

## **Review**

Regarding: competition for the academic position "Associate Professor" in the area of higher education 7. Health and sports, professional field 7.6. Sport, specialty "Biomechanics", announced in the State Gazette. Issue 93 of 22.11.2022 for the needs of the Department of Anatomy and Biomechanics at NSA "Vasil Levski"

Candidate: Assistant Professor Ivan Mirchev Ivanov, Doctor

Reviewer: Prof. Dr. Lyubomir Petrov, Ph.D.

Department of Physiology and Biochemistry, National Sports Academy "Vasil Levski"

This review has been prepared as a member of the scientific jury in connection with the above procedure for occupying the academic position "Associate Professor" in accordance with a decision of the Scientific College of the Department of Anatomy and Biomechanics and approved by order of the 3П-1308/14.12.2022 of the Rector of NSA "Vasil Levski"

In the Associate Professor Competition for the Department of Anatomy and Biomechanics at the Faculty of Sport, as the sole candidate, Assistant Professor Ivan Mirchev Ivanov, Ph. D.

### **I. General information and a brief biography of the applicant**

Ivan Mirchev Ivanov was born in Stara Zagora in 1977. In 2001 he ended with a good rating at Sofia University "St. Kliment Ohridski", Sofia, with a degree in Engineering Physics and the specialization "Medical Physics", and later acquired a Master's degree qualification with a degree in "Engineer-Physician".

In 2006, Ivan Ivanov began work as a physicist at the Institute of Mechanics, Bulgarian Academy of Sciences. In 2009, based on a defense dissertation on the topic "Rheological and electrical properties of blood and their modeling", Ivan Ivanov received the educational and scientific degree Ph.D. in the scientific specialty "Biomechanics" at the Institute of Mechanics at the Bulgarian Academy of Sciences, Sofia city. In 2009, he was already a chief assistant at the same institute. Since 2014, the applicant has held the position of Chief Assistant at the National Sports Academy "Vasil Levski", the Department of Anatomy and Biomechanics.

## II. General characteristics of the materials presented for the review.

The applicant has submitted many scientific research to participate in the competition. The requested publication activity of Assistant Professor Ivan Ivanov includes dissertation work, habilitation work - monograph, and 26 scientific articles, of which 13 were published in English in scientific journals indexed in world databases (Web of Science and Scopus).

According to Art. 27 of the Academic Staff Development Act in the Republic of Bulgaria and the Rules for its implementation to the NSA, the applicant has submitted for review in this competition the following publications:

- dissertation work (Group A - 50 points),
- habilitation labor - monograph (group B - 100 points),
- 13 articles and reports published in scientific publications, referred to and indexed in world-renowned scientific databases (Group D, item 7- a total of 180.5 points)
- 13 articles and reports published in unrefereed journals with a scientific review or in edited collective volumes (Group D, item 8 - 200.5 points).

The importance of the publications of Ivan Ivanov evidences the cited reports. Assistant Professor Ivanov and is a high appreciation of scientific results. The total number of cited scientific works (Group D 10, 11, and 12) is 62 (535 points), of which 23 (345 points) are in the journals indexed in the world databases SCOPUS and Web of Science (Group D 10).

The candidate in the competition was the supervisor of a student from NSA Vasil Levski on the topic "Kinematic analysis of the technical features in the development of jumps in the female figure skating" (Group E, item 25, a total of 20 points).

The scientific activity of Assistant Professor Ivan Ivanov also includes participation in a total of 6 scientific and 1 educational project, of which 2 internationals, 4 with national, and 1 with institutional funding. He was a leader of 2 of the projects, and in the others, he participated as a member of the scientific team (Group E, Vol. 16, 17, 18- a total of 145 points).

We should especially note the participation of Assistant Professor Ivan Ivanov as a head of the project funded by the Fund Research on "Theoretically and Experimental Research of Internal Joint Movements in Isometric Stretching".

## III. Pedagogical activity

Teaching experience of Ch. Ass Ivan Ivanov from 2014 until now is related to the study process in the Department of Anatomy and Biomechanics in NSA "Vasil Levski", where he leads classes with students. The candidate has a sufficient 10-year teaching experience, and participating in this competition is a logical continuation of his professional career.

#### IV. Fields of scientific interests and assessment of the contributions of work

The publications of Assistant Professor Ivan Ivanov, in general, I accept his grades for the scientific contributions in the publications with which he participates in the competition. At this point, I will summarize my own views on the main guidelines and contributions to the applicant's research.

The most sustainable direction in the applicant's scientific activity is related to the problems of hemorheology. In a series of articles, Ivan Ivanov participated in the study of the connection between blood's mechanical and electrical characteristics. These articles experimentally prove the statistically significant correlation between the change of the rheological and electrical properties of normal blood and blood coagulum. The experimental production simultaneously measures the cutting viscosity of a blood sample or coagulum and the change in the specific electrical conductivity of the same objects. The studies presented (dissertation and works with numbers 1, 2, 3, 4, and 5) have shown that the correlation strongly depends on the deformation speed, temperature, and concentration of various supplements in the examined blood samples.

The diagnostic value of the measurement of the specific electrical conductivity  $\sigma$  of the samples is confirmed by the experimental proof that by the measurement of this indicator in the course of the process of blood sample coagulation, parameters describing the kinetics of coagulation (TD, TI, and TS) can also be evaluated.

In connection with the studies related to the rheological and electrical properties of the blood, the algorithm created by the author for calibration of an experimental system to determine the specific electric conductivity of the blood, based on the rotary viscosimeter Lowshear Contraves. A significant contribution is an analytical equation to calculate the actual values of blood samples' specific electrical conductivity  $\sigma$  (mS/cm). Works with numbers 9 and 10 are presented as evidence of the contribution.

As can be seen from three of the articles presented (6, 7, 8, and 26), the applicant participates in the study of the effect of sodium nitrite ( $\text{NaNO}_2$ , preservative E250).  $\text{NaNO}_2$  is a proven modulator of the biomechanical properties of the blood of rats and affects its hemorheological properties. Ivan Ivanov's studies have shown that the opposite effect on leukocyte and platelet populations is obtained in an acute intraperitoneal injection of  $\text{NaNO}_2$ . Treatment statistically significantly reduces the number of phagocytes - monocytes and granulocytes, which can cause reduced resistance to infection. In addition, the chemometric platelet indices show a significant increase in the number of PLT and PCT. According to these

results,  $\text{NaNO}_2$  affects platelet activity by altering the blood coagulation status. According to the candidate's conclusions, the results of these experiments can be used in medical toxicology as hemorheological parameters: complete blood viscosity (WBV), plasma viscosity, and major hematometric indices (HB, HCT, MCV, MCHC, and others) are appropriate biological markers for monitoring of nitrite intoxication in toxicology. It should be noted that these indicators can also find application in sports practice in evaluating the negative effects of nutritional supplements used in athletes containing nitrates and nitrites.

Interest in various types of nanomaterials is growing in connection with their application in various fields of biology, medicine, and technology. Two of the scientific works presented (articles with numbers 11 and 12) examine the effect of nanoparticles based on poly(acrylic acid) (PAA). The influence of two types of nanoparticles on the rheological and electrical properties of erythrocyte suspensions: PAA linear chains with medium molecular weights of 225000, 20000, and 6000 Da and stabilized polymer mycelium with mixed blocks composed of poly(acrylic acid) and poly(ethylene oxide). From the results obtained, the following are made concluded:

1. Over the shear speeds  $11.02 \text{ s}^{-1}$ , pure PAA solutions show a statistically significant increase in the cutting viscosity compared to the mycelium solution or the saline as a result of the interactions between the rod-like linear circuits that are oriented in accordance with the cutting lines:

2. The structure, concentration, and shape of nanoparticles are important factors affecting erythrocyte suspension's rheological and electrical properties. For example, linear PAA nanoparticles are more likely to affect the rheological behavior of red blood cells than stabilized spherical micelles, which should be considered in their biomedical administration.

In three of the articles presented for the competition (articles 18, 19 and 22), Ivan Ivanov participated in the study of hemorheological parameters in patients with diabetes. These patients describe rheological phenomena, such as increased aggregation and decreased deformity of erythrocytes, which contribute to an increase in blood viscosity, leading to changes in blood flow in the blood vessels in diabetes. In other patients with diabetes, significant correlations have been obtained between increased blood viscosity throughout the cutting range and values of skin temperature fluctuations in three frequency ranges. It has been found that spectral analysis of variations in vascular skin tone provides useful additional information about the regulatory mechanisms affecting skin microcirculation.

Another experiment found that the formation of clots in patients with diabetes type two is accelerated compared to healthy controls at low shear. The applicant defines his personal

contribution to these studies as providing experimental support for correctly executing experimental models and processing the results.

Two of the articles presented (23 and 25) evaluate the effect of metal salts - cobalt chloride ( $\text{CoCl}_2$ ) and cadmium acetate ( $\text{Cd}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$ ) on the rheological behavior of erythrocyte suspensions. Erythrocyte anisocytosis in the blood of Cd mice corresponding to the increased RDW indicator has been found. In addition, WBV is significantly elevated in experimental groups throughout the cut-rate range compared to the control group. Another study shows that  $\text{CoCl}_2$  and temperature affect the morphology of erythrocytes and their indices, possibly by inducing structural, biomechanical, and biochemical changes in the erythrocyte membrane. In these studies, Ivan Ivanov also determines his contribution to these studies in providing experimental support for correctly executing experimental models and processing the results.

Part of Ivan Ivanov's research is naturally related to various sports science and practice issues. In his monograph, entitled "Sport and Hemorheology ", the author examines how physical loadings of different frequency, intensity, and duration cause a different hemorheological (strictly individual) response in athletes. The principal author's contribution is the synthesis and structuring of the various changes in the biomechanical and fluid properties of blood and blood cells: erythrocyte deformability; erythrocyte aggregation; change in the concentration of basic plasma components - fibrinogen, albumin, globulins, testosterone, etc.; changes in blood flow (by vasodilation and change in the overall viscosity of the blood); changes in blood volume; changes in the endothelial cells of the vascular walls; changes in blood pressure; changes as a result of tissue hypoxia; Interacting, different in nature hemorrhages.

The original model of hemorheological changes studied and described in the monograph of the candidate and the experimental results obtained can contribute to optimizing the training process to improve the health and sports form of elite athletes.

Ivan Ivanov also has studied in the field of applied biomechanics. Two of the scientific works presented (articles 13 and 14) found an experimentally proven direct link between the equilibrium resistance of competitors in firing a pneumatic pistol and the results achieved during firing. Furthermore, a new quantitative criterion for the stability of the target in firing a pneumatic pistol based on an electronic training system "SCATT" has been formulated. Registering this criterion for different intervals of the weapon targeting, with different firing postures, different weapons grip, and different stages in the preparation of the shooter, can be beneficial in the individual choice of the best shooting position.

Three of the scientific articles presented (those with numbers 15, 16, and 17) address the issue of changes in joints in isometric stretching. In addition to a detailed review of the problem (article number 15), an experimental model has been developed to examine the influence of isometric stretching on the intravenous spatial characteristics of the knee joint. The experimental data obtained would allow the development of models of 1. hydrodynamic and mechanical effects in the deformation of the joint capsule; 2. the interaction between the deformation of the cartilage and the flow of the synovial fluid in it; 3. Changes in the volume of the joint capsule result from simultaneous loading with axial forces, internal pressure, and external pressure due to the action of the adjacent muscles and tendons of the knee.

One of the articles (number 20) presents the results of a study aimed at assessing the relationship between kinematic and anthropometric parameters and the efficiency of the selected combat techniques in a representative group of elite Karate Shotokan competitors. It has been found that a higher sports qualification also determines a higher speed of performing certain techniques than the higher height of the athlete. The conclusions show that the selection and development of athletes with optimum height, controlled muscle mass, and reduced fat mass are required.

#### V. Critical notes and recommendations

Except for a minor inaccuracies and incompleteness that do not change the overall positive performance of the applicant, I have no objection to the submitted documents.

#### VI. Conclusion

The analysis of the documents submitted for participation in this procedure gives me grounds for the following conclusions:

- The attached documents meet the specific science metric requirements of the National Sports Academy "Vasil Levski", adopted in connection with the Law on Development of the Academic Staff in the Republic of Bulgaria.
- The publications presented in this competition are at a high scientific level.
- The theoretical and practical contributions contained in the publications of Ivan Ivanov, as well as his teaching experience, expert and organizational activities, fully meet the relevant quantitative and qualitative criteria for the occupation of the post.
- His scientific production shows that he is a scientist who works in collaboration with distinguished scientists in his field.

Everything listed above gives me the confidence to recommend that the scientific jury choose Assistant Professor Ivan Mirchev Ivanov, Ph.D. of the Academic Position Associate Professor in the field of higher education 7. Health and sports, professional field 7.6. Sport, specialty "Biomechanics", announced in the State Gazette. Issue 93 of 22.11.2022 for the Department of Anatomy and Biomechanics needs at the Vasil Levski NSA.

13.03.2023

Reviewer: .....

/Prof. Dr. Lubomir Petrov, Phd/