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ORIGINAL ARTICLE

DEATHS DUE TO COVID-19 AMONG BRAZILIAN NURSING WORKERS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Objective: to analyze deaths due to COVID-19 in Brazilian Nursing professionals, with confirmed diagnoses of the disease and in quarantine, hospitalized or deceased, at the Federal Nursing Council Observatory. Method: a cross-sectional study conducted in Brazil between March 2020 and August 2021, via the Federal Nursing Council Observatory. The data were analyzed using descriptive and inferential statistics. Results: the prevalence of death due to COVID-19 in Brazilian Nursing professionals was 2.5% (825/32,560) and 4.9% (109/2,224) in nursing assistants, these latter with a higher mean age ($p<0.0001$). Although 84.5% (27,508/32,560) of the sample was female, the percentage of deaths was higher in the male gender, with 5.2% (263/5,052) ($p<0.0001$). The logistic regression analysis showed that gender and professional category can predict deaths due to COVID-19 among Brazilian Nursing workers. Conclusion: the study contributes to evidencing the risks faced by the professional category in coping with COVID-19, as well as to rethinking measures to reduce the harms imposed by the pandemic on this population segment.

DESCRIPTORS: COVID-19; Health Personnel; Death; Occupational Exposure; Nursing.

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INTRODUCTION

Advent of the COVID-19 pandemic brought to light an ancient concern: integrity of Healthcare Workers (HCWs). The history of outbreaks and pandemics has shown the extent to which HCWs are susceptible to infections. At first, such susceptibility is associated with the health work environment and with the characteristics inherent to the activities developed. These impose close contact with sick or infected people and execution of procedures with exposure to droplets, respiratory secretions, bodily fluids and physiological eliminations, among others[1].

Among HCWs, Nursing professionals stand out as bedside care providers, which exposes them more to the risks arising from their work. Thus, this population segment should be thoughtfully analyzed regarding the infection, illness and death risks, vulnerabilities and prevalence. Such studies have the potential not only to point out these workers' health response but, at the same time, shed light on the organization of governments and of the health care network to cope with calamitous situations.

In the COVID-19 pandemic context, the so-called "front-line" HCWs have routinely lived in contact with SARS-CoV-2 contamination and a significant number of them have succumbed to the infection. Unfortunately, there is no comprehensive global database on infections and deaths among HCWs, which limits acquisition of precise information about the issue. Brazil is one of the countries that has been most affected by the pandemic. Consequently, the need emerges to analyze and disclose the records of cases in this area[2].

According to Agência Brasil, 257,000 HCWs infected by SARS-CoV-2 and 226 deaths were recorded in this group up to August 24th, 2020[3]. This article aims at analyzing deaths due to COVID-19 in Brazilian Nursing professionals, with confirmed diagnosis of the disease and in quarantine, hospitalized or deceased, at the Federal Nursing Council Observatory[4].

METHOD

An analytical and cross-sectional study of the deaths due to COVID-19 was carried out among the professional Nursing categories, considering gender, age and Brazilian regions and during the SARS-Cov-2 pandemic period. The study locus covered the entire Brazilian territory based on the records of deaths due to COVID-19 in Nursing workers from all five Brazilian regions, namely: Midwest (MW), Northeast (NE), North (NO), Southeast (SE) and South (SO). The notifications were made from March 20th, 2020, to August 29th, 2021.

The population consists of all the Nursing workers from the Nurse and Nursing Technician and Nursing Assistant categories nationwide. It is estimated that Brazil has 2,334,909 Nursing workers registered at the Federal Nursing Council[4]. They were selected from secondary data available in the Repository of the Federal Nursing Council Observatory from March 20th, 2020, to August 29th, 2021[5]. A total of 58,569 possible COVID-19 cases were notified in this period. Of these, there was exclusion of 26,009 cases which were classified as suspected and/or unconfirmed diagnoses at the collection time. For this study, a total of 32,560 professionals with confirmed diagnosis of the infection and aged at least 18 years old were selected, whether they were hospitalized, in quarantine or deceased.

The outcome variable, Deaths due to COVID-19 (yes/no) among Nursing professionals, was compared to the sociodemographic predictive variables: gender (male and female), professional category (Nurse, Nursing Technician and Nursing Assistant) and Brazilian regions (NE, MW, SE, SO and NO).

The data were tabulated and analyzed by electronic means and presented in tables

with the aid of the Statistical Package for the Social Sciences (SPSS) statistical program, version 20.0. Univariate and bivariate statistical analyses were performed. The chi-square test and the effect size measure (odds ratio) were used to know the factors associated with death due to COVID-19. For the chi-square test of multiple comparisons, a post hoc test was performed with the polytomous independent variables, using the Bonferroni method to adjust the p-value by category[6].

In order to verify data distribution in the numerical variable (age), the Kolmogorov-Smirnov (KS) normality test was used in two situations. In the first, when testing the death outcome (yes/no) for n=32,560, the data did not follow normal distribution. In view of non-normality, the Mann-Whitney test was used to compare the medians of the age variable between the Nursing professionals who evolved to death and those who did not.

In the second situation, only the Nursing professionals who died due to COVID-19 (n=825) were considered, following normal distribution of the age variable. Given data normality, the Student's t test was applied to compare the mean age between the groups of the gender variable. The ANOVA test was used to compare the mean age between the death cases in the Nursing professionals' categories. In order to allow identification of the statistical significance of the death cases by professional category, the Tukey Honestly Significant Difference (HSD) test of multiple comparisons was performed.

The binary logistic regression statistical model was used in the outcome variable, Death due to COVID-19 ("yes"/"no"), depending on the explanatory variables (gender, age in years old, professional Nursing category and regions) to estimate the probability associated with death due to COVID-19 in view of the aforementioned predictive variables. The multivariate and hierarchical regression model was used, in two blocks. Thus, two models were created: model A, with inclusion of the Brazilian regions variable, and model B, without this variable, as it is considered a possible confounding variable in the analysis of the death outcome. p-values < 0.05 and 95% confidence intervals were considered statistically significant.

The research waived approval by any Ethics Committee, as it used secondary and public domain data, with no possibility of individual identification, as recommended by CNS Resolution 466/2012 under the terms of Law No. 12,527/2011.

RESULTS

A total of 32,560 cases of Nursing professionals with confirmed COVID-19 diagnosis were notified: 9,493 nurses, 20,843 nursing technicians and 2,224 nursing assistants. Of these, 825 evolved to death.

There were 825 (2.5%) deaths among the COVID-19 cases in Nursing professionals in Brazil (825/32,560) and the North region presented the highest occurrence of deaths with 5.9% (240/4,049), followed by the Southeast and Northeast regions with 2.2% (218/9,777) and 1.7% (136/8,055), respectively. It is worth noting that the state of Amazonas presented a higher relative frequency of deaths among these professionals, reaching 62.3% (81/130). However, the highest absolute frequency of deaths due to COVID-19 was recorded in the state of São Paulo, with 2% (94/4,557). Through normal distribution, the Southeast region presented the highest absolute frequency of notified cases of COVID-19 infection, with 9,777.

In the professional category variable, nursing assistants presented higher occurrence of death due to COVID-19, 4.9% (109/2,224), whereas in the gender variable, males prevailed with 5.2% (263/5,052). An odds ratio of 2.6 [CI: 2.30-3.06] was verified, with the male gender presenting three times more chances of dying due to COVID-19 when compared to the female gender (Table 1).

From application of the post hoc test (Bonferroni method) with the adjusted p-value, it was possible to find the categories of the polytomous variables that presented a statistically significant difference. Regarding the professional category, statistical significance was verified among the nursing technicians and assistants. In the territorial aspect, a statistical association was found in all the Brazilian regions (Table 1).

Table 1 - Factors associated with deaths due to COVID-19 among Nursing professionals. Brazil, 2020-2021

Variables	Deaths due to COVID-19				OR€	p-value	χ²¥
	Yes		No				
	n	%	n	%			
Professional category							
Nurse	243	2.6	9,250	97.4	1.1	0.841£	0.04
Nursing Technician	473	2.3	20,370	97.7	1.0	0.000£	16.00
Nursing Assistant	109	4.9	2,115	95.1	2.2	0.000£	54.76
Gender							
Male	263	5.2	4,789	94.8	2.6	0.0001	172.8
Female	562	2.0	26,946	98.0	1.0		
Brazilian regions							
SE*	218	2.2	9,559	97.8	1.4	0.021Ŧ	5.29
SO†	106	1.6	6,654	98.4	1.0	0.000Ŧ	32.49
NE‡	136	1.7	8,055	98.3	1.1	0.000Ŧ	33.64
NO‖	240	5.6	4,059	94.4	3.7	0.000Ŧ	187.69
MW§	125	3.5	3,408	96.5	2.3	0.000Ŧ	16.00

*SE = Southeast; †SO = South; ‡NE = Northeast; ‖NO = North; §MW = Midwest; €OR = Odds Ratio; ¥Chi-square; £p-value adjusted by the Bonferroni method (p<0.008) of the Professional category variable; Ŧp-value adjusted by the Bonferroni method (p<0.005) of the Brazilian regions variable
Source: Federal Nursing Council Observatory (2020-2021).

The Mann-Whitney U test showed a statistical difference, with a higher age median in the professionals that evolved to death (Table 2). In the comparison between the age mean values and the professionals who evolved to death (n=825), it was verified that the age variable follows normal distribution, with a p-value of 0.08 in the KS test, as well as that it presents variance homogeneity based on the Levene test, with p-value > 0.05. The comparison of the age mean values in the gender variable presented a statistical difference, with a mean of 47.3 years old for the male gender (n=263; p=0.015) (Table 2).

By means of the one-way ANOVA test, it was shown that there is an effect on age between the groups [F (2.822) = 27.3; p < 0.05]. The Post Hoc Tukey HSD test evidenced that, on average, age in the Nursing Assistant group differs from the other categories. The Nurse and Nursing Technician categories did not present any difference between their age mean values (Table 2).

Table 2 - Mean age of the deceased due to COVID-19 and sociodemographic variables of the Nursing professionals, 2020-2021. Brazil, 2021

Variables	Age median (n=32,560)	p-value	
Death due to COVID-19			
Yes	49.0§	0.0001*	
No	38.0§		
	Mean age in Death due to COVID-19 (n=825)	f	p-value
Professional category			
Nurse	48.1	27.3	0.0001†
Nursing Technician	48.7		
Nursing Assistant	56.4**		
Gender			
Male	47.3	1.5	0.0001‡
Female	50.3		

*Mann-Whitney U test; §Median; †ANOVA test; ‡Student's t test; **Tukey HSD test
Source: Federal Nursing Council Observatory (2020-2021).

The logistic regression statistical model presented significance in some category of the explanatory variables in relation to the Death due to COVID-19 ("yes"/"no") outcome. Nagelkerke "r^2" has a model forecast of 18.5%. As per the Omnibus method, statistical model A presented chi-square = 875 and Degrees of Freedom = six, with p-value < 0.05. With chi-square = 613.0 and p-value < 0.05, model B shows that the models are better than a model without any predictor.

In model A, where the 'regions' variable was included, age group over 60 years old, male gender, the Nursing Technician and Nursing Assistant professional categories and the North, Southeast and Midwest regions showed to be associated. In model B, where the 'regions' variable was removed, the odds ratio maintained the size effects between the categories of the variables, not suggesting any change in effect due to the variable added in model A (Table 3).

Table 3 - Predicting factors for deaths due to COVID-19 among Nursing professionals Brazil, 2020-2021. Brazil, 2021

Variable	Model A		Model B	
	OR	95% CI	OR	95% CI
Age group (years old)				
<60	1.0		1.0	
≥60	10.8	8.9-13.2	11.1	9.1-13.5
Gender				

Female	1.0		1.0	
Male	2.7	2.3-3.1	2.9	2.4-3.3
Professional category				
Nurse	1.0		1.0	
Nursing Technician	1.3	1.0-1.5	1.2	1.0-1.5
Nursing Assistant	1.3	1.1-1.5	1.2	1.1-1.4
Brazilian regions				
NE	1.0			
SO	1.0	0.8-1.3		
NO	3.2	2.6-4.0		
SE	1.2	0.9-1.4		
MW	2.2	1.7-2.8		

Binary logistic regression test
Source: Federal Nursing Council Observatory (2020-2021).

DISCUSSION

The research evidenced a significant prevalence of deaths due to COVID-19 among Brazilian Nursing professionals. They represent a significant percentage among the healthcare workers who were infected and evolved to death. Prevalence of death among Nursing professionals in Brazil is high when compared to the global numbers disclosed in June 2020 (600 nurses)[7]. The outcome investigated in this study, Death due to COVID-19, showed an association with the gender variable, as well as with professional category, age and Brazilian regions. However, the study may suffer from some confounding due to the absence of data/variables in the source researched. Nevertheless, statistical tests were performed to ensure soundness of the inferences.

From the beginning of the pandemic until August 2021, the data from the Federal Nursing Council Observatory reveal a high number of confirmed infections among the categories studied. Among Nursing professionals, this reality can be explained by their constant exposure to the occupational illness risk, with an already expected susceptibility to in-hospital infections. Characteristics inherent to the health service itself, the work activities developed, proximity to infected or potentially infected people and performance of procedures susceptible to contamination by COVID-19 can be mentioned[8].

This understanding is corroborated by a systematic review study that investigated infection and death due to COVID-19 among health professionals and included eight countries in its sample. Among the most cited findings related to the infection are the following: close contact with potentially contaminated patients or co-workers, procedures with risk of aerosol generation, and insufficient air renewal in a negative pressure environment[9].

Other international data are similar to those obtained in this study. The prevalence of COVID-19 among Healthcare Workers was significant at the global level. Countries such as the United States reported a maximum prevalence value of 19% between February and April 2020[7]. Up to May 2020, more than 12,000 infection cases had been recorded in Germany[10]. In Italy and Spain, Healthcare Workers represented 10.5% and 26% of the COVID-19 infection cases by the end of April 2020, respectively[11].

The history of infectious diseases, as well as that of outbreaks and pandemics, has shown the extent to which Healthcare Workers are susceptible. In the SARS 21 outbreak, 07% of infected workers was confirmed at the global level, reaching 57.14% in Vietnam. In turn, during the MERS outbreak, 450 of the total cases (2,519) were recorded in Healthcare Workers[12]. A systematic review study involving the United States, China and Italy showed that almost 10% of the patients who tested positive for COVID-19 were health professionals[13].

Another study, conducted in England, quantified occupational risk for COVID-19 among health professionals and obtained from 1.5% to 2.5% of relative risk for the infection. The Nursing category was among the occupations at highest risk, with 2.26 (95% CI: 2.2-2.3)[14]. Nursing is a category that is deeply involved in providing direct bedside care to the patient. Such being the case, it is significantly exposed to occupational risks and, consequently, to COVID-19.

Another aspect associated with Nursing is its feminization[15]. In this research, the female gender presented a higher relative frequency of infected individuals. However, with regard to the research outcome related to death, our results showed an association with gender; when analyzing the size measure, it was verified that males present three times more chances of dying due to COVID-19 than females.

An antigen test study reported greater positivity in males and makes a reference to empirical studies that found greater disease severity in this gender. It also reports that mortality due to COVID-19 in the male gender was statistically significant in England and Wales[16]. When studying vulnerability to COVID-19 in physicians and nurses, another research study showed that almost 70% of the deaths corresponded to the male gender[17].

Regarding the general data on age in years old, there was a statistical difference between the mean age values. The professionals that evolved to death due to COVID-19 had a higher age median than the group which did not evolve to that outcome. A study conducted in China investigated more than 44,000 patients in relation to the role of age in mortality due to COVID-19 and showed an odds ratio (OR) of 3.4 times more chances of dying due to COVID-19 when compared to the previous 10-year-old age group[18]. Between March and May 2020, in England it was verified that, of the front-line healthcare workers who evolved to death, 36.1% were aged at least 60 years old[19]. Another study, which evaluated more than 9,000 healthcare workers with COVID-19, found a higher frequency of death cases among those aged over 65 years old[20].

In this study, when seeking to understand the statistical significance of male deaths among Nursing professionals, a comparison was made between mean age and the gender variable, which was carried out only among professionals who died due to COVID-19. Interestingly, the mean age corresponding to the death cases in the male population is 47 years old, lower than in the female population, where the mean age in the death cases was 50 years old. This finding pointed out that higher mean age was not the cause for the higher percentage of death cases in the male gender.

The Midwest and North regions stand out with higher occurrence of death due to COVID-19 in the Brazilian regions. Among the states, Amazonas presents higher occurrence of death cases. This fact leads us to reflect on the ability of the health care network in each region to respond to the pandemic. The high occurrence found in the North region draws the attention. Historically, it is a region of the country that suffers the most impacts from infectious diseases[21]. It is to be reminded that this region was the first in the country where the health services collapsed due to the pandemic, although with a lower number of absolute number of cases of the disease.

There was scarcity of resources to fight against COVID-19, namely: structural resources such as adequate ambience, ventilation and air purification; technological equipment such as mechanical ventilators, respiratory filters and non-rebreathing respiratory masks; and personal protective equipment such as N95 masks. A study carried out in China reveals that adaptations in the hospital environment, such as appropriate ventilation, can reduce

the potential risk of COVID-19 infection among healthcare workers[22].

With regard to the incidence of death by professional category, when only the data on deaths due to COVID-19 among Nursing professionals were analyzed, there was a more significant statistical difference in nursing assistants in relation to the other categories. The Nursing Assistant category presented the highest mean age (57 years old), while the Nurse and Nursing Technician categories had a mean age of less than 50 years old.

One of the aspects to be considered is the fact that nursing assistants represent a group of older workers. This category has been extinct for some years, consisting in older individuals and, we can infer, more likely to have comorbidities, increasing the risk for complications and deaths due to COVID-19.

From the regression analysis performed, it was possible to observe that gender, professional category, age and regions are variables that can predict death due to COVID-19 among Nursing professionals. Given the accrued experience and the diverse scientific evidence, the association between older age and death due to COVID is now clear. In this research, similarly to the world literature, it was also possible to observe this association. However, in addition to age, it is important to consider other aspects in the higher incidence of death among nursing assistants.

In the first place, let us consider that this group of Nursing professionals is among the health workers with greater social vulnerability. They also represent a group of health workers with the lowest salaries. This fact can clearly contribute to a higher risk of occupational illness[23]. Added to this are characteristics inherent to the work of nursing assistants and their greater performance in direct patient care activities, being more exposed to health-related wear out due to greater involvement in direct care[24].

It is necessary to cope with the pandemic and with the risks and/or harms it causes to health and nursing workers, which need to be faced with a proactive attitude not only by governments, managers and health institutions but also by Healthcare Workers themselves. Various political and management investments are required to face the situation, such as: community control of the pandemic; structuring of health services; training of workers; fair salary policies; and provision of means, equipment and instruments necessary for the development of assistance with a minimum of risk to workers and the community.

Until this research was concluded, the relationship between age and deaths in the male gender was not clear. The results of this research add new data to knowledge about COVID-19 and, at the same time, raise the need for further research studies to investigate the higher occurrence of deaths among the male population. As a research limitation, in the investigation of this aspect, we cite the fact that we are not aware of the record of comorbidities in the population herein studied.

CONCLUSION

The study evidenced factors associated with death due to COVID-19 among Nursing professionals with statistical significance, with an emphasis on the Nursing Assistant category, male gender and Brazilian North region groups, which presented higher prevalence of death cases. Another finding was the higher age median found in the group that evolved to death due to COVID-19.

The research contributed to showing the significant impact of death cases due to COVID-19 among Nursing workers. It is clear that this expressiveness is not exclusive to the operation of an etiological agent. In its background, there are structural conditions of health services along with inadequate working conditions. As a result, it leads to a reflection on the need for qualification of the health services in their structural aspects, ambience and

provision of resources, as well as on the appreciation of less valued health occupations. Otherwise, other pandemics will come and negatively surprise us.

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