EFFECT OF ENVIRONMENTAL TEMPERATURE AND HUMIDITY ON TOTAL HAEMOGLOBIN CONCENTRATION [+]

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Abstract:

A blood sample of 120 healthy students [60 male and 60 female] where live in Basra province was tested to study the effect of some environmental changes [temperature and humidity] on haemoglobin concentration. Two samples of venous blood were collected from each student during February and June 2012. Hb was estimated by Cyanmethemoglobin method. The results show no significant differences between the two samples collected. The present study suggested that long term exposure to hot and humid climate does not affect total haemoglobin concentration.

تأثير الحرارة و الرطوبة البيئية على تركيز هيموكلوبين الدم

سعد فهد الشواي

المستخلص:

تم فحص عينات دم لمائة و عشرين طالبا و طالبة من سكنةً مدينة البصرة لدراسة تأثير بعض المتغيرات البيئية (الحرارة و الرطوبة) على تركيز هيموكلوبين الدم. تم جمع عينتين من الدم الوريدي في شهري شباط و حزيران لسنة 2012. استخدمت طريقة السيانوميثموغلوبين في تقدير كمية هيموكلبين الدم. أظهرت النتائج عدم وجود فرق معنوي بين نموذجي الدم المحصلة. الدراسة الحالية تقترح عدم وجود تاثير للعوامل البيئية المحددة في الدراسة على تركيز هيموكلوبين الدم.

Introduction:

Physiological stress of environmental origin can affect body functions and fluid consistency [1]. However, total volume of blood normally remains within the normal limits because of blood homeostasis [2]. This homeostasis depends on complex physiological mechanisms [3, 4]. Among them is the hormonal regulation of blood volume [5, 6, and 7] and consistency [8, 9]. The effects of high temperature and humidity on blood haemoglobin concentration were mostly studied on animals [10, 11, 12, and 13]. The relationship between temperature and human blood components in tropical countries has not been investigated extensively. Most of these investigations were concern with the acute effect of temperature on blood indices [1]. It indicates that these effects were temporary and healthy people can return their blood indices with time [14].

Humidity has an additional potential effect to temperature on blood volume and consistency of people's lives in tropics [2]. This is because; high humidity decreases the body's ability to evaporate probably leading to increase heat stress [15]. High humidity also

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increases the density of the air. More dense air creates more resistance to airflow in the airway resulting in an increased work of breathing [16]. This has a negative additive effect on body functions and hence the corrective mechanisms [2, 15]. High temperature and humidity have another effect on the absolute O2 concentration in the air, or the amount of O2 molecules per unit air volume; which is additional environmental stress on body homeostasis [2].

The importance of the extensive studies on this subject is because; the body responses to high environmental temperature and humidity may affect dramatically body functions, mortality, and morbidity [15]. Anemia is a consequence of these changes that decreases the blood oxygen content and viscosity [17], leading to a serious public health problem [15]. Haemoglobin estimation is the primary method for detection of anemia [18] and as consequence the evaluation the physiological stress of environmental origin.

The present study is concern with the effect of some environmental parameters [temperature and humidity] on human haemoglobin concentration at Basra province/Iraq.

Method:

A whole blood of 120 healthy students was collected twice a year. Sixty healthy male students [Average Age = 20.78 ± 1.78] and the same number of healthy female students [Average Age = 20.16 ± 1.54] were chosen. All students are residence of Basra province.

The first collection was performed in February (2012) where the temperature and humidity is acceptable in the region; while the second collection was performed in June (2012) where environmental parameter reaches high levels. Table 1 show environmental temperature and humidity ranges at the time of blood withdraw.

Table 1: Temperature and Humidity Ranges

Time of blood collection	February	June
Temperature Range	8- 18 ^{O}C	36-46 ^{O}C
Humidity Range	9-25%	30-70%

Students were left to rest for one hour or a little more after their arrival to their college. Then blood withdraws would takes place and tested as soon as possible. The Lab indoor temperature was less than that of the outdoor temperature. In February, it was less in about 2 ^{O}C; while in June, it was less in about 5 ^{O}C. This difference is mainly because the indoor room doesn't have cooling system and it depends upon fans for cooling only. Beside the electricity was absent in most of the day. So the indoor cooling depends mostly on outdoor current and that is way the differences between outdoor and indoor temperature of low range.

Haemoglobin [Hb] was tested by Cyanmethemoglobin test because of its advantages [19, 20]. Blood was collected by venous puncture in EDTA vial. The samples were mixed well to avoid blood coagulation. Twenty microliter of blood was added to 5 ml of Drabkin's solution. A Randox kit of Drabkin's solution prepared by Randox laboratories limited [UK] was used. After 15-30 minute the solution read by spectrophotometer at a wave length of 540 nm to estimate the Hb concentration [21]. The total Haemoglobin concentration [g/dl] was directly determined from the calibration curve using haemoglobin standard [22].

The results were tested statically by T Test (23).

Results:

Figure 1 shows the individual presentation of temperature and humidity effects on blood Hb concentration in both sexes.

Male diagram indicates that both tests for each individual are nearly the same. The difference in Hb concentration for each individual at both tests ranges mainly between 0.1-0.6 g/dl. Only one male case has an Hb difference of 0.9 g/dl between both tests [Table 2].

Female diagram indicates that there is an individual difference in Hb value between both tests for few cases. These differences were in both directions. Still these differences are not dramatic. The average level of differences is located between 0.1-0.8 g/dl in most female individuals; only in 2 females the changes reaches 1.4 and 1.7 g/dl [Table 2].

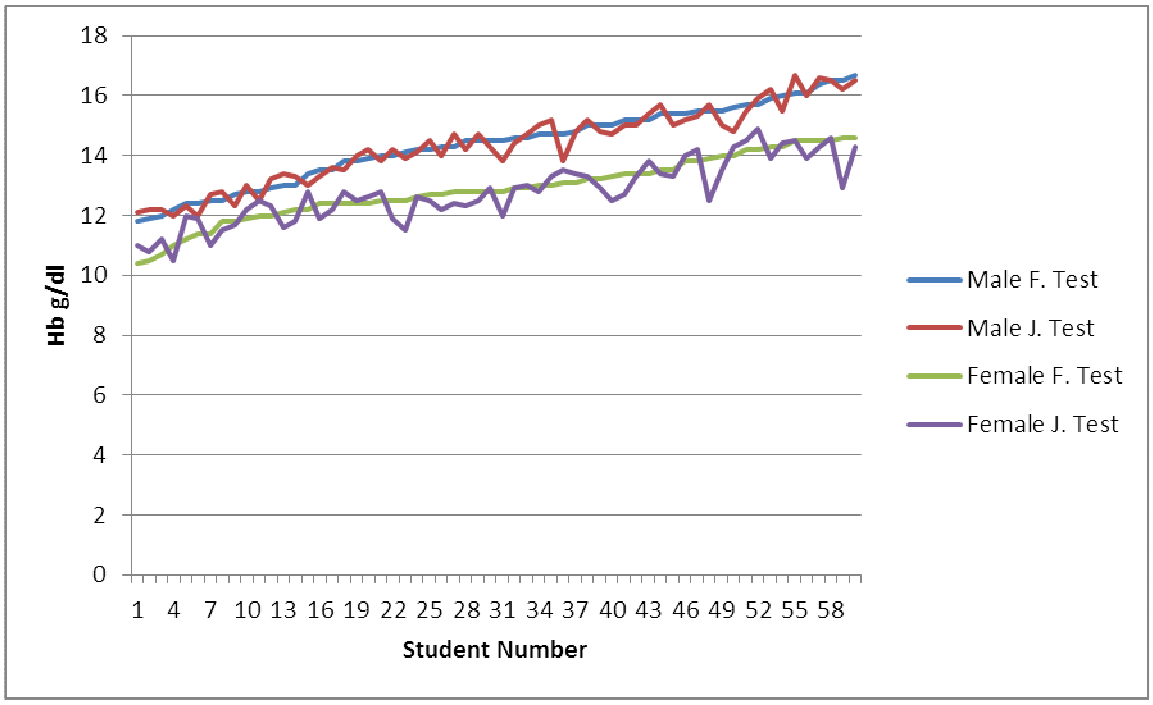

Fig. 1: Individual Presentation of temperature and Humidity effect on Total Hb Concentration

Table2: Male and Female Absolute Values of Hb in g/dl

N0. of Student	Male Hb Values		Female Hb Values		No. of Student	Male Hb Values		Female Hb Values	
	February Sample	June Sample	February Sample	June Sample		February Sample	June Sample	February Sample	June Sample
1	11.8	12.1	10.4	11	31	14.5	13.8	12.8	12
2	11.9	12.2	10.5	10.8	32	14.6	14.4	12.9	12.9
3	12	12.2	10.7	11.2	33	14.6	14.7	12.9	13
4	12.2	12	11	10.5	34	14.7	15	13	12.8
5	12.4	12.3	11.2	12	35	14.7	15.2	13	13.3
6	12.4	12	11.4	11.9	36	14.7	13.8	13.1	13.5
7	12.5	12.7	11.4	11	37	14.8	14.8	13.1	13.4
8	12.5	12.8	11.8	11.5	38	15	15.2	13.2	13.3
9	12.7	12.3	11.8	11.7	39	15	14.8	13.2	12.9
10	12.8	13	11.9	12.2	40	15	14.7	13.3	12.5
11	12.8	12.5	12	12.5	41	15.2	15	13.4	12.7
12	12.9	13.2	12	12.3	42	15.2	15	13.4	13.3
13	13	13.4	12.1	11.6	43	15.2	15.4	13.4	13.8
14	13	13.3	12.2	11.8	44	15.4	15.7	13.5	13.4
15	13.4	13	12.2	12.8	45	15.4	15	13.5	13.3
16	13.5	13.3	12.4	11.9	46	15.4	15.2	13.8	14
17	13.5	13.6	12.4	12.2	47	15.5	15.3	13.8	14.2
18	13.8	13.5	12.4	12.8	48	15.5	15.7	13.9	12.5
19	13.8	14	12.4	12.5	49	15.5	15	14	13.5
20	13.9	14.2	12.4	12.6	50	15.6	14.8	14	14.3
21	14	13.8	12.5	12.8	51	15.7	15.5	14.2	14.5
22	14	14.2	12.5	11.9	52	15.7	15.9	14.2	14.9
23	14.1	13.9	12.5	11.5	53	15.9	16.2	14.3	13.9
24	14.2	14.1	12.6	12.6	54	16	15.5	14.3	14.4
25	14.2	14.5	12.7	12.5	55	16.1	16.7	14.5	14.5
26	14.3	14	12.7	12.2	56	16.1	16	14.5	13.9
27	14.3	14.7	12.8	12.4	57	16.4	16.6	14.5	14.3
28	14.5	14.2	12.8	12.3	58	16.5	16.5	14.5	14.6
29	14.5	14.7	12.8	12.5	59	16.5	16.2	14.6	12.9
30	14.5	14.3	12.8	12.9	60	16.7	16.5	14.6	14.3

Figure 2 and 3 shows the mean group data of total Hb in g/dL for male and female. It is obvious that, there are no significant differences ($P > 0.05$) between februray and July tests for both sexes [Table 3].

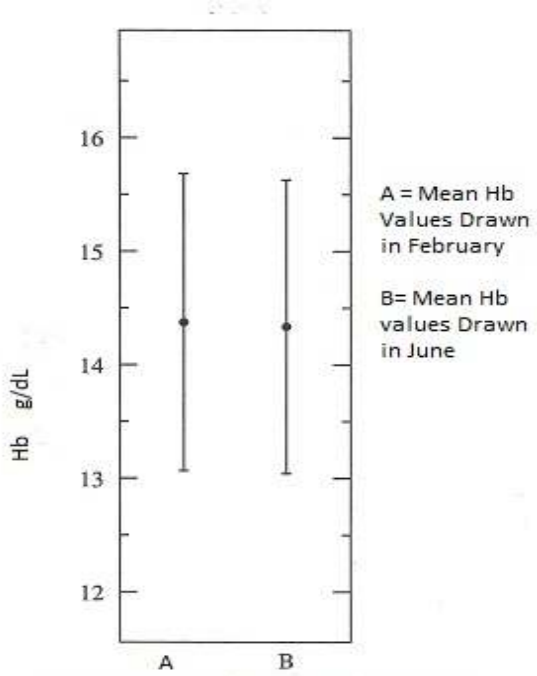

Fig. 2: Male Group Presentation of Some Enviroment Factors Effect on Hb

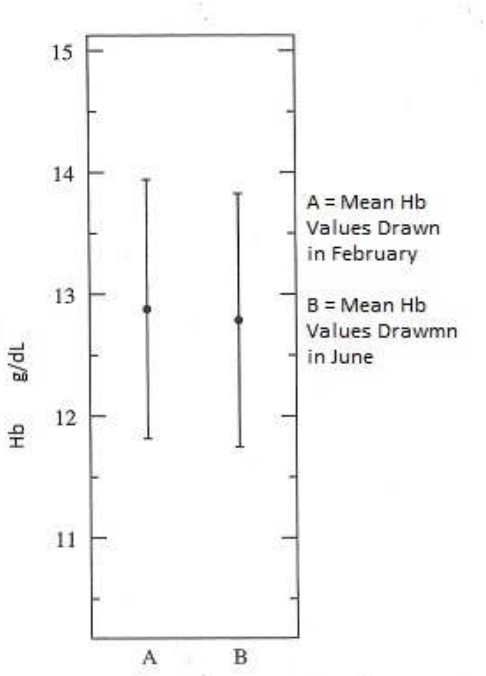

Fig 3: Female Group Presentation of Some Environmental Effects on Total Hb

Table 3: Statistical Data of Total Hb Values for both Sexes

Item	Male		Female	
	February Hb Samples	June Hb Samples	February Hb Samples	June Hb Samples
Number of Samples	60	60	60	60
Mean Hb Value	14.4	14.3	12.9	12.8
Standard Deviation	1.31	1.29	1.06	1.04
Hi. Value	16.7	16.7	14.6	14.9
Lo. Value	11.8	12	10.4	10.5
Average Absolute Deviation from Median	1.06	1.06	0.835	0.827
P Value [null hypothesis]	0.6311		0.8653	

Discussion:

Different studies indicate that acute exposure to a hot climate leads to an expansion of plasma volume and a corresponding fall in the circulating Hb level [12, 15, and 24]. This effect is temporary and hematological levels of healthy people will corrected with time [25].

This study is concern with the effect of long term exposure of humans to hot climate rather than to the acute one. It shows that there is no significant difference between Februray and July (2012) tests [$P > 0.05$] in both individual and group presentation [figure 1, 2, and 3]. This fact may be due to the acclimatization ability of local people to weather changes through blood homeostasis mechanisms [2, 3, 5, 6, 7, and 8].

The fact that high temperature and humidity affect human body functions and O_2 dissociation curve [2] is may be due to different factors. These factors are related to different human body functions. The present study indicates that the total haemoglobin amount is not

one of these factors. It shows that the long term exposure to environmental stress does not affect total Hb amount. This finding is supported by many other studies that indicate the temperature depressed the Hb affinity to oxygen rather than the drop in haemoglobin concentration [10, 26, and 27]. Others indicate that both high temperature and humidity causes breathing difficulties because of the increase in air density and bronchospasm [15].

Table 2 shows few females exhibit a change in Hb concentration in both directions for the two tests. Those who had a difference between 0.1 to o.8 g/dl; although it is not significant, but it could be due to different reasons, among them nutritional, menstrual, physical, or psychological stress [2, 15, 18, and 20]. The other two females who exhibit an Hb change of 1.4 and 1.7 g/dl were just recovered from their menstrual cycle of profuse type and this is might be why they show these changes [2].

Conclusions:

The results of present study show there is no effect of environmental changes [temperature and humidity] on Hb concentration. The results suggest that the symptoms which people suffer from during hot and humid weather are not because the decrease in Hb blood concentration and as consequence low blood oxygen level. It might be due to the decrease in the affinity of Hb to bind oxygen; or because the low partial pressure of air gases.

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