







## Scientific Production of Researchers from the Brazilian Council for Scientific and Technological Development (CNPq) in the Neuroscience area

### Produção Científica dos Pesquisadores do Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) na Área da Neurociência

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#### ABSTRACT

**Introduction:** The aim of this study was to describe the profile and scientific production of research fellows of the Brazilian Council for Scientific and Technological Development (CNPq) in the neuroscience area. **Methods:** We created a database containing 542 researchers who were CNPq fellows in Medicine, of which 94 (17.34%) worked mainly in the neuroscience area. **Results:** The researchers were distributed in eight Brazilian States: São Paulo (n=49; 52.12%), Rio Grande do Sul (n=22; 23.40%), Rio de Janeiro (n=9; 9.57%), Minas Gerais (n=5; 5.31%), Ceará (n=4; 4.25%), Santa Catarina (n=3; 3.19%), Espírito Santo (n=1; 1.06) and Paraná (n=1, 1.06%). Although the neuroscience researchers were from more than 20 institutions, 58.5% worked in only 3 of those, namely USP (n=30), UFRGS (n=15) and UNIFESP (n=10). The median time since obtaining the PhD degree was 18.27 years (range, 5–39). Throughout their academic careers, 94 researchers published 16,488 papers in scientific journals, with an average of 175.40 articles per researcher (ranging from 43 to 715 articles). Of the 16,488 articles, 12,801 or 77.63% were indexed at Web of Science (mean of 136.18 articles/researcher), while 10,166 or 61.65% were indexed at Scopus database (mean of 108.14 articles/researcher). Overall, those researchers advised 1,279 undergraduate students (median of 13.60; range: 0–68), of which 1,329 were master's degree students (median of 14.13; range: 1–49) and 970 PhD students (median of 10.54; range: 0–42). The fellows' median H-index at ISI was 23.75. **Conclusion:** It is observed that the neuroscience fellows constitute a group with significant scientific production (the fellows' median H-index at ISI was 23.75). Most of these scientific publications were indexed at the Web of Science (77.63%) and Scopus (61.65%) databases. Human resources training are also highlighted, including undergraduate students, master's degree students and PhD students. Comparative studies with researchers from other countries, in similar areas of knowledge, are necessary to better understand the present results.

#### KEYWORDS

- Bibliometric indicators.
- Scientific Production.
- Neuroscience.

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## PALAVRAS-CHAVE

- Indicadores Bibliométricos.
- Produção Científica.
- Neurociência.

## RESUMO

**Introdução:** Este estudo avaliou o perfil e a produção científica dos bolsistas do Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) na área de neurociência. **Método:** Construiu-se um banco de dados com os 542 pesquisadores em medicina cadastrados como bolsistas do CNPq. Desse montante de pesquisadores, 94 (17,34%) tinham a área de neurociência como principal campo de pesquisa. **Resultados:** Todos os 94 pesquisadores da neurociência estavam distribuídos em oito estados brasileiros: São Paulo (n = 49; 52,12%), Rio Grande do Sul (n = 22; 23,40%), Rio de Janeiro (n = 9; 9,57%), Minas Gerais (n = 5; 5,31%), Ceará (n = 4; 4,25%), Santa Catarina (n = 3; 3,19%), Espírito Santo (n = 1; 1,06) e Paraná (n = 1, 1,06%). Quanto à instituição de origem, os pesquisadores da neurociência distribuíram-se por 20 instituições diferentes no país. No entanto, três instituições foram responsáveis por aproximadamente 58,50% dos pesquisadores: USP (n = 30), UFRGS (n = 15) e Unifesp (n = 10). A mediana do tempo desde a obtenção do título de doutor foi de 18,27 anos (IQ, 5-39). Ao longo da carreira acadêmica, os 94 pesquisadores publicaram 16.488 artigos em periódicos científicos, com uma média de 175,40 artigos por pesquisador (variando de 43 a 715 artigos). Dos 16.488 artigos, 12.801 (77,63%) foram indexados na Web of Science (média de 136,18 artigos/pesquisador) e 10.166 (61,65%) na base Scopus (média de 108,14 artigos/pesquisador). Durante a carreira, os bolsistas orientaram 1.279 estudantes de iniciação científica (mediana de 13,60; intervalo: 0-68), 1.329 estudantes de mestrado (mediana de 14,13; intervalo: 1-49) e 970 de doutorado (mediana de 10,54; intervalo: 0-42). O índice H mediano no ISI dos bolsistas foi de 23,75. **Conclusões:** Observa-se que os pesquisadores da neurociência constituem um grupo com expressiva produção científica (índice H mediano no ISI de 23,75). A maioria dessas publicações científicas se encontrava nas bases Web of Science (77,63%) e Scopus (61,65%). Também se destacou a formação qualificada de recursos humanos, incluindo iniciação científica, mestrado e doutorado. Estudos comparativos com pesquisadores de outros países, em áreas do conhecimento similares, são necessários para melhor compreensão dos presentes resultados.

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## INTRODUCTION

Quantifying the performance of individual scholars or groups of scholars, departments, institutions, provinces/states/regions and countries has become an integral part of research policy, funding allocations, grant awarding, faculty hiring, promotion and tenure<sup>1</sup>. Academic publishing is a competitive business and editors strive to provide the best possible products to the scientific community<sup>2</sup>.

In Brazil there are two main science funding agencies, the Coordination for the Improvement of Higher Education Personnel (CAPES, *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*) and the National Council for the Development of Science and Technology (CNPq, *Conselho Nacional de Desenvolvimento Científico e Tecnológico*). CNPq is mainly dedicated to research funding, whereas CAPES evaluates and financially supports postgraduate courses. Moreover, CNPq provides a specific type of grant for researchers, called scientific productivity fellowship, which classifies researchers into two main categories: 1 and 2, the former being further subdivided into four levels: 1A, 1B, 1C and 1D<sup>3</sup>.

According to CNPq Advisory Committee, the criteria for researchers' selection and classification in Medicine include, amongst several indicators, scientific production, human resources training, and contribution to innovation. Therefore, in order to be classified as a CNPq investigator in Medicine, the researcher must have met the following requirements in the previous decade: a) published at least 20 articles in scientific journals with an Impact Factor (IF) equal to or above 1; b) completed at least one PhD advisory; and c) to have a defined line of research and a present research project of scientific merit in the medical area.

A number of studies have assessed the profile and the scientific production of CNPq-supported researchers in several areas of knowledge<sup>1,4-6</sup>. The present study aims to describe the profile and scientific production of CNPq research grant recipients in the area of neuroscience.

## METHODS

We selected 542 CNPq fellows who were researchers in the medical area from a database, of which 94 (17.34%) worked mainly with neuroscience according to a list provided by the research funding agency in May 2018<sup>7</sup>. Using the publicly available *Lattes curriculum* in the Lattes Platform (<http://buscatextual.cnpq.br/buscatextual/busca.do?metodo=apresentar>), we constructed a database containing information on each researcher in terms of institution, time since receiving the PhD degree, scientific production (published papers) and human resources training (supervision of undergraduate, master's degree and PhD students).

For the scientific production analysis, we considered all publications and advisories throughout the researcher's career, defined as the period comprised between the first publication and December 2017. We also analyzed publications and advisories in the past 5 years, considering the period between 2013 and 2017 (average duration of the scholarship).

## RESULTS

Among the 94 researchers, there was a predominance of males (n=65; 69.14%). All researchers were distributed in eight Brazilian States: São Paulo (n=49; 52.12%), Rio Grande do Sul (n=22; 23.40%), Rio de Janeiro (n=9; 9.57%), Minas Gerais (n=5; 5.31%), Ceará (n=4; 4.25%),

Santa Catarina (n=3; 3.19%), Espírito Santo (n=1; 1.06%) and Paraná (n=1, 1.06%). Although neuroscience researchers were from 20 different institutions, 58.5% worked in only 3 of them, namely USP (n=30), UFRGS (n=15) and UNIFESP (n=10). The median time since the PhD degree had been obtained was 18.27 years (range, 5–39).

The 94 researchers published 16,488 papers in scientific journals, with an average of 175.40 articles per researcher (ranging from 43 to 715 articles), of which 12,801 or 77.63% were indexed at Web of Science, with an average of 136.18 articles/researcher, while 10,166 or 61.65% were Scopus indexed, with an average of 108.14 articles/researcher (Table 1). Most articles published during the researchers' careers are A1 and A2, while per absolute number of researchers, the highest publication means are A2 (303.42 papers) and B1 (247.33 papers). The lowest average was at level 2 (116.69 per researcher). The same is also observed when evaluating the five-year period (2013-2017) (Table 1).

Over their careers, those researchers advised 1,279 undergraduate students, (median of 13.60; range: 0–68), 1,329 master's degree students (median of 14.13; range: 1–49) and 970 PhD students (median of 10.54; range: 0–42) (Table 2). We found a prevalence of undergraduate students, master's degree and PhD students at A1 and A2. However, when corrected by the scholarship, the highest average of undergraduate students advisory

was in B1 researchers (20.11 students), while for master's degree and PhD students was in A1 researchers (21.57 and 21.15, respectively) (Table 2). The median H-index at ISI of the fellows was 23.75.

**DISCUSSION**

Researchers in the neuroscience area constitute the largest group in the medical area at CNPq (<http://www.cnpq.br/web/guest/bolsistas-vigentes>). It is important to note the concentration of scientific output in a few Brazilian States, with just eight of them accounting for 100% of the researchers, and, most notably, a single State, São Paulo, accounting for over half (52.12%) of all Brazilian neuroscience researchers.

The Brazilian postgraduate system (CAPES) has carried out an important expansion and decentralization in postgraduate programs in the last decade, decreasing the national system asymmetry (<https://sucupira.capes.gov.br/sucupira/public/consultas/coleta/programa/quantitativos/quantitativoRegiao.jsf?jsessionid=IpC19tcuSCVdbQWNHKsjYjWE.sucupira-213>). However, even with efforts in this sense, 95.75% of neuroscience researchers are still concentrated in the South and Southeast regions, with a single State, Ceará, outside this area, reinforcing the Brazilian heterogeneous spatial distribution. This same spatial concentration of researchers in a few Brazilian States can also be observed in other research areas<sup>4,6,8</sup>, supporting the idea of specific government actions towards mitigating such regional differences<sup>9</sup>.

Our analysis showed that male researchers predominate, and although there are more female than male undergraduate and graduate students in many countries, there are relatively few female full professors, and gender inequalities in hiring, earnings, funding, satisfaction, and patenting persist. This fact was observed in our study, given that 69.14% of researchers in neuroscience in Brazil were males. In this sense, Lariviere et al. (2013) have presented a bibliometric analysis confirming that gender inequalities persist in research output worldwide<sup>10</sup>. Moreover, as expected, in Brazil the state of affairs is quite similar and women show a lower proportion in the higher positions in the academic career, that is, those positions associated with higher income and higher academic prestige<sup>11</sup>.

Another point emphasized by our study is the assessment of the scientific output by researchers in neuroscience in quantitative and qualitative terms through the analysis of bibliometric indicators. From the quantitative point of the view, our study showed an important scientific

**Table 1**  
Distribution of researchers in the field of neuroscience, with a scientific productivity grant by the Brazilian Council for Scientific and Technological Development (CNPq), with respect to published papers.

Grant category (n=94)	Published papers (career)		Published papers (2013-2017)	
	n	%	n	%
1A (19)	5,765	34.96	1,670	30.65
1B (9)	2,226	13.51	620	11.38
1C (9)	1,553	9.41	511	9.37
1D (11)	1,576	9.56	467	8.57
2 (46)	5,368	32.55	2,180	40.01
<b>TOTAL</b>	<b>16,488 (100)</b>		<b>5,448 (100)</b>	

**Table 2**  
Distribution of researchers in the field of neuroscience, with a scientific productivity grant by the Brazilian Council for Scientific and Technological Development (CNPq), with respect to training of human resources.

Grant category (n=94)	Training of human resources (n) (%) (career)			Training of human resources (n) (%) (2013-2017)		
	SIS*	MT**	PhD***	SIS*	MT**	PhD***
1A (19)	358 (27.99)	410 (30.85)	402 (41.44)	76 (20.21)	57 (16.86)	91 (27.74)
1B (9)	181 (14.16)	138 (10.38)	109 (11.23)	15 (3.98)	22 (6.50)	34 (10.36)
1C (9)	57 (4.45)	139 (10.45)	89 (9.17)	23 (6.12)	18 (5.32)	29 (8.84)
1D (11)	138 (10.78)	161 (12.11)	107 (11.03)	29 (7.71)	43 (12.72)	56 (17.07)
2 (46)	545 (42.61)	481(36.19)	263 (27.11)	233 (61.96)	198 (58.58)	118 (35.97)
<b>TOTAL (n)</b>	<b>1,279</b>	<b>1,329</b>	<b>970</b>	<b>376</b>	<b>338</b>	<b>328</b>

\*Scientific initiation students; \*\*Master; \*\*\*PhD.

output with an expressive number of publications of scientific articles in periodicals indexed in the Web of Science and Scopus databases. These results are observed throughout the careers, as well as in the last five-year period. These data are similar to those observed for other medical specialties, according to our group's preliminary results<sup>5,12,13</sup>. This quantitative increment in scientific production possibly reflects the several fostering mechanisms implemented by the various national research support agencies<sup>14-18</sup>.

In a previous study, we evaluated the researchers in the field of neuroscience, during the triennium of 2006-2008. This cross-sectional study showed a group with high scientific productivity in terms of quality, with 61% of papers indexed in the Web of Science and 77.5% in the Scopus databases<sup>14</sup>. In the present study, 77.63% were indexed in the Web of Science, (an average of 136.18 articles/researcher), and 61.65% articles were indexed in the Scopus (an average of 108.14 articles/researcher) databases, therefore showing that neuroscience researchers have the highest percentage of indexed articles, when compared to other medical specialties<sup>19</sup>.

According to the CNPq Advisory Committee, the criteria for the selection and classification of scholarships include scientific output, training of human resources, contribution to innovation, coordination and participation in research projects, participation in editorial activities, and scientific management. One of the dimensions of the CNPq researcher is the training of human resources. In the present study, an important average of undergraduate students, master's degree and PhD students training is observed, both throughout the researchers' careers and in the assessed five-year period. These results are similar to other studies from different areas, involving scientific production and student training<sup>5,6,8</sup>.

Unfortunately, the current economic crisis has already resulted in federal and state science funding cuts, probably impairing Brazilian research and hampering scientific output increment in the next years<sup>20</sup>. In recent years, Brazilian scientists have faced a dramatic reduction in financial support for research and postgraduate programs<sup>20</sup>. However, one must highlight that recent budget restrictions and the discontinuity of successful programs can compromise the Brazilian scientific production and the postgraduate national system<sup>21</sup>.

Further studies addressing some important issues, such as research groups' productivity, collaborative efforts, and the impact of the scientific output might contribute to a better understanding of this dynamic area of research.

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#### AUTHORS' CONTRIBUTION

GPD collected the data and wrote the manuscript, DRBM coded the data and performed the statistic tests, SMC and EAO assisted in the writing of the manuscript, RSA aided in the writing, formatting and adequacy of the manuscript, HMJ guided and reviewed the entire manuscript.

#### CONFLICTS OF INTEREST

None

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