

Evaluation of scientific production, patents and human resources training in the Brazilian nursing

Avaliação da produção científica, patentes e formação de recursos humanos da Enfermagem Brasileira
Evaluación de la producción científica, patentes y la formación de los recursos humanos de la Enfermería Brasileña

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ABSTRACT

Objective: to evaluate scientific production, patents and human resources training of nursing researchers with scholarships of research productivity (PQ) in National Counsel for Technological and Scientific Development (CNPq) in the 2000-2012 historic series; to verify the association between this production and characteristics of the researchers regarding gender, education and origin. **Methods:** this analytic cross-sectional study whose inclusion criterion was to be a nursing PQ/CNPq researcher during the period in question. We analyzed *curriculum lattes* of 208 researchers with scholarships between 2000 and 2012. For statistical analyses we used the SPSS[®] software. **Results:** the study points to female predominance, concentration in the Southeast region and existence of an association between scientific production, patents and human resources training and education, gender and origin of the researcher. **Conclusion:** the study presents a significant participation of nursing PQ/CNPq researchers in scientific production and in human resources training, and a modest involvement in the production of patents.

Key words: Scientific Production Indicators; Researchers; Nursing.

RESUMO

Objetivo: avaliar produção científica, patentes e formação de recursos humanos de pesquisadores da enfermagem com bolsas de produtividade em pesquisa (PQ) no CNPq na série histórica 2000-2012; verificar a associação entre esta produção e características dos pesquisadores quanto a sexo, formação e origem. **Método:** estudo transversal analítico cujo critério de inclusão foi ser pesquisador PQ/CNPq da enfermagem no período em questão. Foram analisados *curriculum lattes* de 208 pesquisadores com bolsas entre 2000-2012. Para as análises estatísticas utilizou-se o programa SPSS[®]. **Resultados:** o estudo aponta predominância do sexo feminino, concentração na região Sudeste e existência de associação entre produção científica, patentes e formação de recursos humanos e a formação, sexo e origem do pesquisador. **Conclusão:** o estudo revela uma expressiva participação dos pesquisadores PQ/CNPq da enfermagem na produção científica e na formação de recursos humanos e tímida participação na produção de patentes.

Descritores: Indicadores de Produção Científica; Pesquisadores; Enfermagem.

RESUMEN

Objetivo: evaluar la producción científica, patentes y formación de recursos humanos de enfermería investigadores con becas de productividad en investigación (PQ) en el CNPq en la serie temporal 2000-2012 y la existencia de una asociación entre estos tipos de producción y las características de los investigadores sexo, educación y origen. **Método:** estudio transversal cuyo criterio de inclusión fue ser un PQ investigador/enfermería CNPq en el período en cuestión. Lattes plan de estudios se analizaron de 208 investigadores con becas de 2000-2012. Para el análisis estadístico se utilizó el programa SPSS[®]. **Resultados:**

el estudio muestra predominio del sexo femenino, la concentración en la región Sureste y existe una asociación entre científicos de producción, las patentes y la formación de los recursos humanos y la formación, el sexo y el origen del investigador. **Conclusión:** El estudio revela una importante participación de investigadores PQ/enfermería CNPq en producción científica y capacitación de recursos humanos y una participación modesta en la producción de patentes. Palabras clave: Indicadores de la Producción Científica; Investigadores; Enfermería.

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INTRODUCTION

Knowledge and technology production and human resources training for research are topics that have increasingly occupied a prominent place in academic and governmental spaces. Much has been said about the importance of scientific indicators in the process of growth and development of countries. In this scenario, the National Council for Scientific and Technological Development (CNPq) has implemented important investment policies for the Brazilian researcher – for instance, the Research Productivity Scholarship (PQ).

In nursing, there is more than one process of work: to assist, manage, teach, and research, and all these actions may be executed concomitantly⁽¹⁾. Nursing is an innovative field of scientific and technological knowledge, and a relevant social practice committed to public policies for health care of the Brazilian Unified Health System (SUS). It is characterized as a discipline with interface in several fields of knowledge. One of the greatest challenges of the Brazilian nursing is to accelerate the advancement in technology and innovation. This depends mainly on the knowledge and know-how produced by graduate programs in nursing⁽²⁾.

Quantitative indicators of scientific and technological production of several fields of knowledge have become more vigorous in Brazil, with the Government and the national scientific community recognizing their importance for the formulation of policies, guidelines and investments aimed at the scientific and technological development in the country⁽³⁾.

The PQ scholarship has been considered an important instrument to stimulate Brazilian researchers and to promote scientific production. This scholarship is aimed at researchers who have distinguished themselves among their peers, valuing their scientific production according to normative criteria established by CNPq. The scholarships are classified by CNPq on three levels: 1, 2, and Senior, considering that level 1 is subdivided into four categories: 1A, 1B, 1C and 1D⁽⁴⁾.

Thus this study had the following objectives: to evaluate the performance of scientific production, the creation of patents and the human resources training of nursing researchers who were awarded PQ/CNPq scholarships in the 2000-2012 period; to verify the association between scientific production and human resources training and the characteristics of researchers.

METHOD

Type and universe of the study

It is an analytical cross-sectional study whose inclusion criterion was to be a nursing PQ/CNPq researcher with active scholarships in the 2000-2012 historic series. We analyzed the

curriculum lattes (CL)⁽⁵⁾ of 208 nursing researchers throughout the period in which they were PQ scholarship students. Three modalities of production of these PQ researchers were evaluated: scientific production (publication of scientific articles, books and book chapters), technology (patents) and human resources training (supervision of scientific initiation, master's degree, doctorate and postdoctoral programs).

For the purposes of this study, the nursing researchers were divided into two groups: lower production group and higher production group. To classify the researchers in these two groups, a general survey of the production of the entire nursing PQ group was carried out, and as a cutoff point the 2nd tertile (66.7) of scientific production and human resource training quantitative was used. In the lower production group, the scientific production ranged between 0 and 60 products, and human resources training ranged from 0 to 30 supervisions, equivalent to 66.7% of the researchers. In the higher production group, the scientific production ranged between 61 and 268 products, and the human resources training ranged between 31 and 158 supervisions, equivalent to 33.3% of the researchers.

For data sources we searched the CNPq website, which provides the list of PQ scholarship students of all fields of knowledge, and the CL of researchers⁽⁵⁾ from which the information regarding scientific production, production of patents and human resources training were extracted.

Variables of interest

The variables of interest in this study were: gender, level, geographical location: region, state, and home institution; background: institution and country where they have completed doctoral and postdoctoral programs; scientific production (publication of articles, books and book chapters), technology production (patents), human resources training (number of supervisions of scientific initiation, master's degree, doctorate and postdoctoral programs).

The aforementioned variables were analyzed for all participants of the study (208 researchers) with the exception of the variable "level", since CNPq only provides this information for researchers who are currently PQ. Forty-five of the total of researchers studied were PQ in a particular moment in the studied historical series, but they are not at the present. These were classified as "unidentified level" in the analyses.

Statistical analysis

The statistical analyses were conducted using the database built through the SPSS[®] software for Windows, version 18.0. Frequency distributions of all investigated variables were built, and for numeric variables descriptive measures were calculated (mean and standard deviation).

To evaluate if there was an association between the dependent variables (scientific production and human resources training) and some characteristics of the researcher (gender, origin and background), the prevalence ratio was calculated by the Poisson regression⁽⁶⁻⁷⁾.

RESULTS

Profile and origin of nursing PQ/CNPq researchers

Most (92.8%) of nursing researchers who were awarded PQ/CNPq scholarships in the 2000-2012 period were female. More than half of these researchers (51.9%) were from the state of São Paulo, and about two-thirds (67.8%) are in the Southeast of the country. There is in the group a predominance (49%) of level 2 scholarship students. These researchers are distributed in 31 institutions, but 6 universities in the country concentrate 72.2% of them: University of São Paulo (USP): 41.8%; Universidade Federal do Rio de Janeiro (UFRJ): 7.7%; Universidade Federal de Santa Catarina (UFSC): 6.3%; Universidade Federal de São Paulo (UNIFESP): 6.3%; Universidade Federal do Ceará (UFC): 5.8%; and Universidade Estadual do Rio de Janeiro (UERJ): 4.3%.

Distribution of PQ researchers according to the conclusion of doctoral and postdoctoral programs

Concerning qualification, most nursing PQ researchers (98.6%) completed a doctoral program. Of these, the majority (96.6%) earned a doctorate in Brazil. Regarding postdoctoral programs, the study showed that most of them (64.9%) did not accomplish it. However, of those who earned a postdoctoral degree, most of them (72.6%) chose to earn it abroad.

Scientific production, technology production and human resources training

Table 1 presents the descriptive measures of scientific production, patent production and human resources training of nursing researchers who were awarded PQ/CNPq scholarship in the 2000-2012 period.

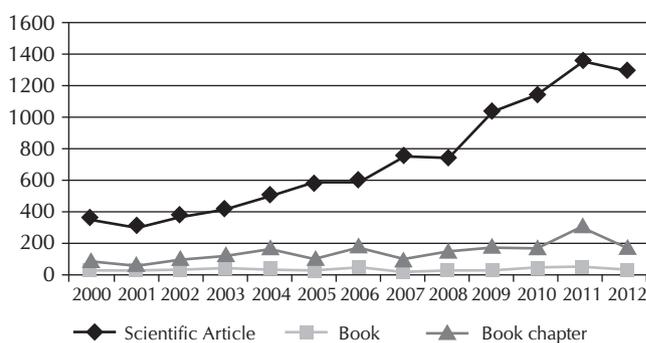


Figure 1 - Performance of nursing PQ/CNPq researchers regarding scientific production (scientific articles, books and book chapters) over the 2000-2012 period

Note:
PQ: Research Productivity
CNPq: National Council for Technological and Scientific Development

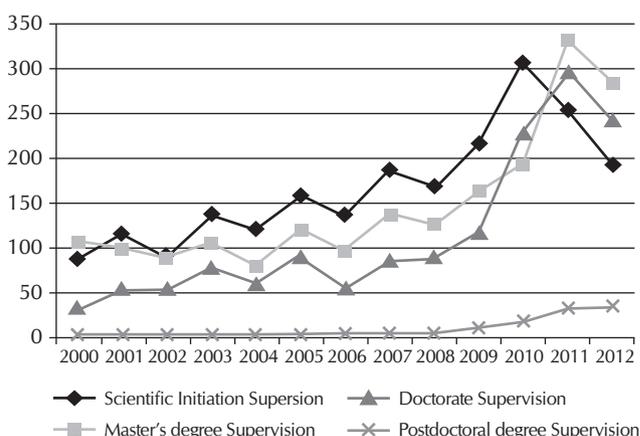


Figure 2 - Performance of nursing PQ/CNPq researchers regarding human resources training (supervision of scientific initiation, master's degree, doctorate and postdoctoral degree) over the 2000-2012 period

Note:
PQ: Research Productivity
CNPq: National Council for Technological and Scientific Development

Table 1 - Descriptive measures of scientific production, technology production and human resources training of nursing PQ/CNPq researchers in the 2000-2012 period

Variable	Production Modalities	Quantity	Mean	Standard Deviation
Scientific Production	Scientific Articles	9.456	45.5	37.7
	Books	395	1.9	3.2
	Book chapters	1.904	9.1	14.3
Total		11.755	56.5	47.1
Human Resources Training	Scientific Research Supervision	2.157	10.4	11.1
	Master's degree Supervision	1.926	9.3	7.3
	Doctorate Supervision	1.485	7.1	5.6
	Postdoctoral degree Supervision	84	0.4	0.9
Total		5.652	27.2	20.3
Technology Production	Patents	12	0.06	0.2
Total		12	0.06	0.2

Note:
PQ: Research Productivity

A vigorous production between nursing researchers was observed regarding scientific production (scientific articles, books and book chapters) and human resources training (supervisions of scientific initiation, master's degree, doctorate and postdoctoral degree); however, technology production (patents) of the group is still small.

Figures 1 and 2 show the performance of nursing PQ researchers regarding scientific production and human resources training over the 2000-2012 period.

The study indicates an increase in scientific production and in human resources training in the 2000-2012 period; however, it draws attention to the publication of articles, which is the production modality that showed the highest growth in the period (Figures 1 and 2). The number of articles ranged from 356 in 2000 to 1,358 in 2011, and to 1,294 in 2012. The number of books ranged from 30 in 2000 to 46 in 2011, and to 24 in 2012. The number of book chapters ranged from 96 in 2000 to 308 in 2011, and to 173 in 2012 (Figure 1).

The human resources training of the nursing PQ also showed an important growth. The number of scientific initiation programs ranged from 86 in 2000 to 253 in 2011, and to 191 in 2012. The number of master's degree programs ranged from 106 in 2000 to 332 in 2011, and to 284 in 2012. The number of doctorate programs ranged from 34 in 2000 to 296 in 2011, and to 242 in 2012. The number of postdoctoral degree programs ranged from 0 in 2000, to 27 in 2011, and to 29 in 2012 (Figure 2). It should be noted that the sharp decline in the 2011-2012 period in all production modalities (Figures 1 and 2) occurred because only the production of one semester of 2012 was registered.

Association between scientific production and characteristics of the researchers

In Table 2 the frequencies of the scientific production of nursing PQ/CNPq researchers are presented according to independent variables (gender, origin and education), as well as the associations found between the investigated variables.

Table 2 - Scientific production of nursing PQ/CNPq researchers in the 2000-2012 period, according to independent variables and associations found between the investigated variables

Independent variables	< Scientific Production n (%)	> Scientific Production n (%)	Total n (%)	Prevalence Ratio (PR)*
Gender				
- Female	126 (65.3)	67 (34.7)	193 (100.0)	1.74
- Male	12 (80.0)	3 (20.0)	15 (100.0)	1.00
State				
- São Paulo	73 (67.6)	35 (32.4)	108 (100.0)	1.67
- Rio Janeiro	21 (75.0)	7 (25.0)	28 (100.0)	1.29
- Ceará	4 (23.5)	13 (76.5)	17 (100.0)	3.95
- Santa Catarina	7 (53.8)	6 (46.2)	13 (100.0)	2.39
- Rio Grande do Sul	8 (72.7)	3 (27.3)	11 (100.0)	1.41
- Other States	25 (80.6)	6 (19.4)	31 (100.0)	1.00
Region				
- Southeast	98 (69.5)	43 (30.5)	141 (100.0)	0.76
- Other regions	40 (59.7)	27 (40.3)	67 (100.0)	1.00
Where Earned Doctorate**				
- Brazil	130 (65.7)	68 (34.3)	198 (100.0)	2.40
- Abroad	6 (85.7)	1 (14.3)	7 (100.0)	1.00
Postdoctoral degree				
- Earned	46 (63.0)	27 (37.0)	73 (100.0)	1.16
- Did Not Earned	92 (68.1)	43 (31.9)	135 (100.0)	1.00
Home Institution				
- USP	54 (62.1)	33 (37.9)	87 (100.0)	1.69
- UFRJ	13 (81.3)	3 (18.8)	16 (100.0)	0.84
- UNIFESP	11 (84.6)	2 (15.4)	13 (100.0)	0.69
- UFSC	7 (53.8)	6 (46.2)	13 (100.0)	2.06
- UFC	2 (16.7)	10 (83.3)	12 (100.0)	3.72
- UERJ	6 (66.7)	3 (33.3)	9 (100.0)	1.49
- Other Institutions	45 (77.6)	13 (22.4)	58 (100.0)	1.00
Level				
1 (A, B, C and D)	12 (19.7)	49 (80.3)	61 (100.0)	5.12
Unidentified***	40 (88.9)	5 (11.1)	45 (100.0)	0.71
2	86 (84.3)	16 (15.7)	102 (100.0)	1.00
TOTAL	138 (66.3)	70 (33.7)	208 (100.0)	---

Note:

* Prevalence Ratio (RP) refers to the highest scientific production;

** 3 researchers have not earned a doctorate and were excluded from this analysis regarding background;

*** The study involved 208 nursing PQ researchers who were scholarship students during the 2000-2012 historic series. However, CNPq only informs the researcher who is currently PQ. Forty-five of the studied nursing researchers were PQ in a particular moment in the historic series, but they are not anymore. Therefore, they are referred at the "unidentified level" in this analysis.

PQ: Research Productivity

CNPq: National Counsel for Technological and Scientific Development

The study showed an association between the scientific production and the independent variables gender, state, region, background (doctoral and postdoctoral degree), home institution and level of the researcher (Table 2).

A scientific production preponderance was evidenced among women. The highest scientific production (articles, books and book chapters) among the nursing PQ female researchers was 1.74 times (74%) higher when compared to PQ male researchers (Table 2).

The concentration of scientific production of nursing PQ researchers in the states of São Paulo, Rio de Janeiro, Ceará, Santa Catarina and Rio Grande do Sul was also evidenced. The highest scientific production among nursing PQ researchers in the state of São Paulo was 1.67 times (67%) higher; among the PQ of the state of Rio de Janeiro, it was 1.29 times (29%) higher; among the PQ of the state of Ceará, it was 3.95 times (295%) higher; among the PQ of the state of Santa Catarina, it was 2.39 times (139%) higher, and among the PQ of the state of Rio Grande do Sul it was 1.41 (41%) higher, when compared to the PQ researchers of other states of the country. The state of Ceará deserves attention – although with only 17 PQ researchers, most of them (76.5%) had the profile of higher scientific production. All other states were more concentrated in the lower production profile (Table 2).

From the regional point of view, although there is a concentration of nursing PQ researchers in the Southeast, the study demonstrated that the higher scientific production between the nursing PQ in the southeast was 0.76 times (24%) lower when compared to the PQ of other regions in the country. This occurs because although most nursing PQ scholarship students were from the Southeast (141 of 208), other Brazilian regions concentrated a highest percentage of scholarship students in this area at the higher production group (40.3%), when compared with the Southeast region (30.5%) (Table 2).

Regarding background, the study points to an association between scientific production and the location where the researcher earned the doctoral degree. The highest scientific production among nursing PQ researchers who earned doctorate in Brazil was 2.40 times (140%) higher when compared to those who earned doctorate abroad. The study also mentions that the highest scientific production between nursing PQ researchers who earned postdoctoral degree was 1.16 times (16%) higher when compared to those who did not earn a postdoctoral degree (Table 2).

As the study showed a concentration of nursing PQ researchers at USP, UFRJ, UNIFESP, UFSC, UFC, and UERJ, we have not found any association between scientific production and home institutions of the researchers. The highest scientific production among nursing PQ researchers of UFC was 3.72 times (272%) higher; among the PQ of UFSC, it was 2.06 times (106%) higher; among the PQ of USP, it was 1.69 times (69%) higher; among the PQ of UERJ, it was 1.49 times (49%) higher when compared to nursing PQ researchers of other universities of the country (Table 2).

Regarding the level of researchers, the study shows that the highest scientific production among level 1 nursing PQ researchers was 5.12 times (412%) higher when compared to

the level 2 PQ researchers. This had to do with a high concentration (80.3%) of level 1 nursing PQ researchers in the higher scientific production group (Table 2).

Association between human resources training and some characteristics of the researchers

In Table 3 frequencies of the scientific production of nursing PQ/CNPq researchers are presented according to independent variables (gender, origin and education) as well as the associations found between the investigated variables.

As occurred in the case of scientific production, the study highlighted the association between human resource training and the independent variables “gender, origin, background (doctorate and postdoctoral degree)” and level of researchers (Table 3).

There was a predominance of human resources training among women. The higher human resources training (supervisions of scientific initiations, master's degree, doctoral and postdoctoral degree) among the nursing PQ researchers was 1.30 times (30%) higher when compared to male PQ researchers (Table 3).

The nursing PQ researchers of the states of São Paulo, Rio de Janeiro, Ceará, Santa Catarina and Rio Grande do Sul distinguished themselves in relation to the human resources training. The highest scientific production among nursing PQ researchers in the state of Ceará was 2.05 times (105%) higher; among the PQ of the state of Rio Grande do Sul, it was 1.41 times (41%) higher; among the PQ of the state of Rio de Janeiro, it was 1.38 times (38%) higher; among the PQ of the state of São Paulo, it was 1.29 times (29%) higher, and among the PQ of the state of Santa Catarina, it was 1.19 (19%) higher when compared to the nursing PQ researchers of other states of the country. It is important noting that the group of nursing PQ researchers of Ceará (17) are strongly (52.9%) inserted in the group of higher human resources training (Table 3).

There was also an association between human resource training and region of origin of the researcher. The higher human resources training among nursing PQ researchers from the Southeast was 0.99 times (only 1%) lower when compared to the nursing PQ of all other regions of the country (Table 3).

The study shows that human resources training is also associated with the researcher's background. The highest human resources training among nursing PQ researchers who earned doctorate in Brazil was 1.22 times (22%) higher when compared to those who earned doctorate abroad. The highest human resources training among nursing PQ researchers who earned postdoctoral degree was 0.94 times (6% lower) when compared to those who did not earned postdoctoral degree. This difference is relatively small considering that most (64.9%) of nursing PQ researchers had not earned postdoctoral degree yet (Table 3).

Just as it occurred in the case of scientific production, there was an association between human resources training and home institute of researchers. The highest human resources training among nursing PQ researchers from UFC was 1.71 times (71%) higher; among the PQ from UFRJ, it was 1.28 times (28%) higher; among the PQ from USP, it was 1.26 times (26%) higher; among the PQ from UERJ, it was 1.14 times (14%) higher, and among the PQ from UFSC, it was 1.05 (5%) higher when compared to the nursing PQ researchers of other universities of the country (Table 3).

Table 3 - Frequencies of the human resources training of nursing PQ/CNPq researchers in the 2000-2012 period, according to independent variables and associations found between the investigated variables

Independent variables	< Human Resources Training n (%)	> Human Resources Training n (%)	Total n (%)	Prevalence Ratio (PR)*
Gender				
- Female	126 (65.3)	67 (34.7)	193 (100.0)	1.30
- Male	11 (73.3)	4 (26.7)	15 (100.0)	1.00
State				
- São Paulo	72 (66.7)	36 (33.3)	108 (100.0)	1.29
- Rio Janeiro	18 (64.3)	10 (35.7)	28 (100.0)	1.38
- Ceará	8 (47.1)	9 (52.9)	17 (100.0)	2.05
- Santa Catarina	9 (69.2)	4 (30.8)	13 (100.0)	1.19
- Rio Grande do Sul	7 (63.6)	4 (36.4)	11 (100.0)	1.41
- Other States	23 (74.2)	8 (25.8)	31 (100.0)	1.00
Region				
- Southeast	93 (60.0)	48 (34.0)	149 (100.0)	0.99
- Other regions	44 (65.7)	23 (28.6)	67 (100.0)	1.00
Where Earned Doctorate**				
- Brazil	129 (65.2)	69 (34.8)	198 (100.0)	1.22
- Abroad	5 (71.4)	2 (28.6)	7 (100.0)	1.00
Postdoctoral degree				
- Earned	49 (67.1)	24 (32.9)	73 (100.0)	0.94
- Did Not Earned	88 (65.2)	47 (34.8)	135 (100.0)	1.00
Home Institution				
- USP	55 (63.2)	32 (36.8)	87 (100.0)	1.26
- UFRJ	10 (62.5)	6 (37.5)	16 (100.0)	1.28
- UNIFESP	10 (76.9)	3 (23.1)	13 (100.0)	0.79
- UFSC	9 (69.2)	4 (30.8)	13 (100.0)	1.05
- UFC	6 (50.0)	6 (50.0)	12 (100.0)	1.71
- UERJ	6 (66.7)	3 (33.3)	9 (100.0)	1.14
- Other Institutions	41 (70.7)	17 (29.3)	58 (100.0)	1.00
Level				
1 (A.B.C.D)	16 (26.2)	45 (73.8)	61 (100.0)	3.76
Unidentified***	39 (86.7)	6 (13.3)	45 (100.0)	0.68
2	82 (80.4)	20 (19.6)	102 (100.0)	1.00
TOTAL	137 (65.9)	71 (34.1)	208 (100.0)	---

Note:

*Prevalence Ratio (PR) refers to higher human resources training;

**3 researchers have not earned a doctorate and were excluded from this analysis regarding background;

***The study involved 208 nursing PQ researchers who were scholarship students during the 2000-2012 historic series. However, CNPq only informs the researcher who is currently PQ. Forty-five of the studied nursing researchers were PQ in a particular moment in the historic series, but they are not anymore. Therefore, they are referred at the "unidentified level" in this analysis.

PQ: Research Productivity

CNPq: National Counsel for Technological and Scientific Development

For the level of researchers, the highest human resources training among level 1 nursing PQ researchers was 3.76 times (276%) higher when compared to the level 2 PQ researchers. Concerning this issue, it is important noting that although the number of level 1 scholarship students was much lower (61 of 208), these students were more concentrated in the highest human resources training group (73.8%), whereas the level 2 PQ researchers (102 of 208) concentrated (80.4%) in the lowest human resources training group (Table 3).

DISCUSSION

The feminization of nursing PQ/CNPq scholarship students is consistent with the feminization of the profession. The Brazil's Federal Council of Nursing (COFEN) performed

in 2010 an analysis of data collected in the Regional Councils of Nursing and published the nursing professional profile in Brazil. The conclusion was that the majority (87%) of professionals were female, single (49%), aged 26 to 45 years (63%), and live in the Southeast region (32%), mainly in the states of São Paulo and Rio de Janeiro⁽⁸⁾.

However, the findings of this study that indicate that the majority (92.8%) of nursing PQ researchers are female are in contrast with the results of other studies that found a male predominance among PQ/CNPq researchers of other fields of knowledge, for instance, those which found 72.7% of male PQ researchers in cardiology⁽⁹⁾, 68% in medicine⁽¹⁰⁾, 70.6% in oral pathology⁽¹¹⁾, and 74% in neuroscience⁽¹²⁾.

The concentration of PQ researchers, scientific production and human resources training in nursing in the state of São Paulo, and in the southeast region of Brazil, is coherent

with the concentration of professionals of this area in this region and state⁽⁸⁾, and it is also consistent with the historical concentration of graduate studies in nursing in such places. In the 1990s, nursing graduate studies in Brazil had significant growth; however, it remained concentrated in the Southeast region, mainly in the state of São Paulo⁽¹³⁾. But this is not a reality only for nursing. Studies on other fields of knowledge also show this concentration in São Paulo and in the Southeast region⁽⁹⁻¹²⁾.

It should be noted that the spatial concentration of scientific production is not a Brazilian peculiarity, instead, it has been a growing tendency in the contemporary world. Technoscientific activities follow the concentrative tendency, distributed unevenly in spaces and in accordance with capital accumulation⁽¹⁴⁾. According to data elaborated by the Observatoire des Sciences et Techniques (OST), of the 4.5 million researchers in the world in 1997, more than a half were in the triad formed by the United States (962,700), European Union (821,244) and Japan (577,932)⁽¹⁶⁾. France and Brazil illustrate well the regional concentration of researchers and scientific production. In France, most researchers act in a specific region of the country, the Île-de-France region. In 1997, this region had 32.7% of researchers from public institutions and 51.1% of researchers linked to private companies. In the Brazilian case, data produced by CNPq show that 43,163 (73%) of 58,961 researchers linked to different research groups registered in 2002 were in the South and Southeast regions. This situation is reflected in the results obtained by the technoscientific practice⁽¹⁵⁾.

Moreover, regarding the concentration of the Brazilian scientific production, studies have stated that, between 1983 and 2000, researchers from institutions located in the state of São Paulo have accounted for 47% of the authorships and co-authorships of indexed papers on the Pascal base, which is an international and multidisciplinary base. These results corroborate the importance of scientific production from São Paulo in the national context, a fact already widely documented and explained. Among other factors that collaborate for this concentration, we could mention: the historical process of institutionalization of Science and Technology in the state of São Paulo, the importance of the economy and industry of São Paulo in Brazil, the size of the community of researchers, and the amount and diversity of universities and graduate programs in the state, besides the aid promoted by Fapesp, CNPq, Finep and other institutions⁽³⁾.

Emphasizing the information on the regional concentration of researchers and scientific production found in this study, statistics of the Coordination of Higher Education and Graduate Training (Capes) show a concentration of graduate studies in the Southeast region of the country. This concentration is observed in the distribution of graduate programs and courses, and in the distribution of scholarships and of students and professors⁽¹⁷⁾.

This study shows a significant scientific production and important human resources training among the group of Nursing PQ researchers. This growth can be associated with the growth of nursing graduate studies in the country.

Nursing is a field of knowledge and a practice that is consolidating and strengthening⁽¹⁸⁾. Graduate studies in nursing in Brazil, in their pinnacle after 40 years of existence, is dynamically expanding. In the period from 2007 to 2010, there was an increase of 62% in the number of master's programs and 80% in the number of doctoral programs in the field of nursing. In 2013, the Brazilian nursing had 63 graduate programs, of which 41.3% (26) offered masters and doctorate program; 33.3% (21) offered only master's degree programs; 22.2% (14) offered courses of professional master's degree, and 3.2% (2) exclusively offered doctoral programs⁽¹⁸⁾.

It is important noting that scientific production and human resources training for research are important variables to overcome the typical challenges of modern science, and that the PQ scholarship maintained by CNPq represents an important incentive in this scenario. This type of scholarship was created in the late 1970s and designed as a way to encourage researchers with a doctorate degree who had relevant scientific production in their areas of expertise for the appreciation of their study^(4,9). The growth of scientific production of nursing PQ researchers is consistent with the increase in the Brazilian scientific production. From 1986 on, a geometric growth was observed in the number of graduate programs in Brazil: 5.4% per year in all fields of knowledge. In recent years, particularly since 2002, Brazil experienced an expansion of scientific production in all fields of knowledge, concurrently with the growth of graduate studies in the country, considering that in the 2002-2006 period the growth of scientific production was 74.34%, and the growth of graduate programs, 72.80%⁽¹⁹⁾.

On the other hand, the modest production of patents verified among nursing PQ researchers is an aspect of the Brazilian reality, which reinforces the idea that in Brazil there is still a large distance between production of knowledge and technological innovation. Paradoxically, the last decades in Brazil were marked by the distancing between the national indicators of scientific and technological production. In the case of nursing PQ researchers, only 12 patents were produced in the period analyzed, whereas in the same period these researchers published 9,456 scientific articles. Within this context, in 2011 Brazil produced 1.4% of the world science, and 0.1% of the world technology⁽²⁰⁾. Currently, it is the 13th in the world scientific production, and its participation in the world market for patents is no more than 0.1%. Therefore, whereas the technoscientific knowledge advance apace in some countries of the world, enabling great economic and social changes, a great portion of the world does not have technoscientific bases to meet relatively simple demands in key areas, such as health and education⁽¹⁵⁾. This disparity between the scientific and technological dimension suggests that Brazil may be wasting technological opportunities created by the current national scientific accumulation⁽²⁰⁾. The differences between the participations concerning Brazil's world scientific and technological production justify the pursuit of measures and policies that could expand the capacity of the productive sector to take advantage of the knowledge created by the scientific infrastructure of the country⁽²⁰⁾.

CONCLUSION

The findings of this study show a significant participation of nursing PQ/CNPq researchers in scientific production and in human resources training, and a modest involvement in the production of patents. This discrepancy between knowledge production and technology production is consistent with the Brazilian reality, which advances in the production of knowledge, but have been showing limitations in transforming this knowledge into innovation.

The study shows that both scientific production and human resources training of the nursing PQ/CNPq researchers

grew significantly during the analyzed period, achieving 11,755 publications and 5,652 supervisions. However, this is a production concentrated in the Brazilian Southeast region, where most of universities and national graduate programs are located. There was also an association between scientific production and human resource training outcomes and some characteristics of the researchers, such as gender, education and origin. These results can be a good source for the government, scientific community and funding institutions to implement new investment and support policies, especially those focused on decentralization and increase in the production of technology and innovation.

REFERENCES

1. Sanna MC. [Work processes in Nursing]. *Rev Bras Enferm* [Internet]. 2007 Mar-Apr [cited 2013 Dec 13];60(2):221-4. Available from: <http://www.scielo.br/pdf/reben/v60n2/a17v60n2.pdf> Portuguese.
2. Erdmann AL, Fernandes JD. Postgraduate programs in nursing in Brazil: challenges and prospects. *Esc Anna Nery* [Internet]. 2011 Jan-Mar [cited 2013 Dec 13];15(1):7-9. Available from: http://www.scielo.br/pdf/ean/v15n1/en_01.pdf
3. Mugnaini R, Jannuzzi PM, Quoniam L. [Bibliometric indicators of the Brazilian scientific production: an analysis from Pascal base]. *Ciência da Informação* [Internet]. 2004 May-Aug [cited 2013 Dec 13];33(2):123-31. Available from: <http://www.scielo.br/pdf/ci/v33n2/a13v33n2.pdf> Portuguese.
4. Cnpq.br [Internet]. Brasília (DF): CNPq; 2013 [cited 2015 Apr 03]. Available from: <http://cnpq.br/documents/10157/5f43cefd-7a9a-4030-945e-4a0fa10a169a>
5. Cnpq.br [Internet]. Brasília (DF): CNPq; 2013 [cited 2015 Apr 03]; Available from: <http://buscatextual.cnpq.br/buscatextual/busca.do?metodo=apresentar>
6. Barros AJD, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol* [Internet]. 2003 Oct [cited 2013 Dec 13];3:21-34. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC521200/pdf/1471-2288-3-21.pdf>
7. Petersen MR, Deddens JA. Approaches for estimating prevalence ratios. *Occup Environ Med* [Internet]. 2008 Jul [cited 2013 Dec 13];65(7):501-6. Available from: <http://oem.bmj.com/content/65/7/501.long>
8. Conselho Federal de Enfermagem (BR). Análise de dados dos profissionais de enfermagem existentes nos Conselhos Regionais. Relatório de Pesquisa. Brasília (DF): COFEN [Internet]. 2011 [cited 2015 Apr 03]; Available from: <http://www.cofen.gov.br/wp-content/uploads/2012/03/pesquisaprofissionais.pdf>
9. Oliveira EA, Ribeiro ALP, Quirino IG, Oliveira MCL, Martelli DR, Martelli-Junior H, et al. Profile and Scientific Production of CNPq Researchers in Cardiology. *Arq Bras Cardiol* [Internet]. 2011 Aug [updated 2015 Jul 08; cited 2013 Dec 13];97(3):186-93. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0066-782X2011001200002&lng=en&nrm=iso&tlng=en English, Portuguese.
10. Martelli-Junior H, Martelli DR, Quirino IG, Oliveira MCLA, Lima LS, Oliveira EA, et al. CNPq-supported medical researchers: a comparative study of research areas. *Rev Assoc Med Bras* [Internet]. 2010 Jul-Aug [cited 2013 Dec 13];56(4):478-83. Available from: http://www.scielo.br/pdf/ramb/v56n4/en_24.pdf
11. Santos MIP, Leite BGL, Paranaíba LMR, Oliveira EA, Veríssimo FM, Oliveira RAD, et al. Profile and scientific production of Brazilian researchers in oral pathology. *Rev Odontol UNESP* [Internet]. 2012 Nov-Dec [cited 2013 Dec 13];41(6):390-95. Available from: <http://www.scielo.br/pdf/rounosp/v41n6/a04v41n6.pdf>
12. Romano-Silva MA, Correa H, Oliveira MCL, Colosimo EA, Martelli-Junior H, Oliveira EA, et al. Profile and analysis of scientific production of Brazilian researchers in Clinical Neurosciences. *Rev Psiquiatr Clín* [Internet]. 2013 [cited 2013 Dec 13];40(2):53-8. Available from: http://www.scielo.br/pdf/rpc/v40n2/en_v40n2a01.pdf
13. Rivero Gutiérrez MG, Vieira TT, Almeida MCP, Elsen I, Stefanelli MC. Following and evaluating the graduate programs in Brazil: a historical retrospective on the nursing area representation. *Esc Anna Nery*. 2001;5(2):161-72.
14. Barros FAF. Os desequilíbrios regionais da produção técnico-científica. São Paulo *Perspect* [Internet]. 2000 Jul-Sep [cited 2015 Apr 03];14(3):12-9. Available from: <http://www.scielo.br/pdf/spp/v14n3/9766.pdf>
15. Barros FAF. Concentração técnico-científica: uma tendência em expansão no mundo contemporâneo? *Inovação Uniemp* [Internet]. 2007 Jan-Feb [cited 2015 Apr 03];3(1):40-1. Available from: <http://inovacao.scielo.br/pdf/inov/v3n1/a22v03n1.pdf>
16. Observatoire des Sciences et des Techniques (FR). Relatórios bi-anuais de 1992 a 2002. Paris: Econômica; 2003.
17. Coordenação de Aperfeiçoamento de Pessoal de Nível Superior. CAPES. Sistema de Informações Georreferenciadas: Geocapes.capes.gov.br [Internet]. Brasília (DF): CAPES; 2013 [cited 2015 Apr 03]; Available from: <http://geocapes.capes.gov.br/geocapes2/>.
18. Coordenação de Aperfeiçoamento de Pessoal de Nível Superior. CAPES Avaliação Trienal 2013 [Internet]. Brasília (DF): CAPES; [cited 2015 Apr 03]. Available from: <http://www.capes.gov.br/images/stories/download/avaliacaotri>

enal/Docs_de_area/Enfermagem_doc_area_e_comiss%C3%A3o_att08deoutubro.pdf

19. Lyra TMP, Guimarães JA. Produção científica brasileira em comparação com o desempenho mundial em ciências agrárias. *Planej Polít Públicas* [Internet]. 2007 [cited 2015 Apr 03];30(1):141-62. Available from: <http://www.ipea.gov.br/ppp/index.php/PPP/article/view/39>
 20. Albuquerque EM, Baessa AR, Kirdeikas JCV, Silva LA, Ruiz RM. [The scientific and technological production of Brazilian metropolitan]. *Rev econ contemp* [Internet]. 2005 Sep-Dec [cited 2013 Dec 31];9(3):615-42. Available from: <http://www.scielo.br/pdf/rec/v9n3/v9n3a06.pdf> Portuguese.
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