

Profile and impact of CNPq research productivity fellows at the Faculty of Medicine of UFMG

Perfil e impacto dos bolsistas de produtividade em pesquisa do CNPq da Faculdade de Medicina da UFMG

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ABSTRACT

Introduction: Mentoring through scientific initiation and post-graduate programs are an essential instrument on the formation of human resources and the perpetuation of national scientific production. The role of research professors in the proper scientific development of graduate and post-graduate medical students has been continuously reaffirmed in several surveys on the quality of Brazilian superior education, despite the continuous desvalorization of higher education in the country. Determine the career and profile of research productivity fellows could measure the impact of these professionals in teaching, researching and internationalization of our university. **Objective:** To characterize the professional profile and scientific production of the Productivity in Research Program fellows from the Faculty of Medicine of the Federal University of Minas Gerais. **Methods:** This descriptive study is based on the analysis of public data available at Lattes Platform. Research productivity fellows were determined based on the results of the 2013, 2016 and 2019 calls for tenders. **Results:** Analysis of the variables showed a decrease in the number of professors with scholarships at the institution, which went from 34 to 29. We observed a significantly higher number of funded projects of male professionals when compared to female researchers ($p=0.03$) and a strong correlation between years of doctorate degree and the number of mentored doctors currently dedicating to research. **Conclusion:** Experienced research professors exert direct impact on the formation of qualified human resources and the internationalization of the federal university.

Keywords: Resume; Scientific Research and Technological Development; Research Financing Sources; Medical Undergraduate Education; Graduate Education in Medicine.

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RESUMO

Introdução: Os programas de iniciação científica e pós-graduação são um instrumento essencial na formação de recursos humanos e na perpetuação da produção científica nacional. O papel dos professores pesquisadores no adequado desenvolvimento científico dos estudantes de graduação e pós-graduação tem sido continuamente reafirmado em diversas pesquisas sobre a qualidade do ensino superior brasileiro, apesar da contínua desvalorização das universidades públicas no país. Avaliar a carreira e o perfil dos bolsistas de produtividade em pesquisa pode fornecer elementos em relação ao impacto desses profissionais no ensino, na pesquisa e na internacionalização das universidades. **Objetivo:** Caracterizar o perfil profissional e a produção científica dos bolsistas do Programa de Produtividade em Pesquisa da Faculdade de Medicina da Universidade Federal de Minas Gerais. **Métodos:** Estudo descritivo baseado na análise de dados públicos disponíveis na Plataforma Lattes. Os bolsistas de produtividade em pesquisa foram apurados com base nos resultados dos editais de 2013, 2016 e 2019. **Resultados:** A análise das variáveis evidenciou diminuição do número de docentes bolsistas da instituição, que passou de 34 para 29. Observamos um número significativamente maior de projetos financiados por profissionais do sexo masculino quando comparados às pesquisadoras ($p=0,03$) e uma forte correlação entre os anos de doutorado e o número de doutores orientados que atualmente se dedicam à pesquisa. **Conclusão:** Professores pesquisadores exercem impacto direto na formação de recursos humanos qualificados e na internacionalização das universidades públicas.

Palavras-Chave: Currículo; Pesquisa Científica e Desenvolvimento Tecnológico; Fontes de Financiamento de Pesquisa; Educação de Graduação em Medicina; Educação de Pós-Graduação em Medicina.

INTRODUCTION

Public Universities are guided by the pillars of teaching, research and extension and have administrative, didactic-scientific, managerial and patrimonial autonomy¹. In the context of the historical Brazilian socioeconomic inequality, the social function of the University consists in the qualified training of professionals able to work in different sectors of the country².

The creation of the National Council for Scientific and Technological Development (CNPq) in 1951 by law No. 1310 was a very important milestone for scientific development in Brazil. CNPq's mission is to promote and encourage scientific and technological development in various fields of knowledge³. CNPq has autonomous internal management and is linked to the Ministry of Science, Technology, Innovation and Communications (MCTIC), responsible for its financial transfers. CNPq has acted since its creation as the main body for promoting research in Brazilian Public Universities⁴.

Current Brazilian scientific production is mostly carried out in public institutions of higher education, with 95% coming from Public Universities, according to the Brazilian Academy of Sciences⁵. In this context, the Federal University of Minas Gerais (UFMG) is a protagonist, occupying the 6th place among the 20 universities that most publish in the country, according to the ranking of the Centre for Science and Technology Studies (CWTS) in 2016, in which no private institution was appointed⁶. According to Times Higher Education (THE), Brazilian universities make up 13 of the top 20 universities in Latin America, with UFMG occupying the 3rd position⁷. Despite the outstanding scenario, there have been successive cuts in the resources allocated to Public Universities and to state and national research founding agencies⁸. Between 2015 and 2018, the Coordination for the Improvement of Higher Education Personnel (CAPES), the institution in charge of evaluating, accrediting and providing support for graduate programs, experienced a budget constraint of BRL 1 billion⁹.

In 2020, a cut of R\$19.8 billion was sanctioned for the educational sector, of which R\$7.3 billion was levied on Federal Universities (9). CNPq resources had a reduction of 18% compared to the previous year¹⁰.

Despite the aforementioned challenges, scientific research in Brazil grows in relevance and robustness, with CNPq playing a central role in funding research projects and granting scholarships to teachers and students¹¹. In this context, the Research Productivity Program (PQ) stands out. The program is aimed at researchers who stand out in their field of expertise when compared to their peers. To receive the scholarship, it is necessary to fulfill some criteria pre-established by CNPq, such as having a doctorate, being Brazilian, and excelling in the research activities performed. After approval, the professional will be classified into categories (1A, 1B, 1C, 1D and 2), based on their doctoral time, their scientific productivity and their contribution to the training of human resources for research. CNPq also provides to *stricto sensu* graduate programs scholarships for master degree and doctorate students, being an important stimulus to their formation. More recently, CNPq prioritized the granting of new scholarships focusing on the strategic areas defined by the MCTIC¹². This change defined which research projects should be prioritized in the 2020-2023 triennium¹³.

Although the evaluation of the individual scientific performance of professors is complex, items such as previous training, motivation and dedication to research and training of human resources are relevant factors¹⁴. Thus, it is considered that the intellectual formation and scientific production of professors, which can be evaluated in their curriculum, are extremely relevant for public institutions of higher education and have a great impact on the education of students. In this sense, the CNPq's PQ program assumes importance for scientific production and training of human resources in Public Universities. In this context, this article aims to characterize the profile and intellectual production of CNPq productivity grantees from the UFMG School of Medicine, in addition to evaluating the contribution of professors to the scientific development of undergraduate and graduate students.

METHODS

STUDY DESIGN AND ETHICAL ISSUES

This is an observational and cross-sectional study based on the analysis of public data made available through CNPq's Lattes platform. Database is fed autonomously by the researchers and the information there described is of individual responsibility. This research does not require ethics committee approval because it is based on public data, as previously described^{11,15}.

STUDY PROTOCOL

We selected the research subjects based on the results of the calls for the three-year CNPq PQ grant from the years

2013, 2016, and 2019. To define the sample and collect data, we selected all 29 researchers who had been awarded the fellowship for the three-year period 2019-2021, who were active faculty members at the UFMG Faculty of Medicine, and whose curriculum vitae had been updated in the last 3 months, counted retrospectively from the date of data collection. In this phase, no researcher was excluded from the study. Subsequently, a standardized spreadsheet was used that contained the variables to be surveyed, including the realization of post-graduation in foreign countries, functional class, time of teaching at the university, number of current and total research projects, CNPq grant level, presence of patents, ongoing and completed post-graduation orientations, ongoing and completed IC orientations, citations, H factor, number of published articles, and number of articles with IC students.

STATISTICAL ANALYSIS

All data were collected independently and manually. Data were analyzed using Graph Pad Prism version 7.0 software. Descriptive measures were calculated for the variables studied, with the categorical variables expressed as percentages and the numerical variables as mean and standard deviation or median and interquartile range, according to their distribution. Spearman's Coefficient test was applied to verify correlations between the categories studied. Significance level was set at $p < 0.05$.

RESULTS

When analyzing the results of CNPq productivity grants by triennium, we observed a gradual decrease in the number of selected among UFMG researchers, going from 34 in the 2013-2015 period, to 30 between 2016-2018, reaching 29 researchers in the current triennium, 2019-2021. Considering the data of professors with CNPq productivity grants from 2019 to 2021 ($n=29$), 62.06% are full professors, 24.13% are associate professors, and 13.79% are assistant professors. Of the 12 departments at the UFMG Faculty of Medicine, 8 of them have professors awarded with productivity grants. The Department of Internal Medicine has the largest number of fellowshipped professors, with 10 of the 29 professors in the sample. Of the 29 professors, 22 performed a postdoctorate (75.86%). This information is available in Table 1.

In the period from 2019 to 2021, the average number of ongoing academic orientations was 1.6 IC students, 3 master's students, and 3.2 doctoral students; the average number of completed orientations was 32.0 ± 17.5 for scientific intitation (IC) students, 23.9 ± 13.7 master's students, 13.5 ± 9.6 doctoral students. Among PhD students, 8.3 ± 6.2 became researchers. The average number of years in the institution was 22.8 years, with an average of 20.7 years counted since obtaining the doctoral degree (Table 2). Sex distribution showed a total of 15 men and 14 women.

The comparison between sex performance showed no statistical significance considering the type of grant (Table 3). There was statistical significance regarding the number of funded projects ($p=0.03$), with male researchers receiving more funding than female researchers.

Table 1. General characteristics, functional class, type of training and allocation by departments of professors with research productivity grants from 2019 to 2021.

Profile	Number of professors (n=29)	Percentage of total
Sex		
Male	15	51.72%
Female	14	48.28%
Functional class		
Assistant professor	4	13.79%
Associate professor	7	24.14%
Titular professor	18	62.07%
Master's at foreign countries*		
Yes	6	79.31%
No	23	20.69%
Doctorate at foreign countries *		
Yes	10	34.48%
No	19	65.52%
Postdoctoral		
Yes	22	75.86%
No	7	24.14%
Postdoctoral at foreign countries		
Yes	18	6.07%
No	11	37.93%
Departamento associado		
Clínica Médica	3	10.34%
Ginecologia e Obstetrícia	10	34.48%
Medicina Preventiva e Social	2	6.90%
Oftalmologia e Otorrinolaringologia	5	17.24%
Pediatria	2	6.90%
Propedêutica Complementar	1	3.45%
Saúde Mental	3	10.34%

*Master's and Doctoral degrees at foreign countries refer to the obtention of the master's or doctoral degree at a research institution outside the country.

Source: Lattes Curriculum.

Additionally, no significance was observed when comparing years of doctoral and teaching tenure, numbers of research projects, academic orientations, articles published in journals or citations between genders, as shown in Table 4.

Table 2. Description of the general characteristics and parameters of intellectual production and training of human resources for research of CNPq productivity grantees evaluated from 2019 to 2021.

Parameter	Total (n=29)
Years of doctorate	20.7 ± 7.3
Years at UFMG	22.8 ± 10.8
Number of ongoing projects	8.4 ± 5.8
Total number of projects	21.1 ± 14.6
Number of funded projects	8.4 ± 5.8
Ongoing master's orientations	3.0 ± 2.3
Ongoing doctorate orientations	3.2 ± 2.6
Ongoing scientific initiation (IC) orientations	1.9 ± 2.7
Master's orientations concluded	23.9 ± 13.7
Doctorate orientations concluded	13.5 ± 9.6
IC orientations concluded	32.0 ± 17.5
Total number of published articles	163.4 ± 110.9
H factor	23.3 ± 10.9
Total number of WoS citations	2.864 ± 4.258
Total number of Scopus citations	2.719 ± 3.274
Total number of Articles including ICs	30.3 ± 46.9
Total number of PhD students who became researchers**	8.3 ± 6.2

**Information obtained through the search of the lattes curricula of doctoral students with guidance completed by the 29 productivity scholarship professors in the period 2019-2021.

Source: Lattes Curriculum.

Table 3. Gender distribution according to the category of scholarship.

Type of scholarship	Men (n=15)	Women (n=14)
PQ1A	5	1
PQ1B	2	1
PQ1C	1	3
PQ1D	0	2
PQ2	7	7

Chi-square value with Yates correction = 1.71; $p=0.201$. PQ: Research productivity scholarship.

Source: Lattes Curriculum.

Table 4. Comparison of analyzed parameters according to the gender of the researchers.

Parameters	Men (n=15)	Women (n=14)	p-value
Years of doctorate	21.3 ± 9.0	20.1 ± 5.1	0.68
Years on UFGM	21.8 ± 11.5	23.9 ± 10.3	0.61
Number of projects from 2019 to 2021	8.2 ± 6.2	8.6 ± 5.5	0.85
Total number of research projects	16.8 ± 12.9	25.5 ± 15.3	0.10
Total number of funded projects	5.5 ± 3.8	11.6 ± 9.9	0.03
Ongoing master's orientations	3.0 ± 2.1	3.0 ± 2.6	0.99
Ongoing doctorate orientations	2.7 ± 3.0	3.7 ± 2.0	0.30
Ongoing ICs orientations	1.3 ± 1.9	2.6 ± 3.4	0.21
Master's orientations concluded	23.9 ± 15.8	23.9 ± 11.8	0.99
Doctorate orientations concluded	14.7 ± 9.6	12.2 ± 9.9	0.49
ICs orientations concluded	34.1 ± 20.7	29.9 ± 13.6	0.52
Total number of published articles	198.6 ± 129.5	125.7 ± 74.0	0.07
H factor	26.4 ± 8.9	19.2 ± 12.5	0.08
Total number of WoS citations	3877 ± 5425	1648 ± 1824	0.15
Total number of Scopus citations	3805 ± 4165	1830 ± 2137	0.12
Total number of articles including CIs	37.3 ± 53.4	22.8 ± 39.6	0.41
Total number of PhD students who became professors at Universities**	8.7 ± 6.1	7.9 ± 6.4	0.73

*Significant p-value; **Information obtained through the search of the lattes curricula of doctoral students with guidance completed by the 29 productivity scholarship professors in the period 2019-2021.

Source: Lattes Curriculum.

The number of years since obtaining the doctoral degree showed a strong and significant correlation: (1) with number of articles published in journals (Spearman's Coefficient = 0.839; $p < 0.01$); (2) with number of completed doctoral orientations (Spearman's Coefficient = 0.748; $p < 0.01$); and (3) with number of doctoral mentors who subsequently became professors at Universities (Spearman's Coefficient = 0.736; $p < 0.01$). Furthermore, it showed a moderate and significant correlation: (1) with the number of citations in Scopus (Spearman's Coefficient = 0.618; $p = 0.04$); (2) with the number of completed master's orientations (Spearman's Coefficient = 0.595; $p < 0.01$); and (3) with the number of completed IC orientations (Spearman's Coefficient = 0.629; $p < 0.01$). On the other hand, the number of years as a PhD did not correlate: (1) with the H factor (Spearman's Coefficient = 0.369; $p = 0.09$); (2) with the number of citations in Web of Science (Spearman's Coefficient = 0.360; $p = 0.10$); nor (3) with the number of participating scholars in scientific publications (Spearman's Coefficient = 0.323; $p = 0.08$). Factor H showed a strong and significant correlation with: (1) the number of citations in Web of Science (Spearman's Coefficient = 0.909; $p < 0.01$) and (2) with the number of citations in Scopus (Spearman's Coefficient = 0.898; $p < 0.01$).

DISCUSSION

This study provides an assessment of the scientific production of researchers with PQ scholarship who are professors at the Faculty of Medicine of UFGM.

The following parameters were evaluated: representativeness of PQ fellows in relation to the entire faculty, academic training of fellows, general characteristics of these fellows and indicators of intellectual production and training of human resources of fellows. Based on the result of the 2019 research productivity grants edict, the Faculty of Medicine of UFGM has 29 professors with grants, 15 men and 14 women. Of these fellows, 62.07% are full professors (n=18) and 75.86% have postdoctoral degrees (n=22). A relatively low number of PQ fellows held a master's degree (n=6, 20.69%) and/or a doctorate (n=10, 34.48%) outside the country. However, 18 (62.07%) of the 29 researchers carried out postdoctoral studies abroad.

There was a decline in the number of researchers with a CNPq productivity grant at the Faculty of Medicine. There were 34 fellows in 2013 and, in 2019, this total reduced to 29. Several factors may have contributed to this reduction. One of them is probably the reduction of resources for scientific research and for federal public universities. The current federal government of Brazil reduced MCTIC resources by 15% and contingency of 40% of Ministry funds in 2020¹⁶. Thus, even though Brazil is among the twenty nations responsible for 90% of world publications, it is classified as a lower-middle-income country in terms of scientific funding¹⁷. The reduction in research and development funding is relevant because it directly impacts the entire chain of training of human resources for science, from the granting of scholarships for IC and graduate studies to the development of teaching in higher education institutions.

Thus, the number of researchers in the country grows while the number of fellows is reduced, revealing the limitation of research support resources. The president of CAPES in 2018 commented about the imbalance between the allocation of resources to the two federal agencies in the country, CAPES and CNPq, which has been suffering successive cuts in relation to the 2% increase in the number of graduate students per year¹⁷. It is also worth noting that, in recent years, the number of PhDs in the country has grown a lot and there has been an expansion of universities and research centers. As a result, there was a significant increase in the demand for scholarships, whose number did not grow proportionately: it remained at the same level or even reduced. Thus, the reduction from 34 to 29 scholarship holders at FM UFGM may not mean lower qualifications of professors, but rather reflect the lack of research productivity scholarships in Brazil.

Researchers in our study presented an average of 25.8 publications between 2013 and 2015, and 28.8 in the triennium 2016-2018. UFGM, along with seven other national institutions, is among those responsible for 80% of the Brazilian production in the areas of health and biological sciences, which ratifies for the scientific development of the country¹⁸. An analysis by the Institute for Applied Economic Research showed that national publications on "General Medicine" obtained three times more citations than the world average between 2016 and 2018. In addition, production in this period consisted of 2.6% of world production, showing a significant increase in the same percentage obtained in 2000, which was 1.2%¹⁹. A report constructed by Clarivate Analytics verified an 18% increase in Brazilian scientific impact, which went from 0.73 in 2011 to 0.86 in 2016. The analysis also showed that UFGM represents 0.67% among the 1% of the most cited articles internationally, with an impact of 0.88 in normalized citations in the Web of Science (WoS)²⁰. Regarding scientific production on the coronavirus disease 2019 (COVID-19) pandemic, UFGM accounted for 5% of the national articles on the disease in 2020, figuring as the fifth most frequently cited Brazilian institution in WoS.

Our results showed a mean of 20.7 ± 7.3 years of doctoral studies, which was strongly correlated to the number of published articles, citations in WoS and Scopus, completed doctoral orientations, and years dedicated to scientific research. This factor also moderately influenced the number of completed master's and undergraduate research orientations. These data may be related to the academic productivism encouraged by the CNPq funding system, in which the results are a consequence of the quantitative and qualitative analysis of the researchers' careers. Although it is very important for the training of human resources for research that the professor guides a significant number of doctoral students, masters and IC students, some authors question the agreement between quantitative analysis and the quality of teaching. Academic production does not always reflect an adequate didactic-pedagogical training for graduate and undergraduate students²¹.

The first contact of undergraduate students with research usually occurs through the IC program. Our data show a large variation in the amount of guidance of IC students per faculty member and of articles that include these students for each researcher. The analysis of IC orientations showed an average of 1.9 ± 2.7 guidance in progress and 32 ± 17.5 guidance completed, emphasizing that there is a difference in the amount of orientations among the faculty researchers, which also occurs in relation to students of postgraduate studies. In relation to articles published with IC students, the contrast is even more expressive, with an average of 30.6 ± 46.9 articles that include undergraduate students. Studies have shown that the participation of undergraduate students in these projects positively affects their training, since this activity during graduation allows the development of complementary skills such as bibliographic research, elaboration of technical texts, discussion and organization of ideas²². Specifically in the medical career, students who engage in scientific activities are not only more likely to pursue an academic career but also to act as researchers within the country within the scope of universities or research institutes²². Regarding their professional life, physicians with a scientific background are more valued in the job market, tend to opt for evidence-based decisions and are more frequently enrolled in postgraduate studies, in addition to obtaining better performance in selection processes for medical residency²³. In the current scenario, with the emergence of the COVID-19 pandemic, the promotion of an evidence-based medical narrative and the rigidity and formality of training are essential for patient care and the dissemination of information based on consistent scientific evidence²⁴.

Differences between genders were not identified between doctoral and teaching years, number of research projects, academic orientation, articles published in scientific journals, citations, and type of funding. However, the absence of statistical differences in our sample cannot be considered a reflection of equal accessibility to science in terms of gender. The panorama prepared by UNESCO in 2015 showed that only 28% of the world's researchers were women and their distribution was uneven, accounting for 44% of presence in Latin America, the Caribbean and Central Asia²⁵. Such numbers are incongruous with the expressive entry of women into undergraduate courses, occupying 53% of the vacancies, which suggests the marginalization of this group in relation to the scientific career. In fact, this phenomenon is influenced by the predominance of male individuals in hiring, setting salary or providing guidance²⁶. Although most of the factors analyzed in our study showed no statistical difference in relation to gender, it was found that female researchers had a significantly lower number of funded projects when compared to male researchers ($p=0.03$). This finding was also reported in other studies. A 2019 study conducted at the Canadian Health Research Institutes found that women received less funding for their studies in areas such as Cancer Research, Respiratory and Circulatory Health²⁷.

This study also pointed to this funding inequality in a global perspective²⁷. Considering the academic productivity on which the CNPq scholarship system is based, the smaller number of projects funded by woman researchers reaffirms the need to reflect on the impact of gender inequality in the scientific field.

The scientific field in Brazil is a reflection of the national scenario in its entirety: a developing area in a developing country. Great challenges have been imposed for the integration between research and teaching, the valorization of the public university, the training of human resources, the commitment to teaching and practice based on evidence, investment in research and development and the fight for equity and gender equality. In a pandemic period, the characterization of our scientists assumes great importance. The indisputable role of these professionals is certainly one of the pillars of Brazilian Public Universities.

AUTHORS CONTRIBUTION

GBP, CEMFS, GMP, LFF, VMN and KL performed data collection of Lattes Curriculum; GBP, CEMFS and KL analyzed the data; GBP, CEMFS, GMP, LFF, VMN and KL wrote the first draft version of the article; ACSS conceived the study, supervised all stages, revised the article and submitted the final version with approval of all authors.

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