International Journal of Physiology
Volume 11 No. 1, January-June 2023

Comparision of Exercise Induced Alteration of Hematological Profile in Sedentary Post Pubertal Boys and Girls

Manivannan P[1], Vinodha R[2], Shanmugapriya C[3]

[1]Final Year Postgraduate, [2]Professor and Head, [3]Assistant Professor, Department of Physiology, Thanjavur Medical College, Thanjavur

How to cite this article: Manivannan P, Vinodha R, Shanmugapriya C. Comparision of Exercise Induced Alteration of Hematological Profile in Sedentary Post Pubertal Boys and Girls. International Journal of Physiology/ Vol. 11 No. 1, 2023.

Abstract

Background: Moderate intensified exercise causes leukocytosis due to increased trafficking of white blood cells and also causes red blood cells damage (RBC) and hemolysis due to osmotic and mechanical stress.

Aim: This study was aimed to investigate the exercise induced changes in the haematological profile in sedentary post pubertal boys and girls

Methodology: 40 participants (20boys, 20 girls) with sedentary behaviour in the age group of 16 to 25 were selected from outpatient department of Thanjavur Medical College, for this study. Participants were asked to run in treadmill at the speed of 3km per hour at 0% elevations for few minutes then progressive incremental treadmill running with change in speed 1km per hour and elevations(1%) alternatively after each 2 mins for 20 mins. Informed consent was taken from the participants.

This study was approved by human ethics Committee Thanjavur Medical College, Thanjavur.

Blood samples collected from sedentary post pubertal boys and girls before and immediately after exercise to assess the hematological variation in Hemoglobin (Hb), White blood cells (wbc), Red blood cells (Rbc) and differential count, and the results were statistically analysed using paired t –test.

Results: Post exercise Hb was significantly higher in post pubertal girls (10.69±1.20 g%) as compared to boys (12.3±1.94 g%); p=0.029, p≤0.05. Also post exercise RBC showed significance with p value of 0.016 (p≤0.05) in girls (4.20 ± 0.47 million/cumm) as compared to boys (4.67 ±0.70 million/cumm, p=0.261, p≥0.05). Leukocyte count, lymphocyte, neutrophil increased significantly in both groups following exercise. Eosinophils increased significantly in girls (3.20±1.15(%), (p=0.024, p≤0.05)) as compared to boys (3.20±0.95(%), (p=0.886, p≥0.05).

Conclusion: We conclude that post exercise Hb, RBC, Eosinophil showed significant rise in females as compared to males. Leukocytes, neutrophils and lymphocytes showed significance in both genders. Genders have insignificant impact on exercise induced alteration of hematological profile except Hb, RBC and Eosinophils.

Key Words: Hb, RBC, WBC, Differential Count, Gender

Corresponding Author: P. Manivannan, Final Year Postgraduate, Department of Physiology, Thanjavur Medical College, Thanjavur.

E-mail: psmvannan1984@gmail.com

Introduction

Acute high intensity exercise increases the white blood cell count in the circulation. Post exercise variation in haematological profile ,depends on individual health status, fitness, type and duration of training. Regular exercise may boost immune system while high intensity exercise or over training may lead to adverse changes in immune system. Few other literature reveals no significant influence of exercise on leucocyte count. High intensity exercise results in significant leukocytosis mediated mostly by transitory lymphocytosis and monocytosis followed by delayed neutrophilia. Such neutrophilia may persist for few hours after exercise. The increase in leukocyte count, especially neutrophilia used as inflammatory marker. Some studies also indicate that exercise induced trafficking of basophil and eosinophil may have vital role in exercise induced upper respiratory tract hyper-responsiveness, broncho constriction, and allergic manifestation.

Studies showing impact of gender on exercise induced variations in blood cell count is very minimal in adolescent age groups. Timmons [6] et al examined the gender variations in blood cell count among peadiatric subjects having minimal age differences of 12-14years of age. The findings did not clearly predict the impact of attainment on gender variations in post exercise haematological alterations among post pubertal boys & girls, Both the findings of Timmons et al [6] in Pediatric age group contradicted the findings of sand KL et al [4] so It is clear that different status of physical and physiological maturations have different effect on gender induced changes in post exercise haematological alterations.

Study on exercise induced alterations of haematological profile is very minimum in India. So the study was aimed to study the exercise induced haematological changes in Total RBC Count, WBC Count, Haemoglobin (Hb) Lymphocyte, Monocytes ,Eosinophil and basophil in post pubertal sedentary boys and girls.

Materials and Methods

Selection of subjects:

Sedentary post pubertal boys and girls were randomly selected for study. 20 boys and 20 girls totally 40 participants of age group between 16 to 25 selected randomly from outpatient department of Thanjavur Medical College Hospital. The study was approved by human ethics Committee Thanjavur Medical College, Thanjavur(958\2022). Written and Informed consent were taken from the participants. The study was done at department of physiology, Thanjavur Medical College from may to july 2022.

Sedentary individual were selected with following criteria.

1. Individual with daily physical training activities for less than 60 minutes. 2) Individuals in sedentary pursuits ,continuously for more than 6-7 hrs/day .

Post pubertal boys and girls with chronic illness, congenital heart disease, severe anemia, known cases of blood dyscrasias, girls during menstruation, and girls using contraceptive pills were excluded from studies. The participants were advised not to involve in in any strenuous or high intensity physical activity or exercise for atleast 10 days prior to study. They were advised to have balanced diet for the above said days.

EXPERIMENTAL PROTOCOL:

With all the pandemic precautions, all the study participants were given Trial on treadmill in order to alleviate the anxiety before participating in study. During the study the subjects were advised to come by 9am to department after light breakfast, subjects were advised to be at rest for 30 minutes before the study. The vital parameters like BP, pulse and heart rate were recorded. Blood samples were collected from anticubital veins. Participants were asked to run in treadmill at the speed of 3km per hour at 0% elevations for few minutes for warmup then progressive incremental treadmill running with change in speed 1km per hour and elevations(1%) alternatively after each 2mins. The procedure continued for 20-30 minutes until the participants gets exhausted. Then post exercise blood samples were collected from anticubital vein immediately after stoppage of exercise.

ERBA H360 HEMATOLOGY ANALYSER &

COSCO K22 TREADMILL were used for this study.

All datas were reported as mean ± SD.

Paired t-test was performed in each group to ascertain significant difference in hematological parameters measured before and after the exercise and P ≤ 0.05 was considered significant.

Results

The pre exercise and post exercise values and the change in hematological parameters are presented in table 1 & 2

Post exercise RBC (4.2095±0.47million\cumm & p=0.016) and Hb (10.695±1.189gm% & p-0.029) are significantly higher in post pubertal girls as compared with preexercise values. Leukocyte count increased significantly in both genders following exercises (boys 8864.50±2791.6cells\cumm, p=0.009(p≤0.05), for girls 10.334±1852 cells\cumm, p=0.004,p≤0.05. No significant intergroup difference in pre and post exercise changes in total leukocyte count following exercise. Significant increase in lymphocytes (boys 40.75±2.722%, p=0.001, girls 42.85±3.768, p=0.001) and neutrophils (boys-62.95±3.665, p=0.000, girls-58.40±3.558, p=0.000) were noted in both gender.

Eosinophils showed significant(3.20± 1.152%,p-0.002 ≤ 0.05) rise in girls, post exercise as compared to boys(3.20±0.95(%), (p=0.886,p≥0.05).

Table 1: Comparison of hematological parameters in pre and post exercise levels in boys

Parameters	Mean		SD	P value	Inference
HB (gms%)	Preexercise	12.2050	0.55105	0.450	Not significant
	Post exercise	12.3000			
WBC (cells\cumm)	Preexercise	8188.50	1030.565	0.009	Significant
	Post exercise	8864.50			
RBC (million\cumm)	Preexercise	4.5670	0.40732	0.407	Not significant
	Post exercise	4.6725			
NEUTROPHIL (%)	Preexercise	57.75	3.665	0.000	Significant
	Post exercise	62.95			
LYMPHOCYTE(%)	Preexercise	38.35	2.722	0.001	Significant
	Post exercise	40.75			
EOSINOPHIL(%)	Preexercise	3.15	1.538	0.886	Not significant
	Post exercise	3.20			
MONOCYTE(%)	Preexercise	2.50	0.813	0.419	Not significant
	Post exercise	2.65			

(P ≤ 0.05 significant)

For boys the values like WBC (boys 8864.50±2791.6 cells\cumm p=0.009 (p≤0.05), Neutrophil (62.95±3.66%, p=0.00), Lymphocyte (40.75±2.722, p=0.001) were significant. HB(12.3±1.94 g%);p=0.029, p≤0.05 ,RBC(4.67 ±0.70 million/cumm, p=0.261,p≥0.05), Eosinophil(3.20±0.95(%), (p=0.886, p≥0.05). and Monocyte(2.65±0.813, P=0.419) were insignificant in boys as compared to girls.

Table 2: Comparison of hematological parameters in pre and post exercise levels in girls

Parameters	Mean		SD	P value	Inference
HB (gms%)	Preexercise	10.5200	0.33226	0.029	Significant
	Post exercise	10.6950			
WBC(cells\cumm)	Preexercise	9752.25	789.313	0.004	Significant
	Post exercise	10334.75			
RBC(million\cumm)	Preexercise	4.1060	0.17599	0.016	Significant
	Post exercise	4.2095			
NEUTROPHIL(%)	Preexercise	54.25	3.558	0.000	Significant
	Post exercise	58.40			
LYMPHOCYTE(%)	Preexercise	39.60	3.768	0.001	Significant
	Post exercise	42.85			
EOSINOPHIL(%)	Preexercise	2.65	0.999	0.024	Significant
	Post exercise	3.20			
MONOCYTE(%)	Preexercise	2.50	0.923	0.163	Significant
	Post exercise	2.80			

(P ≤ 0.05 significant)

For girls all the values like Hb(10.69±1.20g%, p=0.029, p≤0.05, RBC ((4.20 ± 0.47 million/cumm, p=0.016). WBC (10334±789, P=0.004cells/cumm), lymphocyte (42.85±3.768%, p=0.001), neutrophil (58.40±3.558%, p=0.000), Eosinophils(3.20±0.999%, p=0.024), Monocytes (2.80±0.923%, p=0.163) were significant.

Discussion

Exercise leads to moderate rise in blood cell counts especially lymphocyte & neutrophil. This may be due to stress induced alteration of immune function and inflammatory response to exercise. This study examined the effect of exercise induced alterations of hematological parameters in sedentary postpubertal boys & girls.

It is noted from the study that post pubertal boys had higher basal Hb as compared to the girls of same age group. There was insignificant gender difference in baseline values of RBC, Wbc count. Acute moderate intensity exercises shows significance in Rbc count, Hb in girls as compared to boys. Few previous studies reported that exercise leads to Rbc damage and hemolysis due to osmotic and mechanical stress induced by exercise. Foot stroke, hemolysis [1,2] & free radical mediated lipid peroxidations of Rbc membrane [3,4] were seen due to exercise induced intravascular hemolysis results in increased plasma Hb concentrations after the exercises [3]. Though acute high intensity exercise of shorter duration showed no changes in erythrocyte count and Hb. But in this current study showed moderate intensity exercise results in significant influence in Hb, Rbc count in girls. Further studies with more number of participants are needed to confirm the duration endurance and severity of exercise induced variables.

The total leukocyte count increased significantly in both genders. That showed exercise resulted in leukocytosis in both genders due to exercise induced stress.so its noted that moderate and high intensity physical exercise to cause leukocytosis, variation may depend on duration & intensity of exercise[5,6,7]. Previous studies suggested that exercise induced leukocytosis mostly due to release of lymphocyte, monocyte and neutrophil in to the circulation due to exercise stress. Exercise intensity leads to an increase in sympathetic activity leads to release of catecholamines such as epinephrine and norepinephrine, which may be the reason behind increased trafficking of immune cells such as

lymphocytes into circulation from lymphoid organs such as spleen causing increase in wbc count. The lymphocyte count in post exercise status showed significance in both genders.

Post exercises monocyte count showed significant increase in girls as compared to boys. Boys showed insignificant changes, that may be due to –exercise induced trafficking of lymphocyte in circulations which showed decrease in relative proportion of monocyte with respect to total WBC in circulation.

Exercises induces neutrophilia in both genders .The previous studies confirmed similar effect in acute exercise[6]. Similar studies also indicated that neutrophils, mobilized into peripheral circulation in response to exercise from the bone marrow leading to profuse neutrophilia.

Post exercise eosinophil count increased significantly in girls as compared to boys, but the relative proportion of eosinophil showed decrease in level, due to increase in lymphocyte and neutrophil count is higher in both genders as compared to eosinophil. Previous studies also reported that strenuous exercises associated with incidence of upper respiratory tract infections[9], hyperresponsiveness and bronchoconstrictions caused by airway mucosal inflammations. So the eosionophils have been described as one of the proinflammatory cells responsible for upper respiratory tract reactions, including damage to respiratory epithelium. Its also suggested that exercise may cause hypoxemia due to increase in histamine level released mostly from basophils[10,11,12]

Conclusion

We conclude that post exercise Hb RBC, Eosinophil showed significant rise in females as compared to males. Exercise causes substantial rise in leukocyte in both genders mostly neutrophils and Lymphocytes. Eosinophil showed significant rise in girls as compared to boys.

Genders have significant impact on exercise induced altertation of hematological profile in Hb, RBC, Eosinophil.

Limitations of the Study:

Our study provided only a glimpse of haematological changes taking place after exercise in our study participants. Our study included only minimal study participants, so in future more detailed study involving large population with changes in hematocrit and platelet count will also be done.

Financial Support and Sponsorship: Nil

Conflicts of Interest: There are no conflict of interest

Reference

1. Mairbaurl H, Humpeler E, schberger G, Pessenhofer H.Training –dependent changes of red cell density and erythrocytic oxygen transport. J appl physiol Respir Environ Exerc physiol 1983;55:1403-7
2. Radomsky M, sabiston B, Isoard P. Development of sports anemia in physically fit men after daily sustained submaximal exercise. Aviat space Environ Med 1980;51:41-45
3. Senturk UK, Gunduz F, Kuru O, Aktekin MR, Kipmen D, Yalcin O, et al .Exercise –induced oxidative stress affects erythrocytes in sedentary rats but not exercise –trained rats. J Appl physiol 2001;91:1999-2004
4. Smith JA, Kolbuch –Braddon M, Gillam I, Telford RD, Weidemann MJ. Changes in the susceptibility of red blood cells to oxidative and osmotic stress following submaximal exercise. Eur J Appl Physiol Occup Physiol 1995;70:427-31
5. Nieman DC. Exercise, infection, and immunity. Int J Sports Med 1994;15:131-41
6. Timmons BW. Paediatric exercise immunology; Health and clinical applications. Exerc Rev 2005;11:108-44
7. Neves PR, dos Santos Tenorio TR, Lins TA, Muniz MT, pithon –Curi TC, Botero JP, et al. Acute effects of high and low intensity exercise bouts on leukocyte counts. J Exerc sci fit 2015;13:24-8
8. Pedersen BK ,Hoffman-Goetz L,. Exercise and the immune system: Regulation, integration, and adaptation. Physiol Rev 2000;80:1055-81
9. Mucci P, Anselme-Poujol F, Caillaud C, Couret I, Rossi M, Prefaut C. Basophil releasbility in young highly trained and older athletes. Med Sci sports Exerc 1999;31;507-13
10. Exercise physiology for health. fitness, and performance 5th edition 112-21
11. Biomechanics and exercise physiology, Quantitative modeling by Arthur t.Johnson 524-35.