



Biomedical Professionals in Brazil: the need and training of human resources for health development

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ABSTRACT

Introduction: The undergraduate course in Biomedical Sciences has existed in Brazil since 1966. It has expanded strongly in the last two decades and is responsible for training professionals to diagnose and research the causes, effects, and pathological mechanisms of diseases that affect the population. Even after decades of implementation and considering the reasons that led to the creation of the course, the evaluation in which areas these professionals are working is still incipient. **Objective:** Our aim is to know if the Biomedical Sciences graduates are being absorbed by the market job and in which areas. **Methods:** The present work is a retrospective cross-sectional observational study, based on the data of the students who had graduated in the Federal University of the Triangulo Mineiro, Brazil, from the first class of the course in 2003, until the second half of 2018. **Results:** The study has shown that the course of Biomedical Sciences of a Federal institution in Brazil has low evasion and that most of the graduates migrated to post-graduation (62.3%). Moreover, the majority of the professionals are located in the Southwest region of the country and most of them work in one of the specific areas linked to the course (70.3%). In addition, these professionals are more prone to ingress in the academic area. **Conclusion:** These findings demonstrate that, despite being disproportionately distributed in the country, there is still demand for these professionals and clearly indicate the importance of the Biomedical Sciences egresses to teaching and research in Brazil.

Keywords: Biomedical Sciences, biomedical professionals, federal university, graduates.

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1. INTRODUCTION

Considering the skills in vocational training, the human resources sectors always ask for the efficiency in the training process and the qualification in the university environment in which the candidate was trained (GONDIM, 2002). The Brazilian growth in teaching, scientific research and technology has been consolidating in the last decades, showed by the increase in the number and quality of universities and research centers (COSTA & SILVA, 2019; SUZIGAN & ALBUQUERQUE, 2011). This fact is based, principally, with the quality of the formed professionals (GUIMARÃES, 2004; GONDIM, 2002). Among the courses offered in Brazil that are directly involved in the training of human resources in health, we can highlight the Biomedical Sciences course. It has begun in 1966, but expanded in number and quantity of students in public and private universities in the last 20 years (CAMPOS, 2006; HADDAD, 2009).

According to the Federal Council of Biomedical Sciences (Conselho Federal de Biomedicina, CFBM), the course was initially designed “to train specialized

high education teachers to work in the basic sciences”, in order to teach the disciplines to all health courses, such as for example, medicine and nursing, as well as excellent researchers capable of acting and guiding the scientific research produced at the country (CONSELHO FEDERAL DE BIOMEDICINA, 2019a). The biomedical profession was regulated at 1979 (BRASIL, 1979), and since then, several Higher Education Institutions in Brazil have implemented the Biomedical Sciences course, especially in the two last decades (NORONHA, 2018). Until 2018, there were about 238 institutions offering the course in the country, among public and particular centers, and almost 50.000 professionals were registered at the regional councils (CONSELHO FEDERAL DE BIOMEDICINA, 2018; INEP, 2018).

Despite having an initial focus in the academic area, the course of Biomedical Sciences, over the years, established a place in others actuation sectors and today already enables the trained professional to work in about 35 qualifications. The qualifications officially regulated by the CFBM are: Clinical Analysis;

Biophysics; Parasitology; Microbiology; Immunology; Hematology; Biochemistry; Blood bank; Virology; Physiology; Public health; Radiology; Imaging (excluding interpretation); Bromatological Analyzes; Food Microbiology; Histology; Pathology; Cytology; Environmental analysis; Acupuncture; Genetics; Embryology; Human Reproduction; Molecular biology; Pharmacology; Psychobiology; Health Informatics; Pathological Anatomy; Toxicology; Extracorporeal Perfusion; Audit; Esthetics and Exercise physiologist. These qualifications must be obtained through curricular internships with a minimum workload of 500 hours. This vast field of biomedical activity therefore reaches areas of operational support for diagnosis, research, as well as research and teaching (CONSELHO FEDERAL DE BIOMEDICINA, 2019b).

Considering that the implementation of the course in Brazil is recent, it is important to ascertain if these biomedical professionals are being absorbed in the labor market and in which areas their presence is most important. Until now, there are no works correlating the characteristics of the biomedical professionals in Brazil and the major fields that recruits this people. The Federal University of the Triângulo Mineiro (Universidade Federal do Triângulo Mineiro, UFTM), in August 1999, started the undergraduate course in Biomedical Sciences, and since 2003 has been training professionals able to practice with responsibility collective health care, according to the Curricular Guidelines by Resolution No. 2/2003 of the Ministério da Educação - MEC (CONSELHO NACIONAL DE EDUCAÇÃO, 2003). The institution has been demonstrated excellency between the Biomedical Sciences schools in Brazil, and in the last years obtained high scores in the evaluations by the National Student Performance Exam (Exame Nacional de Desempenho dos Estudantes - ENADE) (ENADE, 2016). In this way, this study aims to evaluate and follow the professional profile of the graduates of the Biomedical Sciences course from UFTM, and thus understand how in recent years it allowed to these graduates to work in the health progress and help society. The present work is a retrospective cross-sectional observational study, based on the data of the students who had graduated from the first class of the course until the second half of 2018.

2. MATERIALS AND METHODS

2.1. Data collection

The present study was based on the data of the students who had graduated in the Biomedical Sciences course of UFTM, Brazil, from the first class of the course until the second half of 2018. The study included data about the years of 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2018. The information about the graduates (name and year of conclusion) was provided by the Department of Registration and Academic Control (Departamento de Registros e Controle Acadêmico, DRCA) of UFTM. The remaining information about the graduates was obtained through an analysis of the Lattes Curriculum (Platform Carlos Chagas, Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq). Other internet

network researches or personal contact in social media was conducted when the Lattes Curriculum data was not enough, such as LinkedIn™ social profile search. The following variables were analyzed: year of conclusion; current actuation area; Brazilian state and region where the graduate currently reside; designation of the graduate; relation of the current area of actuation with the Biomedical Sciences; Stricto Sensu post-graduation; and another degree in the curriculum.

2.2. Data analysis

The data obtained by the research tools were tabulated on the Microsoft® Excel software (Microsoft Corporation), classifying the graduates according to the variables mentioned in item 2.1. This information formed a database that was the source of all the tables and graphs presented in this paper. The graphs were plotted using GraphPad® Prism 7 software (GraphPad® Software).

3. RESULTS

3.1. Number of graduates of the Biomedical Sciences course of UFTM from 2003 to 2018

The final composition of the study, from 2003 to 2018, was 340 graduates. The variation in the number of graduates during the course's existence can be observed in Figure 1. In the year of creation, 1999, it was established the entrance of 10 students per semester, two semesters per year. However, in 2006, the course underwent a restructuring, where the number of participants increased from 10 to 20 students per semester. At 2003, the year of conclusion of the first class, up to 2011, an average of 16 students per year completed the course. In the following years, there was a progressive increase in the number of students, with an average of 28 students per year, until the last analyzed year (2018).

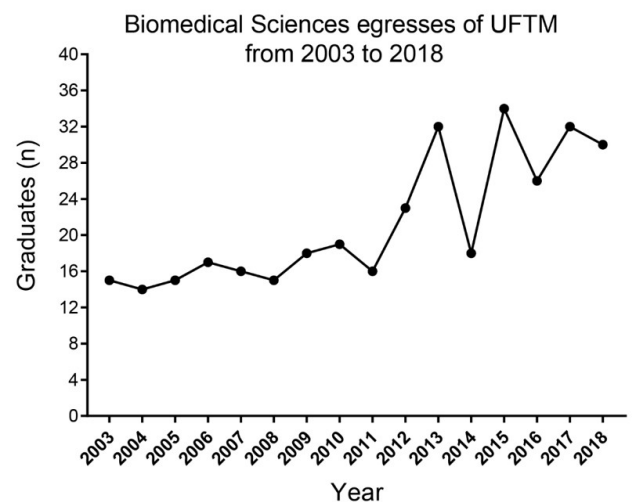


Figure 1. Graduates from the Biomedical Sciences course of UFTM from 2003 to 2018. In the year of creation of the course, in 1999, it was established the entrance of 10 students per semester, two semesters per year. In 2006, the course underwent a restructuring, where the number of participants was from 10 to 20 students per semester. Since then, there has been a progressive increase in the graduate's number, with an average of 28 students per year, until the last analyzed year (2018). n = 340.

3.2. Location of graduates by federal state and region

Regarding the location of the students by Federative State (Figures 2A and 2B), the majority of the egresses resides in the states of Sao Paulo (44%) and Minas Gerais (33%). Together, Pará, Rondônia, Rio Grande do Sul, Santa Catarina, Tocantins, Bahia, Paraíba, Mato Grosso, Rio de Janeiro, Paraná, Federal District and Goiás correspond to 9.7%. In addition, 3.2% of UFTM Biomedical Science graduates are in another country: Canada (2), United States (4), France (1), Netherlands (1), Ireland (1), Sweden (1) and United Kingdom (1). It was not possible to obtain information of the locality of 9% of the graduates. The distribution by federative region is presented in figures 2C and 2D. 78.2% of graduates are located in the Southeast, 4.7% in the Midwest, 2% in the South, 1.1% in the Northeast and only 0.8% in the North. 3.2% are currently in other countries, and from 9.7% of the graduates was not possible to obtain information.

3.3. Actuation area of the graduates

The actuation area of the graduates is presented in Table 1. Analyzing the distribution of the different careers of the biomedical professional, we observed that about 29.4% of the graduates have completed or are attending now on post-graduation studies, and 7.3% are now dedicated to teaching in higher education.

Still, 7% are biomedical candidates in public or private institutions, 3.5% sought specialization, followed by 3.2% who perform their functions in Clinical Analysis. In addition, as a rising actuation fields, we have the careers of esthete, criminal expert, laboratory technician and researcher, adding another 6%. The remaining biomedical professional careers make up 6% of the total number of graduates. 29.7% of graduates did not present information or do not work in areas related to biomedical sciences.

In order to understand if the graduate performances correspond to one of the 35 qualifications accredited by the CFBM, it was observed that 70.3% of the graduates are involved in activities that correlate with the formation of the course, while only 13.5% do not carry out related activities. It was not possible to obtain information for 16.2% of the graduates (Figure 3A). We also analyze the graduates who sought another graduation. About 83% did not do another graduation beyond the Biomedical Sciences course (Figure 3B). Graduates who have chosen to take a second undergraduate course make up 9% of the total. We observed that the vast majority of people who attended or attending another undergraduate degree chose another course within the health area such as Medicine and Nursery. We did not obtain this information for 8% of the graduates.

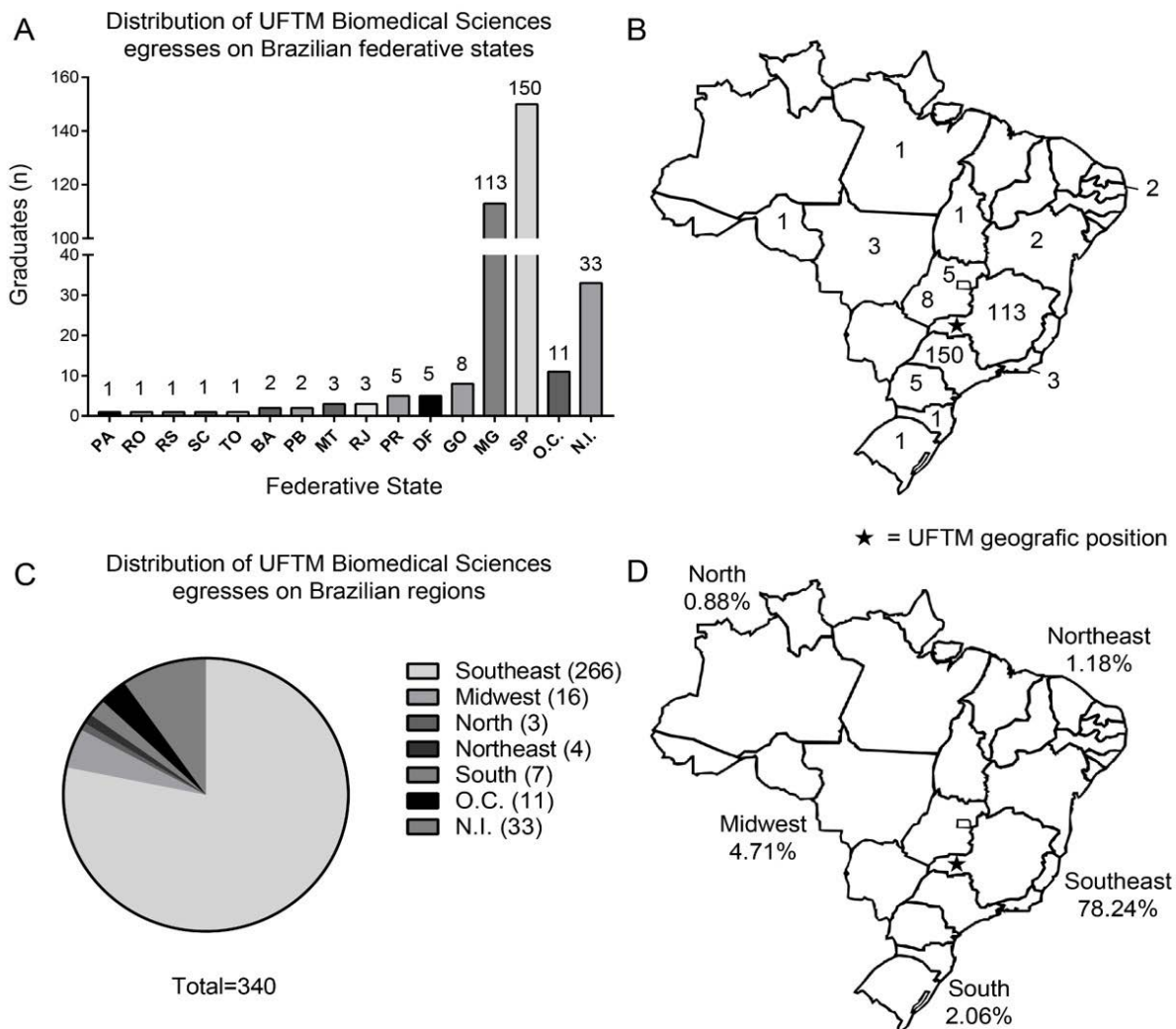


Figure 2. Location of egresses from the Biomedical Sciences course of UFTM by federative state and region. (A) and (B): Location of graduates by federative state. (C) and (D): Location of graduates by federative region. The star symbol in the Brazil map on (B) and (D) indicates in where region UFTM is located. *O.C. = other country; **N.I. = no information; n = 340.

Table 1. Occupation area of the graduates from the Biomedical Sciences Course - UFTM

Occupation area	Frequency	%
Postgraduate student	100	29.41
Post-doctoral position	27	7.94
Professor	25	7.35
Biomedical candidate	24	7.06
Specialization	12	3.53
Laboratorial Analysis	11	3.24
Esthete	5	1.47
Forensics Expert	5	1.47
Researcher	5	1.47
Laboratory Technician	5	1.47
Professional Enhancement	4	1.18
Technical Analyst	3	0.88
Trade Representative	3	0.88
Imaging	2	0.59
Perfusionist	2	0.59
Resident	2	0.59
Intern	2	0.59
ANVISA	1	0.29
Brazilian Air Force	1	0.29
Another Degree	19	5.59
Other areas (not related)	25	7.35
No Information	57	16.76
TOTAL	340	100

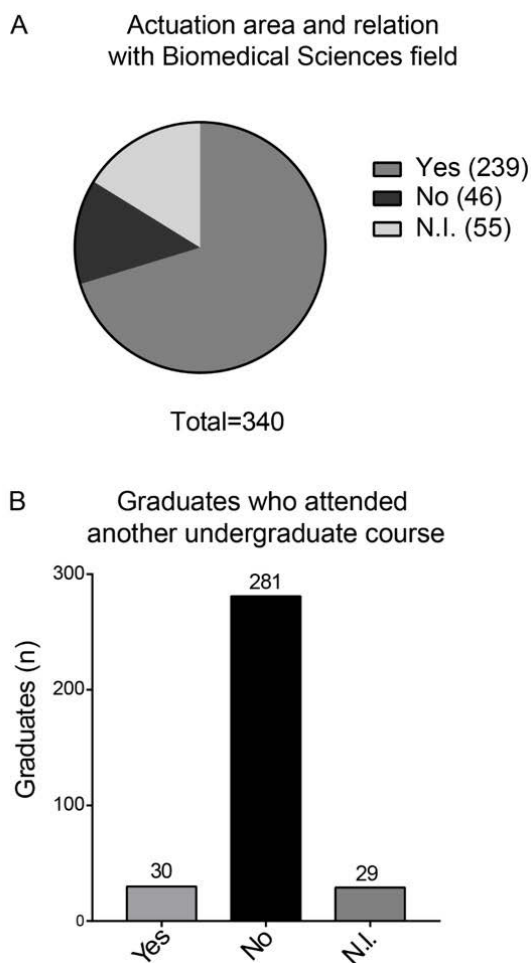


Figure 3. Actuation area in the Biomedical sciences field and another graduation. Actuation area and relationship with Biomedical Sciences field. (B) Graduates who attended a second graduation. We observed that the vast majority of people who attend or attended another undergraduate degree chose another course within the health area. *N.I. = no information; n = 340.

3.4. Academic carrier and Stricto Sensu post-graduation

Among the areas of outstanding performance observed, 39.4% of the graduates remained with a Bachelor's degree in Biomedicine, acquired by the UFTM undergraduate degree, which includes the qualification in Clinical Pathology (Clinical Analyzes). Nevertheless, a great demand of the graduating students by the post-graduation is noticed, since 24.4% and 20.2% are masters and doctors, respectively. 9.7% of graduates sought improvement after acquiring a bachelor's degree. We did not obtain this information from 6.1% of the graduates (Figure 4A). Due to the high rate of graduates who had a master or doctor's degree, we analyzed how many of them graduated Stricto Sensu. This result can be seen in Figure 4B. 62.3% of the graduates of the Biomedicine course have migrated to Stricto Sensu (MSc or PhD). Another 26% opted for other qualifications or did not specialize. This information was not obtained for 12.5% of the graduates.

In addition, we analyzed which were the main areas of activity of the graduates who opted for postgraduate studies (Figure 4C). Most of them obtained a master's or doctorate degree in Immunology (17.4%), followed by Genetics (9.9%) and Parasitology (9.3%). Moreover, alumni obtained titles in various areas related to health sciences, such as omics, physiological sciences or public health, showing that there is diversity in the areas of activity. Furthermore, this data shows a strong academic inclination of these graduates in Biomedical Sciences.

4. DISCUSSION

This study is important since there are no data in the literature showing the scenario of the biomedical professionals in Brazil, especially qualitative works showing how these professionals have been absorbed by the market job after their formation (CAMARGO, 2008). Initially, considering the number of graduates and vacancies available in the course, the number of graduates increased overtime, especially after the year of 2011. This data allows us to extrapolate the expansion of vacancies of the Biomedical Sciences courses in Higher Education Institutions of Brazil, as UFTM. The increase of students on the first decade of the 21st century happened not only in biomedical area, but also in other courses as well. The adhesion of UFTM and other universities to the entry mode via SISU (Sistema de Seleção Unificada - Ministério da Educação - Brazil) increased the number of graduates per year from 2014 and over the years. (MINISTÉRIO DA EDUCAÇÃO, 2014). As well, some social programs of access to the university, as PROUNI (Programa Universidade para Todos - PROUNI, Brazil), can extend this to a similar phenomenon observed in the private institutions (GUERRA, 2009). This could be related to the encouragement of public policies of participation and universalization of higher education that occurred in the last decade in Brazil, among other factors (CATANI AND HEY, 2007; INEP, 2017).

As a natural consequence of Biomedical Sciences courses expansion and an increase in the vacancy numbers, a greater number of qualified professionals have been formed since then, thus keeping health agents able to carry out their activities in the increasingly demanding

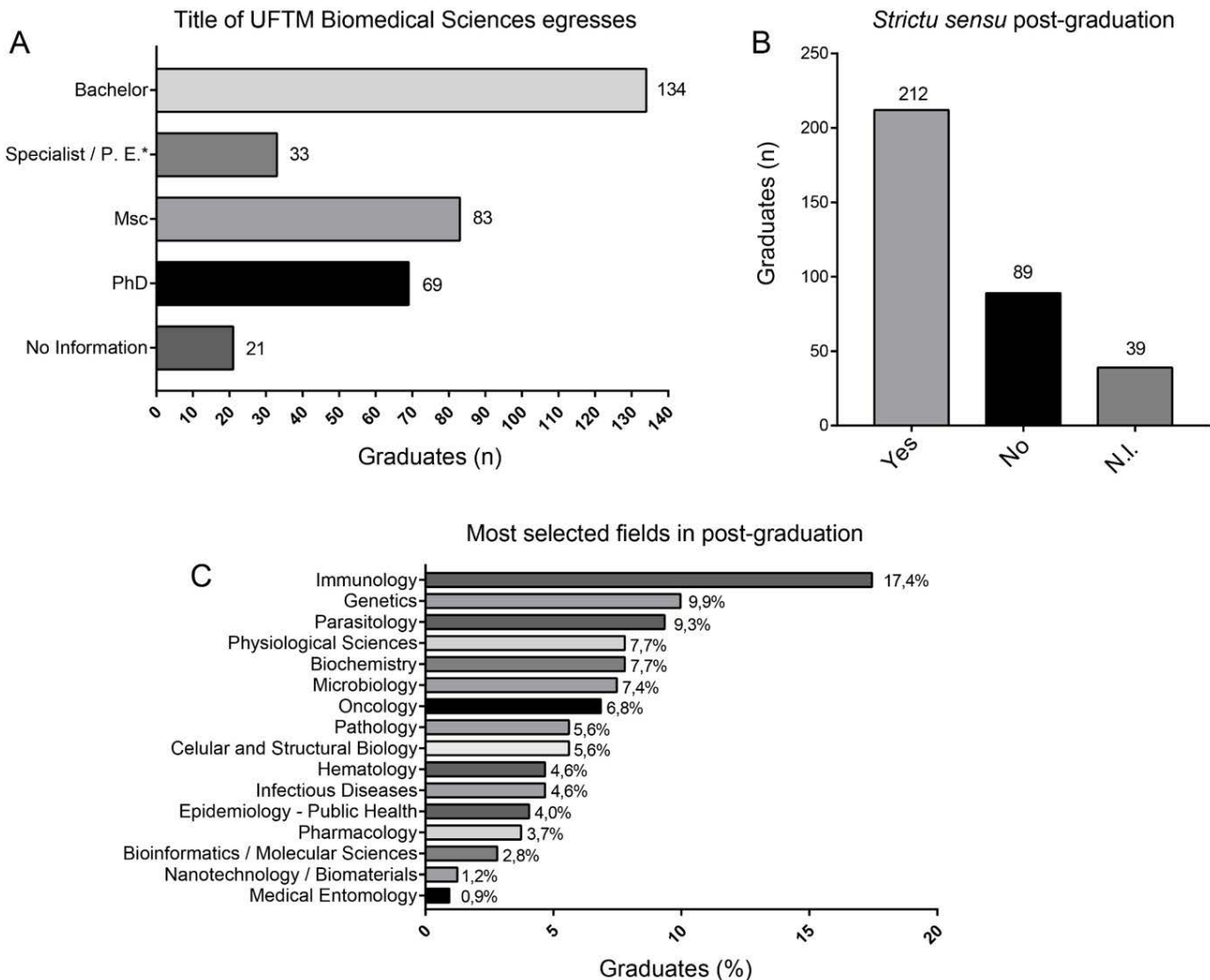


Figure 4. Graduates degree and Stricto Sensu post-graduation. (A) Qualification and title of the graduates from the UFTM Biomedical Sciences course. (B) Graduates who attended Stricto sensu post-graduation. (C) Main areas of activity in postgraduate studies. *P.E. = Professional enhancement; N.I. = no information; n = 340.

and competitive labor market. In addition, due to the high urbanization in the Southeast region, where are located the major centers of industrial and biotechnological, marketing and student investment in Brazil (FARIA, 2008), it is observed that the states of São Paulo and Minas Gerais receive the majority of the graduates on Biomedical Sciences from UFTM. Although these places are considered as technological centers in the health area, there occurs the most speculation for job vacancies and consequently greater competition. The fact of the increase in the number of graduates graduated over the years thus culminated in a saturation of some areas most sought after by professionals in the southeastern region, such as academia and laboratory analysis. This fact also evidences the need for the dissemination of skilled labor throughout the national territory, since there is an increasingly demand of biomedical professionals with professional experience among all the country. A similar situation was observed for professionals from other health areas, such as nursing and medicine (FROTA, 2020; FIGUEIREDO, 2019).

Another interesting point to observe is the actuation area of the graduates. Initially, the course was created to train teachers in basic health disciplines for other courses such as medicine, nursing and dentistry. Nevertheless, in

the present day, other fields have attracted the attention of biomedical professionals. Some fields, as forensics, esthetic and imaging analysis are on the rise and require skilled professionals with multidisciplinary training. The fact that the Biomedical Sciences graduates are involved in these and many others areas in vogue today reflects the need of these professionals in these new areas and validates their technical ability to compete in the labor market. Also, this expansion points to an effort by trained professionals and the professional council to increase the area of activity of biomedical professionals in Brazil. Considering also that the implementation of this course in Brazil is relatively recent, it is also interesting to think that graduated professionals in biomedical sciences are already employed in the respective areas to which the course gives access and acting in a range of different functions, around the country.

Although graduates in biomedical sciences show active performance in all fields that the course allows them, the profile of the professionals trained at the UFTM is consonant with the established origins: the academic area. This is corroborated with the higher percentage of graduates focused on these practices, supplying this educational and technological branch. It is interesting that this objective extends not only to

Brazil, since the graduates are distributed widely by other countries. Thus, a remarkable particularity in the profile of the graduates of Biomedical Sciences is the deep inclination for the Scientific Research and for high-level education. Together, the students that went to post-graduation represent 62.3% of all the graduates, showing that the graduates in Biomedical Sciences from UFTM give continuity to the scientific and academic specialization, even after the conclusion of the course.

In addition to the extensive training of masters and PhD's from the UFTM, an essential aspect that has been observed is the close relationship with the most diverse areas of Biomedical Sciences, since the professionals formed in UFTM actuates in almost all of the 35 habilitations that the course allows. Thus, it is important to emphasize that the traditional fields of action have been maintained with high quality, as in, the clinical analyzes, that with the technological development innovates in the diagnostic and preventive methods. The biomedical scientist from UFTM is not only restricted to clinical and research laboratories, but also in the military, the cardiac surgery room as a perfusionist, in multinationals, serving the major research centers through scientific representatives in the National Agency for Health Surveillance (Agência Nacional de Vigilância Sanitária – ANVISA), or acting as criminal experts, in the scientific police. However, the data explain that less than 10% of the graduates do not find in the professional career the innumerable options that Biomedical Sciences offer. This could be justified by the dense hourly load, or the few job opportunities offered in this area, especially in some regions.

5. CONCLUSION

In conclusion, this study demonstrates a correlation of the Biomedical Sciences egresses especially with the teaching and research areas in Brazil. Despite being disproportionately distributed in the country, there is still demand these professionals and clearly indicate the importance of them to the country development. In addition, it is important to notice this data reflects the reality of a single federal university in Brazil. This could not reflect the totality of the universities along the country, but it helps to infer how these professionals are being formed and absorbed by the job market. More studies, evaluating the conditions and reality of other universities in the biomedical sciences courses in Brazil are necessary. All these data, in conjunct, shows us that the course attends the specifications why it was created and the most of these graduates are now working on biomedical area or in related activities.

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CONFLICT OF INTEREST

The authors declares that there is no conflict of interest regarding the publication of this paper.

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