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ANALYSIS OF HEMOPOIESIS INDICATORS IN BOXERS AND FREESTYLE WRESTLERS*Makhmudov D.E.**Taraleva T.A.**Ablyalimov R.T.**Murathodzhaeva L.E.**Abdulaeva Kh.O.**Ruzikulova A.N.**Republican Scientific and Practical Center for Sports Medicine*

Abstract: This article analyzes hematopoietic parameters in athletes engaged in freestyle wrestling and boxing. Particular attention is paid to parameters involved in the body's aerobic processes (hemoglobin concentration, red blood cell count) and the immune response (leukocytes).

Key words: hemogram indicators, boxing, wrestling, comparative analysis.

Introduction: The blood system in athletes specializing in combat sports plays a key role in ensuring the body's adaptive responses to significant physical and psycho-emotional loads characteristic of contact disciplines. In addition to performing basic physiological functions—such as transporting oxygen and nutrients, maintaining acid–base balance, and providing immunological protection—specific adaptive changes develop in representatives of these sports. These changes affect hemodynamics, the morphological characteristics of blood cells, and the functional reserves of the hematopoietic system. These changes are caused by the regular impact of intense training and competitive loads. Scientific evidence from many researchers shows that the hematological profile of fighters (including leukocyte formula parameters, erythrocyte indices, and markers of oxidative stress) varies depending on the sport specialization, the volume and intensity of training, as well as the level of athletic qualification. Comparative studies of athletes from different combat sports demonstrate differences in blood parameters that reflect the condition of the immune system and the metabolic status of the body [4]. In the practice of sports medicine, regular monitoring of hematological and biochemical blood parameters in combat athletes is used as a tool for assessing functional readiness, analyzing the effectiveness of training programs, and early detection of signs of overtraining or pathological conditions. In addition, data obtained from laboratory monitoring make it possible to predict the adaptive capacity of the body to upcoming physical loads [1]. Athletes engaged in combat sports are characterized by specific changes in the hematological and rheological properties of blood, which are caused by the need to combine strength, speed-strength qualities, endurance, and a high capacity for recovery. Morphofunctional indicators of peripheral blood are considered informative markers of the level of physical fitness and the reserve capacities of the body, which has both theoretical and practical significance in the system of training and medical support [4,5]. The use of laboratory research data by coaches and sports physicians contributes to the optimization of the training process and increases the safety of athletic preparation.

In the study by Sashenkov S. L. (2017) and co-authors, differences in the leukocyte profile of athletes from various training specializations were identified: cross-country skiers and

swimmers demonstrated higher levels of total leukocyte count and eosinophils compared with wrestlers and boxers. At the same time, representatives of combat sports showed an increase in the proportion of band and immature forms of neutrophils along with a relative decrease in mature neutrophils. In addition, athletes engaged in aerobic sports (swimmers and skiers) demonstrated a statistically significant reduction in the number of mature lymphocytes and monocytes compared with wrestlers and boxers with an anaerobic training profile [2, 8–9].

An analysis of the functioning of the circulatory system in combat athletes from Yakutia showed that the morphological composition of peripheral blood is determined by the type of sport, the stage of the training cycle, the level of athletic qualification, and seasonal factors. In a number of studies, the criterion of harmony in the leukocyte formula is applied, based on the principle of the “golden ratio.” Deviations from the optimal proportion are considered indicators of a reduced adaptive potential of the body. It has been established that high-intensity physical loads are accompanied by the strain of regulatory mechanisms, the development of tissue hypoxia, disturbances in water–electrolyte balance, and an increased risk of anemic conditions [3, 6–7].

Under modern conditions, laboratory blood diagnostics has acquired particular importance, as it allows the detection of functional abnormalities at the preclinical stage—long before pronounced pathophysiological changes develop at the level of individual systems or the organism as a whole [10–13]. The study of the hematological and immune status of athletes remains highly relevant, as it helps clarify their role in maintaining homeostatic balance. Under the influence of extreme physical loads that require an increased oxygen-transport function of the blood, changes in the ratio of hemoglobin fractions are observed, shifting toward forms that are more resistant to an acidic environment. Research also continues on the dynamics of blood oxygen capacity and the characteristics of the leukocyte profile in athletes of different specializations [10–12].

Objective: to study the characteristics of the morphological composition of blood in athletes engaged in combat sports.

Materials and Methods. The study was conducted at the base of the Republican Scientific and Practical Center of Sports Medicine (RNPCSM) in 2025. The study involved 40 boxers aged 20.75 ± 0.56 years and 17 athletes engaged in freestyle wrestling aged 21.47 ± 0.40 years. Hemograms obtained during the pre-competition period (January–March 2025) were analyzed.

The analysis of venous blood samples was carried out in the clinical diagnostic laboratory of the Republican Scientific and Practical Center of Sports Medicine using a hematology analyzer Albatros. The following hemogram parameters were analyzed: hemoglobin (HGB, g/dL), hematocrit (Hct, %), mean corpuscular volume (MCV, fL), mean corpuscular hemoglobin (MCH, pg), mean corpuscular hemoglobin concentration (MCHC, g/L), mean erythrocyte volume in the sample (MCV), total leukocyte count (WBC, g/L), percentage of medium-sized cells (MID%), relative and absolute lymphocyte count (LYMF, %; LYMF), percentage of granulocytes (%), total erythrocyte count (RBC, g/L), total platelet count (PLT), percentage of large platelets (P-LCR), mean platelet volume (MPV), red blood cell distribution width (RDW), erythrocyte sedimentation rate (ESR), absolute count of large platelets (PLCC), calculated platelet distribution width (PDW), and plateletcrit (PCT).

Statistical data processing was performed using Statistica 13 and Excel 2003 software. The following statistical characteristics of the analyzed parameters were determined: mean value (M), standard deviation (SD), and standard error of the mean (SE). The significance of intergroup differences was determined depending on the distribution properties using the parametric Student's t-test at a significance level of $p < 0.05$.

Results. The table presents hemogram parameters of boxers and athletes engaged in freestyle wrestling. It was found that the general blood count parameters of the studied athletes mostly do not deviate from normal values, or the deviations are minor. However, some parameters showed statistically significant differences.

According to Table 1, significant differences were found in:

- the relative proportion of lymphocytes in the total leukocyte count ($p < 0.01$),
- the mean corpuscular hemoglobin per erythrocyte ($p < 0.05$),
- the mean platelet volume ($p < 0.01$),
- the calculated platelet distribution width ($p < 0.01$),
- the percentage of large platelets ($p < 0.01$),
- and the absolute count of large platelets ($p < 0.05$).

The level of erythropoiesis increases in the following order: wrestling → boxing; while leukocyte and hemoglobin content increases in the order: boxing → wrestling.

Boxers exhibit the highest percentage of lymphocytes in the total leukocyte count; the greatest absolute number of lymphocytes, erythrocyte count, red blood cell distribution width, mean platelet volume, notable calculated platelet distribution width, plateletcrit, highest percentage of large platelets, absolute number of large platelets, and the highest erythrocyte sedimentation rate. The hematological profile of wrestlers is characterized by the highest total leukocyte count, percentage of medium-sized cells, hemoglobin concentration, hematocrit, mean corpuscular volume in the sample, mean corpuscular hemoglobin, and total platelet count (Table 1).

Table 1. Hemogram parameters of boxers and athletes engaged in freestyle wrestling.

	Boxers	Wrestling
Parameter	40	17
Total leukocyte count (WBC, g/L)	6,57 ± 0,27	7,35 ± 0,35
Percentage of lymphocytes of total leukocytes (LYMF, %)	36,98 ± 0,96	30,65 **± 1,91
Percentage of medium-sized cells (MID, %)	7,33 ± 0,30	7,35 ± 0,43
Absolute lymphocyte count (LYMF, g/L)	2,40 ± 0,10	2,20 ± 0,14
Total erythrocyte count (RBC, g/L)	5,09 ± 0,07	5,06 ± 0,10
Hemoglobin concentration (HGB, g/L)	145,38 ± 2,56	149,53 ± 2,87
Hematocrit (Hct, %)	43,75 ± 0,69	44,06 ± 0,72
Mean corpuscular volume (MCV, fL)	85,99 ± 0,62	87,61 ± 0,72
Mean corpuscular hemoglobin (MCH, pg)	28,74 ± 0,27	29,60* ± 0,30

Mean corpuscular hemoglobin concentration (MCHC, g/L)	334,10 ± 1,52	337,82 ± 1,63
Red blood cell distribution width (RDW, %)	42,03 ± 0,42	41,97 ± 0,59
Total platelet count (PLT, g/L)	263,73 ± 9,06	280,12 ± 9,83
Mean platelet volume (MPV, fL)	10,45 ± 0,13	9,84** ± 0,14
Calculated platelet distribution width (PDW, fL)	11,02 ± 0,23	10,35** ± 0,22
Plateletcrit (PCT)	0,27 ± 0,01	0,27 ± 0,01
Percentage of large platelets (P-LCR, %)	29,83 ± 0,97	25,62 **± 0,99
Absolute number of large platelets (PLCC, g/L)	76,68 ± 2,38	71,06 *± 2,83
Erythrocyte sedimentation rate (ESR, mm/h)	7,55 ± 1,07	6,88 ± 0,88

*Statistically significant differences according to the Student's t-test: * at $p < 0.05$, ** at $p < 0.01$

Conclusions: The results of our study showed that the general blood count parameters of the athletes studied mostly do not deviate from normal values. However, significant differences between boxers and wrestlers were observed in the following parameters: the relative proportion of lymphocytes in the total leukocyte count, mean corpuscular hemoglobin per erythrocyte, mean platelet volume, calculated platelet distribution width, percentage of large platelets, and absolute number of large platelets.

It was found that wrestlers exhibit higher values of formed blood elements compared to boxers.

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