NJPPP National Journal of Physiology, Pharmacy & Pharmacology

DOI: 10.5455/njppp.2015.5.191020141
http://www.njppp.com/

RESEARCH ARTICLE

INFLUENCE OF ATHLETIC TRAINING ON HEMATOLOGICAL PARAMETERS IN RUNNERS: A CROSS-SECTIONAL STUDY

Jyothi Shivalingaiah[1], Sunil S Vernekar[2], Ramachandra N Raichur[2], Shivaprasad S Goudar[2]

[1] Department of Physiology, Karpagam Faculty of Medical Sciences and Research, Othakalmandapam, Coimbatore, Tamil Nadu, India
[2] Department of Physiology, Jawaharlal Nehru Medical College, Nehru Nagar, Belgaum, Karnataka, India

Correspondence
Jyothi Shivalingaiah
(drjove@gmail.com)

Received
04.09.2014
Accepted
29.09.2014

Key Words
Haemoglobin; Running; Physical Training; Performance

Background: Athletics is one of the purest of all sports, relying solely on the strengths of the human body rather than technological implements to improve performances. Alterations of the red blood cell (RBC) system are known to influence physical performance of an athlete: anemia has negative effect on physical exercise capacity, and an increase in RBC mass has been shown to enhance aerobic performance.
Aims and Objective: To assess the influence of exercise on the RBC system and hemoglobin in runners of different duration of training and with age- and sex-matched controls.
Materials and Methods: A Cross-sectional study was carried out in the Department of Physiology, JNMC, Belgaum, India. Study consisted of 31 runners (male and female) aged 16–25 years, divided into two groups depending on number of years of training. Group A (n=12) consisted of players with ≤3 years and group B (n=19) consisted of players with >3 years of training. Blood testing for red blood cell count and hemoglobin levels was carried out and results were obtained by a cell counter, automated cell counter (CBC-360).
Results: Mean RBC count and hemoglobin levels were high in group B than group A runners, and they were high in runners than controls, and the differences were significant.
Conclusion: Physical training and duration of exercise is of major importance in the adaptation of the blood cell system. Runners around the same age with similar anthropometric data submitted to same training type but longer duration of training tend to have better values than those with shorter duration of training, and also better values than the controls.

INTRODUCTION

Sports are organized at competitive levels since ancient times. In India, the scientific community has recently started contributing toward the upliftment of an athlete. But still looking at the vast sporting population, this contribution appears to be meager.

The word "athletes" includes runners, basketball players, volleyball players, kabaddi players, hockey players, and many more.[1] In this study, athletes consist only of runners. Performance depends on many factors such as physical fitness, mental makeup, and duration of training. Apart from these, hematological variables also have their own contribution.

There are a number of published articles on circulatory and ventilatory response to exercise and effect of training on improvement of performance, but the number of studies directed toward the influence of duration of training on hematological parameters and performance appears sparse. Furthermore, there are no studies conducted in this region with respect to this among runners.

In contrast, some of the studies suggest that in endurance-trained athletes hematological parameters such as hematocrit, hemoglobin concentration, and red blood cell (RBC) count are reduced, mainly due to exercise-induced plasma volume expansion, which sets in within a few days of exercise training.[2]

One of the studies suggests that the physical training itself has no significant effect on hematological variables in athletes compared with controls. The specific type of duration of training is of major importance in adaptation of the RBC system and the iron metabolism.[3] Some of the studies suggest that there is an increase in the counts of RBC and

hemoglobin concentration.[4–7] Hence, this study is taken up to assess the influence of duration of training on hematological parameters among runners of young age groups in this region practicing regularly at a district stadium and to compare them with age- and sex-matched controls of this region.

OBJECTIVES

Primary: To assess the influence of athletic training on RBC count and hemoglobin levels among runners practicing at the district stadium with age- and sex-matched untrained controls.

Secondary: To assess the influence of athletic training on RBC count and hemoglobin levels among runners practicing at the district stadium of different training periods.

MATERIALS AND METHODS

Study Design: Cross-sectional.

Source of Data: The present cross-sectional study was conducted at the Department of Physiology, JNMC, Belgaum.

Sample Size: On the basis of universal sample size, all the eligible runners aged 18–25 years of Belgaum city were enrolled at the time of data collection, and the available number of runners who fit into the inclusion criteria was 31.

The study consisted of 31 runners (male 25 and female 6) aged 16–25 years, divided into two groups, depending on number of years of training. Group A (n=12) consisted of players with ≤3 years and >2 years of training, and group B (n=19) consisted of players with >3 years and <10 years of training, practicing regularly at the district stadium, Belgaum. All the runners underwent consistent training. On average, practices were held for 4–5 hours per day, 6 times per week. Throughout the year, apart from running practices, all participants were involved in additional sessions of strength training and conditioning, speed and stretching exercises both preseason and during the competitive season. Both groups had been exposed to similar training regimens.

For comparison, age- (18–25 years) and sex-matched students admitted in 2009 at KLE University, Belgaum, were enrolled as controls. Selection was done using random number table. Data collection was done from July 2009 to December 2009.

Inclusion Criteria: (i) All the sprinters and distance runners practicing for a minimum period of 2 years and in the age group of 16–25 years. (ii) All the students of age- and sex-matched participants coming from same region who had not undergone any sort of athletic training or carried out regular exercise were selected randomly in comparative group.

Exclusion Criteria: (i) Subjects with respiratory, neuromuscular, cardiac, or endocrine disorders. (ii) Students from comparative group who did regular physical exercise, meditation, and underwent physical training.

The study was approved by JNMC Institutional Ethics Committee on human subjects' research. Written informed consent was taken from the subjects after explaining to them briefly about the study. Blood sample was taken in the morning before the participants started practice. Blood testing for RBC count and hemoglobin levels were estimated, and results were obtained by an automated cell counter (CBC-360).

Statistical Analysis: Statistical analysis involved quantitative variables summarized through mean and standard deviation. The difference between means of the two groups was tested using the Student's unpaired t-test, where significance of P-value was <0.05.

RESULTS

Tables 1 and 2 and figures 1–4 show the comparison of hematological parameters between runners and controls, and two groups of runners.

Table 1: Comparison of hematological parameters of runners and controls

	Runners	Controls	*P*-value
Hb (g%)	15 ± 1.11	13.4 ± 1.38	0.000*
RBC count (million/mm^3)	5.1 ± 0.58	4.2 ± 0.41	0.000*

RBC, red blood cell; Hb, hemoglobin.
**P value significance <0.05.*

Table 2: Comparison of hematological parameters of two groups of runners

	Group A	Group B	*P*-value
Hb (g%)	14.4 ± 1.03	15.4 ± 1.02	0.013*
RBC count (million/mm^3)	4.6 ± 0.33	5.4 ± 0.50	0.000*

RBC, red blood cell; Hb, hemoglobin.
**P value significance <0.05.*

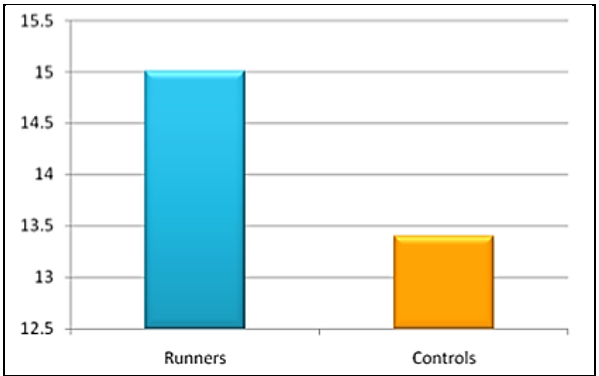

Figure 1: Hematological parameters of runners and controls (hemoglobin in g/dl)

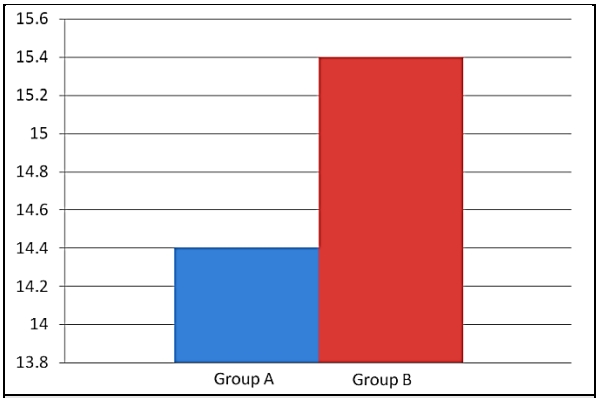

Figure 2: Hematological parameters of two groups (hemoglobin in g/dl)

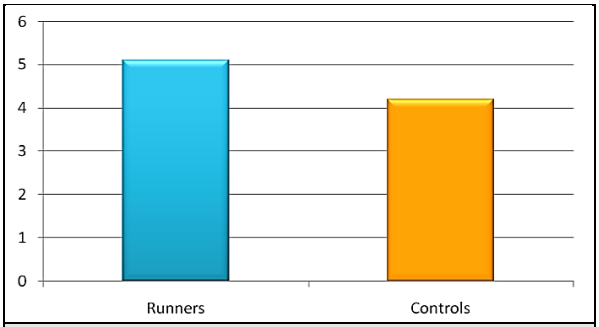

Figure 3: Hematological parameters of runners and controls (red blood cell count in million)

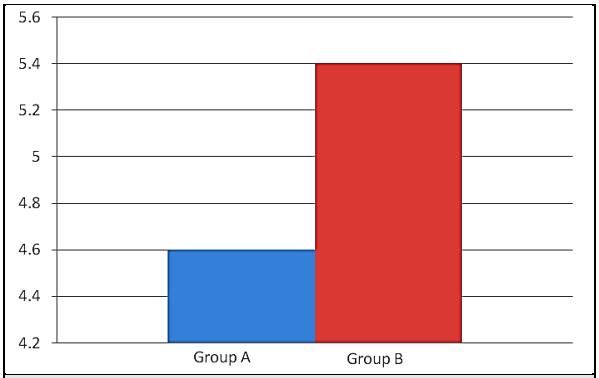

Figure 4: Hematological parameters of two groups (red blood cell count in million)

Mean RBC count and hemoglobin levels were high in runners (5.1 million/mm^3 and 15.0 g %) than controls (4.2 million/mm^3 and 13.4 g%), and the levels were higher in group B (5.4 million/mm^3 and 15.4 g%) than those in group A (4.6 million/mm^3 and 14.4 g%), which was statistically significant (P<0.05).

DISCUSSION

Higher values of RBC count and hemoglobin levels were noted in runners with longer duration of practice, which is very helpful in increasing aerobic endurance of an athlete. Oxygen delivery in the endurance-trained athlete is further improved by increase in blood volume and total hemoglobin.[3,4,8] A study carried out in Turkey demonstrated a significant increase in hematocrit, RBC count, and hemoglobin levels in male soccer players after a training period of 8 weeks.[9] In one of the studies carried out in Germany, results showed that for brief exercise duration and low-intensity training programs, the red cell mass remained constant and only short-term shift in the plasma volume was observed whereas endurance-trained athletes showed an increase in hemoglobin concentration and RBC count.[9] Increase in RBC count and hemoglobin concentration in this study is to fulfill the demand of the body during exercise, which in turn will stimulate erythropoiesis.[3,6]

CONCLUSION

Higher values of RBC count and hemoglobin percentage were noted in runners, which is very helpful in increasing aerobic endurance of an athlete. Young adult runners, undergoing similar type of training, with longer duration of training tend to have higher values for hematological parameters than those with lesser duration of training. Physical training and duration of exercise is of major importance in the adaptation of the blood and circulatory system.

ACKNOWLEDGMENT

The authors thank the management of JNMC, Belgaum, Karnataka, and colleagues and KFMSR, Coimbatore, Tamil Nadu, who helped to carry out the project.

REFERENCES

1. Cumming R Gordon. Fitness testing of athletes. Can Fam Physician. 1970;16(8):48–52.
2. Convertino VA. Blood volume: its adaptation to endurance

training. Med Sci Sports Exerc. 1991;23(12):831–43.
3. Schumacher YO, Schmid A, Grathwohl D, Bultermann D, Berg A. Hematological indicies and iron status in athletes of various sports and performances. Med Sci Sports Exerc. 2001;34(5):869–75.
4. Kratz A, Lewandrowski K, Siegel AJ, Chaun KC, Flood JG, Van Cott E, et al. Effect of marathon running on hematologic and biochemical laboratory parameters, including cardiac markers. Am J Clin Pathol. 2002;118:856–63.
5. Majumdar P. Physiology of Sports and Exercise, 1st edn. Kolkata: New Central Book Agency, 2005.
6. Guyton CA, John EH. Text Book of Physiology, 11th edn. Pennsylvania: Elsevier, 2006.
7. Khurana I. Text Book of Physiology, 1st edn. Pennsylvania: Elsevier, 2006.
8. Fallon KE. Utility of hematological and iron-related screening in elite athletes. Clin J Sport Med. 2004;14(3): 145–52.
9. Joksimovic A, Stankovic D, Ilic D, Joksimovic I, Jerkan M. Hematological profile of Serbian youth national soccer teams. J Hum Kinet. 2009;22:51–60.

Cite this article as: Shivalingaiah J, Vernekar SS, Raichur RN, Goudar SS. Influence of athletic training on hematological parameters in runners: A cross-sectional study. Natl J Physiol Pharm Pharmacol 2015;5:125-128.
Source of Support: Nil
Conflict of interest: None declared