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OPINION

by Prof. Mashenka Borissova Dimitrova – IEMPAM-BAS

Regarding: Competition for the academic position of associate professor in the specialty "Anthropology" (01.06.01), Professional direction 4.3 "Biological sciences", announced in State Gazette - SG no. 43/10.06.2022 for the needs of the "Anthropology and Anatomy" section of IEMPAM-BAS.

The only candidate in the competition is Assist. Prof. Diana Hristova Toneva, PhD from the "Anthropology and Anatomy" section of IEMPAM-BAS. The documentation presented by her is in good order and fully meets the requirements of the Law for the Development of the Academic Staff and its Regulations, incl. IEMPAM's regulations for acquiring scientific degrees and occupying academic positions.

Diana Toneva entered IEMPAM-BAS in 2009 as a master's degree student in general anthropology, specialty of Biology at the "St. Kl. Ohridski". In 2010, she became a PhD in the specialty "Anthropology" after defending a thesis on the topic "Anthropological characterization of the sternum, clavicle, scapula and proximal end of the humerus and evaluation of their gender differences". The candidate has excellent computer skills, 68 scientific publications in our and international journals in the field of anthropology and anatomy, 71 participations in scientific forums, 168 noticed citations, and her h-factor is 5 according to Scopus. She is a participant in 4 projects at the Scientific Fund of the Ministry of Education and Science, in one of which she is the leader. She is also the head of a project under the Program for the Support of Young Scientists from BAS and a participant in the target group of a project under OP "DHR". Dr. Toneva is a member of BAD and the European Anthropological Association. She received the award of BAD "prof. D. Kadanov" for high publication activity in the period 2019-2021. Her expert knowledge is reflected in her review activity for national and international journals.

In fulfillment of the minimum requirements of IEMPAM for acquiring the academic title "Assoc. prof.", reflected in *Appendix 1* of the Regulations of IEMPAM for the acquisition of scientific degrees and holding academic positions, Dr. Toneva participates with **492 points** on indicators A-E with a required minimum (RM) of **430 points,** distributed as follows:

A1 – PhD thesis - **50 points** (RM - 50 points)

C4 – 5 scientific publications equivalent to a habilitation thesis, of which 2 with Q1, 1 with Q2 and 2 with Q3. – **100 points** (RM – 100 points)

D7 – 13 scientific publications in refered and indexed journals, of which 2 with Q1, 7 with Q2, 3 with Q3 and 1 with Q4. – **247 points**

D8 - Published chapter of a book in the international publishing house IntechOpen - **15 points.**

Total in D – 262 points (RM – 220 points)

E11 – 40 quotes – **80 points** (RM – 60 points)

It is noteworthy that all the works with which Assistant Professor Toneva participates in the competition are in prominent international journals such as Annals of Anatomy, Anatomical Record-Advances in Integrative Anatomy and Evolutionary Biology, Anthropologischer Anzeiger, Anatomical Science International, etc. The high quality of her scientific output is also

proven by the large number of citations – 168, of which the candidate has selected 40 citations for the current competition, all in journals, referenced and indexed in international databases.

Dr. Toneva's scientific contributions are mainly in the field of forensic anthropology, virtual anthropology and macroscopic anatomy. Anthropological measurements were mainly carried out on 2D- and 3D-images obtained with modern methods such as computer tomography and laser scanning. For research purposes, proprietary methods have been developed that combine standard statistical analyzes with approaches from the field of machine learning, mathematics, etc. The overall scientific activity of the candidate can be defined as "interdisciplinary", which corresponds to modern guidelines for scientific research.

Dr. Toneva logically divides her contributions into three directions:

1. Development of methods for identification of human bone remains

Gender determination methods: For the first time in our country, subsymbolic algorithms from machine learning were used, with which classification models were obtained for determining biological sex based on 86 metric characteristics of the entire skull, achieving a high accuracy of 95%. Discriminant models have also been developed to determine gender by the area of the "mastoid triangle" with an accuracy of 89%. The potential for gender determination by the size and shape of the large occipital foramen was investigated, and for this purpose a new method was proposed to calculate the area of the foramen from a 3D model by 2D-projection and using a novel set of metric characteristics.

Determining the thickness of the soft tissues of the face: For the first time, data on the thickness of the soft tissues in certain facial points of the Bulgarian population were obtained on head images from computed tomography. Interrelationships have been established between gender and obesity on the one hand and the thickness of soft tissues in different parts of the face on the other. A novel approach for the acquisition of a large amount of soft tissue thickness data based on polygonal models with a preset mesh density is proposed, which enables extremely detailed measurements over the entire facial area.

Changes in the structure of cranial sutures in age-related obliteration: High-resolution micro-computed tomography images were used in the research. Microstructural changes in the sutures in the direction of thickening of the trabeculae and the distances between them, as well as increased anisotropy, were found.

Dr. Toneva's research in *Direction 1* has a direct application in forensic medicine for determining gender, specifying age and obtaining maximally accurate reconstructions of the face on the skull.

2. Evaluation of the reliability and accuracy of digital methods for obtaining data for osteological studies.

The accuracy of counting standard craniometric points on 3D models from laser scanning was evaluated. It is shown that the resolution and texture of the models have different effects on the localization precision of individual point types. The reliability of digital measurements from such models was also evaluated, indicating the most problematic areas, namely the points lying on bone edges. Regarding digital radiography, the influence of the position of the skull on the precise calculation of the dimensions of frontal sinus is studied. Comparative studies show that the most reliable results are obtained in the Caldwell projection.

Direction 2 research allows to verify digital image measurements obtained by different imaging methods and to define approaches to improve their accuracy and reliability.

3. *Study of anatomical variation*

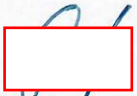
A number of anatomical variations of the skull have been studied, and (what is particularly valuable) for each of them both the etiology and the possible clinical consequences have been discussed. Of particular interest are studies of skulls with a persistent metopic suture. Various methods such as digital morphometric analysis, geometric morphometric analysis, methods for extracting regularities from data (data mining) have been applied in these studies. Statistically significant differences were found in the size and shape of the skull and its individual parts compared to control samples. A relationship between metopic skulls and the appearance of extra bones, as well as frontal sinus pneumatization, has also been established.

The results of *Direction 3* are of fundamental importance and also, with direct application in the clinic.

Conclusion: The documents presented by Dr. Toneva for the competition show an eminent scientist at a high professional level in the field of anthropology and anatomy. Her scientific developments are interdisciplinary with the application of state-of-the-art mathematical and statistical analyses, imaging diagnostics, laser scanning, machine learning methods, etc., with which she contributes to raising anthropological science in Bulgaria to a new high level. The obtained results are of fundamental importance, but also have a direct applied value in forensic medicine, the clinics and to afirm the application of digital analyzes in anthropology. Dr. Toneva's academic performance significantly exceeds the requirements for acquiring the academic title of associate professor. Active research and project activity, as well as collaboration with scientists from other fields, are a guarantee for future progress.

On the basis of the above, I strongly recommend the Honorable Scientific Jury to submit a proposal to the Scientific Council of IEMPAM to award Diana Hristova Toneva the academic title of Associate Professor of "Anthropology" (01.06.01), Professional direction 4.3. Biological Sciences.

09/27/2022

Signature: 

/Prof. M. Dimitrova/