

RESULTS OF A PHD PROGRAM IN MEDICAL SCIENCES IN A PUBLIC SOUTH AMERICAN UNIVERSITY.

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ABSTRACT

Introduction: The number of doctoral programs in medical sciences and health professionals trained for clinical research is scarce, particularly in South America. The aim of this study was to describe the results of a doctoral program in medical sciences (DPMS) in a public South American university. **Methods:** It's an observational study. All cohorts in the program from 2008 to 2020 were included in the analysis. Outcome variables were graduation rate and scientific productivity of graduates in terms of publications in WoS and Scopus journals databases. Other variables of interest were student's biodemographical and academic characteristics, and faculty members (n=11 professors) productivity (WoS and Scopus publications). Descriptive statistics were applied. **Results:** During the evaluation period 211 professionals applied to the DPMS program, 52 were accepted (24.6% acceptance rate), and 18 graduated (graduation rate of 58.1%). Graduate productivity was 160 papers (123 in WoS database and 44 in Scopus), adding up to an average of 9.2 publications per graduate. Median graduation time was 49 months. Faculty members' (n=11) productivity totaled 474 scientific articles between 2016-2020 (450 in WoS database journals and 24 in Scopus database journals), adding up to an average of 40.9 publications per faculty member during that time period, the equivalent of an average of 8.2 publications per academic per year. **Conclusion:** The results of a recent but consolidated PhD program in medical sciences are presented. We emphasize the acceptance and graduation rate, and the scientific productivity of both graduates and faculty members.

Keywords: Chile; Graduate; Medical Education; PhD programs, South America.

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INTRODUCTION

A Doctor of Philosophy (PhD) is the highest academic degree that is conferred by universities, it is awarded following a course of study and having thorough knowledge of the academic field researched. However, a small number of healthcare professionals pursue doctoral studies for research training. These professionals are expected to participate in biomedical research and academic careers, as well as seek an opportunity to play a significant role in research and clinical practice [1]. Nevertheless, there is a limited number of doctoral

programs for healthcare professionals in South America.

By way of illustration, in Chile there are only four doctoral programs with the specific designation of "Medical Sciences" (DPMS): Universidad de Chile (since 1993), Pontificia Universidad Católica de Chile (since 1995), Universidad de La Frontera (since 2008), and Universidad Austral de Chile (since 2010). Yet, even when the above programs are considered, the academic offer for DPMS in the country is only 1.8% [2-5]. Universidad de Chile offers a program whose objective is to train a specialist physician and simultaneously offer a doctoral degree in medical sciences [6]; The

programs offered by the Pontificia Universidad Católica de Chile, and Universidad Austral de Chile are geared toward biomedicine [7,8]; and Universidad de La Frontera DPMS, which is uniquely designed for clinical research using formative assessment tools of evidence-based medicine and translational research. It is a multidisciplinary program, encompassing all areas of medical sciences, including basic sciences, with an important emphasis on the methodological aspects of clinical research. The faculty members and collaborating professors are part of the Faculties of Medicine and Dentistry [9]. The goal of this DPMS is to train critical thinkers to lead research teams in medical sciences, while generating original ideas and experiences specifically related to high priority health issues [9].

There are few comparable programs throughout South America, and they are offered namely in Sao Paulo, Rio de Janeiro in Brazil and Buenos Aires, Argentina. One of these programs, and somewhat similar is the Postgraduate Program on Evidence Based Medicine by Escola Paulista de Medicina, Universidade Federal de São Paulo, which has been in place since 1996 [10].

In 2016, we published the first results of our DPMS, based on 8 years of uninterrupted work [11], which was based upon the consolidation of a Master's in Medical Sciences program, created in 2004.

The aim of this study was to describe the results of a DPMS in a public South American university.

METHODS

The aim of this article was to describe the results of a DPMS in Chile. It was written following the MINCir initiative for the reporting of descriptive observational studies [12].

- **Design:** Descriptive observational.
- **Center:** Doctoral Program in Medical Sciences.
- **Participants:** DPMS students and members of the doctoral faculty.
- **Inclusion-exclusion criteria:** All the program cohorts from 2008 to 2021 inclusively were incorporated. There were no exclusion criteria.
- **Sampling:** Non-probabilistic sampling. No sample size was estimated because it was worked with the entire population in this study.
- **Variables:** Outcome variables were graduation rate and scientific productivity of graduates, measured by publications in journals of Web of Science by Clarivate Analytics (WoS), and SCOPUS by Elsevier databases journals. Other variables of interest were general characteristics of the students (age, sex, origin, profession, previous graduate education, number of years of formal university education); productivity of the

members of the doctoral staff (publications in the same databases); and publications quartiles.

- **Program curriculum:** The curriculum program consists of a total of 246 credits (6881 total hours), 125 for subjects and 121 for the thesis (an intermediate master's degree is not considered). The program's duration is a minimum of 8 semesters of full-time work. Program subjects are as follows: Foundations of Medical Sciences I and II, Foundations of Clinical Research I and II, Biostatistics I and II, Introduction to the development of projects and presentation of results, Qualitative analysis of biomedical literature, Bioethics, Experimentation with biological material, Electives 1 and 2, seminars and research units, and degree thesis. The research lines of the program are concentrated in 3 areas: human pathology, human and experimental morphology; and human reproduction.
- **Definitions:** Graduation rate is obtained from the ratio between the total number of graduates and total number of students able to graduate in the same period (students who have not yet fulfilled their training plan are not considered).
- **Follow-up:** A follow-up of the graduates was carried out to ascertain their employment situation once they completed the program and returned to work full-time.
- **Statistics:** Using the Stata 11.0 statistics package, an exploratory analysis of the data was performed, and descriptive statistics were applied with calculation of percentages, measures of central tendency and dispersion.
- **Ethical principles:** Identity of all the participants (students, graduates, and academics) was masked by coding each one.
- **Ethics Statement:** The study was approved by an institutional review committee and subjects gave informed consent.

RESULTS

General description of the sample: a total of 211 professionals applied to the DPMS program; 52 were accepted (24.6% acceptance rate). The student average age was 35.3 ± 7.7 (25 to 59) years; 51.9% were male. The average number of years of formal university studies was 11.5 ± 1.5 (6 to 12) years; and the most common professions were physicians and dentists (61.5%). Thirty-one students (59.6%) had a master's degree; and 27 (51.9%), a medical or dental specialty. Seventy-six point nine of the students were from Chilean universities, and the remaining 23.1% from international universities. Biodemographic variables and student characteristics are described in **Table I**.

Table I. Characteristics of students during the period of the study (2008-2021). (N = 52)

Variable	Nº	%
Profession		
Physician	18	34.6
Dentist	14	26.9
Physiotherapist	5	9.6
Pharmacist	4	7.7
Dietician	3	5.8
Medical technician	2	3.8
Others *	6	11.6
Graduate studies**		
Magister	27	51.9
Specializations	31	59.6
Both ***	14	26.9
Neither	7	13.5
Origin		
U. de La Frontera	9	17.3
U. de Chile	8	15.3
U. Concepción	8	15.3
U. de Cuenca (Ecuador)	6	11.6
U. Talca	4	7.7
U. Austral de Chile	3	5.8
U. Central del Ecuador	3	5.8
Others ****	11	21.2

* Other: Psychologist, veterinarian, statistician, biologist, midwife, and speech therapist (one of each). ** Graduate studies: Previous graduate education (the sum is greater than 52, as some had a specialty and a Magister's degree). Medical or dental specialization. *** Both: Magister's, medical or dental specialization. **** Others: Pontificia Universidad Católica and Universidad Mayor (two of each). Universities: Particular de Loja (Ecuador), Autónoma de Chile, Católica de la Santísima Concepción, Finis Terrae, de Los Lagos, San Sebastián, and Tarapacá (Chile); one of each.

Analysis of groups and subgroups: Eighteen students graduated, indicating a graduation rate of 58.1% (18/30, which represents 1.8 graduates per year). Of these, 94.4% are involved in academic activities in their originating institutions and have been completely reintegrated.

The graduates' productivity was 160 papers during their stay in the program (123 in WoS database journals and 44 in SCOPUS database journals), totaling an average of 9.2 publications per graduate in the 2008-2020 period, which distribution by quartile is shown in Figure 1. Mean graduation time was 51.4 months and publications per year ratio was 2.29 (Table II).

Table II. Graduates' productivity in WoS and SCOPUS journal databases (during their stance in the program). (N = 18)

Graduate	WoS	Scopus	Total	Graduation time (months)	Graduation Year	Ratio (publications/year)
1	3	1	4	48	2011	1.0
2	3	0	3	48	2012	0.8
3	4	0	4	48	2014	1.0
4	14	30	44	44	2014	12.0
5	6	2	8	44	2014	2.2
6	17	0	17	48	2015	4.3
7	3	0	3	44	2015	0.8
8	12	5	17	44	2016	4.6
9	14	1	15	44	2017	4.0

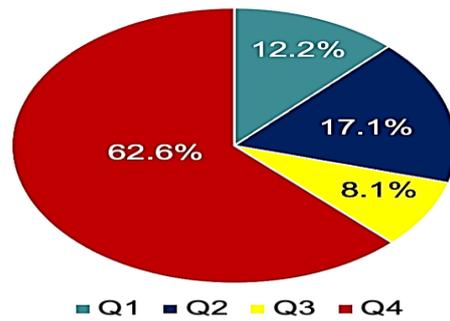


Figure 1. WoS publications of graduated distributed by quartiles.

At the same time, productivity for members of the Doctoral faculty (n=11), was 474 scientific articles in the 2016-2020 period (450 in WoS database journals and 24 in Scopus database journals), corresponding to an average of 40.9 publications per academic faculty member in the 2016-2020 period (Table III). This translates to an average of 8.2 publications per academic per year, with an impact factor average of 4.5 ± 2.0 , and 39.8% of articles in Q1-Q2 (Figure 2).

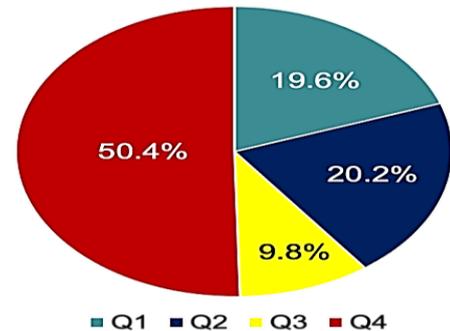


Figure 2. WoS publications of members of doctoral cloister distributed by quartiles between 2016 and 2020.

Twelve students (23.1%) were eliminated from the program during the study period. Some abandoned the program for personal and/or family reasons (7 cases, 58.3%), the remaining were eliminated for poor academic performance (5 cases, 41.7%). Associated variables with the results were no previous master's degree (66.7%), no previous specialty (75.0%) and both of them (41.7%).

10 *	4	2	6	64	2019	1.2
11	3	0	3	58	2019	0.6
12	2	1	3	60	2020	0.6
13	17	0	17	60	2020	3.4
14	5	0	5	50	2020	1.2
15	4	0	5	50	2020	1.2
16	2	0	2	52	2021	0.5
17	5	0	5	60	2021	1.0
18	5	0	5	60	2021	1.0
Total	123	44	160	---	---	---
Mean ± SD	6.8±5.1	2.4±6.8	9.2±9.9	51.4 ± 8.4	---	2.3 ± 0.4
Median	4.5	0	5	49	---	1.1

WoS: Web of Sciences by Clarivate Analytics.; Scopus:by Elsevier B.V.; SD: Standard deviation. *: This graduate had two pregnancies over the course of the program.

Table III. Doctoral Faculty productivity in WoS and Scopus journal databases (2016-2020). (N = 11)

Faculty members	WoS	Scopus	Total
1	75	7	82
2	36	0	36
3	103	3	106
4	50	6	56
5	27	0	27
6	45	5	40
7	53	2	55
8 *	16	0	16
9 *	13	1	14
10 **	17	0	17
11 **	15	0	15
Total	450	24	474
Mean ± SD	40.9±27.1	2.2±2.5	43.1±28.8
Median	36	1	36

WoS: Web of Sciences by Clarivate Analytics.; Scopus:by Elsevier B.V.; SD: Standard deviation. *: These academics joined the program in 2019. **: These academics joined the program in 2020

DISCUSSION

The origin of doctoral programs began at the University of Bologna during the 13th century, when the need to choose the most qualified academics to teach classes was raised. Since that time, doctorate programs have evolved taking on different meanings depending on the university, the educational system, and the country in question [13]. For example, in the United States, Germany, UK, and Spain (among others), the doctorate degree was carried out together with a medical specialty starting in the 1960s [14, 15]. This is quite different from the South American experience (with almost 50 doctorate programs in Medical Sciences), where doctoral programs are generally offered to professional graduates or specialists [7-10,16]. We believe however, that the relevance of doctoral studies related to the education of physicians and other healthcare professionals is set in training scientists with clinical, teaching and research expertise.

Despite the existence of the four medical sciences doctoral programs in Chile, graduation rates are

notably very low. Consequently, it could be stated that a major effort is needed to significantly increase advanced human capital in this area. This would no doubt, result in much lower costs than what is currently allocated by the state to send health care professionals abroad for additional training; some do not return, and others do not find work upon their return. Recent data regarding doctoral programs in Chile, for all areas of expertise in 2021, indicates that doctoral student enrollment was 6,746 (an annual variation of 7%) of which only 482 were part of the healthcare area (Medical Sciences represents only one of these disciplines) an annual variation of -0.2% in this area [17].

There is scarce information regarding the results of doctoral programs, especially in the medical science field, and these are mostly associated with MD-PhD program information [2, 18-25]. At this time, the association of undergraduate to postgraduate teaching in the medical field is a much debated issue. A further and novel approach, is related to the double degree agreement with UNIFESP, established in 2013 and by means of which two of our 18 graduates (11.1%) opted for the double doctoral degree with UNIFESP. This inter-university collaboration was also implemented with some European universities and is similar to the “I.O. PhD Research Program” between the universities of the Maastricht and Utrecht with the Italian Children’s Hospital in Alessandria [26].

The limited number of reported results, make it particularly difficult to compare our findings with previous publications. There are some reports of results in nursing programs [27, 28]. But, in general terms 58.1% graduation rate is somewhat higher than the numbers of some programs in biomedical sciences, microbiology, neurosciences and neurobiology (47.4, 47.1 and 46.2 respectively) reported by the National Academies Press. Nevertheless, an average of 9.2 papers per graduate published during the training period, appears to be adequate when compared with other programs [1,28]. On the other hand, the Basel University

experience with its PhD program in Health Sciences, based on European guidelines was published recently. In its report, highlight among other issues a very low graduation rate (not specified in the article), and a mean time to degree between 3 and 4 years (in a program of 3 years duration) [29].

Median graduation time (49 months) is reasonable in comparison with other experiences in biomedical sciences (median range from 4.9 to 5.7 years for all biomedical science fields with a standard deviation of less than, or equal to one year) [29-31]. On the other hand, grounds listed for leaving the program are: Declining interest in research, isolation, and lack of social integration during the various training phases, suboptimal PhD-advising experiences, unforeseen circumstances to completing PhD research requirements, and loss of funding [1,18,19,32]. In our case, reasons were related to family problems and loss of funding (student did not graduate on time and funding source ended). It should be noted that currently all students have some source of financing (state funds, higher education scholarships, scholarships from healthcare agencies and UFRO scholarships).

For example, in a study of deidentified data obtained from a sample of 88,575 US medical graduates who completed the national Association of American Medical Colleges Graduation Questionnaire from 2000-2006, it was verified that the variables associated with higher probabilities of graduating from a doctoral program, included planning for a career involving research (OR: 10.30, CI 95%: 8.89-11.93); absence of student loans (OR: 17.41; CI 95%: 13.22-22.92) and having scholarships or grants (OR: 3.22; CI 95%: 2.82-3.69). In addition, variables associated with lower probability of graduating was being female (OR: 0.68; 95% CI: 0.60-0.77); race/ethnicity (OR: 0.64; 95% CI: 0.52-0.80) and, in comparison with internal medicine, training in emergency medicine (OR: 0.58; 95% CI: 0.40-0.84) or surgery (OR: 0.70; 95% CI: 0.57-0.85) [32]. Unfortunately, there is no information available in relation to scientific production of program faculty members to compare our results.

It is important to note that in the last 4 years, we lost 7 faculty members were missed (3 due to retirement, and 4 due to the no accreditation as doctoral faculty by the University). This fact impacted on the productivity of the group, but this was partially reverted with the incorporation of 4 new members between 2019 and 2020 (Table III).

Based on these results, we could improve our program applying some strategies including: To ascertain and confirm a source of financing for the duration of the program, favor the acceptance of students with a completed master's degree or

specialty, and require professional experience. Other strategies that could be considered are upgrade the communicational strategies (Website and promotional tools), to have more applications; improve the student's supervision during the thesis period; select a committee with methodological or substantive expertise; and enhance the alumni follow-up network.

CONCLUSIONS

The results of a recent but consolidated PhD program in medical sciences are presented, emphasizing the acceptance and graduation rate, as well as the scientific productivity of both graduates and professorship. We are aware however, of the need to continue efforts to improve all indicators measured and reported in this manuscript.

Conflict of Interest: All authors are professors of the program.

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REFERENCES

1. Dos Santos Rocha A, Combescure C, Negro F. The MD-PhD program in Geneva: a 10-year analysis of graduate demographics and outcomes. *BMC Med Educ.* 2020; 20: 425.
2. Valdés G, Armas R, Reyes H. Main characteristics of current biomedical research, in Chile. *Rev Med Chile.* 2012; 140: 484-92.
3. Baeza P. Diversity and differentiation, PHD program options in Chile. *Calidad en la educación* [online]. 47:179-214, 2017. Available at: <https://calidadenlaeducacion.cl/index.php/rce/article/view/34>. Accessed January 11, 2022.
4. Subsecretariat of Higher Education. Ministry of Education. Academic Offer Base 2020 Consolidated June 2020. Available at: <https://www.mifuturo.cl/bases-de-datos-de-oferta-academica>. Accessed January 22, 2022.
5. Baeza P. Diversity and differentiation, PHD program options in Chile. *Calidad en la educación* [online]. 2017; 47: 179-214. Available at: <https://calidadenlaeducacion.cl/index.php/rce/article/view/34>. Accessed December 18, 2021.
6. Universidad de Chile, Doctorate in Medical Sciences and Specialty. Available at: <https://www.uchile.cl/postgrados/10286/ciencias-medicas-y-especialidad>. Accessed January 18, 2022.

7. Pontificia Universidad Católica de Chile, Doctorate in Medical Sciences. Available at: <https://medicina.uc.cl/postgrado/doctorados/doctorado-en-ciencias%20medicas>. Accessed January 18, 2022.
8. Universidad Austral de Chile, Doctorate in Medical Sciences. Available at: <http://medicina.uach.cl/postgrado/doctorado-en-ciencias-medicinas>. Accessed January 19, 2022.
9. Universidad de La Frontera, Doctorate in Medical Sciences. Available at: <https://doccsmedicas.ufro.cl>. Accessed January 29, 2022.
10. Universidade Federal de São Paulo (UNIFESP), Postgraduate Program in Evidence Based Medicine. Available at: <https://ppg.evidencias.sites.unifesp.br/en>. Accessed March 19, 2021.
11. Manterola C, Otzen T, Cartes-Velásquez R, del Sol M, Olate S, Romero F, Astudillo P. Initial Results of a Doctorate in Medical Sciences Program at a Regional University. *Int J Morphol*. 2016;34(3):1169-1175.
12. Manterola C, Otzen T. Checklist for Reporting Results Using Observational Descriptive Studies as Research Designs: The MInCir Initiative. *Int J Morphol*. 2017;35(1):72-76.
13. Jeffe DB, Andriole DA, Sabharwal RK, Paolo AM, Ephgrave K, Hageman HL, Nuzzarello A, Jones PJ, Whelan AJ. Which U.S. medical graduates plan to become specialty-board certified? Analysis of the 1997-2004 National Association of American Medical Colleges Graduation Questionnaire Database. *Acad Med*. 2006;81 Suppl:S98-102.
14. Montalvo-Javé EE, Mendoza-Barrera GE, Valderrama-Treviño AI, Alcántara-Medina S, Macías-Huerta NA, Tapia-Jurado J. The importance of master's degree and doctorate degree in general surgery. *Cir Cir*. 2016;84(2):180-5.
15. Boes CJ, Long TR, Rose SH, Fye WB. The founding of the Mayo School of Graduate Medical Education. *Mayo Clin Proc*. 2015; 90: 252-63.
16. Pan American Health Organization (PAHO). Report on OAS-PAHO scholarships for member countries: post-graduate degrees in health 2014-2017. Washington, DC 2018. Available at: https://www3.paho.org/hq/index.php?option=com_docman&view=download&category_slug=publicaciones-recursos-humanos-salud-2640&alias=44672-informe-programa-becas-marzo-2018-672&Itemid=270&lang=es.
17. National Education Council (CNED). Postgraduate trends period 2012–2021. Available at: https://www.cned.cl/sites/default/files/161_tendencias_posgrado_20122021.pdf.
18. Andriole DA, Jeffe DB. Predictors of full-time faculty appointment among MD-PhD program graduates: a national cohort study. *Med Educ Online*. 2016; 21: 30941.
19. Begic E, Grbic E, Skrijelj V, Bevanda D, Radulovic D. Bologna Model of Education-MD/PhD Program: Observation of PhD students in Bosnia and Herzegovina. *Acta Inform Med*. 2018; 26: 216-8.
20. Chakraverty D, Jeffe DB, Tai RH. Transition Experiences in MD-PhD Programs. *CBE. Life Sci Educ*. 2018; 17: ar41.
21. Jeffe DB, Andriole DA, Wathington HD, Tai RH. The emerging physician-scientist workforce: demographic, experiential, and attitudinal predictors of MD-PhD program enrollment. *Acad Med*. 2014; 89: 1398-1407.
22. Lamour V, Bessereau JL, Thalabard JC, Gressens P, Bessis A, Barbour B, Clauser É. French network of combined MD-PhD degree programs. *Med Sci (Paris)*. 2018;34:462-3.
23. O'Mara RJ, Hsu SI, Wilson DR. Should MD-PhD programs encourage graduate training in disciplines beyond conventional biomedical or clinical sciences? *Acad Med*. 2015;90:161-4.
24. Waguri S, Ishitsuka K. The MD-PhD program at Fukushima Medical University. *Kaibogaku Zasshi*. 2013; 88: 17-9.
25. Spaniol K, Geerling G. MD PhD programs: Providing basic science education for ophthalmologists. *Ophthalmologe*. 2015;112 (6): 488-493.
26. Bellissima V, Borghesi A, Bozzetti V, Dessì A, Fabiano A, Risso FM, et al. Italia-Netherland PhD Program: the I.O. PhD Research Program. *J Matern Fetal Neonatal Med*. 2011;24 Suppl 1: 111-3.
27. Pimenta CAM, Lagunas LF, Bertolozzi MR, Secoli SR. International Interinstitutional PhD Program in Nursing: a successful experience between Brazil and Chile. *Rev Esc Enferm USP*. 2019; 53: e03467.
28. Ellenbecker CH, Nwosu C, Zhang Y, Leveille S. PhD Education Outcomes: Results of a National Survey of Nursing PhD Alumni. *Nurs Educ Perspect*. 2017; 38: 304-12.
29. Keller F, Dhaini S, Briel M, Henrichs S, Höchsmann C, Kalbermatten D, Künzli N, Mollet A, Puelacher C, Schmidt-Trucksäss A, von Niederhäusern B, De Geest S. How to Conceptualize and Implement a PhD Program in Health Sciences-The Basel Approach. *J Med Educ Curric Dev*. 2018; 5: 2382120518771364.
30. Lorden JF, Kuh CV, Voytuk JA. Research-Doctorate Programs in the Biomedical Sciences: Selected Findings from the NRC Assessment. Washington (DC): National Academies Press (US); 2011. Available at: <https://www.nap.edu/catalog/13213/research-doctorate-programs-in-the-biomedical-sciences-selected-findings-from>. Accessed March 21, 2021.
31. Ostriker JP, Kuh CV. Assessing Research-Doctorate Programs: A Methodology Study. Washington (DC): National Academies Press (US); 2003.
32. Chakraverty D, Jeffe DB, Dabney KP, Tai RH. Exploring reasons that U.S. MD-PhD students enter and leave their dual-degree programs. *Int J Dr Stud*. 2020; 15: 461-83.