



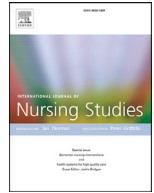
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Contents lists available at ScienceDirect

International Journal of Nursing Studies

journal homepage: www.elsevier.com/ijns

Infection and mortality of nursing personnel in Brazil from COVID-19: A cross-sectional study



Helena Maria Scherlowski Leal David^{a,*}, Ricardo Mattos Russo Rafael^b,
Márcia Guimarães de Mello Alves^c, Karen Lucas Breda^d,
Magda Guimarães de Araújo Faria^e, Mercedes Neto^f, Rômulo Cristóvão de Souza^g,
Marcelo Felipe Moreira Persegona^h, Manoel Carlos Neri da Silvaⁱ

^a Rio de Janeiro State University, Faculty of Nursing, Boulevard 28 de Setembro 157, 7th floor, Vila Isabel, Rio de Janeiro, RJ 20551-030, Brazil

^b Rio de Janeiro State University, Faculty of Nursing, Boulevard 28 de Setembro 157, 7th floor, Vila Isabel, Rio de Janeiro, RJ 20551-030, Brazil

^c Federal Fluminense University, Collective Health Institute, Marques do Parana 303, 3th floor, Annex Building, Centro, Niterói, RJ 24033-900, Brazil

^d University of Hartford, College of Education, Nursing & Health Professions, Department of Nursing, 200 Bloomfield Avenue, 06117 West Hartford, Connecticut, United States

^e Rio de Janeiro State University, Faculty of Nursing, Boulevard 28 de Setembro 157, 7th floor, Vila Isabel, Rio de Janeiro, RJ 20551-030, Brazil

^f Rio de Janeiro State University, Faculty of Nursing, Boulevard 28 de Setembro 157, 7th floor, Vila Isabel, Rio de Janeiro, RJ 20551-030, Brazil

^g Rio de Janeiro State University, Medical Sciences Faculty, Av. Prof. Manoel de Abreu, 444 - Maracanã, Rio de Janeiro, RJ 20550-170, Brazil

^h Federal Council of nursing, Asa Norte Comércio Local Norte 304 - Asa Norte, Brasília, DF 70736-550, Brazil

ⁱ Federal Council of nursing, Asa Norte Comércio Local Norte 304 - Asa Norte, Brasília, DF 70736-550, Brazil

ARTICLE INFO

Article history:

Received 5 November 2020

Received in revised form 8 May 2021

Accepted 2 September 2021

Keywords:

COVID-19

Health care personnel (HCP)

Nurses

Brazil

Mortality

Cross-sectional study

ABSTRACT

Background: Health care personnel (HCP) worldwide are at-risk for contracting the novel Coronavirus disease (COVID-19). Among health care personnel, nurses are at a particularly high risk due to the physical proximity and duration of time spent providing direct care. Documenting accurate rates of COVID-19 infection and deaths among nurses worldwide has been problematic, and many countries such as the USA have no systematic mechanism for collecting this information. Brazil is unique in that it prioritized the implementation of a dedicated database, the *Nursing Observatory* to collect accurate and timely data regarding COVID-19 and Brazilian nursing personnel.

Objectives: The aim of this study was to analyze COVID-19 infections and deaths among nurses registered in the centralized and dedicated Brazilian database called the *Nursing Observatory*.

Design: A cross-sectional study using secondary data from the Brazilian Nursing Observatory was conducted.

Participants: Data are reported for two occupational categories: *professional Nurse* and *technical nurse* by country regions. All cases or deaths of *professional Nurse* and *technical nurse* registered between the 12th and 31st epidemiological weeks of 2020 were included.

Methods: From a unique numerical identification, the appropriate records of nursing personnel affected by COVID-19 were entered by the Technical Responsible Nurse for each service, according to the condition regarding COVID-19. All suspected, confirmed or unconfirmed infections were considered "cases", and all confirmed or unconfirmed deceased as "deaths". Cases and deaths were analyzed according to the variables: 1. region of the country where the case occurred, 2. nursing category and 3. epidemiological week. Universal protocols for collecting and cleaning data were used throughout the country. Infection and mortality rates (per 100,000) were obtained from the relationship between deaths registered and the population of nursing personnel by category and region.

* Corresponding author.

E-mail addresses: helenad@uerj.br (H.M.S.L. David), ricardo.rafael@uerj.br (R.M.R. Rafael), marciagma@id.uff.br (M.G.d.M. Alves), breda@hartford.edu (K.L. Breda), magda.faria@uerj.br (M.G.d.A. Faria), mercedes.neto@uerj.br (M. Neto), Marcelo.persegona@cofen.gov.br (M.F.M. Persegona), secretaria@cofen.gov.br (M.C.N. da Silva).

Social media: (H.M.S.L. David)

Results: Nursing personnel in the Northern, Northeast and Southeast Regions of Brazil had the highest number of COVID-19 infections and deaths overall with an ascending curve occurring mainly after Epidemiological Week 19. COVID-19 infections and deaths spread later to the Midwest and Southern regions also showing an ascending curve, although the total numbers were less.

Conclusions: All occupational categories of nursing personnel showed higher than expected rates of infection and death. Inequalities and a lack of adequate healthcare resources, hospital beds and Personal Protective Equipment varied by region in Brazil. The politicization of COVID-19 and the lack of a coherent national pandemic plan is a factor to be taken into account.

Tweetable abstract: This cross-sectional study shows the evolution of cases and deaths of Brazilian nursing personnel over the first months of the COVID-19 pandemic.

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What is already known

- Nursing personnel worldwide are at increased risk for contracting the novel Coronavirus disease (COVID-19)
- Documenting accurate rates of COVID-19 infection and deaths among nurses worldwide has been problematic.
- The number of cases among health care personnel in South America is still uncertain, due mainly to the absence of centralized and coordinated databases to register cases and to the lack of COVID-29 testing to ascertain the incidence of positive cases.

What this paper adds

- Brazil is unique in that COVID-19 infections and deaths among nursing personnel were accurately documented in the Nursing Observatory, a separate official database for nurses monitored by the Brazilian Federal Council of Nursing (COFEn).
- Brazilian nurses are required to register with COFEn, so counting COVID-19 infections and deaths among nurses this way provides a high-quality number of nurses who suffered and died from the disease
- The number of nursing deaths throughout Brazil from COVID-19 during the period analysed is staggering
- Additional evidence from such databases will assist health care personnel and institutions to effectively prepare for future epidemics.

1. Background

Health care personnel (HCP) worldwide are at-risk for contracting SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19). As early as 3 April 2020 in the People's Republic of China, 4.4% of those who fell ill were health care personnel (Zhan et al., 2020). In Italy, the rate of infected health care personnel reached 20% (The Lancet 2020). In the United States, more than 10,000 cases were registered among health care personnel in only the first two months of the pandemic (Burrer et al., 2020).

Among health care personnel, nurses are at a particularly high risk of illness and death from COVID-19 due to the physical proximity and duration of time spent providing direct care to patients. Despite the collection of some data on nurse deaths, the International Council of Nurses (ICN) reported that the confirmation of nurse deaths globally due to COVID-19 is a severe underestimate and that the actual number is more likely significantly higher (Spencer et al., 2021). The ICN pointed to the difficulties in the documentation of cases of COVID-19 among nurses worldwide, and estimated, at the time, that 7% of all deaths in the world would be among health professionals (International Council of Nurses 2020). Early on in the pandemic, the ICN cited the urgent need for a standardized method of collecting and reporting the incidence of COVID-19 infections and deaths of nurses and other health care personnel. Over a year into the pandemic, in most countries, this has not been done.

We now know that documenting accurate rates of COVID-19 infection and deaths among health care personnel including nurses worldwide is an ongoing problem, and that many countries have no mechanism for comprehensively and systematically collecting this information. In the USA, for example, reporting illness and deaths from COVID among health care providers is voluntary. The U.S. government actually gave administrators in health care institutions the choice to report or not to report incidences of COVID illness and deaths among their employees to the federal government (Spencer et al., 2021).

Brazil stands out as unique in that it prioritized the implementation of a dedicated and centralized database called the *Nursing Observatory* for the purpose of collecting accurate and timely data regarding incidences of illness and death from COVID-19 among its nursing personnel. The database is maintained by Brazil's Federal Nursing Council (*Conselho Federal de Enfermagem*, COFEn) for the purpose of collecting accurate and timely data regarding the incidence of COVID-19 among Brazilian nursing personnel. The national database has a high degree of accuracy as it is mandatory for all nursing units throughout the country to register all incidences of COVID-19 infection and/or death among all nursing personnel. Furthermore, other information is collected such as the category of worker and location of nursing practice sites by region. In Brazil, the *Nursing Observatory* database officially documents all nursing personnel (even those who subsequently retired) as well as the outcome of cases. The database allows for a temporal analysis of the evolution of cases and deaths not only according to the nursing subcategory, but also according to region of the country. It is with this type of accurate data that we can begin to analyze the full impact of COVID-19 on nursing over time.

This study reports on findings from the *Nursing Observatory* database. It includes data from all of the regions in Brazil by category and it encompasses the entire initial period of the pandemic in Brazil including importantly, the initial period of the pandemic, when Personal Protective Equipment (PPE) supply was inadequate and technical training for its use was not broadly available to nursing personnel. The importance and the relevance of accurate data is imperative to any future understanding of the devastating consequences of this illness and death on the Brazilian nursing workforce, the mass psychological trauma termed the "Covid Effect" and the exodus of nursing from the profession which is beginning to be documented (Spencer et al., 2021).

1.1. Brazil, nurses and COVID-19

The population of Brazil is about 200 million. Brazil has a Unified Health System (*Sistema Único de Saúde*, SUS) that gives universal healthcare access to all. It is based on the principle that in Brazil, healthcare for all is considered a constitutional right.

Brazilian nurses, numbering more than 2 million nationally, are the largest group of health care personnel (World Health Organization 2020). After COVID-19 was decreed a pandemic in Brazil

on March 12, 2020, the response from nurses was immediate. The deployment and reassignment of nursing personnel occurred quickly with the relocation and distribution of nursing personnel into acute areas of need. Holidays and leave time were suspended. Nurses' responsibilities were reviewed and when necessary nurses were reallocated. Many were reassigned to emergency COVID-19 wards and hospital areas where and when needed. This allowed more beds to be created and designated as COVID-19-only beds.

The availability and use of PPE in adequate quantity and quality is a key element in reducing the risk of contagion, especially for professionals who deal directly with the most serious cases. In the first months of the pandemic, the distribution of PPE did not occur adequately, indicating that there was no forecast by the health authorities for the supply. In addition, the rules of use were different for each service. The first cases of death among nursing staff in Brazil occurred in March 2020 and by July 2020, Brazilian epidemiological data showed that three out of ten deaths by COVID-19 were from nursing personnel (Conselho Federal de Enfermagem 2020). Moreover, more than 7000 complaints by nurses about the lack of, or the inadequacy of, PPE had already been sent to Brazilian Regional Nursing Councils (Conselho Federal de Enfermagem 2020).

Nationally, Brazilian nursing is regulated by the Federal Nursing Council (COFEn). In Brazil, the categories of nurses are: 1. *professional 'Nurses'*, 2. *technical nurses* 3. *auxiliary nurses* and 4. *midwives*. Professional nurses in Brazil are called '*Nurses*'. They hold a baccalaureate or higher university degree. *Technical nurses* and *auxiliary nurses* are both paraprofessionals prepared in non-university based technical schools. The *Midwife* is a university-prepared professional with obstetric skills who cares only for obstetric patients.

The *professional 'Nurse'* takes on management activities and direct care for critically ill patients, while *technical nurses* and *auxiliary nurses* perform direct care for patients less acutely ill (Brasil 1987). However, due to a shortage of *professional 'Nurses'* in Brazil (prior to and during COVID-19), *technical nurses* and *auxiliary nurses* were allowed to perform some higher-level care duties under the supervision of a *professional 'Nurse'*. The total number of professional '*Nurses*', technical nurses and auxiliary nurses in Brazil, (excluding midwives), is 2327,763 (Conselho Federal de Enfermagem 2020). It should be noted that, for the general public, the differences in education, in roles and duties of different categories of nurses is not clear. In fact, nursing personnel at all levels tend to be referred to generically as "nurses".

2. Objectives

The aim of this study was to analyze COVID-19 infections and deaths among Brazilian nursing personnel registered in the Brazil's Federal Council of *Nursing Observatory* by nursing category, geographical region and epidemiological weeks 12 to 31.

3. Methods

A cross-sectional study design was used. Secondary data were collected through a structured electronic form, registered in the Nursing Observatory open-access dataset for COVID-19 and coordinated by COFEn (Conselho Federal de Enfermagem 2020). From a unique numerical identification, the appropriate records of nursing personnel affected by Covid-19 were entered by the Technically Responsible Nurse for each service, according to the condition regarding COVID-19. The following categories are reportable as cases: a) Suspected of COVID-19 in quarantine; b) Diagnosis confirmed with COVID-19 in quarantine; c) COVID-19 unconfirmed diagnosis; d) Suspected of COVID-19 hospitalized; e) Diagnosis confirmed with hospitalized COVID-19, and f) confirmed with COVID-19.

Deaths were classified as: a) Suspected of COVID-19 deceased, and b) Confirmed diagnosis of COVID-19 deceased.

Protocols for the COFEn Nursing Observatory COVID-19 database involved four distinct stages detailed here (Persegona et al., 2020).

1. Data received by COFEn undergoes a process of extraction, treatment and cleaning (ETL) daily before being made available for the preparation of reports and updating the database of the Nursing Observatory (Conselho Federal de Enfermagem 2020). From the recorded data, redundancies and inconsistencies are excluded and a database created in Excel, for the preparation of reports with graphs and tables of the day.
2. The database for updating the Nursing Observatory on the Internet is mounted on a Power BI (Microsoft © platform), to load a panel of selected indicators. Data processing is carried out daily, including weekends and holidays (Persegona et al., 2020).
3. As the registered cases increased, COFEn improved the process for the exclusion of duplicate data, leaving the most recent.
4. All deaths registered on the Observatory's form are forwarded to COFEn's Communication Advisory to check and confirm the information.

The following variables were used to analyze all suspected and confirmed COVID-19 infections and deaths recorded: 1. region of the country where the case occurred, 2. nursing occupational category and 3. epidemiological week (12th to 31st week).

3.1. Nursing occupational category

A very small number of *Midwives* practice in Brazil and their work is exclusively with obstetric patients. For these reasons, the category of *Midwife* was excluded from the present study. Also, for this study we considered the occupational duties performed by *technical nurses* and *auxiliary nurses* and determined that the duties are similar with many areas of overlap. For this reason, the two categories were combined into a single category labelled '*technical nurse*'. Hence, data in this study are reported under two occupational categories 1. *Professional 'Nurse'* - a university-educated nurse with the minimum of a baccalaureate degree in nursing and 2. *technical nurse* - a technical school-educated paraprofessional nurse with either one or two years of preparation.

3.2. Region of the country

Data were organized according to the five Brazilian regions: The Southeast, the North, the Northeast, the South and the Midwest.

The Southeast Region includes the large urban centers of São Paulo and Rio de Janeiro and some other large cities. The region has the highest population density and it is responsible for nearly 50% of Brazil's GDP.

The Northern Region includes the vast Amazonian rainforest. It has the largest area with the lowest population density. It has a high percentage of people from indigenous groups.

The Northeastern Region has a low GDP and low social indicators despite the presence of some industry and beautiful beaches.

The Southern Region is characterized by a high standard of living, high social indicators and literacy rates. It has a high percentage of European immigrants.

The Midwest Region is the least industrialized area of the country with a low population density. Much of the land is used for animal grazing and agriculture. The exception is the country's capital, Brasilia, a high-income city with many governmental institutions.

3.3. Epidemiological week

Data collection took place and was recorded according to epidemiological weeks between the 12th (March 15th to 21st, 2020)

and the 31st (July 26th to August 1st, 2020). The records of the Council started on March 20th, 2020. This is an open-access and anonymous dataset; therefore, no ethical approval was required.

As mentioned earlier COVID-19 infection cases and deaths among nursing personnel are documented in the *Nursing Observatory*, an official database for COVID-19 cases and deaths among Brazilian nursing personnel, monitored by the Brazilian Federal Council of Nursing - COFEn. All nursing personnel in Brazil are required to register with COFEn. For purposes of the management of *Nursing Observatory* data, each Brazilian health service unit throughout the country has assigned a person who is responsible for the coordination of the *Nursing Observatory* registration database team, to assure that information is put into the system accurately, and updated regularly.

After registration into the *Nursing Observatory*, data were analyzed regarding the incidence and distribution and severity of COVID-19 cases and deaths among Brazilian nurses. Data were analyzed according to epidemiological week, documenting the severity of the disease and changes over time, by nursing category and region.

3.4. Measurements

The primary and secondary outcomes of the study were cases and deaths by COVID-19 in nursing professionals. Deaths were considered to be records of “deceased with a confirmed diagnosis of Covid-19” and “deceased with suspected Covid-19” in the COFEN database. We consider as cases of COVID-19 all the death records and the records of “professionals in quarantine with suspected Covid-19”, “professionals hospitalized with suspected Covid-19”, “professionals in quarantine with confirmed diagnosis of Covid-19”, “hospitalized professionals with confirmed diagnosis”, “professional confirmed with Covid-19 and discharged”. The option to consider suspected cases followed the clinical and epidemiological criteria for the diagnosis of COVID-19 in Brazil, mainly due to the lack of availability COVID diagnostic tests in the country. Records were deleted. In addition, the study's covariates were: the period of time, expressed in epidemiological weeks, the professional category and the place of occurrence.

The sociodemographic characterization of notifications from the COFEn database, the categorical variables age (in years), gender of the professional, in addition to the covariables previously presented were used.

3.5. Statistical analysis

The proportions of cases and deaths were calculated for the sociodemographic characterization of notifications from the COFEn database. This distribution was also calculated according to the country's regions, applying the Chi-Square Test, assuming statistical significance when $\alpha < 0.05$.

The occurrence rates (cases of COVID-19 infection per 100,000 nurses), by nursing category and region were calculated according to the population of nursing personnel registered with COFEn on August 30, 2020. Mortality rates (per 100,000 nurses) were obtained from the relationship between registered deaths and the population of nursing personnel by category and region. The graphs were prepared according to the cumulative historical series.

The cumulative cases and death rates were presented according to the epidemiological week and considering the region of occurrence and the occupational category (*professional 'Nurse'* or *technical nurse*), adding the accumulated cases or deaths from the previous week to the cases or deaths from the current week and dividing by the total number of nurses (*professional 'Nurses'*, *technical nurses*, or both). Missing data were excluded from the rate analy-

sis. All statistical analyzes were performed using the Stata SE 15 software and graphics prepared in Microsoft Excel software.

4. Results

Nursing personnel make up 70.02% of the total Brazilian Health Care Personnel (HCP) workforce, with *technical nurses* representing 53.26% and *professional 'Nurses'* representing 16.94%. The regional distribution shows a high concentration of both *professional 'Nurses'* and *technical nurses* in the Southeast region (location of the urban and industrial centers of São Paulo and Rio de Janeiro), followed by the Northeast and the South. *Technical nurses* are more numerous than *professional 'Nurses'* throughout the entire country. In fact, the distribution of nurses by category in Brazil is notable with about three *technical nurses* to every one *professional 'Nurse'* (Table 1).

Additionally, the density of the nursing personnel per 10,000 inhabitants is 101.66 in total, of which 77.13 are *nursing technicians*, and 24.53 are *professional 'Nurses'*. Differences exist among the five regions of Brazil, with the highest density of nursing personnel in the Southeast region and the lowest density in the Northern region (this is consistent with the density of population in those regions). Distribution by sex shows 83% females to 13% men (total 96%). The age group with the most nursing personnel is between 35 and 54 years old, with one-third of all nurses under 35 years of age.

4.1. Cases of COVID-19 infection and death by nursing category

Regarding incidences of COVID-19 among nurses, 28,136 case records were observed in the period between epidemiological weeks 12 and 31 (Table 2). Of these, 6713 (23.86%) were case reports among *professional 'Nurses'*, 17,599 (62.55%) among *technical nurses* and 3824 (13.59%) notifications did not present records on the nursing personnel category. Of the 6713 *professional 'Nurses'* reported as cases, 2806 (41.80%) cases were suspected cases and 3907 (58.20%) were reported as confirmed cases of COVID-19 infection. Among the 17,599 *technical nurses* reported, 8245 (46.85%) were suspected cases, while 9354 (53.15%) were reported as confirmed cases of COVID-19 infection. Of the total number of 325 reports of suspected COVID-19 deaths, 93 (28.62%) were *professional 'Nurses'* and 232 (71.38%) were *technical nurses*. Regarding the reports of deaths confirmed to be caused by COVID-19, 85 deaths were of *professional 'Nurses'* and 207 deaths of *technical nurses*.

The highest incidence of COVID disease and deaths were recorded in the Southeastern region of the country which corresponds to the most densely populated area of the country. A pattern in the age, gender and professional category in relation to COVID-19 cases emerged, with the largest occurrence of cases primarily in young female technical nurses between 31 and 40 years of age.

Fig. 1 shows the cases of infection and deaths per 100,000 nursing personnel, according to the occupational category and the epidemiological weeks of notification. Attention is drawn to four periods of increase in notifications, which together represent 54.86% of notifications from nursing personnel ($n = 15,437$). They are: the first period between Weeks 14 and 16 (4713 cases), the second between Weeks 18 and 19 (5238 cases), the third between Weeks 24 and 25 (2462 cases), and the fourth between Weeks 27 and 28 (3024 cases).

The cumulative number of cases of COVID-19 infection among nursing personnel (Week 31) was 1208,71 cases per 100,0100, with 1179,84 cases per 100,000 *professional 'Nurses'* and 1000,63 per 100,000 *technical nurses*. The curve accentuates from the 18th epidemiological week, a similar pattern was observed in the curves of the two nursing occupational categories. It is also relevant to note that the absence of information on the nursing personnel categories at the time of the notifications, with a peak in the 15th

Table 1
Nursing professionals by Region and category – Brazil, 2021.

Nursing-categories/Regions	Midwest	Northeast	North	Southeast	South	TOTAL
professional 'Nurses'	49,038	147,930	42,836	259,112	70,061	568,977
technical nurses	122,234	391,037	152,070	862,132	231,313	1758.786
Total	171,272	538,967	194,906	1121.244	301,374	2327.763

Table 2
Sociodemographic characterization of case and death records by COVID-19 in the Federal Council of Nursing database, 2020 (n = 28,136).

Variables	Region												p-value
	Overall		Midwest		Northeast		North		Southeast		South		
	N	N	%	%	n	%	n	%	n	%	n	%	
Age (in years)													
20-30	5,685	20.21	418	19.34	1733	19.52	495	17.31	2101	20.07	938	24.89	<0,001
31-40	11,952	42.48	942	43.59	3907	44.01	1080	37.76	4423	42.25	1600	42.46	
41-50	7,553	26.84	570	26.38	2208	24.87	916	32.03	2937	28.05	922	24.47	
51-60	2,570	9.13	205	9.49	915	10.31	319	11.15	851	8.13	280	7.43	
61-70	343	1.22	24	1.11	109	1.23	47	1.64	135	1.29	28	0.74	
71-80	33	0.12	2	0.09	6	0.07	3	0.10	22	0.21	0	0.00	
Gender													
Female	23,834	84.71	1842	6.55	7709	27.40	2298	8.17	8728	31.02	3257	11.58	<0,001
Male	84.71	15.29	319	1.13	1169	4.15	562	2.00	1741	6.19	511	1.82	
Occupational Category													
Professional 'Nurses'	6,713	23.86	654	2.32	2443	8.68	749	2.66	2020	7.18	847	3.01	<0,001
Technical nurses	17,599	62.55	1432	5.09	5849	20.79	1945	6.91	5731	20.37	2642	9.39	
No information	3,824	13.59	75	0.27	586	2.08	166	0.59	2718	9.66	279	0.99	
Deaths													
No	27,811	98.84	2122	7.54	8792	31.25	2789	9.91	10,356	36.81	3752	13.34	<0,001
Yes	325	1.16	39	0.14	86	0.31	71	0.25	113	0.40	16	0.06	

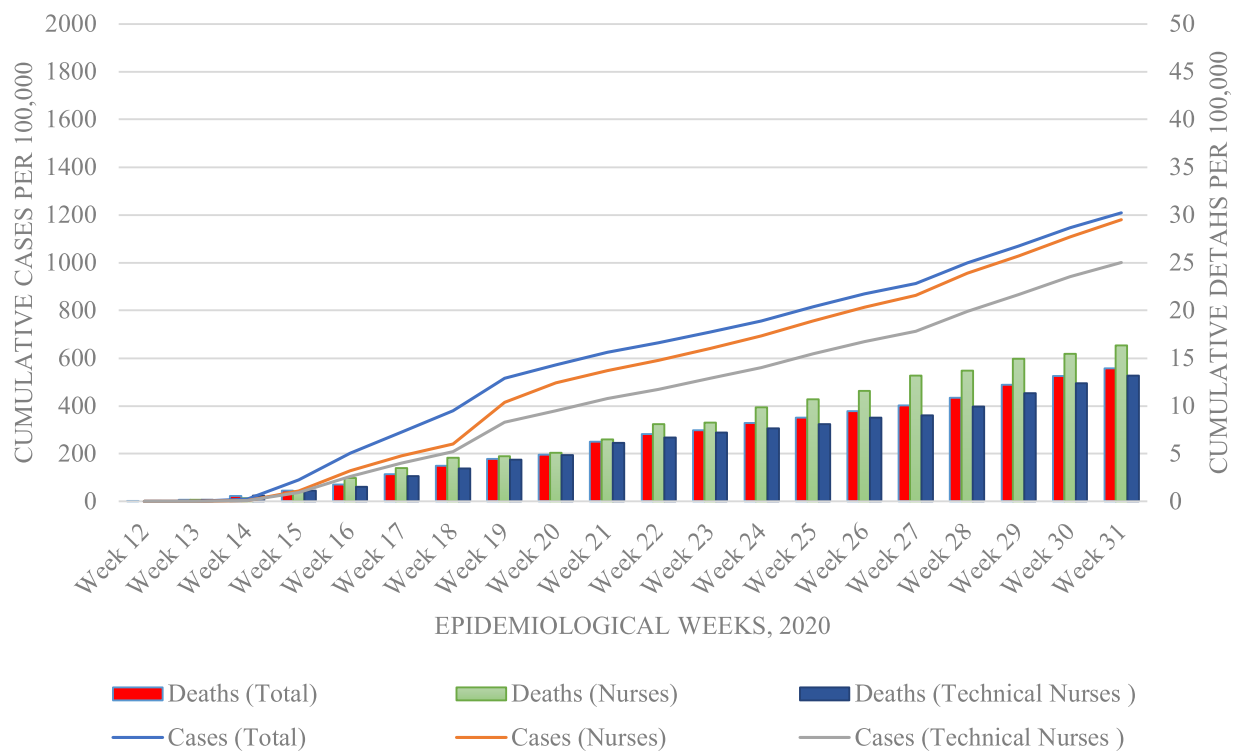


Fig. 1. Cases of COVID-19 infection (right Y-axis) and COVID-19 deaths (left Y-axis) by COVID-19 per 100,000 nursing personnel according to the Brazilian Federal Nursing Council by epidemiological weeks of registration. Weeks 12–31, 2020.

epidemiological week, starts to regress until it disappears after the 21st week.

In relation to deaths from COVID-19, it is important to note the ascending curve throughout the period analyzed, being more accentuated in the beginning, where between the 14th week (with 13 registered deaths) and the 15th week (with 26 registered

deaths) the first doubling in the number of cases occurs; between the 15th and the 17th weeks (67 registered deaths) the second doubling occurs; and the third occurs in the 21st week (145 registered deaths). Nine weeks after the third period, a new doubling in the number of COVID-19 deaths occurs (306 deaths), specifically in the 30th epidemiological week. A similar trend is ob-

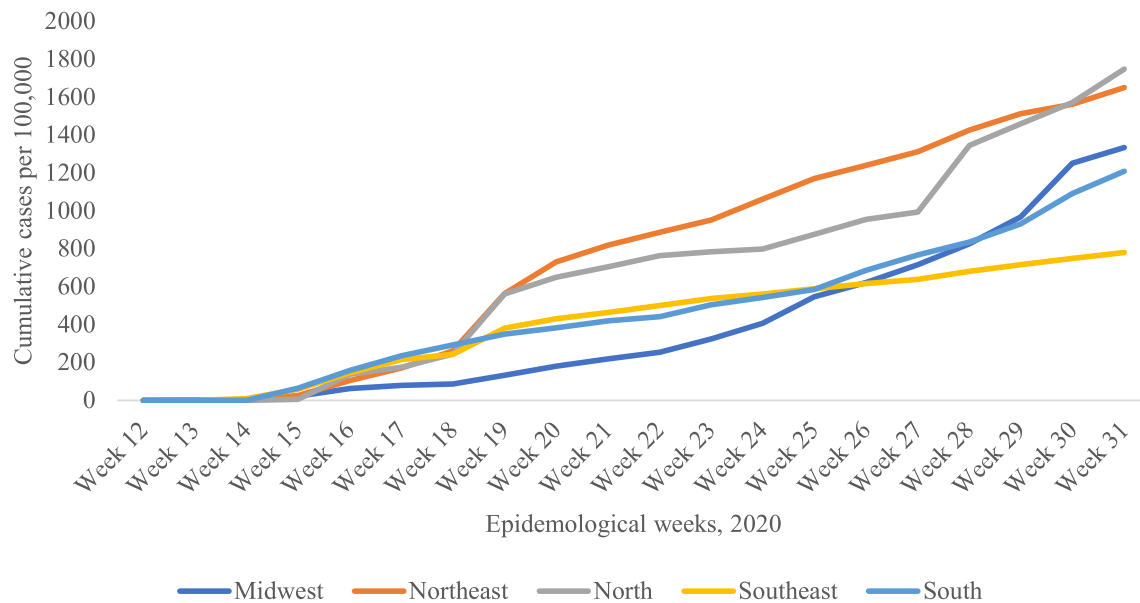


Fig. 2. Cumulative cases of COVID-19 infection per 100,000 *professional 'Nurses'* according to the basis of the Brazilian Federal Nursing Council according to the epidemiological weeks of registration, Brazil, Weeks 12–31, 2020.

served for both *professional 'Nurses'* and *technical nurses*. The cumulative number of deaths among all nursing personnel (Week 31) was 13.96 deaths per 100,000 with 16.35 deaths per 100,000 *professional 'Nurses'* and 13.19 per 100,000 *technical nurses*. Additionally, no missing data from the nursing personnel category were observed in the death record for COVID-19.

4.2. Regional differences

Of the 6713 cases of COVID-19 infection reported for *professional 'Nurses'* (Fig. 2), 36.39% ($n = 2443$) of the records correspond to the Northeast and 30.09% ($n = 2020$) to the Southeast, together making up 66.48% of all notifications of infections in this period. When considering the population base of *professional 'Nurses'* by region in the country, the largest extent of the cases are in the North (1748.53 cases of infection per 100,000 *professional 'Nurses'*) and the Northeast (1651.46 cases of infection per 100,000 *nurses*), followed by the Midwest (1333.66 cases of infection per 100,000 *nurses*), the South (1208.95 cases of infection per 100,000 *professional 'Nurses'*) and finally the Southeast (779.59 cases of infection per 100,000 *professional 'Nurses'*).

Similar to what was observed among *professional 'Nurses'*, of the 17,599 cases of infection among *technical nurses* (Fig. 3), 33.23% ($n = 5849$) of the records correspond to the Northeast and 32.56% ($n = 5731$) to the Southeast, together making up 65.80% of all notifications for the period. When the rates are calculated in relation to the nursing population of the regions, the Northeast with (1495.77 cases of infection per 100,000 *technical nurses*) and the North with (1279.02 cases of infection per 100,000 *technical nurses*) have the highest rates. The next highest region is the Midwest with (1171.52 cases of infection per 100,000 *technical nurses*), followed by the South with (1142.18 cases of infection per 100,000 *technical nurses*) and finally the Southeast with (664.75 cases of infection per 100,000 *technical nurses*). The trends for *technical nurses* by regions are similar to trends among *professional 'Nurses'*.

Although the pattern among categories is similar, the regions differ in relation to the periods of greatest notification (Figs. 2 and 3). With the exception of the period between the 14th and the 16th epidemiological week, the notification of cases of infection

had a higher rate of occurrence at the beginning of the historical series in the North, Northeast and Southeast regions, with the highest values recorded in the 19th epidemiological week. Even though the Midwest and South had increasing characteristics early in the pandemic, the greatest peaks were registered starting in the 29th week. It seems relevant to mention that beginning in the 29th week in the Southern region a new growth trend occurred every three weeks, that is, a new notification peak.

Regarding the deaths of *professional 'Nurses'* shown in Fig. 4, it is observed that, of the 93 deaths, 33.3% (31) and 27.96% ($n = 26$) correspond to the Southeast and Northeast regions, which together make up 61.29% of all deaths registered. In the sequence, the North, Midwest and Southern regions are observed with 25.81% ($n = 24$) deaths, 11.83% ($n = 11$) deaths and 1.08% ($n = 1$) death, respectively. However, when considering the population of *professional 'Nurses'* per 100,000, the North with (56.03 deaths per 100,000 *nurses*) and Northeast with (17.58 deaths per 100,000 *nurses*) have the highest numbers, followed by the Midwest with (22.43 deaths per 100,000 *nurses*), the Southeast with (11.96 deaths per 100,000 *nurses*) and the Southern region with (1.43 deaths per 100,000 *nurses*).

Regarding the distribution of rates throughout the historical series for *professional 'Nurses'*, the markedly ascending curve of the North and Midwest regions has been noted since the beginning of the period analyzed. A similar situation is observed among *technical nurses*, with new increases after the 29th epidemiological week (Fig. 5). In relation to the South, with a linear, low trend throughout the series, there is an increase in notifications beginning in the 26th epidemiological week.

It is important to add that a significant lack of access to PPE in terms of quality and quantity occurred at the beginning of the pandemic. Additionally, all categories of nursing personnel reported that insufficient training on the proper use of PPE generated insecurity for the care of patients with COVID-19. Results presented in a study with 2138 Brazilian nursing personnel show that more than one-half (66.10%) of Brazilian nurses did not feel prepared to face the COVID-19 crisis, slightly more than one-third (35.30%) did not receive the necessary PPE and one-half of all nurses (51.11%) did not undergo specific training for PPE use (Lotta et al., 2020).

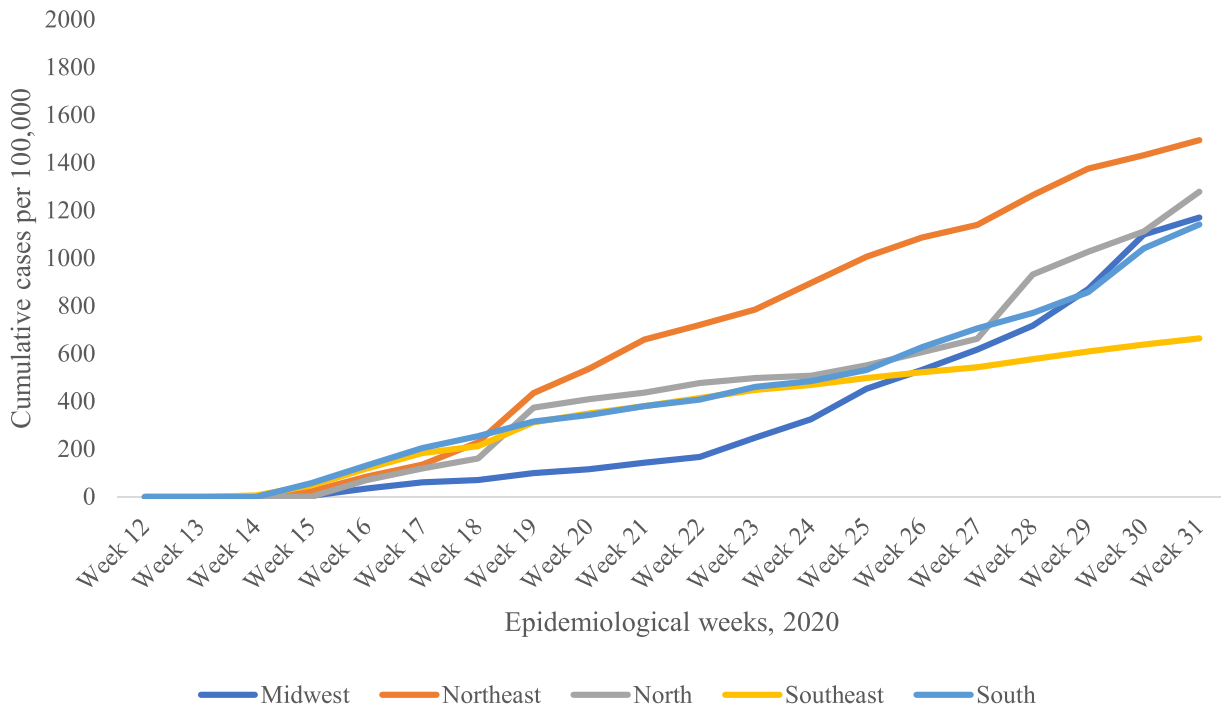


Fig. 3. COVID-19 cases of infection per 100,000 technical nurses according to the basis of the Brazilian Federal Council of Nursing, according to the epidemiological weeks of registration. Brazil, Weeks 12–31, 2020.

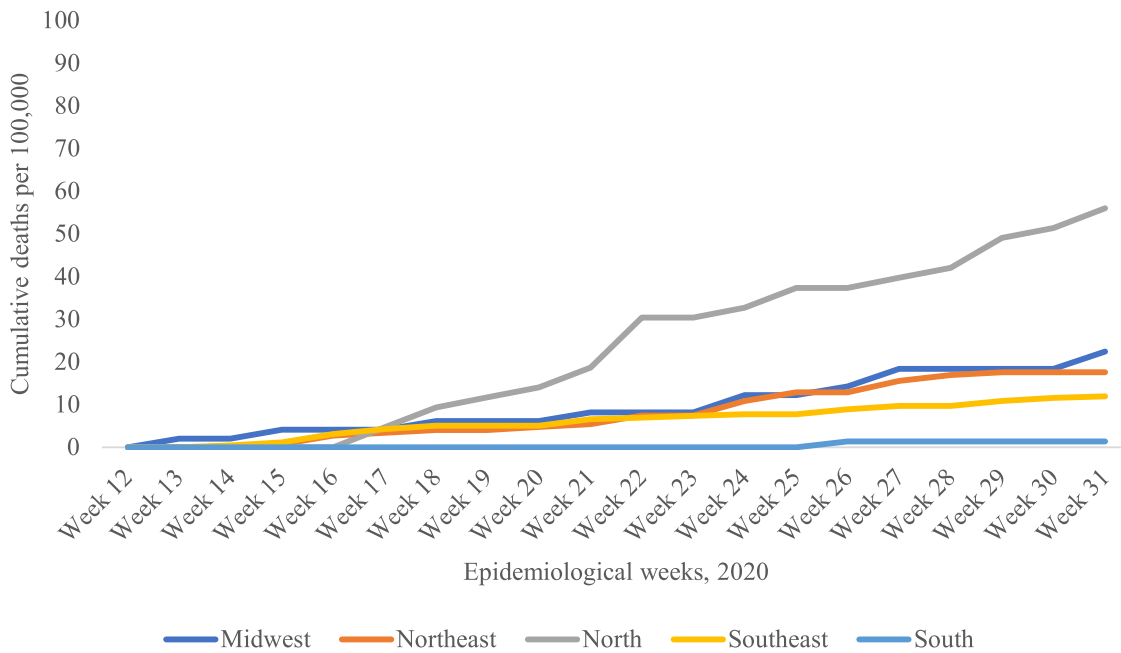


Fig. 4. Deaths from COVID-19 per 100,000 professional Nurses according to the basis of the Brazilian Federal Council of Nursing in function of the epidemiological weeks of registration. Brazil, Weeks 12–31, 2020.

5. Discussion

The purpose of this study was to analyze COVID-19 infections and deaths among nurses registered in the centralized and dedicated *Nursing Observatory* Brazilian database. The strength of the database is related to the comprehensiveness of the system of registering the cases and the high degree of accuracy in the method of reporting. Also, because the reporting of data into the *Nursing Ob-*

servatory is ongoing, it will be possible for researchers to further the analysis over time.

Because all Brazilian nurses regardless of category are required to register with COFEn, counting the number of COVID-19 infections and deaths among nurses in the *Nursing Observatory* has provided us with a good representation of the true number of nurses who suffered and died from the disease over time. Additional information may be possible to ascertain from other sources later on,

such as the clinical practice sites of the nurses and more specific information on the type of PPE available to them. Also, continuing to track the rates of COVID-19 infection and death among nurses by occupational category and geographic region, over time, will be some of the most valuable and important longitudinal information to analyze for future studies.

5.1. General observations

This paper presents a unique analysis of cases of COVID-19 infections and deaths of nursing personnel by Region in Brazil gathered through an open-access database, the *Nursing Observatory* and officially registered and compiled by the Brazilian Council of Nursing. Our findings show that cases of COVID-19 infection and death among nursing personnel rose dramatically throughout the initial period of the pandemic. Nursing personnel in all categories in poorer regions of Brazil and in Regions with fewer health care personnel and health care resources suffered disproportionately from COVID-19 infections and deaths.

In light of the salient findings from this study, it is possible to make observations about the situation pertaining to nurses in Brazil during the early period of the pandemic.

First and foremost, the number of nursing deaths throughout Brazil from COVID-19 during the period analyzed is staggering. It is even more astonishing when considering the fact that we can assume these were fairly healthy nurses working to save the lives of patients in their care when they became sick themselves. Data findings from the *Nursing Observatory* are not anecdotal or case analyses of an occasional nurse who became ill and died. These numbers are a true representation of real human beings who died as a result of their occupation. The devastation and mass trauma brought upon nursing in the context of the COVID-19 pandemic has no parallel in our modern era. Furthermore, nursing was not prepared to lose large numbers of its members to sickness and death without any warning or preparation.

The International Council on Nursing in conjunction with the World Health Organization as well as the various National Nurses Associations across the world are beginning to investigate both the short-term and the long-term ramifications and implications of the magnitude of COVID-19 illness and death on the occupation of nursing ([International Council of Nurses ICN](#); [International Council of Nurses COVID-19 pandemic one year on](#); [International Council of Nurses The COVID-19 Effect](#)). Brazilian researchers also have the luxury of continuing to use the *Nursing Observatory* and as new data are registered to amplify the evidence by creating an expanded analysis of the situation by nursing category in different Regions and States across the country.

Nurses make up the large majority of all health care personnel in Brazil. Our study showed that the largest contingent of all health care personnel is concentrated in the category of the figure of the *technical nurse*. In Brazil *technical nurses* are mainly women. In general, they seek to enter the labor market quickly through a technical school preparation that does not require the time needed for a university degree. The wages for *technical nurses* are significantly lower than that of *professional 'Nurses'*.

The quality of education for *technical nurses* is uneven, with some schools being of high quality and others being less so. In fact, technical schools in Brazil can vary greatly in quality due in part to the large numbers of programs for *technical nurses* created over the last two decades. Additionally, in terms of salary, *technical nurses* have low wages, on average far inferior to the salaries of *professional 'Nurses'*. This often requires them to seek out more than one source of income. Juggling multiple work responsibilities, *technical nurses* in Brazil are under significant work and life stress and at increased risk for severe health consequences. Further re-

search into how the added impact of COVID-19 affected their overall health and wellbeing both in the short and long-term is needed ([Silva and Machado, 2020](#)).

The trajectory for the *technical nurse* described here is consistent with the historically unequal social structure of Brazil, a country in which access to university education has become increasingly difficult. Employment opportunities for *technical nurses* can be precarious, especially in smaller cities and in rural areas. Unemployment for technical nurses in general is at about 10%. *Technical nurses* of color from poor backgrounds can suffer from issues of race, class and gender discrimination ([Baldini et al., 2020](#)). They report high levels of chronic work-related stress and occupational burnout characterized by symptoms of fatigue, generalized energy depletion, higher than normal incidences of depression, obesity, vulnerability to illnesses and high numbers of work absences ([Silva and Machado, 2020](#); [Baldini et al., 2020](#); [Stacciarini et al., 2020](#)).

University educated *professional 'Nurses'* also became infected with COVID-19 and died in significant numbers across the Regions during the initial period of the pandemic. This category of nurse is highly educated and cognizant of infection control policies and procedures. The *professional 'Nurse'* is responsible for both the supervision of nursing units and personnel and for providing direct nursing care to acutely ill intensive care patients.

It is unclear at this time what percentage of these COVID-19 infections and deaths among all categories of nurses could have been avoided. Our hope is that additional evidence garnered over time will lend clarity to these questions to assist health care personnel and institutions to effectively prepare for future epidemics.

5.2. Impact of regional differences in Brazil

Brazil is ethnically and racially diverse with the Northern and Northeastern Regions having higher than average levels of ethnic and racial diversity combined with higher than average levels of poverty. Population density is low in both the North and the Northeast with fewer large cities and more rural areas. Of the top ten states in the Brazilian Federation with the highest Human Development Index, none are located in the North or the Northeast ([International Council of Nurses The COVID-19 Effect 2010](#)). In terms of socioeconomic vulnerability, both the North and the Northeast are considered vulnerable. Health care personnel and health care resources are scarce in both regions. During the initial period of the pandemic, the North and the Northeast suffered COVID-19 mortality rates four times higher than in the Southern, wealthiest region of the country ([Nascimento et al., 2020](#)).

These socioeconomic disparities are taken into consideration when analyzing the incidences of COVID-19 infection and deaths among nurses across regions in Brazil. The concentration of the population and the adequacy of nursing personnel in the Southeast and South Regions, combined with socioeconomic inequalities (with the North and Northeast having fewer health care personnel and resources) are factors that can in part explain the regional and inter-category differences for COVID-19 incidence and deaths among nurses. The Northeast Region has tourist cities with an important flow in terms of the circulation of people, and the Northern Region, although it has a smaller and more dispersed population, has cities like Manaus that concentrate a large number of inhabitants. When the cases of COVID-19 in Manaus began to increase dramatically, it was necessary to mobilize health care personnel and resources immediately from other States to assist with the treatment of serious cases. Unfortunately, this influx of additional personnel and resources was insufficient to offset the enormous spike in cases and the greatly increased demand for beds and care in the North.

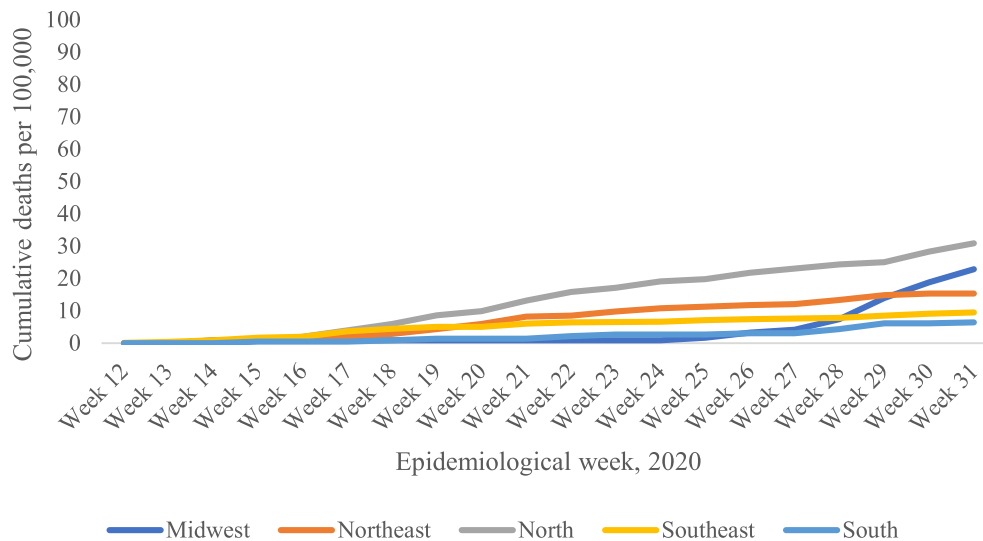


Fig. 5. Deaths from COVID-19 per 100,000 *technical nurses* according to the basis of the Brazilian Federal Council of Nursing due to the epidemiological weeks of registration. Brazil, Weeks 12–31, 2020.

During the pandemic, *technical nurses* as well as *professional 'Nurses'* in some cases were required to assume emergency and direct care for hospitalized and critically ill patients. Due to the notable shortage of *professional 'Nurses'* in the North and Northeast regions, direct care for hospitalized and critically ill patients was taken over primarily by *technical nurses*, while *professional 'Nurses'* assumed both direct patient care and unit managerial activities. Also, in the context of the pandemic, *primary care nurses* who normally provide public health care in the community were mobilized to provide acute emergency and critical care services including the care of patients on ventilators.

Formal studies are being carried out to determine the extent to which the reassignment of primary care community focused nurses to acute and intensive care settings, and the lack of adequate orientation contributed to the higher rates of COVID-19 infection and death of nurses in those areas. At this point in time, circumstantial reports rather than formal studies exist.

Another factor that has been considered as a possible explanation for the rapid increase of COVID-19 cases of infection in the Northern region is that the city of Manaus in the North is a commercial hub between Brazil and China with a constant flow of commodities and people back and forth. It is not known to what degree this business activity between Brazil and China influenced the severity of COVID-19 illness and death in the North (Maciel, 2017).

Difficulties in obtaining sufficient, good quality PPE was an issue that plagued Brazil throughout the entire early months of the pandemic. Lack of evidence about the transmissibility of the virus and the subsequent lack of evidence-based protocols for PPE for HCP was one of the determining factors. The reuse of PPE designated as disposable or single use was a common practice due to the lack of supply. And while PPE was in short supply throughout the country, the areas of the North and the Northeast with fewer health care resources also had less access to PPE thus placing HCP in those regions at increased risk. However, it should be noted that the difficulties in accessing PPE and the lack of a coordinated action plan have affected nurses across the country to some extent, and dramatically in large Brazilian cities, such as São Paulo and Rio de Janeiro.

It is believed that the increase in cases in the Southern region of the country in later weeks of the study period was due, in part, to the slow spread of the pandemic throughout in the country. The

Southern region had a slow evolution of cases in the early weeks when compared to the North (Brasil, 2020).

5.3. Political economy and the pandemic in Brazil

Our data from the *Nursing Observatory* are not directly related to social and political issues. Nonetheless, understanding the Brazilian context can help to explain the way Brazilian nursing was affected by COVID-19. Considering the importance of governmental coordinated actions, we can benefit from considering the current political environment in the country, including the mass media and the role it plays in relation to the health care system.

It is safe to say that a dramatic polarization exists in Brazil between the dissemination of scientific evidence by universities and research institutes, and the negation and lack of coordination of actions by part of government. This phenomenon falls under the category of the politicization of the pandemic (COVID-19 in Brazil 2020).

To begin to understand the context of the Brazilian political economic environment and its relationship to health care, it is important to note that since 2016 and the period of time surrounding the impeachment of President Dilma Roussef, and even earlier with the scandal surrounding the state-run energy firm *Petrobras*, Brazil has undergone numerous political changes that have accentuated inequality in the country and exacerbated class divisions. These changes have economically strapped the Brazilian Unified Health Care system (SUS), with the freezing of important public resources, and engendered a general climate of war against racial, gender and cultural diversity animated mainly by an energetic and fast growing anti-democratic movement toward the right.

As a result, Brazil has had great difficulty in establishing a consensual public health initiative for COVID-19 which requires smooth coordination among multiple tiers of government including the Federal Government, the States, and the Municipalities. This has had an enormous negative effect on the health sector and the government-based Unified Health System (Ortega and Orsini, 2020). This reality is particularly disheartening since Brazil's SUS is known historically for excellence in coordinating large public health campaigns particularly in the organization around family health, immunization and communicable disease prevention. In fact, the Brazilian SUS has been cited repeated in the past as a global model of public health coordination and efficiency.

7. Conclusions

In conclusion, this study is critically important as it is the first picture of the involvement and measurement of the influence of COVID-19 in the Brazilian nursing personnel according to Regions and nursing categories. The exploratory nature of this study sets the stage for further, more targeted research with nursing personnel and other occupational categories, helping to explain the regional disparities related to COVID-19 found in Brazil.

Declaration of Competing Interest

None.

Funding

No external funding.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.ijnurstu.2021.104089](https://doi.org/10.1016/j.ijnurstu.2021.104089).

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