ORIGINAL ARTICLE

Study of RBC Count and Haemoglobin Concentration in Female Athletes

Dilruba Akhter[1], Md. Ruhul Amin[2], Najneen Akhter[3], Md. Atiar Rahman[4], Md. Montasir Islam[5]

Abstract:

The present study was designed to observe RBC count and haemoglobin concentration in female athletes. For this purpose, a total number of 60 females, age ranged from 17-38 years, were selected. Thirty of them were athletes (experimental group) and 30 non-athletes (control). Athletes were selected from Dhanmondi Mohila Krira Complex and controls from students of Dhaka University. RBC count and haemoglobin concentration were measured by electronic cell counter method. RBC count was found significantly lower in athletes than that of controls but there was no change in haemoglobin concentration. The result of the study reveals that lowered RBC count was due to mechanical damage of erythrocytic membrane leading to shortening of mean life span of RBC.

Introduction:

Increased physical exercise generally results in no or only a small decrease in haemoglobin concentration, and RBC count has been found to be lower in physically well trained female athletes than in their sedentary counterparts[1]. A sub-optimal haematological status has been recorded in athletes involved in intense physical activity[2]. There have even been reports of "Sports anaemia" associated with intense physical activity[3]. A single bout of physical effort and, even more, repeated exercise may change the morphological indices of blood and influence the erythropoietic processes in the bone marrow[2]. Endurance training can lead to 'sports anaemia' although under normal conditions RBCs have a life span of about 120 days, the rate of ageing may increase during intensive training[3]. Exercise-induced haemolysis has been observed in particular, in distance running and has been associated with significant destruction of RBC with RBC turnover being substantially higher in runners compared to untrained controls[4].

Materials and method:

The study was carried out on healthy females and involved 60 subjects aged between 17 and 38 years. Thirty female athletes were recruited from Dhanmondi Mohila Krira Complex as experimental group. A control group of 30 non-athletes was recruited from students of Dhaka university. All the control subjects were regarded as apparently healthy persons who had never done exercise and were non-smoking women.

1. Lecturer, Department of Physiology, Holy Family Red Crescent Medical College, Dhaka.
2. Professor and Head of the Department of Physiology, Dhaka Medical College, Dhaka.
3. Associate Professor, Holy Family Red Crescent Medical College, Dhaka.
4. Assistant Professor, Department of Anatomy, Holy Family Red Crescent Medical College, Dhaka.
5. Assistant Professor, Tairunnessa Memorial Medical College and Hospital, Dhaka.

While the experimental subjects were considered as one who had exercise at least two hours daily, five days a week, for one year or more. The samples were selected randomly. Subjects suffering from any cardiopulmonary disease and mild infection or fever within one month before enrollment were excluded from the study. Both the experimental group and control group were subdivided according to age. Subjects in both groups were divided into A_1, A_2, A_3 (experimental) and B_1, B_2, B_3 (control) according to 17-22, 23-30 and 31-38 years. All the subjects were explained about the aims and objectives of the study and the test procedures were briefed. Written consent was taken from the persons concerned in a prescribed form. A detailed history of each subject was obtained by using a pre-tested questionnaire. All subjects completed a questionnaire concerning their dietary habit, medication history, family history, athletic status including training intensity and duration, height (cm), weight (kg), and Body mass index (BMI) (kg/m^2). Blood pressure and resting heart rate were recorded. Blood samples were collected before exercise. RBC count and haemoglobin concentration were measured by electronic cell counter method. Statistical significance of difference between groups were evaluated by using students unpaired 't' test.

Results:

The mean (±SD) of red blood cell count in experimental groups A_1, A_2, A_3 were 3.90±0.24 million/cmm, 3.87±0.39 million/cmm, 4.13±0.19 million/cmm and in control groups B_1, B_2, B_3 were 4.50±0.81 million/cmm, 4.62±0.40 million/cmm, 4.90±0.52 million/cmm respectively. The results are shown in Table-I and the Figure-1. The mean red blood cell count was significantly lower ($p<0.001$) in group A compared to that of group B. Furthermore, this level was significantly lower in group A_1 ($p<0.05$), group A_2 ($p<0.001$) and A_3 ($p<0.01$) compared to that of group B_1, B_2, B_3 respectively.

The mean (±SD) hemoglobin levels in experimental groups A_1, A_2, A_3 were 11.98±1.06 gm/dl., 11.70 ±0.99 gm/dl, 11.84±1.04 gm/dl respectively and in control groups B_1, B_2, B_3 were 11.77±0.93 gm/dl, 10.52±1.78 gm/dl, and 12.91±1.07 gm/dl respectively.

The results are shown in Table-II and Figure-2.

No statistical significance in difference of haemoglobin levels were revealed between experimental groups and control groups.

Table- I: The mean (±SD) of RBC count in different study groups.

Red blood cell (Million/cmm) (Mean±SD)				
Subgroup	**Number**	**Group-A**	**Group-B**	**P value**
1	13	3.90±0.24 (3.40-4.20)	4.50±0.81 (3.86-6.84)	<0.05*
2	10	3.87±0.39 (3.40-4.60)	4.62±0.40 (4.00-5.10)	<0.001***
3	07	4.13±0.19 (3.90-4.52)	4.90±0.52 (4.02-5.70)	<0.01**

Values in parenthesis indicate ranges. P values were obtained by unpaired 't' test.
* = significant by unpaired student 't' test.

Table– II: The mean (±SD) of haaemoglobin in different age groups of subjects.

Hemoglobin (gm/dl) (Mean±SD)				
Subgroup	**Number**	**Group-A**	**Group-B**	**P-value**
1	13	11.98±1.06 (9.90-13.40)	11.77±0.93 (10.30-13.50)	$>0.50^{ns}$
2	10	11.70±0.99 (9.20-12.50)	10.52±1.78 (6.60-12.30)	$>0.50^{ns}$
3	07	11.84±1.04 (10.50-12.80)	12.91±1.07 (11.50-14.60)	$>0.50^{ns}$

Values in parenthesis indicate ranges. P values were obtained by unpaired 't' test.
ns = not significant.

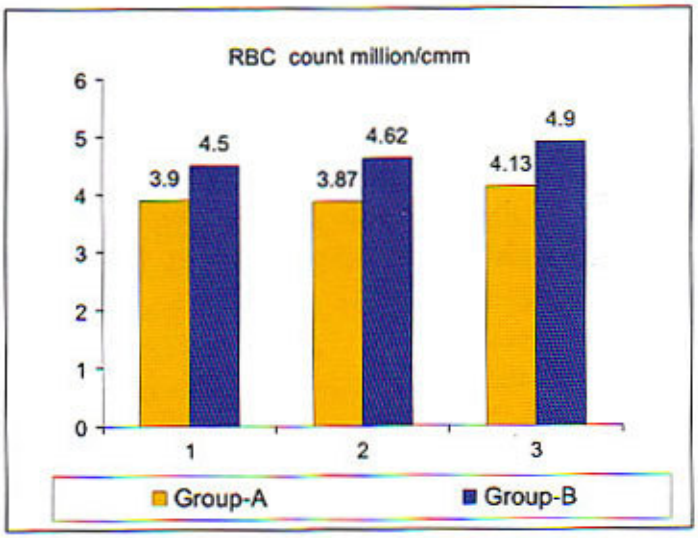

Figure-1: Distribution of mean (±SD) red blood cell count in different groups.

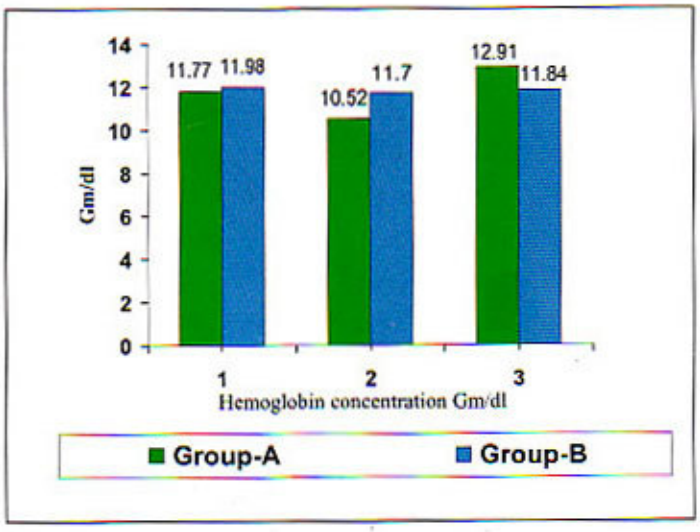

Figure-2: Distribution of mean (±SD) haemoglobin level of different study groups.

Discussion:

In this study, the mean (±SD) RBC count were significantly lower (P<001) in football players, cricket players, runners, hand ball players, and volleyball players when compared to that of control. These findings were consistent with the findings of others[3,2,5]. Decreased RBC count in athletes was due to shortening of the mean life of RBC by 30-40% [4,5]. Under normal condition, RBCs have a limited life span of 120 days in the circulation of humans[5]. The prevention of anaemia requires the rate of replacement of RBC to keep pace with that of destruction. Intensive physical training causes survival of RBCs for only 74 days in individuals running up to 130 Km/week compared to 114 days in untrained subjects. RBC deformability was higher in a group of world-class endurance (road) cyclists compared when with that in a group of untrained controls [3,4]. Exercise training accelerated the destruction of the smaller aging red blood cell and replacement by younger larger erythrocytes[5]. The precise mechanism for this changes include squeezing and rupture of the erythrocytes by treading on the foot sole, rupture of blood cells in blood capillaries during muscle contraction, hemolysis due to increased blood flow and blood pressure [5].

Increased intravascular haemolysis occurred in activities including weight lifting, swimming, long distance running, and cycling. It was observed that there were mechanical damage of RBC in the feet vessels (foot strike haemolysis) especially when running on a hard surface which promote destruction [4,6,7]. Decrease in haematological parameters of erythrocytic system below pre-exercise level was observed one hour after a single prolonged intensive physical effort, even though they could be elevated immediately following it [2]. Maximum decrease of the above parameters were noted between the 24th and 72nd hours following exercise, ("post-exercise over hydration" or "overshoot rehydration") was pointed out as the main cause of changes [2].

Haemolysis in exercise could result not only from running long distance where erythrocyte were stroke, but also from other mechanism such as the oxidative stress in which the free radicals were over the systemic mechanisms of the anti-oxidative defense and making them susceptible to present injury in their enzymatic systems, as well as in lipids and membrane receptors[6].

In this study, haemoglobin concentration in football players, cricket players, runners and hand ball players did not show statistically significant differences (p>0.05) than that of control. The results are in agreement with that of others [4,5]. Moderate intensity exercise and high intensity exercise cause post-exercise haemodilution at 24 hours and 48 hours and did not have a significant effect on haemoglobin concentration[8]. Sports anaemia in athletes is due to an expanded plasma volume and haemodilution (pseudoanaemia) rather than true red blood deficiency. No significant difference (p>0.05) occurred in haemoglobin concentration and RBC concentration before and after each of the exercise trials. In individuals who practice frequent aerobic sport activity there may be coexisting events such as haematuria, gastrointestinal blood loss, as well as an increase in the intravascular haemolysis [5].

Athletes performing marathons and ultramarathons in higher altitudes over several

years, may have stability in haemoglobin level as an index of general health status and exogenous stimulation of bone marrow[9]. Severity of this sports anaemia correlate with the amount of training. Intravascular haemolysis occurred during all the races; the fastest swimmers in the longest races had the greatest decrease in haemoglobin[4].

References:

1. Chen KT, Yang RS. Effects of exercise on lipid metabolism and musculoskeletal fitness in female athletes. World J Gastroenterol 2004; 10: 122-126.
2. Szygula Z. Erythrocytic system under the influence of physical exercise and training. Sports Med 1990; 10: 181–91.
3. Smith JA, Bradden MK, Gillam I, et al. Changes in susceptibility of red blood cells to oxidative and osmotic stress following sub maximal exercise. Eur J Appl Physiol 1995; 70: 427– 436.
4. Telford LP, Richter EA, Kiens B. Increased plasma FFA uptake and oxidation during prolonged exercise in trained vs untrained human. Am J Physiol 1992; 262: E791–9.
5. Green HJ, Sutton JR, Coates G, et *al.* Responses of red cell and plasma volume to prolonged training in humans. J Appl Physiol 1991; 70: 1810-1815.
6. Bonilla JF, Narvaez R, Chuaire L. Sports as a cause of oxidative stress and hemolysis. Am J Med 1986; 81: 791-794.
7. Weight LM, Byrene MJ, Jacob P. Haemolytic effects of exercise. Clin Sci.1991; 81: 147–152.
8. Peter BF, Russel PR, Quing NU, Gregory MS. Effects of acute exercise on plasma erythropoietin levels in trained runners. Med Sci Sports Exer 1999; 31: 543– 546.
9. Banfi G, Rol GS, Dolci A, Susta D. Behaviour of hematological parameters in athletes performing marathons and ultra marathons in altitude ('sky runners'). Clin Lab Hematol 2004; 26: 373.