

The effects of a 2-hour physical exercise session using the oriental dance training mechanism on changes in selected indices of blood morphology

Wpływ 2-godzinnej wysiłku fizycznego w mechanizmie treningu tańca orientalnego na zmiany wybranych wskaźników morfologii krwi

Alicja Zawadzka¹ (ABDF), Bartłomiej Ptaszek^{2,3} (DEF), Andrzej Mikuśkiewicz⁴ (DF), Aneta Teległów⁵ (ABDF)

¹ M.A. student, Faculty of Motor Rehabilitation, University of Physical Education in Krakow, Poland

² Department of Physiotherapy, University of Physical Education in Krakow, Poland

³ Ph.D. student, Faculty of Physical Education and Sport, University of Physical Education in Krakow, Poland

⁴ S. Czarnecki Primary School No. 47 in Krakow, Poland

⁵ Department of Clinical Rehabilitation, University of Physical Education in Krakow, Poland

Keywords

blood morphology, oriental dance

Abstract

Introduction: Movement in combination with music, i.e. dance, is one of the most popular types of physical activity at all ages. Dance is a form of activity that differs in style and technique, and thus, energy consumptions during training are different. Under the name of oriental dance one can find: folklore, religious, ritual and popular dances that are associated with everyday life. In Polish and international literature on the subject, there are no studies in which changes in blood morphological properties of dancers practicing oriental style dance would be demonstrated. The results of laboratory tests published so far rarely describe the effect of dance on morphological blood indices, in addition, they are results for styles other than oriental dance.

Study aim: The objective of the study was to demonstrate the effects of 2-hour physical exercise using the mechanism of oriental dance training on changes in selected quantitative indices of blood morphology in a group of young women.

Materials and methodology: The study group consisted of 12 young women between the age of 20 and 35, with the average of 26.4 ± 0.52 years, training oriental dance. Blood tests were performed twice: before and after the 2-hour workout. The dancers practiced a variation of oriental dance called *shaabi*, a high-intensity dance with a lot of jumping figures.

Results: Analysing the average values of morphological indices before and after oriental dance training showed a statistically significant increase in WBC [$10^9/L$] by 23.28% and a decrease in RBC [$10^{12}/L$] by 1.29%, HGB [g/L] by 1.00% and HCT [L/L] by 1.22% in the study group after the 2-hour oriental dance training session.

Conclusions: The applied training influenced the results of blood indices in dancers participating in the study. Physical activity carried out in the form of dance causes quantitative changes in morphological blood indices.

Słowa kluczowe

morfologia krwi, taniec orientalny

Streszczenie

Wprowadzenie: Ruch w połączeniu z muzyką, czyli taniec jest jednym z najbardziej popularnych rodzajów aktywności fizycznej w każdym wieku. Taniec jest formą aktywności, która różni się pod względem stylu i techniki, a co za tym idzie inne jest zużycie energii podczas treningu. Pod nazwą tańca orientalnego kryją się zarówno tańce folklorystyczne, religijne, obrzędowe jak i popularne, które są związane z codziennym życiem. W piśmiennictwie polskim i międzynarodowym nie ma badań wykazujących zmiany we właściwościach morfologicznych krwi u tancerek ćwiczących styl orientalny. Dotychczas opublikowane wyniki badań laboratoryjnych rzadko opisują wpływ tańca na wskaźniki morfotyczne krwi, w dodatku są to wyniki dotyczące innych stylów tanecznych niż taniec orientalny.

The individual division of this paper was as follows: A – research work project; B – data collection; C – statistical analysis; D – data interpretation; E – manuscript compilation; F – publication search

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Cel badań: Celem pracy było wykazanie wpływu 2-godzinnego wysiłku fizycznego w mechanizmie treningu tańca orientalnego na zmiany wybranych wskaźników ilościowych morfologii krwi w grupie młodych kobiet.

Materiał i metodyka: Grupę badaną stanowiło 12 młodych kobiet w wieku od 20 do 35 roku życia z jego średnią 26.4 ± 0.52 lat, trenujących taniec orientalny. Badania krwi przeprowadzono dwukrotnie: przed rozpoczęciem i po zakończeniu 2-godzinnego treningu. Tancerki ćwiczyły odmianę tańca orientalnego o nazwie *shaabi*, tańca o wysokiej intensywności wysiłku z dużą ilością figur skocznych.

Wyniki: Analizując średnie wartości wskaźników morfologicznych przed i po treningu tańca orientalnego wykazano statystycznie istotne zwiększenie WBC [$10^9/L$] o 23,28% oraz zmniejszenie RBC [$10^{12}/L$] o 1,29%, HGB [g/L] o 1,00%, HCT [L/L] o 1,22% w grupie badanej po 2-godzinnym treningu tańca orientalnego.

Wnioski: Zastosowany trening wpłynął na wyniki morfologii krwi u tancerek biorących udział w badaniu. Aktywność fizyczna realizowana w formie tańca powoduje zmiany ilościowe wskaźników morfologicznych krwi.

INTRODUCTION

Oriental dance does not have an unambiguous history. It can be rooted in North Africa and Middle Eastern countries: the United Arab Emirates, Saudi Arabia, Yemen, Oman, Iran, Iraq, Jordan, as well as Egypt, Turkey and Morocco. In Arabic, this dance is called *raqs al-sharqi*, which means "eastern dance". Under the name of oriental dance, one may also find: folklore, religious, ritual and popular dances that are associated with everyday life. There are several stories related to the birth of oriental dance. Some of them come from ancient times, others date back to the 18th century. Nowadays, it is danced in many countries around the world. Various events and competitions are organised at which dancers can improve their knowledge and expand their range of dance skills, as this dance is constantly evolving and developing^{1,2}.

The blood is full of liquid connective tissue travelling through the blood vessels. It has an intense red colour due to haemoglobin contained in erythrocytes. The intensity of the blood colouring depends on its oxygen saturation. Blood constitutes 7% of the total human body mass and has a huge nutritional effect on the human body. It performs a variety of functions, among others, it is responsible for coagulation, transportation, thermoregulation and immunity. Blood consists of plasma and blood cells suspended in it. Water accounts for a significant portion of the plasma volume, and the remainder comprises nutrients, primarily proteins. In contrast, the morphological elements of the blood are composed of: red and white blood cells as well as platelets³⁻⁵.

Red blood cells, or erythrocytes, are the most numerous group among the morphological indices of the blood. These are nuclear-like cells in the shape of a double concave disc. Their primary task is transportation of oxygen and carbon dioxide, which occurs with the help of haemoglobin responsible for the red colour of the blood cells. White blood cells, or leukocytes, together with erythrocytes and thrombocytes, are the most important blood components. Leukocytes have a cell nucleus and the ability to move. They are a smaller group than erythrocytes, although their cells are larger. The task of leukocytes is primarily to combat pathogenic microorganisms that have entered the human body. Among white blood cells, granulocytes (neutrophils, basophils and eosinophils) and agranulocytes (lymphocytes and monocytes) can be distinguished. Thrombocytes (the smallest of the components of blood morphology) form in the bone marrow as a result of a process called thrombopoiesis. Platelets are variiform and devoid of a cell nucleus. The most important task of thrombocytes is to participate in the process of blood clotting⁵⁻¹⁴.

STUDY AIM

The aim of the study was to demonstrate the effects of 2-hour physical exercise using the mechanism of oriental dance training on changes in selected morphological blood indices, and above all, to answer the following question:

1. Does a 2-hour oriental dance training session implemented in the form of general fitness exercises change the following morphological properties of the blood

(RBC, WBC, PLT, HGB, HCT, MCV, MCH, MCHC) in young women:?

Research hypothesis:

1. Physical activity carried out in the analysed group of women in the form of dance causes changes in morphological blood indices.

MATERIALS AND METHODOLOGY

The study group consisted of 12 young women between the age of 20-35 years (26.4 ± 0.52), performing oriental-style dance at the Sihar dance studio in Krakow. The dancers practice 1-2 times a week for 2 hours. The dance season lasts from September to the end of June, on the day of the dancers' examinations, it was the month before the end of the season. Blood was collected from the subjects twice: in fasting state in the morning - before training and after the morning training sessions; in the amount of 4 ml from the ulnar vein and was put into test tubes with EDTAK.2. Blood was collected by a qualified nurse, under medical supervision and in accordance with applicable standards at the Laboratory of Blood Physiology of the University of Physical Education in Krakow. The study was approved by the Bioethical Commission at the Regional Medical Chamber in Krakow.

The dance training consisted of a warm-up (preparing muscles for work), learning basic figures, practicing the choreography (interspersed with short intervals for resting), and ended with relaxation and breathing exercises. The choreography was arranged according to the applicable guidelines, i.e. having a beginning, middle and end. The danc-

ers practiced a variation of oriental dance called *shaabi*, a dance characterised by fast pace and a large number of jumping figures. The intensity of the effort was additionally regulated by the number of repetitions of individual parts of the choreography. Due to the specifics of the training, it was carried out in fasting state, and the dancers did not intake fluids during the session.

Measurements were performed using the ABX MICROS 60 hematology analyzer (USA). The following indices were marked:

1. Red blood cells – RBC [$10^{12}/L$],
2. Haematocrit – Hct [L/L],
3. Haemoglobin – Hgb [g/L],
4. Mean corpuscular haemoglobin – MCH [fmol],
5. Mean corpuscular volume – MCV [fL],
6. Mean corpuscular haemoglobin concentration – MCHC [mmol/L],
7. White blood cells – WBC [$10^9/L$],
8. Platelet count – PLT [$10^9/L$].

Statistical analysis

The test results were analysed using the Statistica 13.1, StatSoft (USA) programme. Quantitative variables are represented by mean and standard deviation. In order to analyse parameter changes in the study group, the Student’s *t*-test was used for dependent variables. The following level of significance level was assumed: $\alpha = 0.05$.

RESULTS

After 2 hours of oriental dance training, statistically significant changes were found for WBC, RBC, HGB, HCT morphological indices, while no changes were found for other morphological blood indices, i.e. PLT, MCV, MCH, MCHC (Table 1).

Analysing the average values of morphological indices before and after the oriental dance training session, a statistically significant increase in WBC [$10^9/L$] by 23.28% and a decrease in RBC [$10^{12}/L$] by 1.29%, HGB [g/L] by 1.00% and HCT [L/L]

by 1.22% were found in the study group after 2 hours of oriental dance training (Table 1, Figures 1-4).

DISCUSSION

In Polish and international literature on the subject, there are no studies demonstrating changes in morphological blood properties among dancers practicing oriental-style dance.

The results of laboratory tests published so far rarely describe the effects of dance on morphological blood indices, in addition, these are results for other styles than oriental dance. Physical activity, regardless of the level of intensity, affects the morphological indices of the blood. During training, blood volume decreases even by 15% already within 15 minutes of initiating exercise, while along with the duration of training, this val-

Table 1

Mean value ± standard deviation (SD) of selected morphological parameters before and after training in women performing dance

	before training	after training	level of significance	change [%]
WBC [$10^9/L$]	6.744 ±1.269	8.314 ±1.333	0.0075*	23.28
RBC [$10^{12}/L$]	4.486 ±0.246	4.428 ±0.222	0.0151*	1.29
HGB [g/L]	13.567 ±0.543	13.433 ±0.427	0.0426*	1.00
HCT [L/L]	40.2 ±1.828	39.717 ±1.528	0.0448*	1.22
MCV [fL]	89.717 ±2.98	89.842 ±2.683	0.9558	0.14
MCH [fmol]	30.258 ±0.901	30.383 ±0.958	0.4899	0.41
MCHC [mmol/L]	33.858 ±0.68	33.817 ±0.445	0.2024	0.12
PLT [$10^9/L$]	266.25 ±49.295	266 ±46.178	0.8025	0.09

* $p < 0,05$

RBC – red blood cells – WBC – white blood cells; HGB – haemoglobin; HCT – Haematocrit; MCV – mean corpuscular volume; MCH – mean corpuscular haemoglobin; MCHC – mean corpuscular haemoglobin concentration; PLT – platelet count

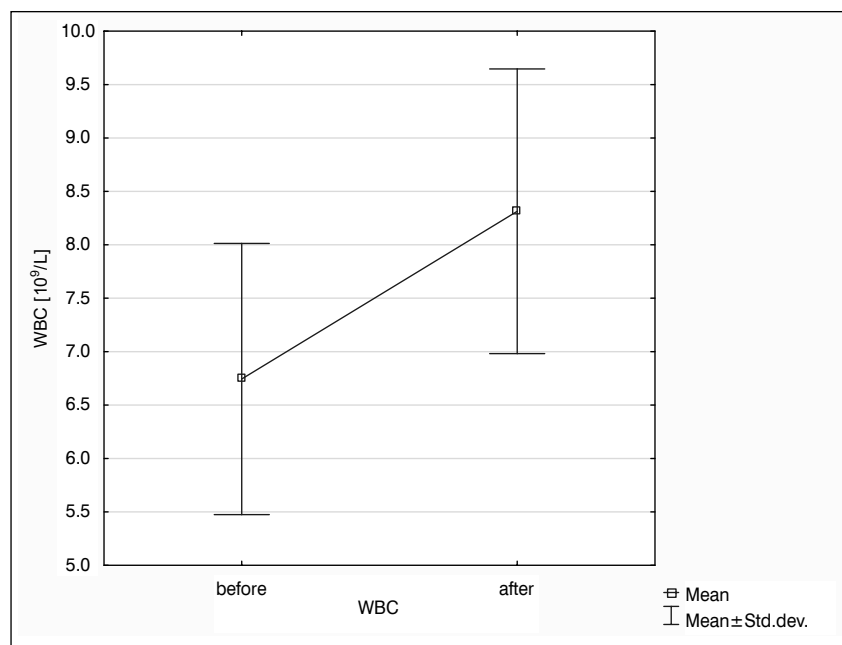


Figure 1
Average WBC [$10^9/L$] values in the tested group before and after the 2-hour oriental dance training session

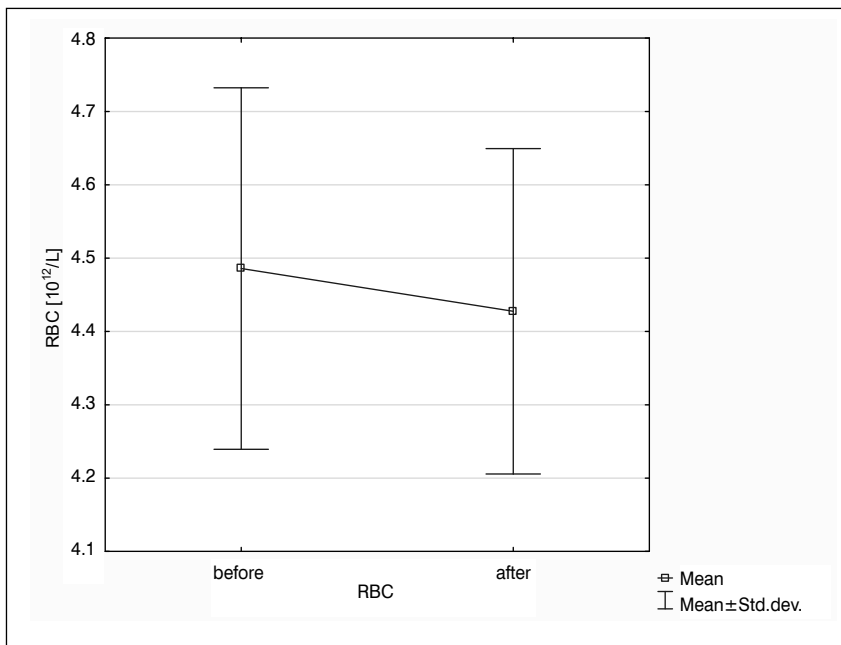


Figure 2

Average RBC [10¹²/L] values in the tested group before and after the 2-hour oriental dance training session

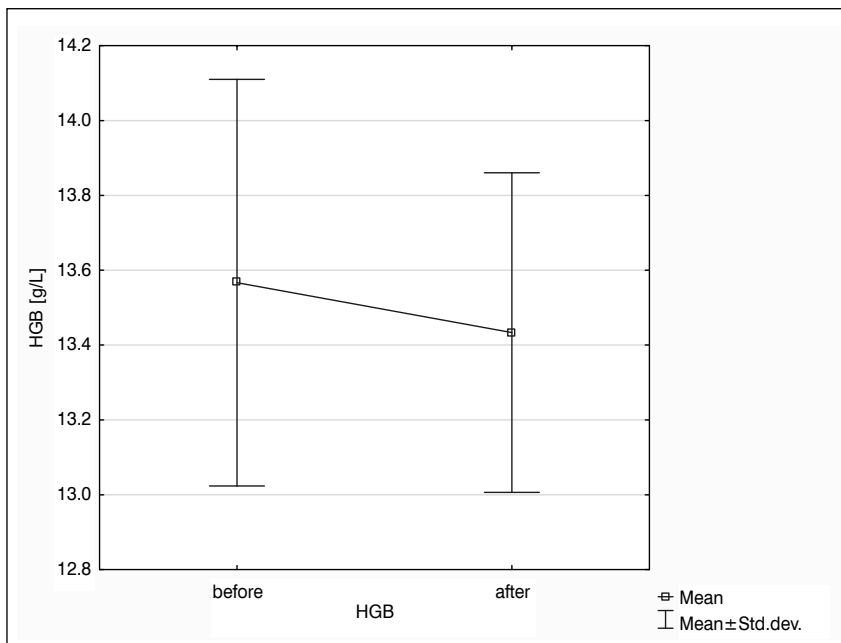


Figure 3

Average HGB [g/L] values in the tested group before and after the 2-hour oriental dance training session

ue does not radically change¹⁵. During exercise, there is also an increase in blood pressure, which decreases only after its completion. During the workout, there is also a change in the amount of water in the body, which affects the results of blood tests in those exercising¹⁶.

Haematology is a field of medicine dealing with blood and haematopoietic research. Thanks to this field, it is known that the content of haematocrit during physical exercise can change by up to 8% depending on hydration of the body¹⁷. This is important information if tests are carried out among ath-

letes who are exposed to water loss during the performance of sports¹⁸. Stability of blood morphological indices is one of the most important components of maintaining a proper and optimal physical fitness level of the human body¹⁹. Therefore, biochemical research is commonly used to determine the state of health and physical condition of the human body.

Movement combined with music, i.e. dance, is one of the most popular types of physical activity among representatives of all ages²⁰. Dance training achieves a positive outcome in the research results of studies conducted among people suffering from various dysfunctions and diseases, including, hypertension, cardiovascular fitness or obesity²¹⁻²³. In their research, Conceição et al.²¹ describe the effects of dance therapy on blood pressure. Dance training sessions took place 2-3 times a week and lasted about 60 minutes. The authors observed changes in blood pressure. Both systolic and diastolic pressure decreased²¹. In turn, Petrofsky et al.²² conducted research in which, in addition to dance training, diet monitoring was also used. It turned out that after 7 days of training, there was a difference in heart and blood pressure rates. As in the above-mentioned studies, systolic and diastolic blood pressure decreased as well as heart rate²².

In research, it is shown that not only dance training, but also listening to music itself, affects changes in the human body^{24,25}. In their research, Trappe et al.²⁵ showed that listening to classical music, e.g. the symphonies by Mozart or Vivaldi, can lower blood pressure, reduce heart rate and affect heart rate variability²⁵.

Dance is a form of activity that varies in style and technique, and therefore, the usage of energy during training is different. Maciejczyk and Feć²⁰ conducted research on folk dancers. The purpose of this study was to measure the body's aerobic fitness level. The exercise intensity of the analysed dance was close to the threshold of decompensated metabolic acidosis²⁰. The occurrence of metabolic acidosis may be associated with a sudden change in pH under

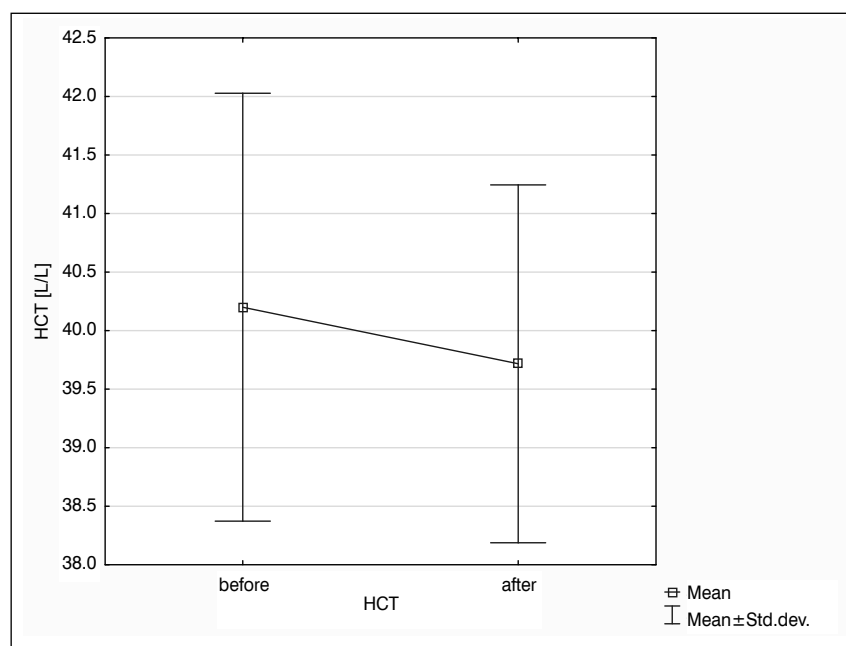


Figure 4

Average HCT [L/L] values in the tested group before and after the 2-hour oriental dance training session

prolonged exercise. The chance for it to occur in a person with good physical fitness appears at 60% of maximum load, and in less well-trained people, acidosis can already occur with a load half as high²⁶.

In his study, Szygula²⁷ emphasizes that human physical fitness is determined by many factors, and one of them is the ability to transport oxygen through the blood. This component is mainly determined by haemoglobin concentration and the number of red blood cells, as well as their ability to perform their functions. In addition, the author believes that a single effort or repetition of activities can contribute to changes in blood counts, as well as affect the process of erythropoiesis in the bone marrow²⁷.

Erythrocytes are responsible for oxygenating the entire human body. The observed increase in haemoglobin concentration in the blood improves oxygen transportation in the body, and thus, also increases blood buffer capacity²⁸. In the research conducted by Ostojic et al.²⁹, it is shown that changes in haematocrit are due to an increase in plasma volume. Experts say this increase could be as much as a quarter of the baseline. This is associated with high intensity of training²⁹. In the research by Mal-

covati et al.³⁰, it is demonstrated that a decrease in haematocrit may also result from intense effort after prolonged period of staticity. This has been observed in athletes preparing for competitions³⁰.

A decrease in haemoglobin may occur under the influence of a phenomenon called haemolysis, i.e. destruction of erythrocytes during and after physical training³¹⁻³⁴. Kargotich³⁵ and Neumayr³⁶ also argue that the decrease in haemoglobin may be due to haemodilution, which occurs in athletes because of an increase in plasma volume^{35,36}.

Haemoglobin has a significant association with VO_2 max, its optimal level is required to maintain adequate performance in athletes. The research conducted by Baldari and Guidetti³⁷ was carried out in three groups: dancers, gymnasts and a control group. It was observed that the physical fitness index is higher in gymnasts than in dancers³⁷.

Post-exercise haemolysis can also be caused by transient hypoglycaemia, i.e. too low blood sugar level. A decrease in blood glucose may affect the osmotic resistance of erythrocytes, which also facilitates the process of erythrocyte destruction²⁷.

Carrot et al.³⁸ conducted research

regarding the impact of physical rehabilitation in the form of music and movement exercises on the rheological and haematological properties of the blood in senior women. The study group consisted of 30 women aged 60-89. The women performed music and movement exercises for 5 months, 3 times a week for 30 minutes. Blood was collected for testing both before and after the tests. In this study, it was shown that there was an increase in the red blood cell count and haematocrit of seniors following exercise³⁸.

Based on the authors' research, statistically significant changes were found in the level of the following morphological indices after 2-hour oriental dance training: RBC, HGB and HCT. All of the above-mentioned indices have decreased their value compared to the results before the beginning of training. The research results obtained by the authors of this study are confirmed in the work by Okdan et al.³⁹. In this research, the main objective was to assess the effect of 12-week folk dance training on blood oxidative stress levels. In the study, there were 38 healthy dancers within the 21-28 age group. All measurements were carried out twice - before and after the testing period. The training sessions lasted 2 hours a day and the dances were practiced in a different order. Based on the results of the research, it was found that the level of haemoglobin decreased (probably due to haemolysis) and the total antioxidant capacity of the dancers (TAC and OSI) was almost completely deferred³⁹.

Silva et al.⁴⁰ also conducted research among ballet dancers. The aim of the study was to show changes in physiological and biochemical markers. The study participants were 24 dancers within the 12-15 age group. The total training time was 10 hours per week. Analysis of research analysis shows a slight decrease in the number of erythrocytes⁴⁰.

Leukocytes have a protective function in the body. They are responsible for defending the system against viruses and bacteria. Under the influence of intensive training, an increase in the amount of leukocytes

in the blood is observed. As a result of physical exercise, the number of granulocytes as well as lymphocytes and monocytes may increase^{41,42}.

In the case of short-term but intense physical exercise, the number of neutrophils increases after about 30 minutes after the completion of training. Then, there is another increase, but is much slower than the first. Repeated neutrophil growth is associated with the effect of endogenous cortisol on the bone marrow^{43,44}.

Based on the results obtained by Younesian et al.⁴⁶, it can be concluded that the process of continuous "exchange" of leukocytes may depend on physical exercise. The authors of the study also note that fluctuations in the number of white blood cells may depend on many aspects, including large pre-workout meal, past infections, taken medication, as well as training and stress. According to researchers, an increase in the number of white blood cells improves acquired immunity⁴⁵⁻⁴⁷.

In the research conducted by Silva et al.⁴⁰, statistically significant changes in leukocyte index among dancers were not demonstrated. Training lasted 17 weeks, at least 10 hours per week. Young girls practicing ballet took part in the study⁴⁰.

In the authors' research, an increase in leukocyte count was observed after the 2-hour oriental dance training session. In a study conducted by Akar et al.⁴⁸, it was also found that physical effort increases the number of leukocytes in the blood compared to results from before training. The authors explain this phenomenon by the loss of plasma during exercise⁴⁸. Platelets play an important role in blood clotting. In the research by Younesian et al.⁴⁶, it was shown that intense exercise can lead to an increase in the number of thrombocytes in the blood, but after a while, this number returns to normal. This phenomenon is not yet fully understood, but the authors of the study suggest that it may be associated with an increase in the rate of platelet production in the bone marrow during exercise or with reduced clearance of thrombocytes from the blood by the spleen⁴⁶.

Akar et al.⁴⁸ confirm that there is a difference in platelet count before and after intense training. The authors of the study explain this phenomenon by the decrease in plasma volume under the influence of physical exercise⁴⁸. In the research by the authors of this paper, no statistically significant changes were observed for PLT [$10^9/L$], comparing the results before and after the 2-hour oriental dance training session.

Further investigation regarding issues associated with demonstrating changes in the blood morphological properties of oriental dancers requires more extensive research that would accurately explain this phenomenon and allow to learn the body's response in these conditions.

CONCLUSIONS

The obtained results allow to formulate the following conclusion:

1. The 2-hour oriental dance training session implemented in the form of general fitness exercises causes beneficial changes in selected blood counts among young women.

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Author for correspondence

Bartłomiej Ptaszek
bartlomiej.ptaszek@awf.krakow.pl