

# The Effect of Physical and Heat Stress on Some Physiological Parameters among Workers in a Number of Occupations

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## Conclusion

This study was conducted to investigate the effect of heat and physical stress on workers in some occupations exposed to heat and physical stress. The study included 100 males working in occupations exposed to heat and physical 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 and physical stress. The study included estimation of the concentrations of plasmin, plasminogen, total protein, albumin and globulin. The results showed a significant decrease ( $p \leq 0.05$ ) in the concentration of plasminogen in groups A and C compared with the control group and there was no significant difference in groups B and D compared with the control group. The results also showed there are no significant difference ( $p \leq 0.05$ ) in plasmin concentration in group A, B, C and D compared with the control group. The results also showed a significant decrease ( $p \leq 0.05$ ) in total protein concentration in groups A,B,C and D compared with the control group. The results also showed a significant decrease ( $p \leq 0.05$ ) in albumin concentration in group A compared with the control group and there was no significant difference in groups B, C and D compared to the control group. The results also showed a significant decrease ( $p \leq 0.05$ ) in globulin concentration in groups A,B,C and D compared to the control group.

**Keywords:** Physical stress, Heat stress, Total Protein, Albumin, Globulin, Plasmin, Plasminogen

## Introduction

Heat is a natural hazard, and there are many known effects of high temperatures on the bodies of living organisms, including mammals, including humans. Heat stress affects the health of the human being who is a mammal through its direct or indirect effect on organ functions, catabolic and building processes, enzymes, hormones, as well as the immune system. In addition, it is expected that the heat problem will be an aggravating problem. In the near future, this is 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].

Physical stress is The most apparent form of physical stress is through an acute injury. An acute injury is an injury that has occurred as a result of a specific event, Pulling a muscle slipping, fracturing your wrist bowling, dislocating a shoulder skiing; these are examples of acute injury that constitute physical stress, Acute injuries encompass everything from muscle pulls, fractures, and ligament sprains to dislocations[4].

However, not all types of physical stress come in such obvious form. The most common and under treated form of physical stress comes from a longstanding condition or overuse, both of which are also known as chronic stress. The accumulation of sitting with bad posture daily or conditions such as arthritis, create a stress on the body that can be just as harmful as any injury[5].

Total Protein measures the amount of protein in blood. The two main proteins found in the blood are globulins and albumin. . If protein levels are low, it can mean that liver or kidney disease[6].

Globulins are a group of proteins in blood. They are made in liver by the immune system. Globulins play an important role in liver function, blood clotting, and fighting infection. There are four main types of globulins. They are called alpha 1, alpha 2, beta, and gamma[7].

Albumin is the main protein found in plasma, as it is the most popular and abundant in human blood compared to other plasma proteins, albumin is synthesized in the liver in the form of a primary protein called Proalbumin, which is formed in the lumen of the endoplasmic reticulum of hepatocytes in the form of preproalbumin [8].

Plasminogen is an inactive zymogen form of plasmin, which is mainly synthesized in the liver [9]. As well as in each of the main organs and tissues [10]. It is present in large quantities in extravascular fluids, and under physiological conditions, plasminogen is converted to plasmin through cleavage in the activation loop (between Arg561 and Val562) by Tissue plasminogen activator (tPA) or Urokinase plasminogen activator (uPA). Also, kallikrein and F.XIa and F.XIIa factors are able to act as plasminogen activators [11] [12].

Plasminogen and its active form plasmin play important physiological and pathological roles in fibrinolysis, haemostasis, cell migration, tissue remodeling, wound healing, angiogenesis, inflammation and cancer cell migration [13].

## **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 and physical stress, in addition to (20) males who do not work in the field of occupations exposed to heat and physical stress and of the same ages of workers as a control group, for the time period from August 2022 Until October 2022, noting that all workers working in occupations exposed to heat and physical 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 and physical 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 total Protein and albumin of each of the workers as well as the control group, by using the Spectrophotometer device and the test kit equipped from the French company Biolabo and according to the methods used by [14][15].
- Calculating the concentration of globulin in the serum after finding the concentration of total protein and albumin in the serum according to the method used by [16].
- Estimate the concentration of the plasmin and plasminogen, by using the Enzyme-Linked-Immunesorbent Assay (ELISA) and the test kit equipped from the French company Biolabo and according to the methods used by [17][18].

## 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.

## Results and discussion

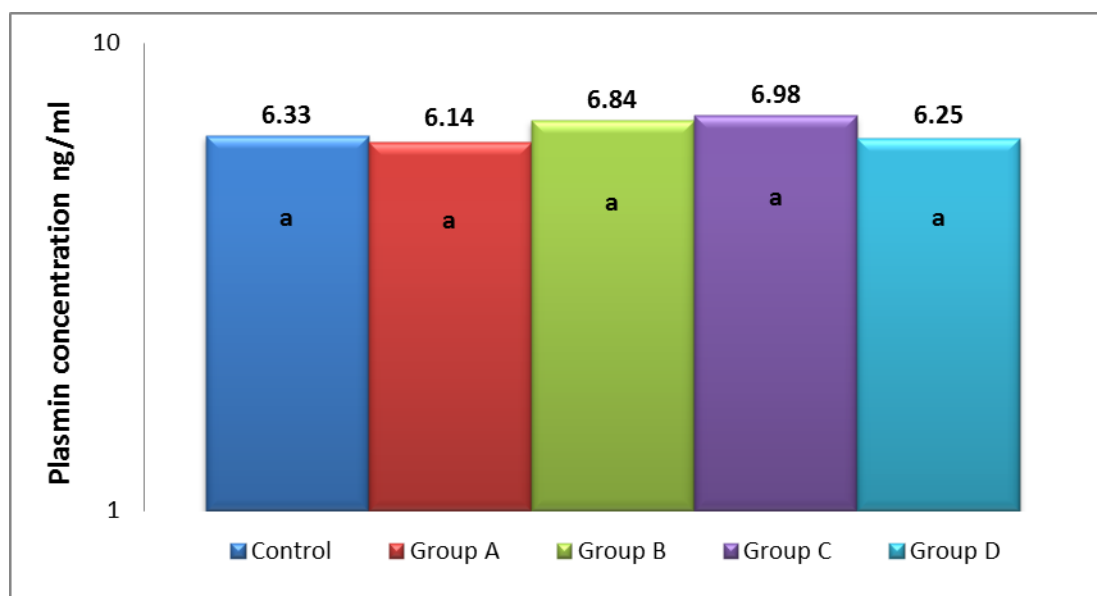
### The concentration of plasmin and plasminogen:

-The results in Figure (1) showed there are no significant difference in plasmin concentration in group A, B, C and D, as it recorded  $6.14 \pm 0.52$  ng / ml,  $6.84 \pm 0.41$  ng / ml,  $6.98 \pm 0.61$  ng / ml and  $6.25 \pm 0.32$  ng / ml on respectively, compared to the control group ( $6.33 \pm 0.73$  ng / ml), Also, no significant differences were observed between the four groups when comparing them with each other.

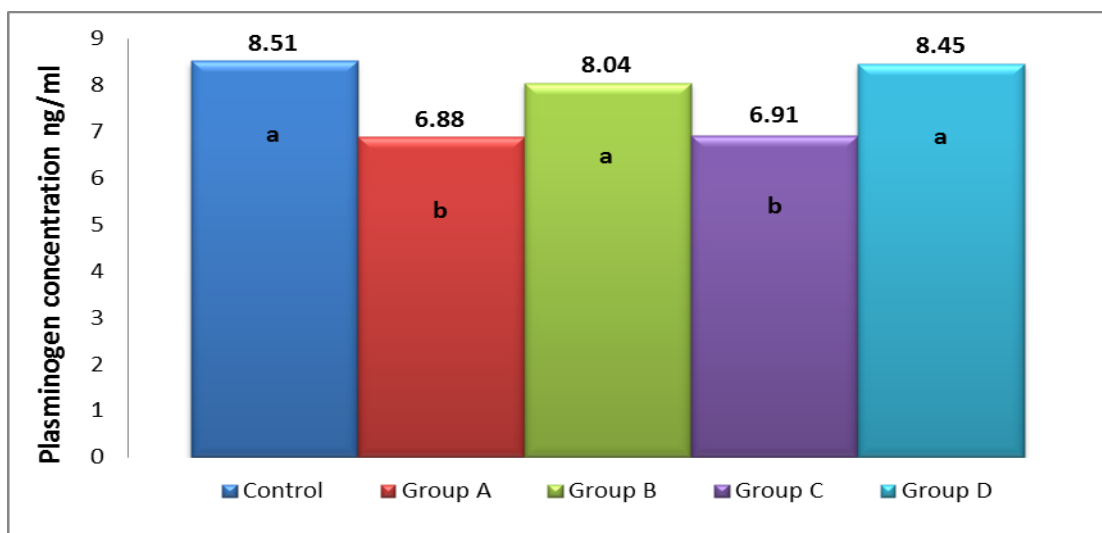
-The results in Figure (2) showed a significant decrease in plasminogen concentration in groups A and C, as it recorded  $6.88 \pm 0.23$  ng / ml and  $6.91 \pm 0.34$  ng / ml on respectively, compared to the control group ( $8.51 \pm 0.76$  ng / ml), while no significant difference was observed for groups B and D

as it recorded  $8.04 \pm 0.15$  ng / ml and  $8.45 \pm 0.40$  ng / ml on respectively, compared to the control group, but when comparing between the groups, we notice that there are no significant differences between groups B and D, and a significant decrease for groups A and C compared to groups B and D.

The reason for the decrease of plasminogen concentration in the serum may be due to the effect of high temperatures, as the high temperature leads to thermal decomposition of protein by increasing the kinetic and mechanical energy of the protein molecules, which leads to their separation from each other and thus disintegrate the weak peptide bonds that link them [19]. Since plasminogen is a proteolytic enzyme [20][21], we believe that the high temperature leads to a decrease in its concentration in the blood serum. The reason for not decreasing the concentration of plasmin, which is also a protein enzyme and is derived from plasminogen [22] may be due to the possibility that the sensitivity of plasmin to high temperature is less than that of plasminogen.



**Figure 1.** Concentrations of plasmin in serum of the five groups.



**Figure 2.** Concentrations of plasminogen in serum of the five groups.

Different letters mean that there are significant differences at a significant level of ( $p \leq 0.05$ )

### **The concentration of total protein, albumin and globulin:**

-The results in Figure (3) showed a significant decrease in total protein concentration in groups A,B,C and D, as it recorded  $5.5 \pm 0.10$  gm /100 ml,  $5.51 \pm 0.22$  gm /100 ml,  $5.7 \pm 0.06$  gm /100 ml and  $5.67 \pm 0.11$  gm /100 ml on respectively, compared to the control group ( $7.97 \pm 0.24$  gm /100 ml), but when comparing between the groups, we notice that there are no significant differences between the four groups.

-The results in Figure (4) showed a significant decrease in albumin concentration in group A as it recorded  $4.29 \pm 0.20$  gm /100 ml compared to the control group ( $5 \pm 0.16$  gm /100 ml), while we did not notice any significant difference for groups B, C and D as it recorded  $4.72 \pm 0.20$  gm /100 ml,  $4.9 \pm 0.04$  gm /100 ml and  $4.95 \pm 0.07$  gm /100 ml on respectively, compared to the control group, but when comparing between the groups, we notice that there are no significant differences between group B,C and D, and a significant decrease in group A compared to groups B, C and D.

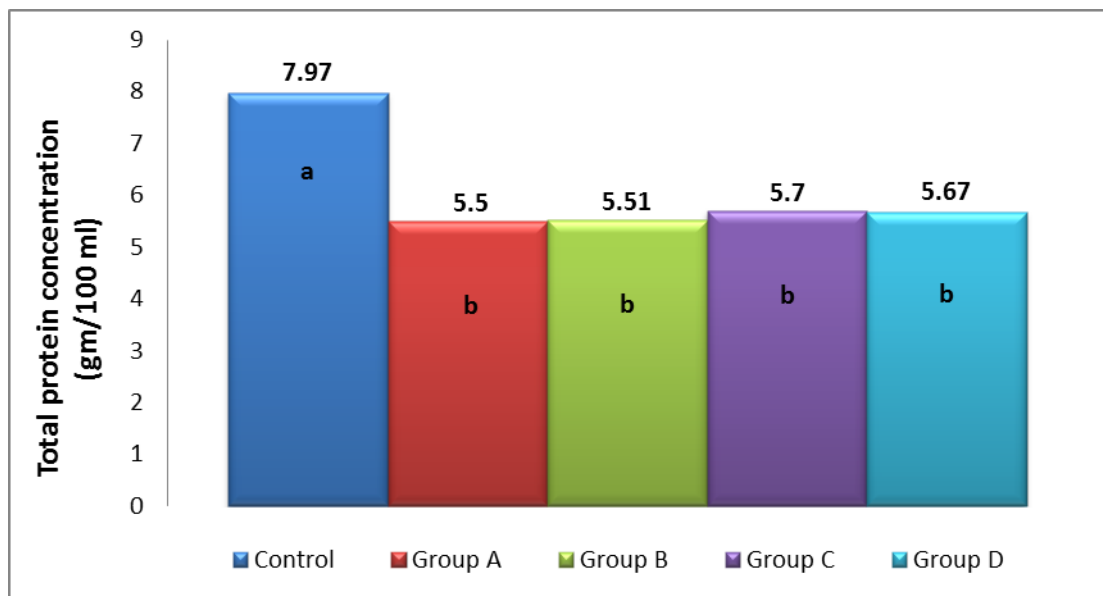
-The results in Figure (5) showed a significant decrease in globulin concentration in groups A,B,C and D, as it recorded  $1.21 \pm 0.14$  gm /100 ml,  $0.79 \pm 0.04$  gm /100 ml,  $0.80 \pm 0.06$  gm /100 ml and  $0.72 \pm 0.08$  gm /100 ml on respectively, compared to the control group ( $2.97 \pm 0.13$  gm /100 ml), but when comparing between the groups, we notice that there are no significant differences between group B,C and D, and a significant increase in group A compared to groups B, C and D.

The reason for this decrease may be due to the effect of high temperature on blood serum proteins and its increased degradation [23]. The reason can also be attributed to the occurrence of cases of thermal decomposition of protein or its accumulation in the cell or within cellular organelles, as exposure to high heat increases the kinetic energy of cellular molecules, then this energy spreads and is distributed inside the cell, so it is possible that the cases that we referred to above may occur. It has already been noted in previous studies that proteins are present in different cellular parts, such as mitochondria, microbodies, and nuclei [24]. As shown by AL-Qysi (1984) [25] in the study of plasma membranes exposed to high temperature to cause deformation of proteins and their degradation, because the high temperature leads to an increase in the activity of proteolytic enzymes, which leads to the destruction and decomposition of cell membrane proteins. In cell membrane lipids, it was also mentioned that the processes of protein degradation follow the process of changing lipid classes.

The results of the albumin agreed with the findings of Ganaie and his group (2013) [26], The reason for the low concentration of albumin can be attributed to its consumption as an antioxidant in the blood [27][28]. As albumin is an antioxidant because it works to reduce the production of free radicals [29]. Or the cause could be due to free radicals resulting from oxidative stress, which leads to renal impairment (nephron damage) and an increase in the amount of albumin protein filtered from the blood into the urine through the renal glomeruli [30][31]. The reason for the decrease in albumin concentration may be attributed to cases of severe and chronic hepatic impairment resulting from free radical toxicity [31].

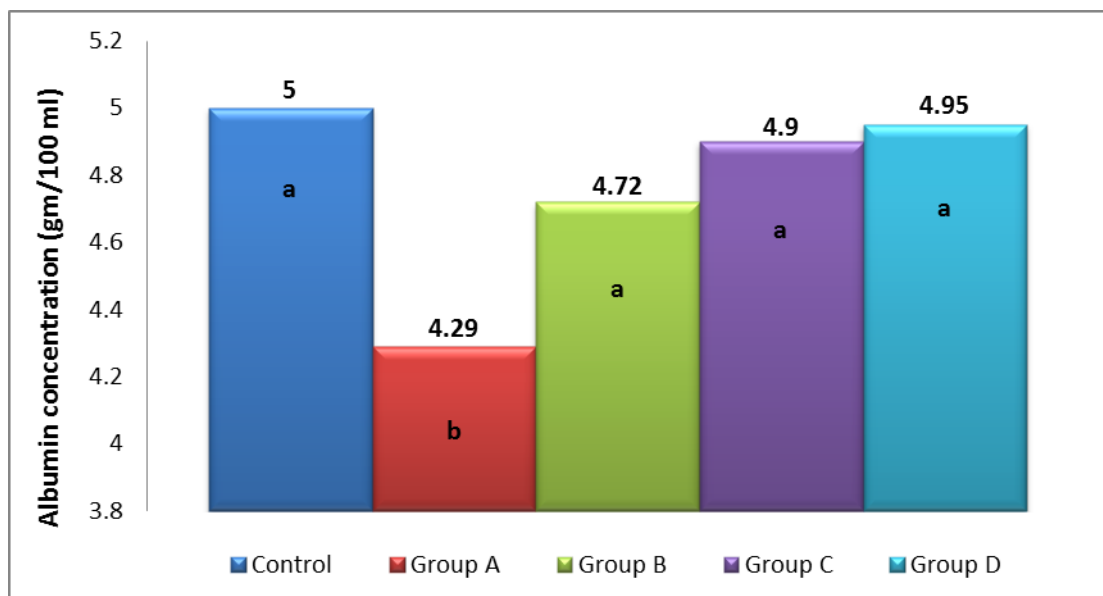
The decrease in globulin may be attributed to the weakness of the T- lymphocyte cells, as exposure to heat can cause changes in different parts of the immune and hormonal systems, which may lead

to an increase in the work of the central nervous system and the hypothalamus-hypophyseal axis, which in turn leads to an increase in some hormones such as cortisol, epinephrine and norepinephrine, as cortisol leads to undermining the body's natural immune response, causing the gradual destruction of lymphoid tissue and a decrease in the production of antibodies and lymphocytes, and given that immunoglobulin is produced by T- lymphocytes, it will be affected by the influence of lymphocytes, weakness or destruction [32].



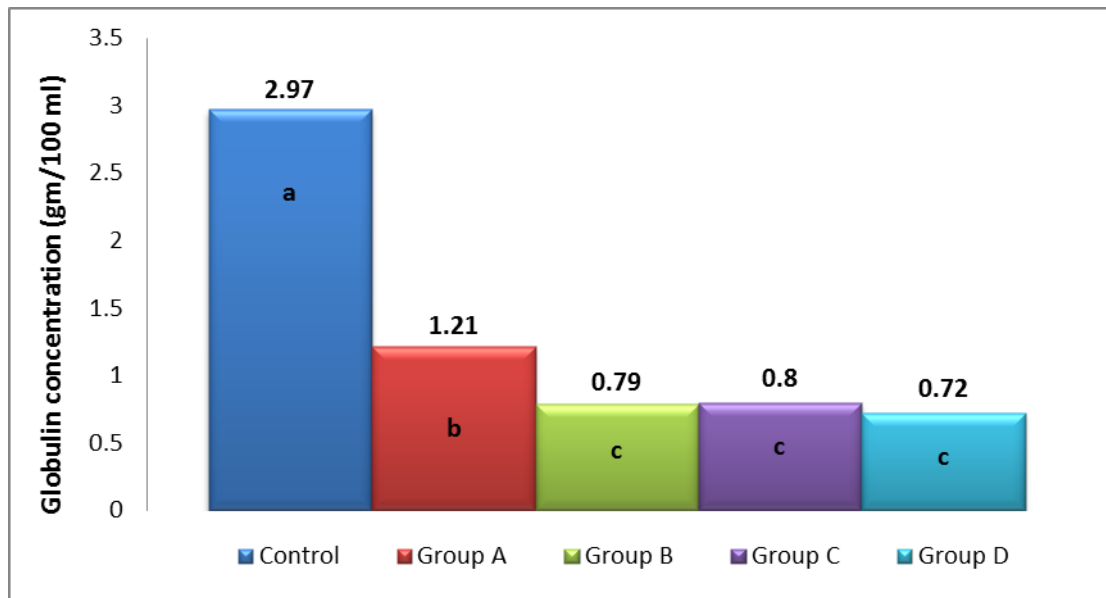
**Figure 3.** Concentrations of total protein in serum of the five groups.

Different letters mean that there are significant differences at a significant level of ( $p \leq 0.05$ )



**Figure 4.** Concentrations of albumin in serum of the five groups.

Different letters mean that there are significant differences at a significant level of ( $p \leq 0.05$ )



**Figure 5.** Concentrations of globulin in serum of the five groups.

Different letters mean that there are significant differences at a significant level of ( $p \leq 0.05$ )

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