

# An analysis of Hemoglobin, Hematocrit, Serum Iron and Total Iron binding capacity tests of recruits of Police training school, Indore

Manohar Bhandari<sup>1</sup>, S.K Wankhede<sup>2</sup>, Ravi Jain<sup>3</sup>

<sup>1</sup>Assistant Professor, Department of Physiology, <sup>2</sup>Associate Professor, Department of Anatomy, <sup>3</sup>Assistant Professor, Department of Pathology, MGM Medical College, Indore, Madhya Pradesh, India

Correspondence to: Dr. Manohar Bhandari ([drmbhandari@gmail.com](mailto:drmbhandari@gmail.com))

## Abstract:

**Introduction** – Soldiers & sportsman are symbol of physical excellence. The facts of the medical science are, however, contrary to this common belief. In fact various studies reveal that soldiers in combat training & even Olympic record holder athletes are very often anemic. This type of anemia which occurred particularly in those who performed regular strenuous physical exercise was termed as “sports anemia”.

**Aims & Objectives** – To study the Hemoglobin, Hematocrit, Serum Iron & Total Iron binding capacity levels in non-exercising recruits of Police training school, Indore, to study the Hemoglobin, Haematocrit, Serum Iron & Total Iron binding capacity levels in exercising recruits of Police training school, Indore & to compare the hematological parameters in both the groups.

**Materials & Method** – Fifty physically fit young males (aged 20 to 29 years), all members of police training school, Indore, volunteered as subjects for this study. These recruits were subdivided into three groups according to their exercising period. All the subjects were examined thoroughly. Complete medical examination was done in each subject. No subject reported a history of anemia & none was taking supplementary iron or other medication. Collection of blood – fasting, early morning venous specimens were drawn from each subject & were subjected to Hemoglobin, PCV, MCHC, Serum Iron & Total iron binding capacity tests.

**Observations** – All the 3 groups did not differ significantly in age, Height & weight. All the parameters are reduced in group B except TIBC which is increased. The decrease in Hb, PCV & Serum Iron is statistically significant. In Group C all the parameters are on higher side as compared to group B, but little lower & statistically insignificant as compared to group A.

**Summary & Conclusion** – The present study showed that “Sports anemia” also occurred in the recruits of Police training school who underwent sub maximal exercise during training period.

**Key words** - *Sports Anemia, Iron, Hemoglobin, TIBC, Haematocrit, Athletes*

## Introduction

Soldiers & sportsman are symbol of physical excellence. These physically fit young men are regarded as examples of healthy beings. The facts of the medical science are, however, contrary to this common belief. In fact various studies reveal that soldiers in combat training & even Olympic record holder athletes are very often anemic. It was observed by many workers that prolonged & strenuous physical activity induced a significant decrease of hemoglobin, haematocrit & serum iron in highly trained runners. It was commonly conceded that “iron deficiency usually develops slowly, progressing through several stages before there was evidence of anemia” (Clement et al)<sup>1</sup>. Serum iron depletion

occurred in well-established athletes, mostly long distance runners undergoing regular endurance training for several months (Colt & Heyman<sup>2</sup>; Dufaux et al<sup>3</sup>). It was observed by Stewart et al<sup>4</sup> on Australian Olympic athletes that athletes with subnormal hemoglobin levels did not perform well in endurance events. Yamaji<sup>5</sup> found that anemia as well as hypoproteinemia appeared in athletes engaged in training for sports temporarily & returned to normalcy after the training was over. This type of anemia which occurred particularly in those who performed regular strenuous physical exercise was termed as “sports anemia” by Yoshimura<sup>6</sup>. Many explanations for this type of anemia e.g. hemolysis, hematuria, gastrointestinal bleeding, hemodilution, iron loss

through sweat, decreased absorption of iron etc. have been proposed by different workers. The above mentioned & many more studies have been done in marathon runners, swimmers, Olympic athletes, wrestlers, boxers, soldiers in combat training & others. The present study was aimed to find out whether “sports anemia” also occurred in the recruits of police training school who underwent submaximal exercise during training period.

#### **Aims & Objectives –**

- To study the hemoglobin, hematocrit, MCHC, serum Iron & TIBC levels in non-exercising recruits of Police training school, Indore
- To study the hemoglobin, hematocrit, MCHC, serum Iron & TIBC levels in exercising recruits of Police training school, Indore
- To compare the hematological parameters in both the groups.

#### **Materials & Method –**

1) Screening & designing of study – Fifty physically fit young males (aged 20 to 29 years), all members of police training school, Indore, volunteered as subjects for this study. They were selected randomly. These recruits were subdivided into three groups according to their exercising period (Table 1). All the subjects were examined thoroughly. Complete medical examination was done in each subject. Personal history, including food habit, addiction & perspiration were recorded. Complete examination of all the systems was carried out. The subjects selected for the study were healthy & had no history of any chronic disease or acute febrile illness. No subject reported a history of anemia & none was taking supplementary iron or other medication. Height without shoes & body weight with light clothing were taken. All subjects belonged to same socio-economic status. All were vegetarian & non-smokers except few. All subjects perspired moderately except few who did profusely. All the three groups did not differ significantly in their age, height & weight. All of them were taking meals in the same mess & formed a relatively homogenous population of required study. Moreover, the two exercising groups did not differ in their weekly training Programme & daily duration

of exercise performed by them. The daily training of exercising recruits constituted of physical training for 40 minutes including about 2 km running & other exercises, parade for 2 hours & 40 minutes which included drill, march with & without rifles & running (parade was done in two sessions, 1 hour & 20 minutes each), & 1 hour playing either football or volleyball. They ran approximately 20-25 kms per week with moderate speed. The total duration of the daily exercise was 4 hours & 20 minutes. The type of exercise they performed was submaximal physical training.

#### 2) Hematological Investigations –

- a. Collection of blood – fasting, early morning venous specimens were drawn from each subject. 6 ml of blood was collected from the antecubital vein by venipuncture by a large bore disposable sterilized needle under aseptic conditions with a sterilized disposable syringe. 1 ml of the blood was put in a rubber corked, clean & dry centrifuge tube. The serum was allowed to separate in the refrigerator & later further separation was effected by centrifugation for 15 minutes, taking all precautions to avoid hemolysis. This serum was employed for estimation of serum iron & total iron binding capacity. 1 ml of blood was poured in oxalated bulb & was used for estimation of hemoglobin & Hematocrit.
- b. Estimation of Hemoglobin – was done by Cyanmethemoglobin method, using kit manufactured & supplied by Biolab Diagnostics, Mumbai.
- c. Estimation of Hematocrit – was done by Wintrobe<sup>7</sup> method.
- d. M.C.H.C – This value was calculated by following formula –
- e.  $MCHC \% = \frac{Hb \text{ in gms\%}}{PCV\%} \times 100$
- f. Serum Iron & TIBC – Estimation of Serum Iron & TIBC was done by Ferrozine method (Tietz<sup>8</sup>) using kit manufactured by Span diagnostics Pvt. Ltd & reading of optical density was taken on Erba Chem-5, a semi-automatic analyzer of Transasia instruments Ltd, Mumbai. All the data of the hematology tests were statistically analyzed.

**Observations**

**Table 1 – Distribution of cases**

Group	No
A- Control (Non-exercising)	10
B- Exercising since 2 months	20
C- Exercising since 10 months	20
Total number of cases	50

This table reveals the distribution of subjects in the present study. Group A (Control) comprised of 10 non-exercising recruits. Group B of 20 recruits exercising for 2 months & Group C comprised of another 20 recruits exercising for 10 months.

**Table:2 Physical characteristic of control & exercising groups**

Physical characteristic	n=10 Control A	n= 20 Exercising since 2 months B	n= 20 Exercising since 10 months C
	Mean±SD	Mean±SD	Mean±SD
Age(Years)	24.6±2.22	24.25±2.63	23.7±2.47
Height (cms.)	165.3±5.12	169.95±4.96	168.8±3.77
Weight (Kgs.)	53.9±4.70	59.5±4.81	58.6±3.67

This table shows physical characteristics of the control & exercising groups. It is evident from the above table that all the 3 groups did not differ significantly in age, Height & weight.

**Table:3 Hematological parameters of Control & exercising groups**

Parameters	A	B	C
Hb (gms %)	14.5±0.63	13.10±1.20	13.85±1.45
PCV (%)	43.5±2.27	40.85±3.04	42.79±3.52
MCHC (%)	33.37±1.57	32.08±2.13	32.89±2.16
S.Iron(µg %)	112.78±16.5	81.80±29.8	100.7±21.3
TIBC (µg %)	302.3±22.81	317.6±43.4	329.5±31.3

\*values are expressed as Mean±SD

This table shows Mean±SD of hematological parameters in all 3 groups. It is apparent from the table that all the parameters are reduced in group B except TIBC which is increased. The decrease in Hb, PCV&S.Iron is statistically significant. In Group C all the parameters are on higher side as compared to group B, but little lower & statistically insignificant as

compared to group A. TIBC levels are higher in B & C than A.

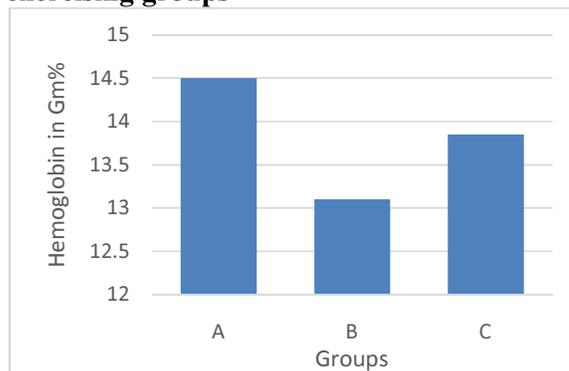
**Table:4 “t” values of hematological parameters.**

Parameters	A vs. B	A vs. C	B vs. C
Hb	3.44*	3.35	1.78
PCV	2.44*	0.57	1.91
MCHC	1.81	0.62	1.16
S. Iron	3.04*	1.66	2.22**
TIBC	1.03	2.42	0.99

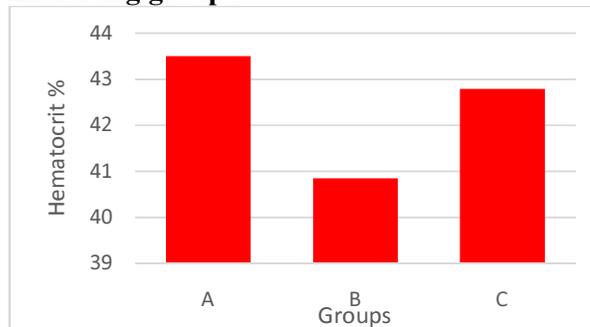
\*Significant at 0.05 confidence level at 28 degree of freedom

\*\*Significant at 0.05 confidence level at 38 degree of freedom

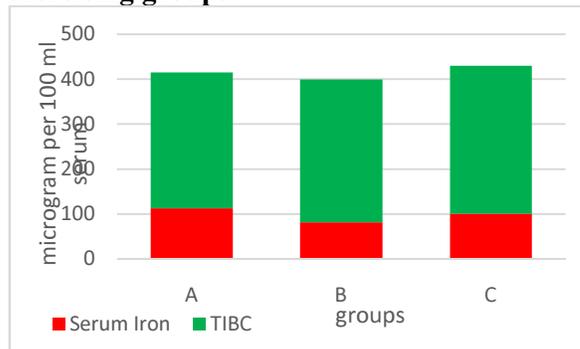
**Graph 1 – Hemoglobin (±SD) of control & exercising groups**



**Graph:2 Hematocrit (±SD) of control & Exercising groups**



**Graph 3 – Serum Iron & TIBC in control & exercising groups.**



## Discussion

The present work was undertaken on 50 recruits of Police training school, Indore with main objective of assessing whether the phenomenon known as “sports anemia” would occur in physically fit young men after prolonged daily submaximal exercises. Physical exercise has been shown to cause transient decrease in Hb, PCV, MCHC, serum Iron & TIBC by many workers. The development of this type of anemia has been associated with heavy physical training, endurance events, physical training of unfit subjects or previously sedentary individuals & in physical fit individuals performing daily submaximal exercise.

The subjects were divided into 3 groups (Table 1). This table reveals the distribution of subjects in the present study. Group A (Control) comprised of 10 non-exercising recruits. Group B of 20 recruits exercising for 2 months & Group C comprised of another 20 recruits exercising for 10 months.

A comparison of the hematological values obtained for different groups could be effected by the Table 3, 4& graphs 1, 2&3. As it is evident from the tables & the graphs that Hb, PCV& serum iron were significantly reduced in recruits exercising for 2 months in comparison with non-exercising control group. While TIBC level was somewhat higher which was statistically insignificant. However a true anemic state cannot be suggested because Hb values fall into lower limits of normal range (Dacie et al<sup>9</sup>). In the recruits of group C, decrease in levels of Hb, PCV, MCHC& serum iron were observed in comparison with Group A but this decrease was not statistically significant. However, TIBC level increased significantly. Although all the hematological parameters were found to be on higher side in group C as compared to group B, but all except serum iron, were not statistically significant (Table 4). The present findings are in consonance with the studies of De-Wijn et al<sup>10</sup>; Hunding et al<sup>11</sup>; Magnusson et al<sup>12</sup>; Magazanik et al<sup>13</sup>& Lukaski et al<sup>14</sup>. In all the above studies, decrease in Hb, PCV & MCHC were observed in participants of Olympic games, runners & joggers, swimmers & athletes involved in vigorous exercises. The values are also similar to the findings observed by Bell &

cowan<sup>15</sup>; Lindeman<sup>16</sup>; Uddin et al<sup>17</sup>& Radomaski et al<sup>18</sup>. These workers studied Hb, PCV & MCHC values in soldiers or cadets in basic training & found low or low normal levels of Hb & PCV after or during training. As evident from Tables 3 & 4, Graphs 1, 2& 3 that Hb, PCV, MCHC, serum iron & TIBC in group C were on higher side as compared to group B & seemed to be shifting towards control (Group A) levels. This might be due to some adaptive physiological mechanisms taking place in the body (Yoshimura<sup>6</sup>). This iron status in the present study might be due to hemolysis or hemodilution. Hemolysis might be due to increased destruction of Red blood cells i.e. due to exercise induced increase in red cell fragility or due to mechanical trauma. Lindeman<sup>16</sup>& many other workers demonstrated lowered hemoglobin, hematocrit & haptoglobin levels during training in a group of military basic training. They also demonstrated increase in serum bilirubin concentration, which could be another indication of the hemolytic process. Yoshimura<sup>6</sup> has suggested that the destruction of red cells during exercise might be an adaptive reaction to promote growth or hypertrophy of muscles & the regeneration of new red cells in strenuous physical training. Another important possible cause of low hematological values in this study may be the hemodilution. Yoshimura<sup>6</sup>; De-Wijn et al<sup>10</sup>; Hunding et al<sup>11</sup>; Magazanik et al<sup>13</sup>& many other workers concluded that the occurrence of low or low-normal red blood cells, Hb, PCV levels in otherwise healthy athletes are relatively common. The suggested possible interventions to prevent the development of iron deficiency in these individuals include nutrition counselling to increase dietary protein & iron intake, screening with serum ferritin levels at the beginning & at least at the mid-point of the season & supplemental oral iron therapy

## Summary & Conclusion

The present study was undertaken on physically fit healthy recruits of Police training school, Indore. They were divided into 3 groups A, B, C. A group comprised of 10 recruits who had not started their training. B group recruits were doing their exercise training for 2 months, while group C were

doing their exercise training for 10 months. The case record of each subject was maintained. The subjects had no history of any chronic disease or acute febrile illness. Hemoglobin, hematocrit, MCHC, Serum iron & TIBC were determined in all three groups. Hemoglobin, Hematocrit & serum iron were significantly lower in group B as compared to group A & TIBC was higher in group B than group A. On comparing group A with C, although value of all the parameters were lower in group C but these were not statistically significant, while TIBC was higher in group C than A & this was statistically significant. The present study showed that "Sports anemia" also occurred in the recruits of Police training school who underwent submaximal exercise during training period.

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