COMPARATIVE STUDY OF HEMATOLOGICAL ADAPTATIONS TO PROLONGED HEAT ACCLIMATIZATION IN TRAINED AND UNTRAINED MALES

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ABSTRACT

BACKGROUND: Adaptation to exercise stands for body's physiological response to training. The process through which the body becomes acclimated to a specific exercise or training regimen through repeated exposure is referred to as the principle of adaptation. This study aims to assess the effect of exercise on haemoglobin concentration and some other haematological parameters in trained and untrained male individuals.

METHODS: Healthy trained and healthy untrained men were selected, who fulfilled the inclusion criteria and after that blood sample were taken by the cooperation of Biochemistry and Pathology department. From the blood sample Hb, MCV, MCHC, and MCH were calculated.

RESULTS: The trained group of individuals showed significant increase in haemoglobin, MCH, MCHC and MCV values as compare to untrained male individuals and these values were significant among 21-30 years of age group.

INTRODUCTION

An organism's capacity for exertion and sustained activity over time, as well as its resistance to stress, tiredness, and wounds, as well as its capacity to recover from these stresses, are all example of endurance. In either aerobic or anaerobic activity, it is typically used. When engaging in high intensity anaerobic exercise, the definition of "long" is minutes; when engaging in low intensity aerobic exercise, the term is hours or days. Reduced capacity to exert endurance strength can result from endurance training.[1] During the initial exercise-heat exposure, physiological strain is high, as manifested by elevated core temperature and heart rate. Each day of acclimatisation reduces the physiological stress brought on by the same exercise-heat stress. Exercise in the heat increases physiological strain, attenuates exercise

capabilities and increases susceptibility to exertional heat illness and the potentially fatal, exertional heat stroke.[2] Also it was reported that even a comparable brief training session of six weeks would result in rapid changes in the RBC population, increasing the proportion of youthful RBCs and rejuvenating the entire RBC population.[3] The human body responds to any physical stimulus with a sequence of coordinated changes in function that affect the majority, if not all, of its physiologic systems. The ability to move requires the activation and regulation of the musculoskeletal system, which can only be sustained for long periods of time by the cardiovascular and respiratory systems. Each of these physiologic systems goes through distinct adaptations when the body exercises several times a week or more regularly, increasing the body's efficiency and capability.

The focus of the present study is on resistance exercise such as exercises for building strength and aerobic exercise such as walking, running, cycling, jogging swimming, and dancing.[4] An individual become healthier and more energised after exercising and also feel better about himself. As it is well known that exercise is beneficial for health if it is done on regular basis. In present research this is proved by the facts, when it was seen that there was a difference in the numerical value of blood parameters (Hb, MCH, MCV, and MCHC) in trained and untrained individuals. The study showed that regular exercise has a relationship with increased values of haemoglobin and blood indices (MCH, MCV, and MCHC) level.

MATERIAL AND METHODS:

The study was done on 60 randomly selected male subjects of age group between 21 - 40 years of age. Two groups were created. Group 1, included 30 Trained Male Individuals and group 2, included 30 untrained Male Individuals. 30 subjects of group 1, were trained individuals selected from Endurance and Kingkong gym in Pawanpuri, Bikaner, Rajasthan

and another 30 subjects of group 2 were untrained individuals selected randomly from Bikaner city. All selected individuals were in between the age group of 21-40 years. This cross sectional comparative study was conducted in the department of Physiology in association with of Department of Pathology, S.P. Medical College, Bikaner, Rajasthan after taking informed consent of the subjects. The following inclusion and exclusion criteria was used:

Inclusion Criteria:

(a) Healthy individuals in the age group of 21 – 40 years.

(b) Individuals who were co-operative with the method and given consent.

Exclusion Criteria:

(a) Anaemic and polycythemic individuals.

(b) Patients of Respiratory disease (obstructive and restrictive) individuals.

(c) Smokers

According to inclusion and exclusion criteria subjects were selected. Height (cm) and weight (Kg) was measured with the help of validated and standardized instruments, stadiometer and weighing machine and thereafter BMI was calculated. Blood samples were taken to measure the haemoglobin level, MCV, MCH and MHCH level in the blood.

Statistical Analysis:

The study groups (group 1 & 2) were analyzed after dividing into two age groups, one was 21-30 years of age and another was 31-40 years of age each for trained and untrained male

individuals. Student's t test for independent sample was used to compare the measured variables between trained and untrained individuals. P value 0.05 was taken as significant.

RESULTS: Following observations were noted and presented in tabular forms:

Table 1: Distribution of cases according to age group with trained and untrained individuals

S. No.	Age Group (years)	Trained individuals (n)	Untrained individuals (n)
1.	21-30	15	15
2.	30-40	15	15
Total		30	30

Table 2 : Mean BMI comparison with trained and untrained individuals

Age group	Study group	BMI		t vale	p value
		Mean	SD		
21-30	Trained	21.66	3.026	1.636	0.1131
	Untrained	20.28	1.244		
31-40	Trained	21.00	1.488	0.2696	1.141
	Untrained	21.67	1.716		

Table 3: Mean Hb comparison with trained and untrained individuals

Age group	Study group	Hb		t vale	p value
		Mean	SD		
21-30	Trained	16.79	0.2487	4.476	0.0001
	Untrained	14.58	1.703		
31-40	Trained	16.73	0.3658	0.8489	0.4032
	Untrained	24.87	3.712		

Table 4: Mean MCV comparison with trained and untrained individuals

Age Group	Study group	MCV		t vale	p value
		Mean	SD		
21-30	Trained	97.70	1.398	5.711	0.0001
	Untrained	85.77	7.973		
31-40	Trained	97.87	1.053	5.761	0.0001
	Untrained	87.24	7.072		

Table 5: Mean MCH comparison with trained and untrained individuals

Age group	Study group	MCH		t vale	p value
		Mean	SD		
21-30	Trained	31.59	0.4926	2.033	0.0517
	Untrained	30.07	2.854		

31-40	Trained	31.49	0.5599	1.137	0.2651
	Untrained	30.86	2.100		

Table 6: Mean MCHC comparison with trained and untrained individuals

Age group	Study group	MCHC		t vale	p value
		Mean	SD		
21-30	Trained	35.31	0.4926	5.970	0.0001
	Untrained	32.20	1.814		
31-40	Trained	34.82	0.7233	1.137	0.0011
	Untrained	33.18	1.593		

DISCUSSION:

The present study showed no statistic significant difference for BMI level between trained and untrained individuals (Table 2). A statistically significant difference was seen in the mean value of haemoglobin level between endurance trained and untrained individuals between the age group of 21-30 years (p= 0.0001), however no significant difference was seen for haemoglobin level in age group of 31-40 years (p= 0.4032) (Table 3) . The present study showed a significant difference for that mean value of MCV and MCHC in endurance trained and untrained individuals of both the age groups. ($p<0.05$) (Table 4 & 6). It was also observed that mean value of MCH in endurance trained and untrained individuals between the age group of 21-30 year was significantly different (p= 0.05) than those who were in age

group of 31-40 years (p= 0.26) (Table 5). A study done by McCleave et al in 2017 found that in endurance trained individuals with high Haemoglobin mass, heat imposed on Endurance Trained may trigger a further erythropoietic stimulus, leading to additional Haemoglobin mass expansion.[5] Same type of finding was reported by Periard et al in 2016 that exercise-heat acclimation may impose an erythropoietic stimulus which further increase Hb mass. In present study it was found that mean values of haemoglobin was higher in the trained individuals of 21-30 years of age group.[6] The haematological response to acute and chronic exercise has recently been reviewed and it is commonly accepted that both acute and chronic exercises induce many haematological changes in humans which can justify the variations of MCH, MCV and MCHC values in the trained and untrained individuals. Researches within the past few years have demonstrated that exercise stimulates erythropoiesis and tends to increase the RBCs after competition or training.[7] Hu et al (2011) also addressed that exercise have a positive effect on RBCs indices in human.[8] In present study all the indices of RBC was found significantly higher among age group of 21-30 years in trained individuals. MCV is often used as a sensitive indicator in the diagnosis of iron deficiency anemia.[9] In the process of exercise-induced haemoglobin in the correlation analysis between haemoglobin and red blood cell parameters shows that MCHC and MCV have the greatest correlation with haemoglobin concentration, also a certain correlation between MCH, MCHC, and MCV was reporetd.[10,11] Physical activity in the terms of regular exercise stimulates the activity of skeletal muscle which causes increase oxygen consumption and increases the number of red blood cells, so the trained individual were doing exercise since last two years which leads to enhance in the blood indices values (MCH,MCV, and MCHC). Trained individual were doing exercise daily and consuming protein rich food or diet so this type of food pattern leads to increase in haemoglobin concentration also.

CONCLUSION:

This study was conducted with the aim of comparing beneficial effects of exercise on blood parameters like haemoglobin and blood indices (MCV, MCH, and MCHC). The trained group of individuals showed significant increase in haemoglobin, MCH and MCV value. The study concludes that doing exercise is, has their own positive effect like enhance our Hb concentration along with blood indices(MCH,MCV,MCHC), therefore exercise on a regular basis or at least 5 days in a week is important for healthy body and mind.

ABBREVIATIONS

Hb: Haemoglobin

RBC: Red blood cells

BMI: Body mass index

MCH : Mean corpuscular haemoglobin.

MCV: Mean corpuscular volume.

MCHC : Mean corpuscular haemoglobin concentration

REFERENCES:

1. RC Hickson .“Interference of strength development by simultaneously training for strength and endurance over a long period”. European journal of applied physiology and occupational physiology 1980;45(2-3):255-263.

2. Racinais S, Periard J D, Karlsen A, Nybo L. Effect of heat and heat acclimatization on cycling time trial performance and pacing. Medical Science Sports Exercise 2015; 47 : 601–606.
3. Brinkmann C, Bizjak DA, Bischof S, Latsch J, Brixius K, Bloch W. Endurance training alters enzymatic and rheological properties of red blood cells (RBC) in type 2 diabetic men during in vivo RBC aging. Clinical Hemorheol Microcircirculation 2016;63:173–84.403–7.
4. Armstrong RB, Warren GL, Warren JA. Mechanisms of exercise-induced muscle fibre injury. Sports Medicine 1991;12:184–207.
5. McCleave, E. L., Slattery, K. M., Duffield, R., Saunders, P. U., Sharma, A. P. Crowcroft, S. J. Temperate performance benefits after heat, but not combined heat and hypoxic training. Medical Science Sports Exercise. 2017;49: 509 –517.
6. Periard, J. D., Travers, G. J., Racinais, S. and Sawka, M. N. (2016). Cardiovascular adaptations supporting human exercise-heat acclimation. Auton. Neurosci. 196, 52–62.
7. Biomarkers of bone formation and association with red blood cell variables. J Physiol Biochem, 2011;67:351– 358 Hu M, Finni T, Xu L, Zou L, Cheng S.
8. Schumacher YO, Schmid A, Grathwohl D, Bültermann D, Berg A. Haematological indices and iron status in athletes of various sports and performances. Medical Science Sports Exercise. 2002;34(5):869-75.
9. Pitriani P, Febrianty MF. The Sex Difference in Haemoglobin Level, Systolic and Diastolic Blood Pressure of Dragon Boat Athletes 4th International Conference on Sport Science, Health, and Physical Education (ICSSHPE 2019). Adv Health Sci Res. 2020;21: 199-201.

10. Weng X, Chen H, Yu Q, Xu G, Meng Y, Yan X, et al. Intermittent Hypoxia Exposure Can Prevent Reductions in Haemoglobin Concentration After Intense Exercise Training in Rats. Front Physiol. 2021;12: 627708.
11. Mir Balochi R, Salesi M, Chardah Cheric M, Koushki Jahromi M, Sadeghipour HR. The Effect of One Session Exhaustive Exercise on Hepcidin, Iron, Ferritin and Haemoglobin of Female Athletes. J Fasa Univ Med Sci. 2019;9(3):1585-95.