4]. The thyroid gland is a butterfly-shaped gland consisting of the right and left bulbous lobes connected by a thin structure called the isthmus. The thyroid gland is located in the neck, and wraps around the anterior trachea just below the larynx. On average, it is 5 cm high and 5 cm wide and weighs 20- 30 g in adults, slightly heavier in women [5]. And that the thyroid is a rich vascular structure, receiving its blood supply mostly from two sources, the superior thyroid artery, the first branch of the external carotid artery, feeds the upper half of the thyroid gland in more than 95 % of people, as for the lower part of the thyroid gland, it is commonly fed by the lower thyroid artery, which branches from the thyroid trunk, which is itself a branch of the subclavian artery, and sometimes the inferior thyroid artery may be absent or duplicate [6]. Additionally, the thyroid gland has extensive lymphatic drainage that includes multiple levels of lymph nodes [5].

The thyroid gland secretes two hormones, thyroxin and triiodothyronine, which are known as T4 and T3, respectively. Monoiodotyrosine (MIT) and diiodotyrosine (DIT), which are precursors of T3 and T4 and that these hormones contain iodine [7]. And the thyroid gland secretes hormones that do not contain iodine such as calcitonin (CT) [8]. Both T3 and T4 hormones have a significant effect on

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increasing the body's metabolic rate, so stopping the secretion of these hormones causes the metabolism to drop to less than 40% of the normal metabolic level, and the excessive increase in thyroid secretion of these hormones causes an increase in the metabolic rate from 100-60% above the normal level of metabolism [9].

The production of thyroid hormones is controlled by a complex mechanism of positive and negative regulation, as Thyroid Releasing Hormone (TRH) stimulates Thyroid-Stimulating Hormone (TSH) from the anterior lobe of the pituitary gland, thus TSH stimulates Synthesis and release of thyroid hormones from them [10].

Materials and methods

1-Study samples:

The current study was conducted in the city of Kirkuk on (100) men of workers who work in occupations exposed to heat stress, in addition to (20) males who do not work in the field of occupations exposed to heat stress and of the same ages of workers as a control group, for the time period from July 2023 Until October 2023, noting that all workers working in occupations exposed to heat stress do not suffer from any chronic diseases such as hypertension, diabetes and others, and also they are not smokers, and they practice the profession for a period of not less than 6 months, and the workers were divided into four groups according to the profession in which they work By (25) workers for each group:

-Group A: Included bakers

-Group B: included isogam workers (thermal insulation)

-Group C: included blacksmiths

-Group D: included construction workers

In addition to the control group, which included (20) males who do not work in occupations exposed to heat stress.

2- Collect blood samples:

Blood samples were obtained from the humeral vein using a syringe of (5 ml) from each male in the morning hours before lunch. The withdrawn blood was placed in plastic test tubes with a tight cover and free of anticoagulants and the blood was left at laboratory temperature for half an hour. The serum was separated using a centrifuge at a speed of 3000 rpm for a period of 15 minutes, after which the serum was withdrawn using a micropipette and the serum was placed in a test tube and kept at (-20) Celsius until the required tests are carried out , which included:

-Estimate the concentration of the TSH hormone of each of the workers as well as the control group, by using the Enzyme-Linked-Immunosorbent Assay (ELISA) and the test kit equipped from the French company Biolabo and according to the methods used by [11][12].

-Estimate the concentration of the T3 hormone of each of the workers as well as the control group, by using the Enzyme-Linked-Immunosorbent Assay (ELISA) technique and the test kit equipped from the French company Biolabo and according to the methods used by [13].

-Estimate the concentration of the T4 hormone of each of the workers as well as the control group, by using the Enzyme-Linked-Immunosorbent Assay (ELISA) technique and the test kit equipped from the French company Biolabo and according to the methods used by [14].

statistical analysis

The data were analyzed statistically using Minitab and according to a one-way analysis of variance. Arithmetic means of the parameters were tested using the Duncuns Multiple Range test with a significant level ($p \leq 0.05$) to determine Significantly differences between groups.

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Results and discussion

The concentration of TSH, T3 and T4:

-The results in Figure (1) showed there are no significant difference in TSH hormone concentration in group A, B, C and D, as it recorded (0.26 ± 2.01 IU/ml), (0.28 ± 2.69 IU/ml), (0.37 ±2.22 IU/ml) and (0.29±2.58 IU/ml) respectively compared to the control group (0.27 ±2.05 IU/ml). Also, no significant differences were observed between the four groups when compared with each other.

-The results in Figure (2) indicate that there were no significant differences in the concentration of T3 hormone in groups A, B, C and D, as it recorded (0.08 ± 2.05 nmol/L), (0.12 ± 2.47 nmol/L), (0.10 ± 2.04 nmol/L) and (0.07 ± 2.06 nmol/L) respectively compared to the control group (0.19 ± 1.96 nmol/L). Also, no significant differences were observed between the four groups when compared with each other.

- Also, the results in Figure (3) showed that there were no significant differences in the concentration of the T4 hormone in group A, B, C and D, as it recorded (3.88 ± 106.25 nmol / L), (2.68 ± 115.36 nmol / L), (3.63 ± 116.07 nmol/L) and (5.13 ± 105.88 nmol/L), respectively compared to the control group (7.02 ± 110.34 nmol/L). Also, no significant differences were observed between the four groups when compared with each other.

These results agreed with what was reached by Rahimi and his group (2013) [15] in their study on the effect of exercise and training on thyroid hormones, as there were no significant differences in the concentrations of TSH, T3, and T4 during the exercises, as physical exercises lead to raising the body temperature [16]. These results also agreed with the findings of Norloei and his group (2017) [17] in their study on the effect of heat stress on a number of blood parameters and levels of thyroid hormones in foundry workers, as there was no clear effect of chronic exposure to heat on the concentrations of thyroid hormones T3 and T4. Quintanar-Stephano and his group (1991) [18] have shown that cold is one of the factors related to regulating the secretion of the TSH hormone and thus regulating the secretion of thyroid hormones, as exposure to cold increases the need for quantities of T3 and T4 in order to increase the metabolic rate, as the effect of cold on the secretion of the TSH hormone occurs very quickly. From the above, we believe that heat stress do not have a clear effect on TSH and thyroid hormones T3 and T4.

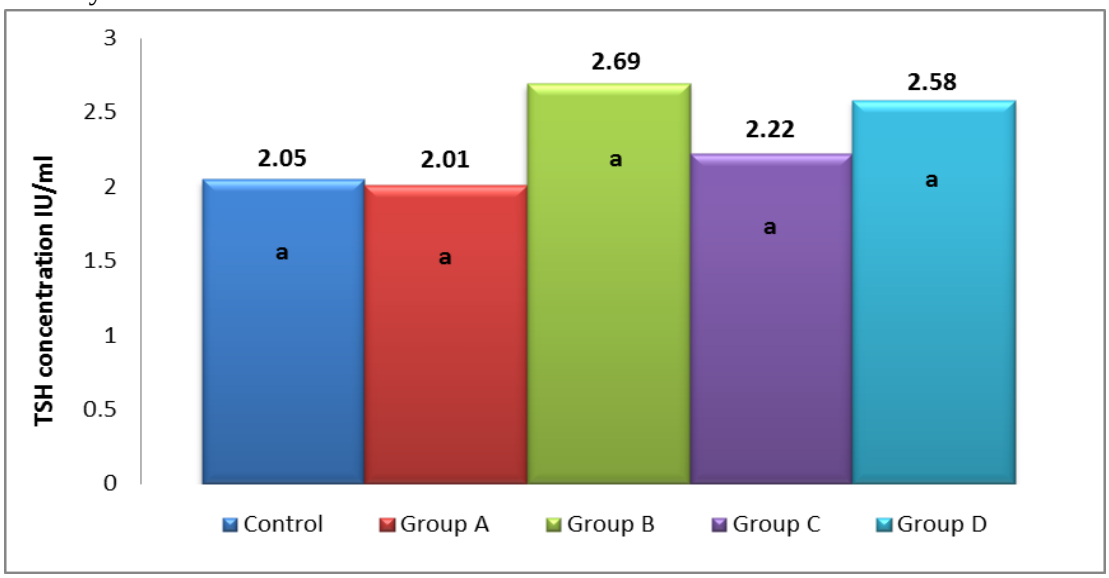

Figure 1. Concentrations of TSH in blood serum for the four groups and the control group.

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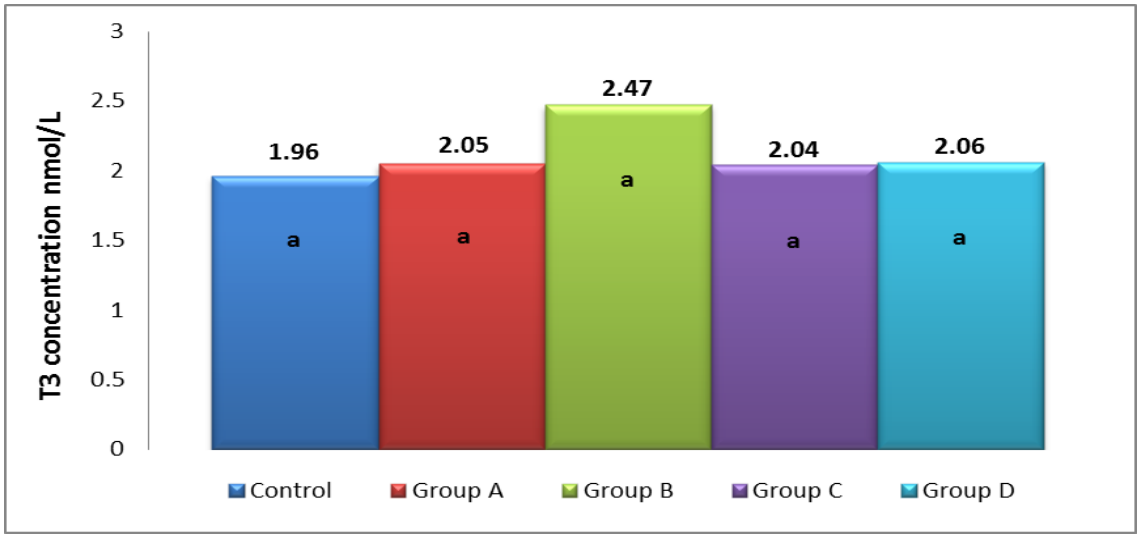

Figure 2. Concentrations of T3 in blood serum for the four groups and the control group.

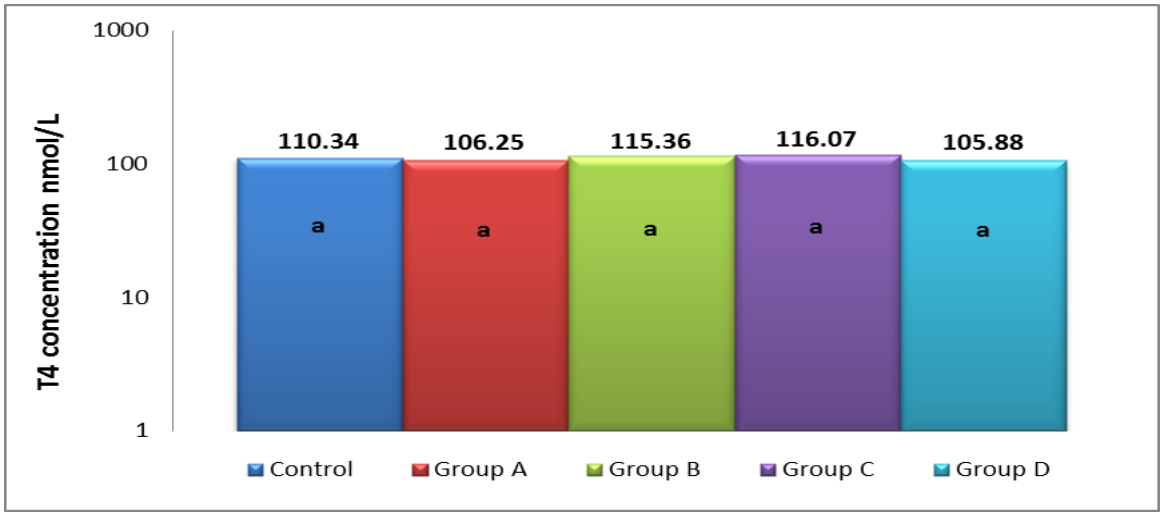

Figure 3. Concentrations of T4 in blood serum for the four groups and the control group.

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