

Stimulating the Formation of the Physician-Scientist; Scientific Exposure during the Medical Course in Brazil

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Abstract

Despite major advances in medical research, there is a decline in the number of physician-scientists. It is necessary to stimulate the involvement of MDs in the scientific endeavor. Brazil has a national program which stimulates the participation of undergraduate students, including medical students, in research projects as a regular academic activity. Herewith we analyze the introductory scientific program and the involvement of MDs in research in Brazil. The program to promote early scientific exposure during the undergraduate or medical course has the objective of recognizing students with aptitude for scientific research. Brazilian research groups in the area of medicine show a continuous increase, and the health sciences represent a sizable part of graduate students who receive scientific initiation fellowships. An important part of students who participated in introductory scientific programs continued in scientific activities in graduate programs. This finding supports the importance of basic scientific research in stimulating students to follow a scientific career.

In Brazil approximately 2% of the population 15 years old or older has a postgraduate degree and Brazil produces approximately 2% of the internationally-indexed scientific papers worldwide.^{1,2} In 2008, Brazil's world ranking in production of scientific articles was 13th (30,415 manuscripts) in the Institute for Scientific Information (ISI) database.³ The Thomson Reuters' report on Brazil's situation in science indicates that the country doubled its output in the ten years prior to 2007, and that its growth exceeds those of most other economies.⁴ Brazil invested 1.09% of its Gross Domestic Product (GDP) in scientific research, an average investment of US\$ 121.4 per capita and US\$ 172,732 per researcher, according to data from 2008.⁵ For comparison, USA in the same year published 340.638 studies and invested 2.77% of GDP on scientific research, representing US\$ 1307.2 per capita and US\$ 243,900 per investigator.^{3,5}

As a country's development is linked to scientific activity, the country needs to increase its post graduate population to enhance its scientific

productivity. To stimulate the expansion of a country's scientific base it is necessary to stimulate an interest in research early in the students' life. The country's technological development is closely linked to the manner and extent to which young people are encouraged to do research. It is in this context that there rises the idea of introductory scientific programs (ISP).⁶

Physician-scientists are essential to ongoing biomedical advances.⁷ However, the number of physician-scientists continues to decrease.⁸ Progressively fewer physicians are interested in a scientific career because of the low remuneration, long training and preparation, as well as low government investment in this issue. In this study, we comment on introductory scientific programs with emphasis on the Brazilian national program, present data on the current situation of medical research and the involvement of MDs in research in Brazil.

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Advantages and goals of introductory scientific programs

ISPs aim to introduce undergraduate students into the realm of scientific research. One goal of these programs is to encourage new potential talents, through participation in research projects supervised by qualified researchers, preparing them for entry into graduate studies. Furthermore, the introductory scientific programs aim to contribute to reducing the average time for completion of PhDs, accelerating the formation and scientific expertise of students.⁹ Pursuit of an academic career in educational institutions in Brazil requires proper scientific training and even in the case of MDs the need for obtaining a PhD. The interest in teaching has been confirmed by the intense growth of students in graduate programs and in those who affirm that a future academic career is a major goal for them.¹⁰ Because of intense competition, those with greater scientific training and research knowledge have better opportunities.

ISPs may have impact the professional career, as it enables a greater understanding of the labor market by allowing the interaction between the scientific world and practical activities of the profession.¹¹ ISP-exposed individuals develop a cooperative attitude through teamwork, by developing a systematic vision of interdisciplinary and cooperative work and developing activities related to planning, implementing, interpreting and communication of scientific research and its results.^{12,13} Additionally, they are more interested in their professional formation and present lower dropout rates in their undergraduate courses.¹⁴

Introductory scientific programs in Brazil

The Brazilian National Council for Scientific and Technological Development (CNPq) finances ISP through the granting of annual fellowships to encourage postgraduate research, an effort followed by several State Agencies throughout Brazil¹⁵. In 1988 CNPq created the Institutional Program of Introductory Scientific Fellowships - PIBIC. This program grants a quota of scientific fellowships to educational institutions which are directly responsible for managing the fellowships and their evaluation. The program reaches 78% of public educational institutions and 71% of private ones countrywide¹⁶. An annual meeting where fellows present their scientific production is mandatory. Student performance is evaluated by a committee which includes external observers.¹⁵

The number of introductory scientific fellowships distributed by CNPq has grown since 1976. In 1976, 845 students received fellowships from CNPq; in 1997 it reached 18,856 students, and this figure continues to increase. In 2009, 24,043 undergraduate students received PIBIC fellowships and 3,485 (14.49%) of them were in the health sciences (Figure 1). In the same year, CNPq invested approximately U\$ 420 million in research fellowships, and scientific initiation fellowships accounted for 10.12% of these expenses.¹⁷ In recent years biological sciences represented the area with the largest number of fellows (Table 1).¹⁷ Of note is the fact that in the last ten years female fellows outnumbered male fellows, and in 2009 the former group accounted for 56% of all scientific initiation fellowships granted.

Area / Modality	Number of fellowships-year		
	2001	2005	2009
Agrarian Sciences	3.143	2.798	3.325
Biological Sciences	3.100	3.411	3.996
Health Sciences	2.423	2.512	3.485
Earth and Exact Sciences	2.357	2.936	3.550
Humanities Science	2.768	2.860	3.457
Applied Social Sciences	1.396	1.425	1.639
Engineering	2.682	2.896	3.170
Linguistics, Literature and Arts	854	905	1.094
Multidisciplinary / Other / not reported	55	169	328
Total	18.778	19.912	24.043

Table 1: Number of introductory scientific fellowships distributed by PIBIC according to area/modality of science between 2001 and 2009. Source: CNPq (National Council for Scientific and Technological Development).

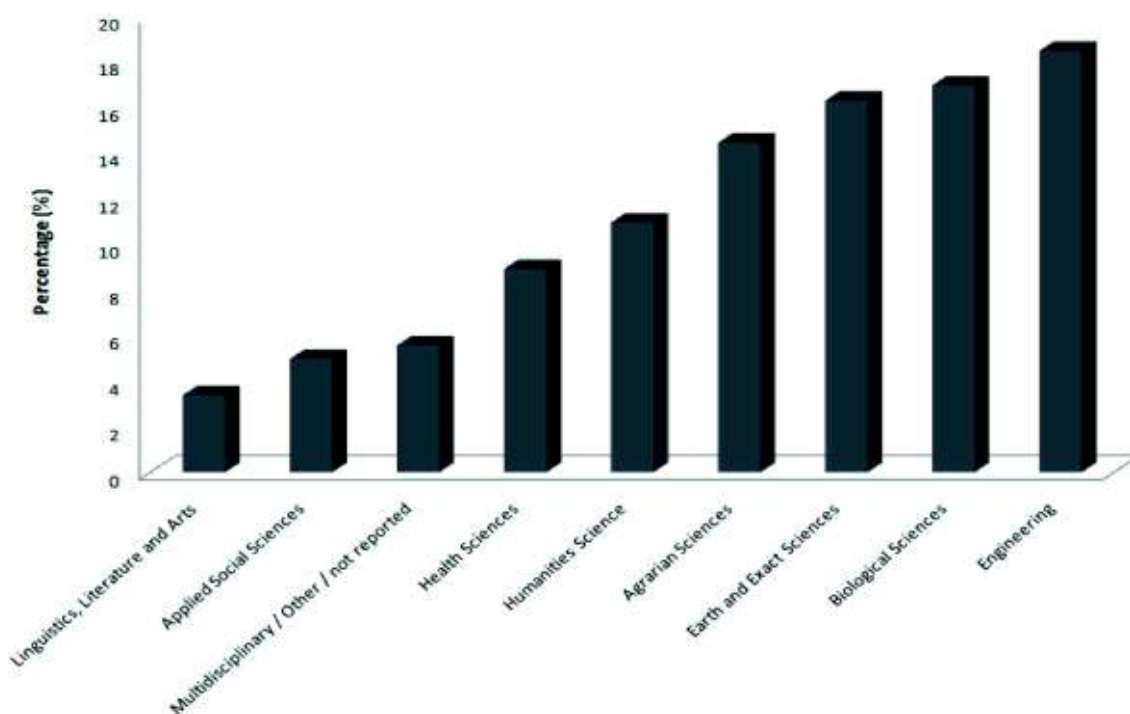


Figure 1: Percentage of CNPq investments in fellowships according to area of science in 2009. CNPq investments are subdivided according to area of science. In this figure each column corresponds to an area of science and its percentage of fellowships from the total supported by the CNPq in 2009. Source: CNPq (National Council for Scientific and Technological Development).

According to an interesting study conducted by CNPq, about 26% of students who participated in ISP in the period between 1994 to 2006 continued in scientific activities in graduate programs in the period 1996-2008.¹⁷ The chance for enrolling in a graduate program is approximately six times higher with former PIBIC fellows compared to individuals without ISP experience. This finding confirms the importance of ISP in stimulating the students to follow a career based on scientific expertise. Additionally, experience in ISP during undergraduate study relates to a reduced time for completion of a graduate program compared to students who have not had this experience during their undergraduate work (Table 2). Additionally, 44% of the graduates from public educational institutions, and about 50% of those from private institutions, consider that introductory scientific projects had contributed to their education. On the other hand, 20% of graduates said that the ISP had little or no impact in their development.¹⁶

Introductory scientific programs in medicine and the physician-scientists

According to the Brazilian National Curriculum Guidelines for Medicine Graduation, educational institutions which offer medical courses need to develop complementary activities in addition to a minimum curriculum, and among such offerings is the ISP.¹⁸ About 84% of medical students advocate mandatory ISP at graduation, while only 7% of them indicate no interest in research.¹⁹ Real numbers of participation show a slightly different picture. In a study of 413 medical students from six different schools, it was found that 68% of them participated in the ISP during undergraduate study, while 28 % went through the entire course without enrolling in this kind of activity.¹⁹ Participation in ISP during undergraduate study differs among professional careers. Medical students participate more in introductory scientific programs when compared to law students (30.8% versus 2.9%).²⁰ It seems that the medical course encourages students to participate in scientific activities. The same study evidenced that ISP influenced development in the understanding of theoretical and practical scientific concepts over time.²⁰

Age (years) at end of graduate studies	Former PIBIC fellows during undergraduation (%)	Non fellows during undergraduation (%)
Up to 24	8.46	2.45
[25,27]	49.55	20.39
[28,30]	26.27	19.67
Above 30	15.72	57.49

Table 2: Comparison between the ages of graduates students who had or did not have scientific initiation fellowships in undergraduate courses, between 1996 and 2008. PIBIC: Institutional Program of Introductory Scientific Fellowships. Source: CNPq (National Council for Scientific and Technological Development).

Year	MD	MD, PhD	MD, PhD as % of total
2000	2,234	1,481	44.76
2008	4,687	3,372	46.26
Increase (%)	209.8	227.7	

Table 3: Number of MD and MD-PhD Brazilian scientists funded by CNPq. CNPq: National Council for Scientific and Technological Development. Percentage of total refers to the total of investigators holding doctoral degrees (MD, MD-PhD, PhD) and listed in medical research groups.

There is no large survey about the significance of ISP in medical courses. Several institutions have published their experiences of implementing such programs on their sites.⁶ These publications point out the difficulty of installing a consistent project of ISP, which may be the reason why only a small number of medical courses have a well established program of Scientific Initiation.²¹

The scientific advances in medicine progressively increase over time and physician-scientists are progressively less frequent.²² The number of physician-scientists is not following the increase of scientific and research needs in the medical area, hampering scientific advances. Research groups in the area of medicine increased from 737 in 2000 to 1355 research groups funded by CNPq in 2008, an increase of 83.85% in 8 years.²² In 2000, 1481 (44.76% of total) of medical researchers were PhDs. Approximately 46.26% of the physician-scientists (n=3372) were PhD in 2008. Between 2000 and 2008 the number of physician-scientists increased 209.8% for MD medical researchers and 227.7% for those with the MD, PhD (Table 3).

Conclusions

Scientific production is closely related to the social and economic development of a country and Brazil has a growing but still small production of scientific articles. Additionally, if the advances of medicine

are not followed by the number of physician-scientists and the future of medical research may be compromised. Therefore, specific policies should be made in order to stimulate medical students to follow a scientific career. Inclusion of the student in scientific research is crucial to the formation of potential scientists and introductory scientific programs are effective mechanisms for this reason. The Brazilian introductory scientific program is making progress in offering research experience to undergraduates, including medical students. It is also of note the increase in the number of physicians (with MD or MD/PhD degrees) active in medical research in Brazil in the period from 2000 to 2008. It is not possible to establish a link between these two aspects, as many other factors are involved, but relationship between participating in scientific initiation programs and participation in medical research afterwards seems promising in the Brazilian context.

Acknowledgments

Mr. Claudio Valério, from CNPq, kindly provided the data used in Table 3. We are indebted to Drs. Allen Cheever and Robert Verhine for critically reading the manuscript.

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Keywords

Physician-Scientist, Medical Education, Scientific Initiation

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