

REVIEW

by Prof. Hristina Hristova Nocheva-Dimitrova, MD, DMD, PhD

Re: defence of a dissertation *for the award of the educational and scientific degree “PhD”* in the field of higher education 7. “Healthcare and Sport”, professional field 7.1. Medicine, by a doctoral student in full-time training, Dr. Gabriela Georgieva Panayotova.

By Order of the Rector of MU – Varna, No. R-109-283/30.07.2026, I have been appointed a *member of the Scientific Jury* in the procedure for the award of the educational and scientific degree “PhD”.

Pursuant to Protocol No. 1/11.08.2026, I have been appointed a *reviewer* in the procedure for the award of the educational and scientific degree “PhD” with candidate Dr. Gabriela Georgieva Panayotova at the Medical University of Varna.

Dr. Gabriela Georgieva Panayotova has submitted within the deadline all the documents envisaged for the respective procedure in connection with the defence of her dissertation on the topic “A study of the therapeutic potential of biofeedback training as a method for reducing stress and improving the mental health of international medical students”.

I find no omissions in the procedure for the award of the educational and scientific degree “PhD”, nor in the documentation submitted by Dr. Gabriela Georgieva Panayotova, in accordance with the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its Implementation and the Rules for the Development of the Academic Staff at MU – Varna.

I declare that I have no joint scientific works with the candidate.

Gabriela G. Panayotova was born on 14.04.1995 in the town of Gorna Oryahovitsa. In 2020 she obtained a Master’s degree in Medicine (Medical University – Varna). In 2022 she became a Master in Health Management and Medico-Social Care (MU – Varna). In the period 2021–23 Dr. Panayotova undertook postgraduate professional training in digital marketing, SEO and digital branding (SoftUni Digital, Bulgaria), and in the period 2023–24 she completed the Global Clinical Scholars Research Training at Harvard Medical School, Boston, USA. In 2025 she became a Master in Artificial Intelligence in Biomedicine.

Since 2021 and up to the present, Dr. Panayotova has been an assistant at the Department of Physiology and Pathophysiology, MU – Varna, and since 2023 she has been a full-time doctoral student at the same department. In 2025 she acquired the specialty “Physiology”.

Dr. Panayotova’s biographical data are notable for her interesting clinical training and international placements: in the period 2017–19 she completed one-month courses at St. Anna University Hospital, Varna (Clinic of Paediatric Surgery), Pomeranian Medical University, Szczecin, Poland (Department of General Surgery, Gastroenterology and Transplantology), I. I. Mechnikov North-Western State Medical University, St. Petersburg (Department of Anaesthesiology and Intensive Care), Rey Juan Carlos University, Faculty of Medicine, Madrid, Spain (Paediatric Emergency Medicine). These data correlate with her wide-ranging research interests: human physiology and pathophysiology, psychophysiology, biofeedback,

stress, artificial intelligence in biomedicine, prevention, digital health, biomedical innovation, science communication, interdisciplinary biomedical research. The dissertation presented is an illustration of the interdisciplinary approach in the candidate's training.

Dr. Panayotova holds diplomas in three disciplines that differ substantially in their nature (Medicine, Health Management and Medico-Social Care, and Artificial Intelligence in Biomedicine), which are integrated perfectly in the topic of her doctoral work. The candidate uses her medical knowledge in order to analyse the physiological markers of stress (in this case – heart rate). Her medical knowledge of the damaging effect of chronic stress on mental and physical health motivates her to seek methods for controlling stress, such as biofeedback – a strictly medical and scientifically proven method. The candidate proposes a specific social and medical programme addressed to international medical students. This is a specific social group subjected to enormous cultural, linguistic and academic stress and to a risk of developing burnout syndrome. It is here that her managerial approach becomes apparent – her education in health management gives her that characteristic perspective on organising care for specific groups of people and on the management of health (the proof of this being the Practical Recommendations drawn up and appended at the end of the dissertation!). Her education in Artificial Intelligence enables her to make free use of software algorithms that capture and analyse specific biosignals. This makes the study proposed interdisciplinary – exceptionally interesting and modern. The topic does not merely coincide with, but is the perfect point of intersection of, the candidate's three radically different yet complementary educational backgrounds.

The dissertation presented comprises an impressive 185 pages, including: a Title page, Contents (4 pages), a list of Abbreviations used (1 page), Introduction (2 pages), Literature review (52 pages), Aim, objectives and hypotheses of the study (2 pages), Materials and methods (15 pages), Results and discussion (64 pages), Conclusion (3 pages), Conclusions (2 pages), Contributions (2 pages), Practical recommendations (1 page), a list of Publications and scientific communications related to the dissertation (1 page), a list of References (37 pages), 7 Appendices (11 pages).

The literature review is thorough and comprises several sections which set out the parameters of the work to follow:

- **STRESS:** the candidate demonstrates a good command of the research on stress; it is notable that up-to-date data have been used – the greater part of the literature cited dates from after 2020; the neurobiology, the participants in the development of the stress response and its effects on the individual body systems (cardiovascular, respiratory, digestive, immune, reproductive, musculoskeletal) are examined consistently; special attention is paid to the problem of stress among medical students, and specifically among international students, in whom additional factors are present that provoke / intensify the manifestations (a new environment, a foreign culture, language limitations, social isolation, possible financial problems, a risk of discrimination, the family's expectations of good performance, etc.). In view of the socio-economic, political and cultural changes we have been witnessing in recent years, travelling abroad for the purpose of study is occurring ever more frequently. Notwithstanding the growing incidence of young people who take this step, however, the change accompanying such

a decision brings with it challenges and risks, primarily in psycho-emotional terms. With this I wish to underline once again the topicality and the scientific significance of the candidate's work;

- **DEPRESSION AND ANXIETY DISORDERS:** their epidemiology, aetiology, pathogenesis and clinical manifestations are examined. This part of the review is important, since it is connected with the topic of stress: the systems underlying the stress response are involved in the pathogenetic mechanisms of the disorders indicated, and stress is therefore a serious risk factor for their development – this justifies the Scales used in the study for assessing stress, anxiety and depression. The candidate dwells more specifically on the prevalence of depression and anxiety disorders among medical students, drawing attention to certain particularities of their manifestations;

- logically, the review also introduces the concept of “BIOLOGICAL FEEDBACK” (biofeedback, BF), examining in detail this distinctive technique, which affords the possibility of becoming acquainted with one's own physiology with a view to better self-control. The history of biofeedback begins in the middle of the last century; the technique is based on the connection between physiological processes and psychological states. The aim is that, through thorough self-knowledge, self-regulation should be achieved (e.g. of heart rate or other physiological parameters). The Biofeedback Research Society was established in 1969, and since then a Handbook of Psychophysiology has been published and updated, by means of which an ever broader internationalisation of the techniques and professional development are being achieved. The candidate dwells to a sufficient extent on the devices used to record the physiological parameters which we seek to influence through biofeedback techniques – this is necessary since, for example, photoplethysmography (PPG) is used in the present work for the purpose of recording heart rate. The review provides the requisite level of information in order to substantiate the design of the dissertation and the adequacy of its implementation.

The aim of the study is to evaluate the therapeutic potential of BF training as a method for lowering stress levels and improving the mental health of international medical students. I consider that it is correctly formulated and substantiated.

The scientific hypothesis – that BF training will reduce the levels of stress, anxiety and depression – was tested by means of a well-chosen set of objectives and methods:

- Determination of the baseline levels of stress, anxiety and depression among international students with the aid of established psychometric tests (Perceived Stress Scale; Self-Rating Anxiety Scale; Beck Anxiety Inventory; Beck Depression Inventory) – the scales used are presented in the Appendices to the dissertation;

- Conduct of a biofeedback training programme with a group of students with high levels of stress / anxiety / depression;

- Self-assessment (by means of the Scales indicated) and objective assessment of the effect of BF training by means of recordings of:

- heart rate variability (measured by a PPG sensor) and
- cortisol and IgA levels in saliva samples.

The design of the study is described in detail in the Materials and methods section. The study itself was conducted in the form of a controlled longitudinal study including a control and an experimental (training) group. The protocol for the individual stages was carefully specified and was approved by the Research Ethics Committee of MU – Varna; the consent of the study participants was also obtained – the Appendices to the dissertation present the address to the students, in which the aim is clearly stated and the stages of the study are described in detail. I consider that the experimental design described is sufficient, given good execution, to answer the questions posed in connection with the aim of the dissertation and the confirmation of the candidate's scientific hypothesis.

The good use of visual presentation is notable – for example in the form of tables (on the distribution by sex, age, height and weight and year of study of the participants, as well as on additional information concerning religion, ethnicity, harmful habits, etc.), which lends clarity to the exposition. The participants selected form homogeneous groups with respect to age, height and weight; by way of a remark, the predominance of the female sex (85.1%) may be noted, which, however, could also have its own epidemiological significance in the interpretation of the results. Figures illustrate the devices used, as well as the individual modules employed during the training sessions.

The conduct of the individual stages of the study is traced consistently and in detail. The labour- and time-intensive character of the study performed is notable: the methodology presupposes individual work with each one of the participants, in addition to the administration and interpretation of the scales, which each participant completed individually. Alongside this, however, the study also incorporates a software platform (emWave Pro Plus), which makes it possible to monitor various physiological indicators over a prolonged period and in different body positions, to analyse and integrate the results and to produce graphs. This distinctive integration of the human analytical factor with contemporary technological achievements lends weight, depth and a modern resonance to the study.

The results are described in detail. Their interpretation is preceded by rigorous statistical analysis – likewise described and elucidated exhaustively. The doctoral student's thorough multifactorial analysis of the individual data obtained deserves to be underlined. The interpretation of the results presented is set within a thorough analysis of the literature on similar studies and on comparable supporting data.

It must be noted that, besides the detailed and well-argued presentation of the results, they are also rendered visually through tables and figures. The dissertation includes a total of 30 tables and 40 figures (in colour, at that), which lend clarity and completeness to the exposition and reinforce the conviction that Dr. Panayotova is exceptionally well acquainted with the theoretical framing of the problem, handles the information obtained with ease and interprets it confidently and in depth.

The conclusions follow logically from the results presented and their analysis. I accept the conclusions formulated by the doctoral student – set out in 9 main points, each with additional specifications. In brief, the dynamics of the results observed support the scientific hypothesis regarding the effectiveness of the programme applied to the training group: the psycho-emotional distress recorded at the beginning of the study in the experimental group was lowered

to levels comparable with those of the control group. The results of the determination of the serum levels of cortisol and IgA, as well as the monitoring of heart rate variability in the participants, likewise do not contradict the doctoral student's scientific hypothesis of an expected positive effect of the 11-week BF training.

I accept the **contributions** formulated by the doctoral student – of both an original and a confirmatory character.

The **Abstract** presented (in Bulgarian and in English) reflects adequately and to a sufficient degree the principal points of the study conducted. The English translation corresponds to the original.

In connection with the defence of the dissertation, Dr. Panayotova has presented **3 publications in peer-reviewed scientific journals** and **4 scientific communications** – in all of which she is first author. All the publications listed are related to the topic of the dissertation.

The candidate is a participant in one research project, likewise related to the topic of the dissertation: "Evaluation of the therapeutic potential of biofeedback training as a method for reducing stress and improving the mental health of international medical students".

In conclusion of the above, I declare that I shall vote "**YES**" and shall confidently propose to the Scientific Jury that Dr. G. Panayotova be awarded the educational and scientific degree "**PhD**" in professional field 7.1. Medicine.

Заличено на основание чл. 5, §1, б. „В“ от Регламент (ЕС) 2016/679
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/Prof. Hr. Nocheva, MD, PhD/

03.09.2026
Sofia