

“Science without Borders” program and Brazilian-Hungarian collaboration in thermoregulation

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Here we discuss how the Science without Borders program has helped Brazilian medical students to spend 2 semesters studying in Hungary and to get theoretical and practical training in the field of body temperature regulation at the Medical School, University of Pécs.

Brazil has been sending graduate (particularly PhD) students for studying abroad for more than 20 years. As a recent strategy for outbound student mobility, the Science without Borders (Ciência sem Fronteiras) program expanded this initiative and included undergraduate students. The Science without Borders program is a joint effort of the Ministry of Education and the Ministry of Science and Technology funded by the Brazilian Federal Government. From 2011 to 2014, the program has invested the equivalent of approx. 1 billion US dollars and granted ~80,000 scholarships to strengthen and expand the initiatives of science, technology, innovation, and competitiveness through international mobility of

undergraduate and graduate students and researchers.¹ The program focuses mainly on science, technology, engineering, and math, including health and biomedical sciences, clinical and pre-clinical sciences, pharmaceuticals, and biotechnology. Among the 43 partner countries participating as hosts in the program, the United States, the United Kingdom, and France are the top 3 destinations, while Hungary is the 11th most popular country by receiving over 2,000 Brazilian students since the launch of the program.² In Hungary, the whole higher education institution system is represented by the Hungarian Rector's Conference, a body comprising the heads of higher education institutions. There are 17 Hungarian higher education institutions included in the project, which offer 68 undergraduate, 1 postgraduate, 46 PhD and 7 health science courses.³ After completion of the scholarship the undergraduate students are expected to return to Brazil to complete their degrees. By accepting the scholarship the students imply their commitment to stay in Brazil for the same number of months as the duration of their studies abroad funded by the program. It is expected that the returning students apply some of the knowledge obtained abroad for the development of science and technology in Brazilian universities and industries. The program's focus on industrial interest ensures that award-holders will have strong chances of employment both in industry and in academia.

In 2014, a total of 1,542 Brazilian students applied to study in Hungary in the Science without Borders program and 382, i.e. ~25% of them were selected to spend one or more semester(s) at a Hungarian institution. The most popular destination cities were Budapest, Debrecen, Pécs, and Szeged among the students. Interestingly, Medical School belongs to

the universities in all 4 of these cities. The oldest institution among them, and in the country, is the University of Pécs, which was founded by Louis the Great in 1367. With 22,000 students, 1,600 lecturers and 10 faculties the University of Pécs is currently one of the largest higher education institutions in Hungary and the center of knowledge within the Transdanubian region. A total of 80 Brazilian students have visited the University of Pécs with the help of the Science without Borders program, 41 of them, including 3 of the authors of this piece (LC, AT, and ACR), studied at its Medical School. For the duration of their visit, the program has provided the students with several benefits, including air ticket allowance, monthly stipend to cover living expenses, settlement and health insurance allowance, and tuition fee coverage. During the scholarship, students could attend courses at the host institution and then spend an 8-week long internship in a department of their choice.

One of the optional courses at the Medical School, University of Pécs was “Thermomania: the medicine of thermoregulation,” which was attended by several students of the Science without Borders program. This course was directed by one of the authors (AG), who brought together a motivated team of young lecturers, whose specialties included evolutionary biology, pathophysiology, nutrition, anesthesiology, urology, pediatric surgery, and pulmonology, but they all shared the common motto: “Maintenance of normal body temperature means life.” Students applying for the course could learn about the importance of body temperature regulation and gain an insight into the mechanisms maintaining body temperature in accordance with the modern theories of thermoregulation.⁴ They could see how certain food ingredients

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(e.g., chili, menthol, etc.) influence body temperature, how thermoregulation differs between dinosaurs and humans and what the subcellular heater units of our body are. Based on the theoretical knowledge obtained in the first part of the course, students were then introduced to extreme thermoregulatory disorders (e.g. hypothermia in high mountains, malignant hyperthermia), furthermore, to the characteristics and peculiarities of the clinical appearance, diagnosis and therapy of thermoregulatory disorders in adult and childhood in the form of clinical and pathophysiological case studies. During the second part of the course, students had the opportunity to visit different clinical departments and to observe the signs and symptoms of certain diseases firsthand. Titles of the lectures included “Mechanisms of body temperature maintenance”; “Microscopic heating units of the body: heat production in the mitochondria”; “Proper techniques of temperature measurement”; “Temperature maintenance from dinosaurs to humans: the evolution of thermoregulation”; “The role of chili, menthol, wasabi, cinnamon and their receptors in temperature regulation”; “Chili-pepper against obesity? Role of the capsaicin receptor in energy balance”; “Feeding as a heat generator”; “Hypothermia in high mountains”; “Brain-teasing pathophysiology case studies”; “Characteristic and peculiar clinical cases” and others.

The major part of the Thermomania course took place in the Department of Pathophysiology and Gerontology, Medical School, University of Pécs. The department was established in 1949 by Professor Szilárd Donhoffer, who was also the founding father of thermoregulatory research in Pécs.⁵ Prof. Donhoffer’s scientific initiatives and achievements are still continued in the department by his former pupils (currently emeritus professors) and their pupils who still actively conduct scientific research on various aspects of thermoregulation and complex energy

balance. The Thermoregulatory Group is formed of multiple generations of research staff, including emeritus professors, associate and assistant professors, postdocs, PhD and medical students, and technicians. Student volunteers who are interested in the research activities of the group can join the department for shorter or longer periods of time and engage in thermophysiological research. On that account, after finishing the Thermomania course, the Brazilian authors of the current report were inspired to spend their 8-week long internship in the Department of Pathophysiology and Gerontology. During the internship the students could deepen their understanding of body temperature regulation and they could also observe the different research techniques and experimental setups that are used in the department. The laboratories are equipped to study thermoregulatory parameters in restrained and freely-moving unanesthetized small animals under controlled thermal conditions. A recent description of the commonly used experimental setups can be found elsewhere.⁶

In the Thermomania course the students were presented with slides illustrating the complexity of energy balance,⁷ feeding-related thermoregulatory effects,⁸ and mechanisms of heat loss,⁹ which were published in *Temperature* in a special format called “Teaching Slide.” Encouraged by the obtained theoretical and practical knowledge and inspired by the slides presented in Thermomania, one of the students (LC) decided to participate in the preparation of a teaching slide about the pathophysiology of heat exposure to be published in *Temperature*.¹⁰ This was not the first example for a productive teamwork between Brazilian and Hungarian researchers. Professor Andrej Romanovsky’s FeverLab in Phoenix, Arizona, has constituted a central site where research scientists visiting from Brazil and from Hungary could join forces to make advances together in the field of thermoregulation as evident from the publications from the host laboratory.¹¹⁻¹⁴ Some fellows

in FeverLab (e.g., Maria Camila Almeida, presently Assistant Professor at the Federal University of ABC, São Bernardo do Campo, SP, Brazil) were also supported through the Science without Borders program. Successful completion of the course and the internship by the Brazilian students at the University of Pécs and publication of articles jointly with Hungarian co-authors represent further testimony of the fruitful Brazilian-Hungarian collaboration for the study of thermoregulation.

Disclosure of potential conflicts of interest

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