Influence of the COVID-19 pandemic in the academic production of researchers from public universities in the health area of the State of São Paulo, Brazil

Influência da pandemia de COVID-19 na produção acadêmica dos pesquisadores das universidades públicas do estado de São Paulo, Brasil

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ABSTRACT

Introduction: Knowledge about what may influence the academic output of researchers during the COVID-19 pandemic may help direct efforts to improve individual researchers' capacity and minimize the impact of other aspects on their academic output. **Aim:** To evaluate the influence of the COVID-19 pandemic in the academic production of researchers from public universities in the health area in the State of São Paulo. **Material and Methods:** Cross-sectional, online survey. Health researchers from public universities in the state of São Paulo were evaluated anonymously. Questionnaires addressed sociodemographic and professional characterization of researchers, their academic production and the scientific production related to research projects on COVID-19. Data were collected using the SurveyMonkey® program. Chi-square tests and logistic regression analyses were performed using IBM-SPSS v.21.0 software; significance was determined by $p<0.05$. **Results:** 568 researchers answered all questionnaires. Regarding research partnerships, 297 (50.51%) said they were negatively affected. 231 (39.29%) confirmed difficulty in obtaining financial support. The pandemic changed the way 91.1% of researchers deal with their work routine. The greatest workload of the research team was associated mainly with nurses (46.7%). Biologists have greater chance (OR=4.8) of encountering difficulties in relation to physicians, and researchers from UNIFESP (OR=2.75) are the ones who are more likely to encounter difficulties. FAPESP was the agency that most funded studies related to COVID. **Conclusion:** These findings reinforce the need to establish funding targets and research incentives, especially for early career researchers. Future studies are needed to determine the impact of the pandemic on researchers' scientific output over time.

Keywords: COVID-19, pandemic, researchers, action research.

RESUMO

Introdução: Conhecer o que pode influenciar a produção acadêmica dos pesquisadores durante a pandemia pode ajudar a direcionar esforços para melhorar a capacidade individual dos pesquisadores e minimizar o impacto de outros aspectos em sua produção acadêmica. **Objetivo:** Avaliar a influência da pandemia de COVID-19 na produção acadêmica de pesquisadores de universidades públicas da área da saúde do Estado de São Paulo. **Material e Métodos:** Pesquisa transversal, online. Pesquisadores foram avaliados anonimamente. Os questionários abordaram a caracterização sociodemográfica e profissional dos pesquisadores, sua produção acadêmica e a produção científica relacionada à COVID-19. Os dados foram coletados por meio do SurveyMonkey®. Testes qui-quadrado e análises de regressão logística foram realizados com o software IBM-SPSS v.21.0; a significância foi de $p<0,05$. **Resultados:** 568 pesquisadores responderam a todos os questionários. Sobre parcerias de pesquisa, 297 (50,51%) afirmaram ter sido afetadas negativamente. 231 (39,29%) confirmaram dificuldade em obter apoio financeiro. A pandemia mudou a forma como 91,1% deles lidam com sua rotina de trabalho. A maior carga de trabalho da equipe de pesquisa esteve associada aos enfermeiros (46,7%). Os biólogos têm maior chance (OR=4,8) de encontrar dificuldades em relação aos médicos, e os pesquisadores da UNIFESP (OR=2,75) são os que têm maior probabilidade de encontrar dificuldades. A FAPESP foi a agência que mais financiou estudos relacionados à COVID. **Conclusão:** Há uma necessidade de estabelecer metas de financiamento e incentivos à pesquisa, principalmente para pesquisadores em início de carreira. Estudos futuros são necessários para determinar o impacto da pandemia na produção científica a longo prazo.

Palavras-chave: COVID-19, pandemia, pesquisadores, universidades.

INTRODUCTION

Scientific and technological developments are fundamental to the growth of a country. Several countries, especially developed ones, have given special attention to scientific investment, seeking strategies to promote the growing increase of scientific investigations with potential practical applicability, regardless of the area of knowledge. The World Health Organization (WHO) encourages the use of scientific production in the decision-making process in the health field since it can provide managers with reliable and up-to-date information that can contribute to the planning and definition of public policies[1].

When evaluating the investment in research with funds from any source (governmental, private, and other), the average investment of the countries in the group of 20 (G20) is around 2.04% of GDP (Gross Domestic Product)[2]. Of the G20 countries, the countries with the highest investments are South Korea (~ 3.6% of GDP), Japan (~ 3.5% of GDP), the USA (~ 2.9% of GDP), and Germany (~ 2.8% of GDP). Brazil invests approximately 1.2% of its GDP in Science and Technology, with 55 to 60% of this important amount by the government[3].

In Brazil, the main sources of funding for research are the National Council for Scientific and Technological Development (CNPq), the Coordination for the Improvement of Higher Education Personnel (CAPES), and state foundations, such as the São Paulo Research Foundation (FAPESP), Minas Gerais Research Funding Foundation (FAPEMIG), Rio de Janeiro Research Funding Foundation (FAPERJ), among others. Of these, FAPESP stands out, distributing 19.8 billion Reais/year (2010 data) to researchers who can demonstrate scientific capability and innovative ideas[3]. Measuring the impact and scientific productivity of a researcher has practical implications for obtaining degrees and better academic positions to increase the chances of obtaining research funding[4, 5]. What objectively evaluates a researcher are his scientific publications in indexed journals, therefore, researchers are encouraged to publish in journals with a higher impact factor.

Several factors can influence the academic production of researchers, resulting in a huge disparity in terms of Brazilian scientific production concerning that of developed countries. Among these factors, administrative and infrastructure problems stand out, such as the lack of a clear distribution of responsibilities, with the consequent excessive dilution of decision-making processes, the unplanned growth of institutions, and the lack of adequate maintenance in laboratories[6]. Furthermore, a European study pointed to factors such as lack of funding, insufficient knowledge, lack of infrastructure and support, lack of technical support, lack of time, and lack of research training programs as the main general barriers to research in the field of, for example, Palliative Care[7]. Another similar study, also European, questioned the main difficulties encountered by health professionals in conducting research and found that in 80% of cases the main difficulty was time constraints caused by work overload[8].

In the current context, the pandemic of COVID-19 may have directly or indirectly influenced the academic production of researchers around the world, more specifically those from Brazil. Health researchers may have had greater influence such as lack of financial resources, restrictions in conducting research in locus (as in hospitals, for example), and mental health impacts, due to the high emotional, and workload placed on them during the pandemic.

Considering scientific production as a key element for the development of a country, knowledge about the factors that may influence the academic production of public university researchers in the health field at a time of global crisis due to COVID-19 can help direct efforts to improve the individual capacity of researchers and minimize the impact of other aspects on their academic production. Thus, the objective of this research was to evaluate the influence of the COVID-19 pandemic on the academic production of researchers from public universities in the health area in the state of São Paulo, Brazil.

MATERIAL AND METHODS

Study design

We developed a cross-sectional, online, anonymous survey.

Selection of researchers

It was defined to evaluate researchers in the health area from graduate programs of public

universities in the state of São Paulo, considering that they are the ones with a significant number of academic productions and some of these universities are considered the best in the country. A total of 2,638 researchers were identified. Of these, 810 are from the Universidade de São Paulo (USP), 390 from Universidade Estadual Paulista (UNESP), 496 from Universidade de Campinas (UNICAMP), 51 from Universidade Federal do ABC (UFABC), 127 from Universidade Federal de São Carlos (UFSCar), 649 from Universidade Federal de São Paulo (UNIFESP), 86 from Faculdade de Medicina de São José do Rio Preto (FAMERP), and 29 from Faculdade de Medicina de Marília (FAMEMA).

Eligibility criteria

Health researchers linked to graduate programs, master's and doctoral levels, from public universities in the state of São Paulo who used institutional e-mails or official social media of the respective programs were included. Researchers from other areas, not specific to health, were excluded.

Data Collection Instruments

All the participants completed the Researchers' sociodemographic and professional characterization questionnaire, Researchers' academic production questionnaire, and Researchers' scientific production evaluation questionnaire related to research projects on COVID- 19. The instruments have been carefully developed by the authors through expert committee analysis.

Data collection procedure

For the application of the data collection instruments, the SurveyMonkey® online program was used, legally acquired by registering on the site. The program has a system for sending questionnaires via e-mail, social networks, or web pages. The data received are organized and properly identifiable (according to the sending groups) sequentially organized on the registration page and kept in confidential databases with password-restricted access (Copyright © 1999-2014 SurveyMonkey®). In general, the response rate using this software in other studies ranged from 14%[9, 10] to 63%[11].

For this study, 8 links with the data collection instruments were developed, divided one for each university. The links were sent individually, via e-mail, to each researcher who met the inclusion criteria, according to the university at which they worked. The informed consent form (ICF) was included in the online program, where the invitation option "accept to participate in this research" deliberated the next phase, which is to complete the data collection instruments. A total of 4 attempts were made to send the survey link to each researcher.

Statistical Analysis

The responses for each item were analyzed descriptively using mean values. The responses were analyzed to characterize a personal-professional profile that is associated with one of the university's research groups.

The association between the university where the researcher works and the professional background with perceived difficulties to conduct research during the pandemic was performed using the Chi-square or Fisher's Exact tests. Univariate and multivariate logistic regression analyses were conducted to identify predictors of perceived difficulties perceived by researchers. Statistical significance was determined by $p<0.05$. Analyses were performed using IBM-SPSS v.21.

Ethical aspects

The project was approved by the Research Ethics Committee of Hospital do Câncer de Barretos (4.524.021). The determinations of Resolution No. 466/2012 of the National Health Council (C.N.S), which provides for the ethical-legal aspects of scientific studies involving human beings, were used.

RESULTS

A total of 2,638 researchers were identified through the universities' official platforms. Data collection was conducted between March and July 2021. The survey link was emailed to researchers, individually by email. Of those, 682 (25.85%) clicked "yes", accepting to participate in the research, but 568 (83.28%) answered all the questionnaires and had their data analyzed in the study. The results obtained from the questionnaire on sociodemographic data and professional characteristics are presented in Table 1.

Table 1. Sociodemographic data and professional characteristics of researchers from public universities in the State of São Paulo, Brazil.

Variable	n (%)
Age mean (min, max)	53 (28-87)
Gender	
Female	393 (63.59)
Male	225 (36.41)
Marital status	
Married ou with partner	476 (77.02)
Widower	13 (2.10)
Separated/divorced	63 (10.19)
Single	66 (10.68)
Number of children	
0	148 (23.95)
1	159 (25.73)
2	225 (36.41)
3	69 (11.17)
4	16 (2.59)
5	1 (0.16)
Researcher's degree	
MSc., PhD.	141 (22.82)
Post-PhD	218 (35.28)
Associate Professor	232 (37.54)
Other	27 (4.37)
Time from graduation	
Up to 1 year	-
2-5 years	78 (12.62)
6-10 years	28 (4.53)
11-20 years	112 (18.12)
More than 20 years	400 (64.72)
Academic Background	
Doctor	145 (23.46)
Nurse	105 (16.99)
Biologist	62 (10.03)
Pharmaceutical	58 (9.39)
Biomedic	38 (6.15)
Physical therapis	29 (4.69)
Psychologist	18 (2.91)
Dentist	17 (2.75)
Nutritionist	12 (1.94)
Occupational therapist	11 (1.78)
Speech therapist	8 (1.29)
Social worker	4 (0.65)
University	

USP	197 (31.88)
UNESP	95 (15.37)
UNICAMP	73 (11.81)
UFABC	11 (1.78)
UFSCAR	29 (4.69)
UNIFESP	151 (24.43)
FAMEMA	8 (1.29)
FAMERP	22 (3.56)
Time working at the university	
< 1 year	1 (0.16)
2-5 years	35 (5.66)
6-10 years	109 (17.67)
11-20 years	208 (33.66)
More than 20 years	265 (42.88)
Time working in research	
Up to 1 year	1 (0.16)
2-5 years	12 (1.94)
6-10 years	53 (8.58)
11-20 years	214 (34.63)
More than 20 years	338 (54.69)
Time (hours/day) dedicated to research BEFORE the COVID-19 pandemic	
1-4 hours/day	226 (36.57)
5-8 hours/day	243 (39.32)
More than 8 hours/day	149 (24.11)
Time (hours per day) dedicated to research DURING the COVID-19 pandemic period	
1-4 hours/day	270 (43.69)
5-8 hours/day	170 (27.51)
More than 8 hours/day	138 (22.33)

Legend: USP (Universidade de São Paulo); UNESP (universidade Estadual Paulista); UNICAMP (Universidade Estadual de Campinas); UFABC (Universidade Federal do ABC); UFSCAR (Universidade Federal de São Carlos); UNIFESP (Universidade Federal de São Paulo), FAMEMA (Faculdade de Medicina de Marília); FAMERP (Faculdade de Medicina de São José do Rio Preto).

Implications of the Pandemic COVID-19 on the academic production of researchers

Most researchers stated that there was no change in the number of students during the pandemic. This pattern was maintained for scientific initiation, (n=, 32.82%), master's (n=, 60.88%), and doctoral (n=, 66.26%) students. As for research partnerships, 297 (50.51%) researchers said they were negatively affected. Regarding funding or financial assistance to conduct research during the COVID-19 period, 239 (40.65%) researchers did not submit research for this purpose, while 231 (39.29%) of them confirmed difficulty in obtaining financial support. On the other hand, 349 (59.35%) researchers answered that the pandemic did not make it difficult to submit or write papers in 2020. For the vast majority of researchers (n=, 91.1%), the COVID-19 pandemic changed the way they deal with their work routines (Table 2).

309 (52.6) participants described no funding approval. From those describing funding, FAPESP, CNPq, CAPES, and Ministry of Health represented 26.0% (n=153), 16.9% (n=99), 6.3% (n=37), and 3.2% (n=19) of the approvals, respectively.

Table 2. Evaluation of the academic production of researchers both before and during the COVID-19 pandemic.

Variables	Categories	n (%)
Number of SCIENTIFIC INITIATION students, with research projects under development, BEFORE the COVID-19 pandemic:	0	100 (17.0)
	1 to 3	384 (65.3)
	4 to 6	88 (14.9)
	More than 7	16 (2.7)
Number of SCIENTIFIC INITIATION students with research projects under development DURING the COVID-19 pandemic:	0	167 (28.4)
	1 to 3	318 (54.0)
	4 to 6	83 (14.1)
	More than 7	20 (3.7)
Regarding SCIENTIFIC INITIATION students, during the pandemic, there were:	Increase in the number of students	98 (16.6)
	Decreased number of students	193 (32.8)
	It is exactly the same as before the pandemic	297 (50.5)
Number of MASTERS students with research projects in development BEFORE the COVID-19 pandemic:	0	55 (9.3)
	1 to 3	416 (70.7)
	4 to 6	102 (17.3)
	More than 7	15 (2.5)
Number of MASTERS students with research projects under development DURING the COVID-19 pandemic:	0	79 (13.4)
	1 to 3	372 (63.6)
	4 to 6	118 (20.0)
	More than 7	19 (3.2)
Regarding MASTERS students, during the pandemic, there were:	Increase in the number of students	108 (18.3)
	Decreased number of students	122 (20.7)
	It is exactly the same as before the pandemic	358 (60.8)
Number of DOCTORAL students, with research projects under development, BEFORE the COVID-19 pandemic:	0	125 (21.2)
	1 to 3	257 (56.0)
	4 to 6	103 (96.5)
	More than 7	13 (2.2)
Number of DOCTORAL students with research projects under development DURING the COVID-19 pandemic:	0	124 (21.0)
	1 to 3	340 (57.8)
	4 to 6	108 (18.3)

	More than 7	16 (2.7)
Regarding DOCTORAL students, during the pandemic, there were:	Increase in the number of students	113 (19.2)
	Decreased number of students	86 (14.6)
	It is exactly the same as before the pandemic	389 (66.1)
The COVID-19 pandemic interfered with national and international research partnerships in the following ways:	Negative	297 (50.5)
	Positive	104 (17.6)
	No changes	187 (31.8)
DIFFICULTY in obtaining funding or financial aid to carry out research DURING the COVID-19 pandemic	Yes	231 (39.2)
	No	118 (20.0)
	Did not submit research for funding or financial aid.	239 (40.6)
The COVID-19 pandemic made it DIFFICULT to write and submit articles in 2020	Yes	226 (38.4)
	No	349 (59.3)
	Did not write or submit papers in the year 2020 for other issues that were not influenced by the pandemic of COVID-19	13 (2.2)
The COVID-19 pandemic changed the way of dealing with the work routine		
	Yes	536 (91.1)
	No	25 (4.2)
	More or less	27 (4.5)
Number of projects related to the COVID-19 theme	0	241 (41.0)
	1 to 3	303 (51.6)
	4 to 6	33 (5.6)
	More than 7	10 (1.7)
Number of research projects related to the COVID-19 theme that were SUBMITTED to funding agencies or other types of financial aid	0	370 (63.0)
	1 to 3	198 (33.7)
	4 to 6	18 (3.0)
	More than 7	1 (0.1)
Number of research projects related to the COVID-19 theme that were APPROVED for development agencies or for other types of financial aid	0	478 (81.4)
	1 to 3	103 (17.5)
	4 to 6	5 (0.8)
	More than 7	1 (0.1)

From the total, 49.7% (292 of 597) of the researchers reported more difficulty in getting funding or financial aid during the pandemic of COVID-19. The difficulties and barriers faced by researchers while conducting research during the pandemic of COVID-19 are shown in Supplementary Table 1.

The association between the academic background of researchers with difficulties in conducting research during the pandemic of COVID-19 was shown to be significant with research team workload (p=0.047) and no perceived difficulty (p=0.042). It is observed that the greatest workload of the research team was associated mainly with nurses (46.7%). In the category "other difficulty", difficulties were described as social isolation, less availability of resources, restricted access to laboratories and data collection sites, lack of patients, among others (Table 3).

The association between the university in which they work and "no perceived difficulty" were found to be significant (p=0.002); researchers from the Faculdade de Medicina de São José do Rio Preto (FAMERP) were the ones who perceived the least difficulties, while researchers from the Universidade Federal University de São Carlos (UFSCAR) were the ones who noticed them the most (Supplementary Table 2).

Regarding the association between length of experience at the university and difficulties in conducting research, it is noted that researchers who have been working for between 6 and 10 years were the ones who most reported an insufficient number of students in scientific initiation, master's, and doctorate (27.5%); researchers who work for more than 20 years in the same institution are the ones who most reported not noticing any difficulties (16.6%). The association was significant with "insufficient number of students" (p=0.002) and "no perceived difficulty" (p=0.042).

Logistic regression analyses were conducted to identify variables related to perceived difficulties in conducting studies during the pandemic (Table 4). Biologists were independently associated with perceived difficulties compared to doctors (OR=5.41, p=0.029). In addition, regression analyses showed that researchers from the Federal University of São Paulo (UNIFESP, OR=2.75, p=0.012) and São José do Rio Preto Medical School (FAMERP, OR=0.30, p=0.019) were associated with perceived difficulties when compared to researchers from the University of São Paulo (USP).

DISCUSSION

This study evaluated the influence of the COVID-19 pandemic on the academic production of researchers from public universities in the health area in the state of São Paulo, Brazil. The profile of the researchers shows a high level of academic degrees, with 72.8% of the interviewees having postdoctoral or full professorships, 89.3% having been researchers for more than 10 years, and 76.5% worked for more than 10 years at the same university. This was the first Brazilian study to evaluate the profile of researchers from public universities in the health area and the influence of the COVID-19 pandemic on the scientific production and routine of these researchers, identifying the main problems faced by them. Furthermore, this study may contribute to reinforcing the importance of universities in scientific production and the generation of evidence-based knowledge, and especially the need to value Brazilian researchers.

Scientists report that during the initial phase of the pandemic there was a major decline in time spent on research[12-14]. Previous studies showed that COVID-19 did not affect all scientists equally[12, 15, 16] with the female population being the most affected, especially those with younger dependents. In our study, 393 (63.59%) of the researchers were female, 476 (77%) were married, and 384 (62.14%) had one to two children. Moreover, it is important to note that such disparity between male and female scientists is not something new[17, 18], but an inequality that may have been further exacerbated by the current pandemic.

In Brazil, researchers have been facing a severe reduction in financial support for research and graduate programs[19]. However, a study showed that Brazil is among the 12 countries responsible for 95% of the world's scientific production in COVID-19, totaling 2,582 papers in the Web of Science (WoS) database in 2020[20]. Moreover, the same study showed that the three most important funding agencies in the country are strictly public institutions (CNPq, CAPES,

Table 3. Association of academic background of researchers from public universities in the state of São Paulo with difficulties in conducting research during the COVID-19 pandemic.

Difficulties	Academic Background					
	Doctor	Nurse	Pharmacist	Biologist	Others	p value*
Shortage of research team time	26.9	30.5	34.5	38.7	27.4	0.375
Research team workload	36.6	46.7	24.1	32.3	40.3	**0.047**
Reduced/inadequate number of professionals destined for research	35.9	13.3	27.6	45.2	25.0	**<0.001**
Professionals not qualified to carry out research	6.9	5.7	3.4	6.5	6.5	0.923
Lack of support/encouragement from the institution's managers to carry out research	15.9	10.5	12.1	14.5	14.9	0.766
Insufficient number of students (scientific initiation/ Masters/Doctorate) to conduct research	10.3	7.6	32.8	46.8	17.7	**<0.001**
No perceived difficulty	13.8	18.1	6.9	3.2	12.5	**0.042**

* Pearson Chi-Square
Significant p-values are shown in bold type.

and FAPESP), highlighting the important role of public funding for national research and development. This result was confirmed in this study, highlighting the FAPESP funding agency as the one that financed the most health research projects during this pandemic period (26%), followed by CNPq (16.8%). However, a considerable part of the researchers (52.6%) stated that they were not approved by the funding agencies and 49.7% felt more difficultiy to obtain funding or financial assistance during the first year of the pandemic.

Thus, an unequal balance between having to produce and not being able to produce science during the pandemic is evident, leading to extremely detrimental effects for researchers, as shown in the results of this research, among which are heavier workloads, limited or reduced funding, and infrastructure difficulties. Furthermore, studies have shown that researchers who belong to social minorities, who are first-generation college students, or who are economically disadvantaged have been the most affected by the negative effects of the pandemic. Additionally, they are less likely to receive independent federal research funding, and even less likely to achieve the position of the principal investigator[21].

Although scarce, current Literature shows that the difficulties and limitations observed in conducting research in the current global scenario are not restricted to Brazil. Several countries also suffer from reduced research funding, overwork, cost-cutting, and prioritization of covid-related studies, which causes other areas to be neglected[22-25].

In this survey, we noticed that, for most researchers, the number of students involved in scientific initiation, master's, and doctoral studies, remained the same compared to the pre-pandemic period (50%, 60.8%, and 66.2% respectively), despite all the difficulties reported. This is mainly due to the universities' transition to teleworking (home office) during the period of restrictions and social isolation. On the one hand, this allowed activities to continue to take place, contributing to students engaging in research activities, but on the other hand, it changed the way researchers dealt with their work

routine, translated into staff overload (41.3%), with symptoms of stress and anxiety (89.9%) and difficulty in implementing data collection (57.6%). As a result of such difficulties during the COVID-19 pandemic, 192 (33.5%) researchers reported being unsatisfied with their academic output.

Furthermore, when associating academic background with difficulties in conducting research during the pandemic, the insufficient number of students was significantly related mainly to biologists (46.8%). This can be explained by the difficulty in accessing laboratories and data collection sites and university closures due to COVID-19 prevention protocols, including social isolation, which may have resulted in a reduction in research staff. The association of difficulties encountered during the pandemic with time at the university, we observed that professionals with less experience at the university (between 1 and 10 years) experienced more difficulty regarding insufficient numbers of students than those who had more than 10 years of work. This may be reflected in the ease or difficulty that the researcher has in being able to conduct their research and in obtaining research funding, which may have the variable length of experience as an important characteristic.

It was also evidenced that some researchers reported no difficulties or barriers to successfully conducting research during the pandemic. It is believed that these researchers could be those who work at more established universities with high funding resources, and who have more experience in the research field and more time dedicated to the university where they work. Studies corroborate these findings, stating that younger researchers were indeed the most affected during the pandemic, and are the ones who will have the greatest long-term consequences and difficulties[22, 26].

This study has some limitations. First, it is a cross-sectional study, and it is impossible to determine cause-and-effect relationships. Another limitation is that our survey respondents are from self-selected samples and may not be representative of the full population of researchers. Another potential limitation was the fact that we did not measure the academic production (thesis, dissertations, manuscripts accepted and/or published) during the pandemic compared to before it. However, we believe that the perception of researchers regarding their difficulties is sufficient to map the relevant information we sought. Moreover, the fact that the survey was anonymous limited us from objectively analyzing the academic production of the study participants.

CONCLUSION

The present study showed that researchers had difficulties conducting research during the pandemic of COVID-19. Insufficient numbers of scientific initiation, master's, and doctoral students were indicative of a negative impact, especially for researchers with short academic careers. FAPESP was the research agency that most funded research related to COVID-19. Biologists had more difficulties to develop research compared to physicians and other researchers. These findings reinforce the need to establish funding targets and research incentives, especially for early career researchers. Future studies are needed to determine the impact of the pandemic on researchers' scientific output over time.

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Supplementary table 1. Difficulties and barriers faced by researchers in conducting research during the pandemic of COVID-19.

Variables	N (%)
Human resources	
Shortage of time for the research team	183 (32.05)
Research team workload	236 (41.33)
Reduced or inadequate number of professionals destined for research	172 (30.12)
Professionals not qualified to conduct research	38 (6.65)
Lack of support and encouragement from the institution's managers regarding the conduct of research	87 (15.24)
Insufficient number of students (Scientific Initiation, Masters, Doctorate) to conduct research	115 (20.14)
No perceived difficulty	76 (13.31)
Other	162 (28.37)
Financial resources	
Absence or low financial resources	215 (37.65)
Difficulty in getting research funding	199 (34.85)
Lack of material resources, resulting from cancellations or reduction of financial support	112 (19.61)
No perceived difficulty	147 (25.74)
Other	124 (21.72)
Health status of the researcher or colleagues	
Impact on working time due to COVID-19 diagnosis	106 (18.56)
Impact on working time due to death by COVID-19 of a member of the research team	20 (3.50)
Researcher or team members with stress symptoms	284 (49.74)
Researcher or team members with anxiety symptoms or diagnosis	230 (40.28)
Researcher or team members with symptoms or diagnosis of depression	149 (26.09)
Researcher or team members with symptoms or diagnosis of burnout	122 (21.37)
No perceived difficulty	137 (23.99)
Other	74 (12.96)
Study design	
The research study design made it DIFFICULT to collect data or implement the research during the pandemic.	329 (57.62)

Need to RESTRUCTURE the research study design, as it WAS IMPOSSIBLE to carry out the same	292 (51.14)
Need to CANCEL the research, as it was IMPOSSIBLE to modify the study design	79 (13.84)
No perceived difficulty	81 (14.19)
Other	48 (8.41)
Transition to online/remote work	
Difficulty in adapting to the digital environment	109 (19.09)
Difficulty adapting to teleconference programs (Skype, Google Meet, Zoom, Moodle etc.)	101 (17.69)
Difficulty in maintaining effective online communication with other researchers involved in the study	130 (22.77)
No perceived difficulty	260 (45.53)
Other	93 (16.29)

Legend: FAPESP (The São Paulo Research Foundation); CNPq (National Council for Scientific and Technological Development); CAPES (Coordination for the Improvement of Higher Education Personnel); MS (Ministry of Health)

Supplementary Table 2. Association of the university where researchers from public universities in the state of São Paulo work with difficulties in conducting research during the COVID-19 pandemic.

	University								
	USP %	UNESP %	UNICAMP %	UFABC %	UFSCAR %	UNIFESP %	FAMEMA %	FAMERP %	p value*
Perceived difficulties									
Shortage of research team time	29.4	33.7	28.8	45.5	13.8	30.5	37.5	18.2	0.504
Research team workload	34.0	40.0	47.9	18.2	44.8	35.1	50	36.4	0.269
Reduced/inadequate number of professionals destined for research	30.5	29.5	32.9	36.4	10.3	26.5	12.5	27.8	0.144
Professional is not qualified to carry out research	8.1	6.3	8.2	9.1	-	4.6	-	9.1	0.444
Lack of support/encouragement from the institution's managers to carry out research	11.7	16.8	16.4	45.5	17.2	13.2	12.5	18.2	0.066
Insufficient number of students (SI/Masters/Doctorate) to conduct research	17.3	21.1	20.5	18.2	17.2	18.5	12.5	9.1	0.926
No perceived difficulty	14.7	16.8	8.2	9.1	3.4	6.0	25.0	36.4	**0.002**
Another difficulty[a]	26.9	16.8	24.7	45.5	27.6	34.4	25.0	9.1	**0.041**

Legend: USP (Universidade de São Paulo); UNESP (universidade Estadual Paulista); UNICAMP (Universidade Estadual de Campinas); UFABC (Universidade Federal do ABC); UFSCAR (Universidade Federal de São Carlos); UNIFESP (Universidade Federal de São Paulo), FAMEMA (Faculdade de Medicina de Marília); FAMERP (Faculdade de Medicina de São José do Rio Preto); SI (Scientific Initiation).

* Pearson Chi-Square. Significant p-values are shown in bold type.
[a] Lower availability of resources; social isolation; restricted access to data collection sites; lack of patients