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A survey on the professional profile of biomedical informatics graduates from Porto Alegre, Brazil

Um levantamento sobre o perfil profissional de graduados em Informática Biomédica de Porto Alegre, Brasil

Gabriela de Meneses Pinto[1], Luciano Costa Blomberg[1] ✉

ORCID: 0009-0004-9179-1131 · 0000-0002-1649-9315

[1] Federal University of Health Sciences of Porto Alegre, Porto Alegre (RS), Brazil.

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CORRESPONDING AUTHOR
Luciano Costa Blomberg
lucianocb@ufcspa.edu.br

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ABSTRACT

Objective: To analyze the professional profile of graduates in the Biomedical Informatics undergraduate program from the Federal University of Health Sciences of Porto Alegre, focusing on their integration into the job market. **Method:** Descriptive study with a quantitative approach, using an online questionnaire for data collection. An attempted census was conducted, including 52 graduates, representing 91.2% of the total of 57 graduates between 2019 and 2024. **Results:** At the time of data collection, 40 (77%) of the 52 respondents were employed, of whom only 9 (22.5%) were working in areas related to Biomedical Informatics. **Conclusion:** The undergraduate program in Biomedical Informatics from the Federal University of Health Sciences of Porto Alegre provides students with a solid foundation for professional practice. However, strategic efforts are needed to ensure that graduates remain engaged in roles related to their field of study.

Keywords: Informatics; Surveys and Questionnaires; Job Market.

RESUMO

Objetivo: Analisar o perfil profissional de graduados do curso de Informática Biomédica da Universidade Federal de Ciências da Saúde de Porto Alegre, com foco na sua inserção no mercado de trabalho. **Método:** Pesquisa descritiva, com abordagem quantitativa, utilizando questionário online para a coleta de dados. Uma tentativa de censo foi realizada, abrangendo 52 graduados, representando 91,2% do total de 57 graduados entre 2019 e 2024. **Resultados:** À época da coleta de dados, 40 (77%) dos 52 respondentes estavam empregados, sendo que apenas 9 deles (22,5%) atuavam em áreas relacionadas à Informática Biomédica. **Conclusão:** O curso de graduação em Informática Biomédica da Universidade Federal de Ciências da Saúde de Porto Alegre proporciona aos alunos uma base sólida para o exercício profissional. No entanto, são necessários esforços estratégicos para garantir que os graduados permaneçam engajados em funções relacionadas à área de formação.

Descritores: Informática; Inquéritos e Questionários; Mercado de Trabalho.

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1 INTRODUCTION

The generation of knowledge in the medical field originally relied on paper-based records, encompassing both scientific articles and patient documentation. However, mid-20th-century advancements in computer technologies led to a gradual shift from traditional paper records to digital systems. By the 1960s, a growing number of researchers conducting advanced biomedical studies had begun to incorporate computer systems into their work. At that time, there was considerable uncertainty over how to define the application of computing within the field of biomedicine [1].

The term "Medical Informatics" emerged in the 1970s, derived from the French term for computer science, "*informatique*" [1]. The word was combined with medicine to define the intersection of computing and healthcare. Over time, the field inspired the development of Biomedical Informatics (BMI), which has a broader scope, integrating other areas of health and biological sciences, beyond traditional medical applications. BMI gained substantial momentum in the 1990s, driven by initiatives such as the Human Genome Project, which highlighted the critical role informatics methodologies serve in biomedicine [2].

Over the past two decades, the increasing demand for professionals with interdisciplinary expertise in healthcare and informatics has contributed to the establishment of undergraduate programs in BMI and other fields related to digital health.

In Brazil, BMI was first introduced as an undergraduate program in 2003 at the Ribeirão Preto School of Medicine, part of the University of São Paulo (USP). Subsequently, the Federal University of Paraná (UFPR, Universidade Federal do Paraná) launched its own undergraduate program in 2011, followed by the Federal University of Health Sciences of Porto Alegre (UFCSPA, Universidade Federal de Ciências da Saúde de Porto Alegre) in 2015. These undergraduate programs have played a pivotal role in training professionals with the skills required to work in digital health. Notably, digital health involves the use of information and communication technologies to improve healthcare delivery, enhance patient engagement, and facilitate the collection and analysis of health data for better decision-making [3].

Despite the innovative nature of these fields, the career trajectories of BMI graduates specifically remain an underexplored area of research. To the best of our knowledge, there is just one study in Brazil about the professional outcomes of BMI graduates, conducted by Macedo *et al.* [4]. In that study, researchers analyzed data about 145 USP alumni using the application of a structured questionnaire to survey all Biomedical Informatics graduates who had completed their degrees by July 2015. The findings of the study revealed that 52% of the graduates were working in BMI, while 38% were employed outside the BMI field (but worked in other IT subfields), and 3% were unemployed. Two additional studies conducted outside Brazil have also examined the career outcomes of BMI-related graduates.

Knaup *et al.* [5] investigated the professional trajectories of the first Medical Informatics graduates from the University of Heidelberg and the University of Applied Sciences Heilbronn, in Germany. The study employed an observational design, using a questionnaire distributed to alumni, and obtained responses from 446 graduates who had completed their studies by March 31, 2001. Among them, 43% were working in medical informatics, 51.4% were employed working outside medical informatics, but within other informatics subfields and 5.5% were employed in fields unrelated to informatics.

Ammenwerth and Hackl [6] analyzed the professional profiles and career paths of 175 graduates of the biomedical informatics bachelor's and master's programs at the Tyrolean university UMIT between 2001 and 2013. The study analyzed data obtained through the application of a survey, which received responses from 170 BMI graduates. The findings of the study revealed that among the 88 master's graduates, 68% were working as biomedical informaticians, 9% as medical doctors, 17% as informaticians outside the healthcare sector, and 6% in other areas.

Nearly a decade after the study conducted by Macedo *et al.* [4] in Brazil, an opportunity arose to expand this inquiry by examining the experiences of UFCSPA graduates, providing a comparative perspective.

This study explores the professional and academic trajectories of UFCSPA graduates in the BMI undergraduate program. A survey collected demographic information, details on the graduates' academic and career paths, and their perspectives on the program. Accordingly, the study seeks to answer the following research question: What is the professional profile of the graduates of the Biomedical Informatics program from UFCSPA? The findings aim to identify strengths and areas for enhancement, contributing to the continuous improvement of the educational program.

2 METHODS

Considering the purpose of this study, which is oriented toward gaining a better understanding of the professional characteristics of graduates from the Biomedical Informatics program from UFCSPA, this section presents the methodological approach adopted for the research, including the research design, target population, sampling strategy, data collection instruments, research themes, data collection procedures, and methods used for descriptive analysis.

2.1 Research Design

The research was structured as a descriptive study, with a quantitative approach. The descriptive component aims to identify and detail the professional profile of graduates in BMI from UFCSPA, providing a comprehensive overview of their fields of practice and career trajectories. The quantitative approach enables the structured collection and statistical analysis of numerical data, providing a solid basis for the interpretation of results and the extrapolation of findings to broader contexts [7].

2.2 Survey Method

Data collection was conducted through a survey, a research method designed to produce statistical insights into a target population. This is a research method that enables quantitative descriptions of the population under study through the data collected. It allows the identification of patterns, trends, and relationships between variables based on numerical data. However, it is important to consider that, while the statistical method offers a high level of precision, it should be regarded as an approximation with a high probability of accurately representing reality rather than an absolute truth [7].

2.3 Target Population

The target population of this study comprised graduates in BMI from UFCSPA, ranging from the first cohort that began in 2015 to those who completed the program at least six months before the survey was conducted. Graduates who failed to meet this criterion were excluded, as it is understood that a period of six months may be insufficient for entering the job market and developing a strong professional profile. According to Di Meglio and Camiña [8], most professionals require between three and nine months to establish themselves in the workforce and gain relevant experience. Therefore, the exclusion of these students seeks to ensure that the data collected more accurately reflects the professional reality of the graduates. An attempted census approach was employed, in which all 57 eligible graduates between 2019 and 2024 were invited to participate. A total of 52 graduates responded, representing a response rate of 91.2%.

2.4 Research Themes

The survey questions were developed based on previous studies by Macedo *et al.*, Knaup *et al.*, and Ammenwerth and Hackl [4-6]. Additional questions were included to investigate the demographic characteristics of graduates. Understanding factors such as individuals' backgrounds is important, as these elements are known to influence career trajectories [9]. These questions aim to provide a broader perspective on how diverse experiences and contexts shape professional outcomes in the field. The topics addressed include the following:

- **Demographic data:** Age, gender, ethnicity, socioeconomic background;
- **Academic experience:** Whether or not there was continuity in higher education, participation in undergraduate research, perception of academic support;
- **Professional trajectory:** Area of activity, positions held, companies in which they work, description of activities performed;
- **Satisfaction and perception of the BMI undergraduate program:** Satisfaction with the training received, perception of the usefulness of the subjects.

2.5 Data Collection Instruments

Data collection was conducted using an online form created with Google Forms. This platform was chosen due to its widespread use in academic settings, its cost-free nature, and its ability to support a variety of question formats, allowing for the creation of a robust and user-friendly questionnaire [10]. Once the themes and issues of interest were defined, the Google Forms survey was structured with 40 questions, including 10 open-ended questions, 6 dichotomous questions, 22 multiple-choice questions, and 2 Likert-scale questions. Among these 40 items, three questions addressed i) participant identification, ii) consent to participate in the study, and iii) exclusion-criteria screening. An open field for comments was also provided to allow participants to share additional information they deemed relevant to the research and not addressed in the structured questions.

2.6 Data Collection Procedures

The list of graduates was obtained from the open data section of the UFCSPA website, and the corresponding institutional email addresses were later matched using the available classroom records. The survey was then distributed to all graduates via email in November 2024, through a link to a Google Forms survey. The informed consent statement was presented within the online form, positioned at the beginning of the document, followed by a dichotomous question that required respondents to indicate whether they agreed to participate in the study. The informed consent form described the purpose and method of data collection and ensured that the data would be kept confidential. The Human Research Ethics Committee of the Federal University of Health Sciences of Porto Alegre approved the study. The Certificate of Submission for Ethical Review associated with this research is numbered 83666824.3.0000.5345 and was approved under ethical opinion 7.214.913. Ethical approval ensures that all research procedures comply with established ethical standards, safeguarding participants and upholding the

ethical integrity of the study, in accordance with Resolution 466/12 [11] of the Brazilian National Health Council and the guidelines outlined in the Declaration of Helsinki.

Participants were given a two-week window to complete the form. After data collection, the responses were exported to a .csv file and edited to remove the email address column, which contained identifying information, in order to ensure anonymization.

2.7 Procedures for Descriptive Analysis

After completing data collection, the survey responses were analyzed in several steps. The initial phase involved preprocessing the data to ensure it was clean, quantifiable, and measurable, providing a solid foundation for subsequent analysis. Descriptive statistical techniques [10] were applied to quantify, analyze, and interpret the data. Tools such as Power BI and Google Sheets were utilized to facilitate this process and prepare the research results. The findings are presented primarily through graphical visualizations, with textual descriptions for added clarity. The use of visual data representations was chosen to enhance comprehension and support the identification of potential patterns during the interpretation of results.

3 RESULTS

An attempted census was conducted, including 52 graduates from the BMI undergraduate program from UFCSPA, representing 91.2% of the total number of graduates between 2019 and 2024. Compared to related studies, the number of BMI graduates is notably smaller than that of other universities [4-6].

3.1 Demographic Data Analysis

Of the participants, 65% identified as male and 35% as female. Their ages ranged from 23 to 56 years in 2024, with an average age of 28.3 years. The standard deviation of age was 5.7 years, reflecting moderate variability within the sample. Another demographic characteristic analyzed was ethnicity. Based on the classification developed by the Brazilian Institute of Geography and Statistics (IBGE, Instituto Brasileiro de Geografia e Estatística) [12], the responses were concentrated in the following categories: 92% of the participants identified as white, 4% as mixed-race, and 4% as black. Regarding residence, most graduates live in the state of Rio Grande do Sul, Brazil, specifically in the city of Porto Alegre. Notably, 12% of the graduates live abroad, most of them in Europe. Over half of the participants graduated between the ages of 18 and 24.

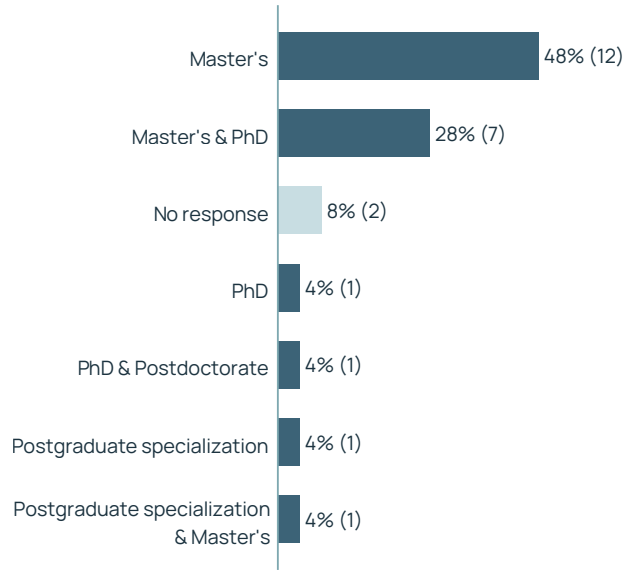
In Brazil, there are several types of affirmative actions for university admission. Almost half of the respondents (44%) entered university through overall admission, via open competition. Meanwhile, 38% were admitted through affirmative action policies for public school students, 4% through policies aimed at students from low-income families, 2% through policies for black, mixed-race, or indigenous individuals, and for 8% there was intersectionality regarding affirmative action policies. Besides, 4% of the students were accepted into university through graduate admission.

3.2 Academic Experience

Before graduating from the BMI undergraduate program, 11 respondents (21%) had already earned another undergraduate degree. More than half of them (55%) were obtained from technical and vocational programs related to IT, 27% were bachelor's degrees in health sciences, and 18% were programs or degrees in unrelated fields. The most common duration for completing the BMI undergraduate program was five years, with approximately half of the 52 respondents graduating within this period. About 31% of graduates finished the program within four years (the expected duration of the curriculum), while 15% graduated in six years.

The university provides several undergraduate research opportunities for students to participate in. The graduates were asked about their participation in three different types of research projects: scientific initiation program (IC, Iniciação Científica), technology and innovation initiation program (ITI, Iniciação Tecnológica e Inovação), and teaching initiation program (PID, Programa de Iniciação à Docência). Among the 52 survey respondents, 82% had participated in at least one research project during their BMI undergraduate program. Additionally, approximately 19% of respondents received some form of financial assistance from the university, including transportation, food, housing, or retention grants.

Figure 1. Distribution of Postgraduate Education Levels among Alumni

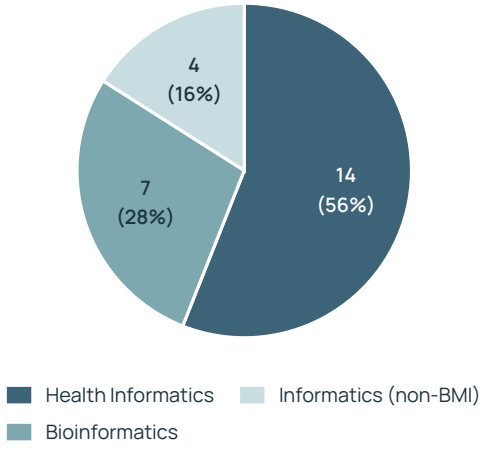


Source: Prepared by the authors (2026).

The survey also explored whether graduates pursued postgraduate education. Among all survey respondents, 25 reported being currently enrolled in or having completed a postgraduate program. Within this subgroup, the distribution of postgraduate pathways varied: 48% were pursuing or had completed a Master's degree, 28% had completed a Master's degree and were pursuing or had obtained a doctoral degree, and 4% were pursuing or had completed a PhD without previously obtaining a Master's degree. A smaller proportion reported involvement in postdoctoral training or specialization programs, while some respondents did not provide information regarding their postgraduate education (Figure 1).

Among the 25 graduates who pursued postgraduate education, a substantial proportion of postgraduate research activities were related to BMI (21 graduates; 84%). More than half of these graduates (56%) were focused on Health Informatics research, 28% were engaged in Bioinformatics, and 16% pursued research in Informatics areas unrelated to health (non-BMI) (Figure 2). The graduates are distributed across 14 different educational institutions. Most are enrolled in institutions based in Porto Alegre, with UFCSPA and the Federal University of Rio Grande do Sul (UFRGS, Universidade Federal do Rio Grande do Sul) accounting for nearly half of the total postgraduate enrollments.

Figure 2. Research Fields among Alumni Pursuing or Having Completed Postgraduate Education

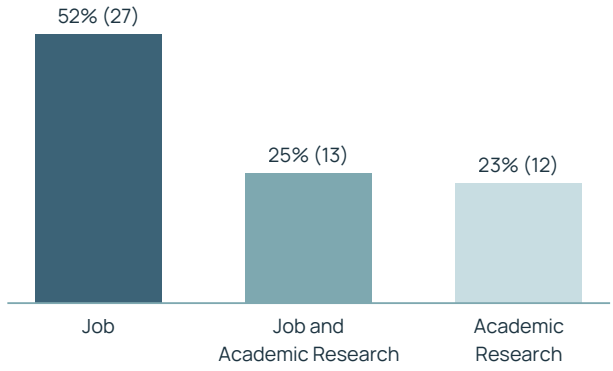


Source: Prepared by the authors (2026).

3.3 Professional Trajectory

Similarly to the aforementioned results, related to previous degrees, among all survey respondents, 15 (28.85%) had prior jobs or careers before graduating in BMI. Slightly over half of them (53%) were employed in IT roles, 27% in the health sector, and 20% in unrelated fields. Nearly 39 (75%) of graduates participated in non-curricular internships during their studies, with most of these internships focusing on health informatics and informatics in non-BMI areas. Additionally, 27 (51.92%) of the 52 respondents held jobs during their undergraduate program: 56% worked in informatics outside the health field (non-BMI), 22% in Health Informatics, and 22% in other areas. Regarding their current professional status, 40 (77%) of the 52 respondents were actively employed. Among all respondents, 13 (25%) combined professional activities with academic research, while 27 (52%) were exclusively engaged in professional activities. Additionally, 12 (23%) were dedicated exclusively to academic research. Notably, none of the graduates lacks an occupation in some way (Figure 3).

Figure 3. Distribution of Work and Study among Graduates



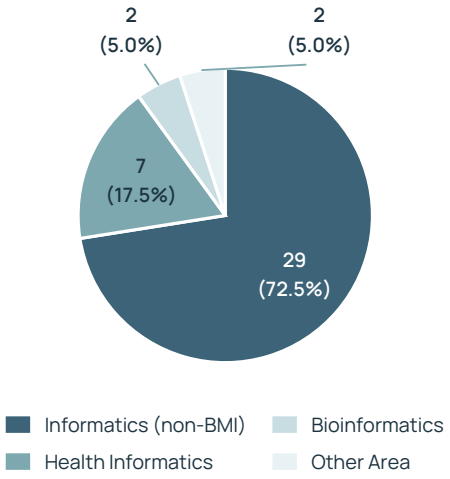
Source: Prepared by the authors (2026).

Almost half of the survey respondents (48%) secured jobs before obtaining their degree. Meanwhile, 15% took at least six months to find employment, another 15% have not yet entered the job market, and the remaining graduates are distributed as follows: 10% took over two years, 6% took between six months and one year, and 6% took between one and two years to secure a job. Currently, among the 40 employed alumni who responded to the survey, 29 (72.5%) work in informatics (non-BMI), 9 (22.5%) work in BMI-related fields (Health Informatics and Bioinformatics), and 2 (5%) work in fields outside informatics (Figure 4). The most common job titles include data analyst, software engineer, and software developer. Frequently mentioned activities include the development of data pipelines, the creation of interactive dashboards, back-end development, full-stack development, data management, project management, and teaching. Editor's note: since the ranges add up to 100%, the 15% correspond to less than 6 months.

Among the 40 employed respondents, the private sector was the primary employment sector, with 30 (75%) working in this domain. The remaining 10 (25%) were evenly distributed between the public sector and the third sector. The distribution of fields of work is as follows: 30 (75%) in business, 5 (12.5%) in education, 3 (7.5%) in health, and 2 (5%) in nongovernmental organizations (NGOs). Regarding work arrangements, a substantial shift occurred during the COVID-19 pandemic, when many companies were compelled to

embrace remote working. Among graduates in the BMI undergraduate program, 18 (45%) currently work in a hybrid model, 17 (42%) are fully remote, and only 5 (13%) are entirely office-based.

Figure 4. Distribution of Fields of Work Among Employed Graduates

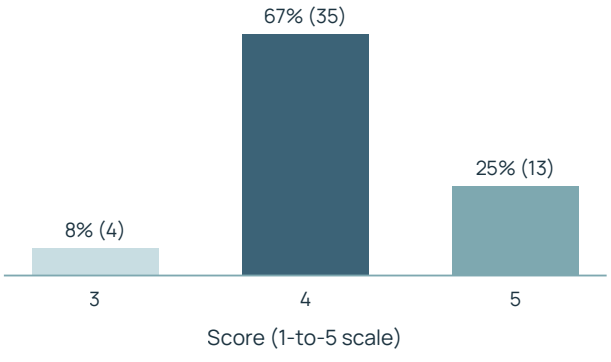


Source: Prepared by the authors (2026).

3.4 Satisfaction and Perception of the Program

The quality of education was assessed on a scale from 1 to 5, where 1 = very bad, 2 = bad, 3 = regular, 4 = good, and 5 = excellent. Among the 52 graduates interviewed, 35 (67%) rated the quality of education as "good," 13 (25%) considered it "excellent," and 4 (8%) rated it as "regular" (Figure 5). No alumni selected the categories "bad" or "very bad" for the quality of the BMI undergraduate program.

Figure 5. Perception of the Quality of Education (1-to-5 Scale)



Source: Prepared by the authors (2026).

The most relevant disciplines for their careers in the curriculum, as perceived by the graduates, were those related to data science, software engineering, and object-oriented programming. Conversely, the least relevant subjects for the alumni were those in the human and social sciences areas, along with a few specific classes in the biological and health sciences fields. The graduates were also asked about their perception of institutional support during their studies. Among the 52 respondents, 21 (40%) indicated that they "always received support," 16 (31%) received "plenty of support," 14 (27%) received "moderate support," and 1 (2%) received "little support." Responses were based on a 5-point scale, where 1 = received no support, 2 = received little support, 3 = received moderate support, 4 = received plenty of support, and 5 = always received support.

4 DISCUSSION

The typical demographic profile of graduates shows low ethnic and gender diversity compared to the Brazilian population [12], a pattern commonly observed in Science, Technology, Engineering, and Mathematics (STEM) fields [8]. This trend reflects broader social and structural factors that influence access to and retention of minorities in these areas. Addressing this imbalance through targeted policies can enhance both the inclusivity and the innovative potential of the field. A notable finding for a relatively new undergraduate program is the overwhelmingly positive feedback from graduates regarding the quality of teaching, indicating that the program provides valuable education. This aligns with the findings of previous research on the same topic [4,5].

An interesting observation is that only 31% of students complete the BMI undergraduate program within the designated four years, while the remaining 69% take one to three additional years to graduate. This delay may be attributed to the high proportion of students balancing jobs (half of the students are employed) or internships (75% of the graduates) alongside their studies, which limits their ability to focus solely on academic progress. This highlights an important characteristic of the profile of the graduates: they divide their time between academic responsibilities and professional activities.

It is important to acknowledge the difference in the number of graduates among universities. UFCSPA has a notably lower number of graduates compared to the other universities that offer the BMI undergraduate program. While the dropout rates for bachelor's degrees in STEM fields are generally higher than in other programs [13], the retention rate in UFCSPA's undergraduate program appears to be particularly high. This could be attributed to the students' profile, as the program's full-time schedule may limit opportunities for students to balance their studies with work, thereby prolonging their time in the program. This hypothesis is put forward, but there is no clear evidence on this matter, indicating that further research is needed.

Table 1. Comparison of Fields of Work between Studies

Studies	Start Year	BMI-related fields (%)	Informatics non-BMI (%)	Other (%)
Ammenwerth and Hackl (Austria) [6]	2001	68%	17%	13%
Macedo *et al.* (Brazil) [4]	2003	52%	38%	7%
Pinto and Blomberg (Brazil)	2015	22.5%	72.5%	5%

Note: In the two previous studies, percentages were calculated using the total number of respondents in each study, and research activities were classified as BMI-related work. In the present study, the occupational distribution was calculated exclusively among graduates who reported holding employment positions (n = 40). Postgraduate research activities were not classified as employment positions. Therefore, the percentages are not directly comparable across studies, as different denominators and classification criteria were used. In addition, the occupational categories in the present study refer only to employed graduates and do not represent the entire survey sample (n = 52).

Source: Prepared by the authors (2026).

One of the key findings of this study is the favorable job situation for graduates, with 77% currently employed. Among those employed, 95% are working in informatics, including both non-BMI fields (72.5%) and BMI-related fields (Health Informatics (17.5%) and Bioinformatics (5%)), a result closely aligned with previous research findings [4-6]. The most relevant subjects in UFCSPA's undergraduate program are nearly identical to those found in a previous study [4]: data science disciplines, software engineering disciplines, and object-oriented programming. During the analysis of the results, it was possible to note that the most common jobs are directly related to the most relevant classes, as perceived by the graduates. However, there are notable differences in the fields of work between this paper and previous findings in the related work. Although most graduates pursue careers in Informatics outside the healthcare sector (non-BMI) or in other fields (77.5% combined), only 22.5% are employed in areas directly related to BMI, such as Health Informatics and Bioinformatics. The proportion of graduates from UFCSPA working in BMI and non-BMI fields in comparison with previous research is shown in Table 1.

The comparatively lower percentage of graduates working in BMI may reflect the limited opportunities available in Rio Grande do Sul, where most graduates and the companies they work for are based. In contrast, the state of São Paulo, where USP is located, offers a higher concentration of innovative job opportunities, including those in BMI. The same hypothesis is applicable to the studies in universities in Europe [5,6]. It is also important to consider that the present study chose not to count postgraduate education or research involvement as job positions in the BMI field, which contributes to the lower percentage observed when compared to other studies [4-6]. Jobs in research institutions are more frequent abroad, but such a feature does not reflect the predominant reality in the local context where this study was conducted.

The remaining graduates who are not currently on the job market are pursuing postgraduate education, representing approximately 23% of the total respondents. An important finding of this study is that the BMI undergraduate program provides many opportunities for its graduates, emphasizing that all of them are actively engaged in academic pursuits, professional activities, or both. With regard to sectors, most graduates work in the private sector, similarly to the findings of the study conducted by Macedo *et al.* [4].

Interestingly, in both academic and professional matters, the area of Bioinformatics is frequently less present. There could be different causes for these circumstances, such as a lack of opportunities in this area or just a general lower interest from the graduates in following the career/academic path of a bioinformatician. There is no clear evidence on this matter; hence, it should be studied in future research. These observations underline areas for improvement in the BMI undergraduate program at UFCSPA. Enhancing the visibility and recognition of the field, fostering targeted job opportunities, and reevaluating the integration of diverse disciplines could substantially influence the professional trajectory of its graduates.

5 CONCLUSIONS

This research study shed light on several previously unknown aspects of the professional profile of graduates in BMI from UFCSPA. A key finding of this study is the strong job market prospects for graduates, particularly in the field of IT. Despite providing students with an interdisciplinary training that integrates health sciences and IT, the curriculum prepares graduates to work in areas beyond biomedical informatics.

Nearly half of the respondents (25/52; 48%) are pursuing or have completed advanced degrees, with the majority conducting research in BMI. This highlights the prominence of the field in research opportunities. The program itself is innovative and relatively new, in both academia and the job market, offering various opportunities to students during their studies and after they earn their bachelor's degree.

The data collected through the survey will serve as a valuable legacy for the BMI undergraduate program. Insights from alumni feedback can support curriculum revisions and address relevant issues, such as the low engagement in the bioinformatics area. When

comparing UFCSPA's undergraduate program with previous work on the same topic [4-6], we observed many similarities and a few differences in the responses. Further studies will be essential to fostering growth in the field and ensuring the continued evolution of biomedical informatics education and its application. Additionally, undergraduate programs in BMI have contributed to the development of a qualified workforce capable of supporting the advancement of digital health applications.

Regarding the limitations of the study, we can highlight the smaller number of graduates compared to other studies analyzed. Although different time frames were considered, there was no further analysis of the proportion of graduates relative to the number of seats offered. In the case of UFCSPA, it is known that, taking only regular admissions into account, 280 seats were offered between 2015 and 2021, with 57 graduates by the beginning of the 2024 academic year, which highlights new opportunities for investigations related to academic attrition. Additionally, it is important to emphasize the need for adjustments in the survey to allow for the inclusion of cases in which research activities constitute a work position. Although less frequent, some respondents expressed doubts in this regard. Finally, the absence of questions involving voluntary tutoring, as well as the difference between participation in paid and unpaid institutional programs, was also pointed out, which we likewise consider a limitation of this study.

Author contributions. The authors contributed equally to all stages of the article: conception and design of the study; data collection, analysis, and interpretation; drafting and critical revision of the manuscript; and approval of the final version.

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Use of artificial intelligence. The authors declare that no AI tools were used for any purpose.

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EDITORIAL NOTES

The Journal of Health Informatics is a scientific journal maintained by the Brazilian Society of Health Informatics (Sociedade Brasileira de Informática em Saúde), a non-profit scientific association dedicated to the development of Health Informatics and Digital Health in Brazil. The editorial process is conducted with scientific independence, free from institutional, commercial, or sponsor interference, and follows international best practices in publication ethics.

This article was double-blind peer reviewed by specialists in the field. The editorial team used artificial intelligence tools, under human supervision, in the initial screening, in checking the text, references and numbers and, when needed, in redrawing figures, charts and tables, which the authors approved in the proof. The tools and safeguards are described in the journal's Policy on the use of artificial intelligence. Editorial decisions were made by people.

