Increased interest in physiology and science among adolescents after presentations and activities administered by undergraduate physiology students

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In this article, we present a set of activities performed in south Brazil that are aligned with the objectives of PhUn Week and promote the integration between universities and public schools and dissemination of knowledge of physiology. To achieve this goal, we adopted a program in which undergraduate physiology students visit schools. We reasoned that undergraduate students, previously trained in physiology, could better impact the interest and motivation of students toward science than physiology researchers, since these two groups of students are closer in age. Thus, the objective of this work was to share knowledge of physiology and demonstrate the presence of physiology in daily life to promote the interest of students in physiology and science. Here, we describe the activities developed in this sense and their impact. We hypothesized that such activities will improve knowledge and increase general interest in physiology and science among students.

METHODS

The activities described in this report were conducted in four public schools in the city of Uruguaiana, Rio Grande do Sul, Brazil, from October 21 to November 8, 2013. All activities were approved by the local Institutional Outreach Committee (Institutional Review Board no. 10.035.14).

Invitation and disclosure. Schools were contacted and invited to host visiting undergraduate physiology students on specific days and times. After confirmation, we introduced activities in the schools through brochures, posters, social networking sites, and the university website.

Participating schools and students. All participating schools were public schools located in city neighborhoods. The schools contributed to the implementation of the program by providing space to develop the course of action. A total of 328 students, aged 10-14 yr, participated in the activities. Of these students, 59.1% (n = 194) were girls and 40.9% (n = 134) were boys; 22.8% (n = 75) were 10 yr old, 29.6% (n = 97) were 11 yr old, 21.6% (n = 71) were 12 yr old, 21.3% (n = 70) were 13 yr old, and 4.7% (n = 15) were 14 yr old.

Activities. The activities during the visits were organized in a circuit in which students were organized in small groups and began participation at different stages of the circuit. All activities were completed, and each circuit stage was independent of the others (Fig. 1).

For each stage, two tutors (trained undergraduate students) conducted the activities. All undergraduate students acting as tutors were previously trained by a physiology (professor and researcher), a postdoctoral researcher, and a PhD student. All undergraduate students had basic knowledge of physiology.

The proposed activities included:

1. Human physiology concepts. In this activity, the tutors presented the concept of human physiology to the students by discussing its presence in daily life through conversation using an explanatory poster and leaflets containing information about body functions and how scientific discoveries are made.
Students were instructed to select the most appropriate answer. Questions identify the students and contained multiple-choice questions in which drug use. This activity used an explanatory banner and leaflets that of drugs, the rational use of medicinal drugs, and the risks of illegal logical mechanisms and structures involved in the biotransformation systems and physiological mechanisms. The content addressed con- with students by relating these processes to the functioning of body absorption, distribution, metabolism, and elimination were discussed ing information about the benefits of physical activity on brain student who participated in this activity received a bookmark contain- illustrated the relationship between attention and reaction time. Each different situations: full attention and divided attention. This practice the central nervous system and how physical activity can improve regular physical activity on health while relating these benefits with underlying the function of the nervous system and the benefits of this activity, the tutors explained to students the general mechanisms in physiological parameters after physical activity.

2. Blood physiology. In this activity, tutors and students discussed topics related to biological individuality, genetics, and disease contagions. In this stage, we performed an exercise to determine blood type. The demonstration was made through the collection of three drops of blood from one of the tutors responsible for the activity using a lancet. The drops were placed on a sterile blade, and antibody-A, antibody-B, and antibody-D reagents were then added. Students visualized agglu- tination of the sample to identify the blood type and then discussed various topics, including antigen-antibody reactions and biosafety. In this module, each student that participated in the exercise received a card with information on this subject and different blood types.

3. Cardiorespiratory changes during physical activity. In this mod- ule, students received basic information about the functions of the cardiiorespiratory system during rest and physical activity using syn- thetic anatomic models of cardiorespiratory organs. Later, students were asked to perform an exercise with the aid of a toy used to make soap bubbles to promote breath awareness, noting the phases of inspiration and exhalation. In addition, volunteers were selected for measurement of vital signs (i.e., heart and respiratory rate, O₂ saturation, and blood pressure) before and after a short period of intense physical activity (in this case, the student was asked to jump on a small trampoline). In this practical activity, students observed changes in physiological parameters after physical activity.

4. Physical exercise and its influence on memory and cognition. In this activity, the tutors explained to students the general mechanisms underlying the function of the nervous system and the benefits of regular physical activity on health while relating these benefits with the central nervous system and how physical activity can improve learning and memory. Students completed reaction time tests in two different situations: full attention and divided attention. This practice illustrated the relationship between attention and reaction time. Each student who participated in this activity received a bookmark contain- ing information about the benefits of physical activity on brain function.

5. Drug action in the body. In this activity, the processes of drug absorption, distribution, metabolism, and elimination were discussed with students by relating these processes to the functioning of body systems and physiological mechanisms. The content addressed con- ceptual aspects of routes of drug administration and delivery, phys- iological mechanisms and structures involved in the biotransformation of drugs, the rational use of medicinal drugs, and the risks of illegal drug use. This activity used an explanatory banner and leaflets that were distributed to the students.

Two questionnaires, one questionnaire before the start of the activities and a second questionnaire after the completion of the activities, were applied to assess the impact of these activities. The questionnaires did not identify the students and contained multiple-choice questions in which students were instructed to select the most appropriate answer. Questions and possible answers contained in the questionnaires are shown in Table 1.

The program lasted about 4 h, and each school was visited only once. Questionnaires were applied at the beginning and end of the visit. The answers were tabulated, and the results were presented in the next session in the form of percentages and/or means and SDs, depending on the question. The Wilcoxon test was used to compare results of questions 5 and 6 before and after participation in the program.

RESULTS

In response to the question “Do you know what physiology is?” most students responded that they did not know (92%; Fig. 2A). However, after the visit, the percentage of students with no knowledge of physiology considerably decreased (22%; Fig. 2B).

When asked about the main focus of the field of physiology, most students were unsure in the first assessment (63%; Fig. 2C). However, in the postintervention assessment, the percentage of students who recognized the main focus of the field of physiology had increased (97%; Fig. 2D).

Regarding the importance of learning about physiology during the school day, 72% of students reported that it was important even before our intervention (Fig. 2E). After the program, the number of students interested in learning about physiology had increased (81%; Fig. 2F). Likewise, the percentage of students who considered that it was important to learn about science and research increased after the program: 48% (before; Fig. 2G) versus 64% (after; Fig. 2H).

When we requested students to rate the importance of physical exercise to promote health on a scale from 0 (not important) to 10 (very important), the mean score before the intervention was 8.12 ± 0.74 and 9.73 ± 0.49 afterward (P < 0.01 by Wilcoxon test).

Finally, we requested students to quantify their knowledge about science and physiology on a scale from 0 (nothing) to 10 (as much as possible). Before the intervention, the average score was 3.41 ± 0.82, whereas after the activities, the average score increased to 8.94 ± 1.31 (P < 0.01 by Wilcoxon test).

DISCUSSION

The purpose of the activities implemented in this study was to develop knowledge about physiology and science among school-aged children to promote a closer relationship between universities and communities through outreach activities de- veloped by undergraduate physiology students. The results of this study clearly indicate that this purpose had been fulfilled. Students were given the opportunity to participate in practical activities and experience examples of how the human body...
responds to different situations, which probably also contributed to the success of the intervention.

The program contributed to the understanding of physiology and its application to daily life among the participating students. As shown in Table 1, the questionnaire did not ensure the students’ knowledge of physiology but rather indicated students’ self-perceptions of knowledge. Also, the data collected by the questionnaire allowed us to determine that the importance given by school students to learn about physiology, science, and research increased compared with preintervention results.

It is important to mention that the sequence of stages proposed in the activities circuit, the sex distribution, and the age distribution did not influence student understanding of the concepts discussed. Additionally, the impact of the activities was measured immediately after completion. Hence, long-term learning and retention were not the goal of this study, as the questionnaire was designed to assess perceptions of short-term learning and there was no long-term assessment. Although a limitation of this study, a short-term effect can be considered a positive result, since before participation in the activities, these students had limited previous knowledge of physiology and no contact with the university students.

Despite the inherent limitations implicated in carrying out an activity of this scale with a large number of students, the results were very positive. These results probably are related not only to the interest of school students in the theme, which in itself attracts the attention of students, but also in the manner in which the activities were proposed and conducted during the visits. According to recent studies, modern methodologies used to teach content stimulates learning and interest better than traditional teaching methods (12, 13). Jensen et al. (8) demonstrated numerous benefits of partnerships between schools and universities (Minnesota model) to stimulate interest and learning. Moreover, these partnerships can pique the interests of high school students in the disciplines of human anatomy and physiology and encourage further study at the university level. These benefits include learning to work in cooperative groups, engaging in scientific inquiry, and learning about core principles of human anatomy and physiology (8). At present, in both schools and universities, alternative teaching methods are being developed to pique student interest and facilitate the learning process (1, 2).

Additionally, we consider that participation of undergraduate physiology students in the school environment and incorporation of different innovative methodologies also contrib-
uted to the success of the project. The involvement of undergraduate students allows the students to become more comfortable with the subject matter and, at the same time, enables the inclusion of new content in the subjects taught in schools by combining content to the school curriculum and everyday life experiences. In the same way, activities are chosen to facilitate popularization of science. It is known that initiatives aimed at science popularization are necessary to minimize the apprehension of students to learn science (7). In addition, the inclusion of undergraduate students in the community contributes to the formation of professionals who are more critical, creative, and sensitive to social problems.

At present, science and technology continue to evolve at incredible rates, so knowledge should no longer be limited to those familiar with the subject matter and methods and are needed to explain scientific findings in simpler terms (3). In this sense, we realized that the integration between university and schools during our study became a gateway to exchange and deliver knowledge of physiology to school students.

After completion of this study, we initiated a permanent partnership with the participating schools. We currently are developing a long-term program in these schools aimed at increasing student interest in science, technology, engineering and mathematics (STEM) careers, especially science. This program is funded by the Brazilian government, the Ministry of Education/Brazil (Ministério da Educação/Brasil), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)/Brasil, and the Newton Fund (STEM International Cooperation Program British Council/CAPES). In addition, these actions serve to reinforce the three doctrines of the university: teaching, research, and community/outreach activities.

There were some limitations to the present study that should be addressed. First, the time between the activities and the following evaluation was short, so long-term learning and retention were not assessed. Second, the questionnaire only permitted evaluation of the students’ self-perceptions of physiology learning/knowledge. In future studies, a long-term evaluation (days or months after the activities) and open questions permitted evaluation of the students’ self-perceptions of physiology learning/knowledge. In future studies, a long-term evaluation (days or months after the activities) and open questions could help to solve these issues. Additionally, a broader age group (which obviously will require some adaptation in the activities) and analysis of the impact of the activities in each age group could elucidate the age of students most receptive to this type of intervention.

In conclusion, the use of undergraduate physiology students to implement this program in schools was an important and effective strategy to promote the interest of school students in physiology and science.

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DISCLOSURES
No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS

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