Original article

Effect of Regular Exercise on Some Hematological Parameters: A Cross-Sectional Analysis

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Abstract:

Background: Regular exercise is thought to play a key role in controlling the function of blood cells. Exercise is a powerful stimulus to alter hematological parameters like red blood cell count, hemoglobin, hematocrit, mean corpuscular volume, total white blood cell count, differential count (%) of neutrophils, lymphocytes, and platelets. **Objectives:** To observe the effect of regular exercise on some hematological parameters in regularly exercising healthy adult males and relate the RBC parameters with exercise duration. **Methodology:** This cross-sectional study was conducted from July 2021- June 2022 in the Department of Physiology, Chittagong Medical College in collaboration with Lift n Life Fitness Arena gym; Muscle Mania gym, and Agrani Bank Laldighi corporate branch, Chattogram. A total of 74 male subjects, aged between 20-50 years and with a BMI of 18.5-27.5 kg/m² were included in this study by convenient sampling. 37 persons exercising regularly in the gym were included in group A. Age, height, weight, and BMI matched 37 persons were included in group B who were selected from bank officials. Collected data were analyzed by SPSS-26. Between groups, a comparison of quantitative variables was done by independent sample t-test. Pearson's correlation test was done to see the correlation of RBC parameters (RBC count, Hb, HCT, MCV) with the duration of exercise. **Result:** Mean values of RBC count, Hb, and HCT were significantly higher but total WBC count was significantly lower in group A (gym exercising) compared to group B (non-exercising). (p<0.05). MCV, DC (%) of neutrophils, lymphocytes, and platelets showed insignificant changes between groups. (p>0.05). RBC and MCV showed a significant positive correlation with the duration of exercise (p<0.05), while Hb and HCT didn't show any correlation. (p>0.05). **Conclusion:** The results of this study conclude that regular exercise has an effect on some hematological parameters in healthy adults.

Keywords: Exercise, Adult males, RBC count, Hemoglobin (Hb), Hematocrit (HCT), Mean corpuscular volume (MCV), total WBC count, differential count (%) of neutrophil and lymphocyte, platelets.

Introduction:

A sedentary lifestyle adversely affects the physical performance of human beings.[1] There is increasing evidence of the link between a sedentary lifestyle and adverse outcomes.[2] According to WHO, up to 5 million deaths per year can be prevented if the global population is more active.[3] It was reported that insufficient physical activity is

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highly prevalent among the Bangladeshi adult population.[4] Regular exercise improves the efficiency of various systems in the body, whereas lack of exercise results in hypovolemia, hematocrit imbalance, and immune dysfunction.[5,6] Physical activity indicates walking, cycling, swimming, sports, and active recreation that can be done at any level of skill.[7] Adults should do moderate-intensity physical activity for at least 150-300 mins or 75-150 mins physical activity of vigorous-intensity or an equivalent combination of both moderate and vigorous-intensity activity every week.[7] Exercise can increase RBC and Hb which enables the transport of respiratory gases, carries metabolites such as lactate and normalizes blood pH.[5] Oxygen-carrying capacity and oxygen binding capacity are decreased due to reduced RBC and Hb which may negatively impact health and performance.[5] Exercise causes hyperplasia of hematopoietic bone marrow and the release of several hormones and cytokines that result in increased erythropoiesis, red cell mass, and blood volume. Therefore exercise could be an appropriate non-pharmacological intervention to improve anemia in patients.[8]

The immune system is very responsive to exercise.[9] White blood cells (WBCs) are an important component of the immune system. WBC protects the body from bacteria, viruses, infections, and damaged cells that are harmful to the body.[5] It is worth mentioning that, in physically inactive persons leukocytosis and neutrophilia indicate chronic low-grade inflammation and novel risk factors for coronary heart disease, HTN, and type 2 DM.[10,11]

In the hemostatic system of the body, platelets play a crucial role. It contributes to the formation of pathologic thrombus leading to coronary artery disease and stroke.[12] Exercise has been documented to alter platelet number, size, and function.[12] It is assumed that acute and strenuous exercise increases platelet count and causes platelet activation in sedentary individuals.[12,13] But in regular exercising individuals platelet activation is inhibited and cardiovascular mortality is reduced [13] due to adaptation to hemostatic system.[14]

Hematological disorders and various non-communicable disorders can be prevented and treated with regular moderate exercise. Exercise might be a safe, promising, adjuvant, and non-pharmacological method to reduce the financial burden of these diseases. Healthy adults are the mass source of manpower. Exercise should be adopted in daily life to lead a healthy lifestyle. Therefore, this study was designed to observe the effect of regular exercise on some hematological parameters in regularly exercising adult males.

Materials and Methods:

This comparative cross-sectional study was conducted at the physiology department of Chittagong Medical College in collaboration with selected gyms and bank of Chattogram city from July 2021 to June 2022. 74 study subjects were selected by using the prevalence formula from select-

ed gyms and bank. A convenient sampling method was used for selecting study subjects. Some 37 healthy adult males, engaged in regular exercise in the gym for at least 150 mins/week for a minimum of 12 weeks were included in group A (gym exercising), and 37 healthy age and BMI-matched adults not engaged in gym exercise or do activities like walking, jogging, swimming, cycling, yoga for <150 mins /week were included in groupB (non-exercising). Study subjects having DM, HTN, COPD, CHF, and malignancy were excluded. Smokers, alcoholics, obese, and users of any medication or supplement that affects hematological parameters were also excluded. The research protocol was approved by the Ethical Review Board of Chittagong Medical College. After obtaining written informed consent from the respondents data were collected by general examination, face-to-face interview, and using weighing machines and measuring tapes for height and weight measurement. These data were recorded on a predesigned case record form. Study subjects were instructed to refrain from exercise 48 hours prior to blood collection day. On the day of blood collection, 3 ml of blood was drawn from each participant for the hematological test. A hematology auto-analyzer (Sysmes XN 1000, Japan) was used for the complete blood count. Analysis was done according to hydrodynamic focusing (DC Detection), flow cytometry method, and SLS-hemoglobin method. Statistical analysis was done using SPSS-26 and Microsoft Excel. A p-value of <0.05 was considered significant.

Results:

A comparison of the mean values of hematological parameters for group A (gym exercising) and group B (non-exercising) is shown in Table I. Independent sample t-test was performed to compare the hematological parameters between the groups. The result of the t-test revealed that mean values of RBC count, Hb, and HCT were significantly higher but WBC count was significantly lower in gym exercising subjects. ($p<0.05$). However, the mean value of MCV, DC of neutrophil, lymphocyte, and platelet count did not differ significantly between the two groups. ($p>0.05$). In correlation of RBC parameters with the duration of exercise in the gym exercising subjects Table II revealed that RBC count and MCV significantly positively correlated with exercise duration. ($p<0.05$).

Table 1: Comparison of hematological parameters between group A (gym exercising) and group B (non-exercising). (n=74).

Attributes	Group A (gym exercising) (Mean± SD) (range) (n=37)	GroupB (non-exercising) (Mean ± SD) (range) (n=37)	P-value (t-value)
RBC count (million/cumm)	5.37 ± 0.37 (5.00-6.85)	5.13 ± 0.38 (4.00-5.91)	0.006 ** (2.81)
Hb (gm/dl)	15.14 ± 0.89 (13.60-18.00)	14.38 ± 1.28 (10.60-17.90)	0.004 ** (2.965)
HCT (%)	43.60 ± 2.87 (36.80-49.30)	42.14 ± 2.43 (34.30-50.70)	0.021** (2.37)
MCV (fl)	83.40 ± 5.25 (68.4-92.6)	82.50 ± 4.55 (67.80-90.50)	0.429 ns (0.795)
Total count of WBC ($\times 10^3$/cumm)	7.66 ± 1.697 (5.2-10.12)	8.41 ± 1.451 (6.52-12.35)	0.04** (2.051)
DC of neutrophil (%)	50.70 ± 6.64 (35.00-65.00)	51.43 ± 7.71 (31.00-68.00)	0.703 ns (0.383)
DC of lymphocyte (%)	39.57 ± 7.65 (26.00-60.00)	39.73 ± 7.77 (25.00-56.00)	0.928 ns (0.090)
Platelet count ($\times 10^3$/cumm)	269.24 ± 66.00 (124.00-426.00)	258.65 ± 76.01 (150.00-487.00)	0.524ns (0.640)

Independent sample t-test was applied to analyze the data.

Table 2: Correlation of RBC parameters with duration of exercise in group A (gym exercising). (n=37).

Attributes	RBC count		Hb %		HCT		MCV	
	r value	p value	r value	p value	r value	p value	r value	p value
Duration of exercise (years)	0.345	0.04**	0.015	0.93^{ns}	0.075	0.66^{ns}	0.372	0.03**

*r = correlation coefficient; **= statistically significant, ns= not significant at p>0.05 level.*

Pearson's correlation coefficient test was applied to analyze the data.

Discussion

This present study was conducted to observe the effect of regular exercise on some hematological parameters in healthy adult males. The mean ± SD of group A and group B age was 32.46 ± 8.46 and 35.89 ± 8.74 respectively. Exercise improves the hematopoietic microenvironment by osteoblastic differentiation and inhibits adipogenic differentiation in the bone marrow. Several hormones and cytokines are increased due to exercise which are associated with self-renewal, proliferation, and maturation of hematopoietic stem cells.[8] Exercise also promotes hematopoietic stem cells to produce more hemoglobin. Hematocrit is the percent saturation of hemoglobin. So, an increase in RBC follows an increase in HCT.[15] In the present study RBC, Hb, and HCT were significantly higher in group A (gym exercising). These findings are in line with previous research findings.[1,15] 12 weeks of aerobic exercise significantly increased RBC and Hb in anemic patients with breast cancer in a randomized clinical trial.[16] Contradictory findings are also present where a reduction in RBC, Hb, and HCT was found in exercising persons termed as 'pseudoanemia' mainly in the athletic population.[17,18] Al-Bewayney HMR reported a reduction in MCV in exercising individuals.[19] These reductions may be explained by hemodilution [18] via the renin-angiotensin-aldosterone system.[20] However, Baffour-Awuah B et al. (2017)[21] did not find significant differences between the two groups. MCV showed non-significant change between groups in a study.[18]

In this study, the WBC count of exercising subjects is higher than their non-exercising peers. This finding is consistent with a previous study where significant leukopenia was observed in physically active persons with lower BMI.[22] This may be explained by exercise-induced adipose tissue reduction. Thereby reduction in the release of pro-inflammatory cytokines which further reduces leukopoiesis in the bone marrow.[22] Also chronic adaptation to long-term regular exercise may contribute to this finding. However, leukopenia is beneficial because high circulating WBC is a novel risk factor for coronary artery disease and type 2 DM.[5] Chastin F et al,[10] reported insignificant change in WBC count. Improper history and lack of device-based measurement of exercise were the cause of insignificant findings.[10] DC of neutrophils and lymphocytes did not show any significant differences between groups in this study. It is assumed that WBC parameters like DC of neutrophils and lymphocytes except natural killer cells do not differ between exercising and non-exercising groups at resting conditions.[23]

The current study shows that platelet count did not differ significantly between the groups. Some studies indicated exercise increases the number of platelets [15,24] while other studies indicated exercise does not have an effect.[19,21] An Increase in platelet count may be explained by hemoconcentration [24] or epinephrine-induced splenic contraction which releases stored platelets into circulation immediately after exercise.[15]

In this study, RBC and MCV showed a significant positive correlation with exercise duration. In a study, it was observed that the 3-10 years duration of exercise had a significant positive correlation with RBC and Hb.[25] Duration of exercise plays an important role in the adaptation of blood and circulatory system. The more the exercise duration the more adaptation occurs.[25]

Conclusion

The study findings show that long-term regular exercise has an effect on hematological parameters. Chronic adaptation to exercise may explain the higher value of RBC parameters and lower count of WBC. These values are within the reference range so the differences do not pose any serious clinical problems for exercising persons. The increasing or decreasing value of the parameters is based on the type, intensity, duration of exercise, and condition state of subjects. Also age, genetic factors, physical and physiological conditions of participants might be the cause of different study findings. Participating in regular exercise has a positive effect on hematological parameters, thus increasing aerobic endurance and improving the life quality of an individual.

Limitations

The duration of our study was limited, and the sample size was too small to allow for broad generalization. Additionally, only male subjects were included, making the findings inapplicable to the female segment of the population. Furthermore, the type and intensity of exercise were not evaluated and measured.

Acknowledgments

Conflict of interest

The authors hereby declare that no conflict of interest exists.

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