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Epidemiological study of COVID-19 among Nursing professionals in São Paulo in 2021 and 2022

Estudo epidemiológico da COVID-19 entre profissionais de Enfermagem de São Paulo em 2021 e 2022
Estudio epidemiológico de la COVID-19 en profesionales de enfermería de São Paulo en 2021 y 2022

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Abstract

Objective: to analyze the prevalence and factors associated with COVID-19 in Nursing professionals in the State of São Paulo, in the pandemic context. **Methods**: cross-sectional epidemiological study with remote data collection via Google Forms®, between October 2021 and January 2022. A total of 1,073 professionals participated. Snowball sampling was used, and statistical analysis was performed with adjusted Poisson regression, considering COVID-19 infection as the dependent variable. **Results**: the infection prevalence was 39.4% and was associated, in the adjusted model, with: having children (PR=1.44; 95% CI: 1.12–1.86), working for more than 10 years (PR=1.42; 95% CI: 1.04–1.94), working in COVID-19 sectors (PR=1.36; 95% CI: 1.08–1.70), and negative self-rated health (PR=1.38; 95% CI: 1.07–1.79). **Conclusion**: The high prevalence of COVID-19 was related to sociodemographic and occupational factors and perceived health, indicating the need for specific protection and support strategies aimed at this group in dealing with health emergencies. The findings highlighted the importance of concrete measures, such as investments in training, safety protocols, preventive actions, and public policies that ensure the rights and value of these professionals, who are fundamental to the functioning of the health system.

Descriptors: Nurse Professionals; COVID-19; Mental disorders; Risk Factors; Occupational Health.

Whats is already known on this?
The Nursing team was one of the categories most exposed to the risk of COVID-19 infection during the pandemic, and these professionals continue to feel its psychosocial impacts to this day.

What this study adds?
It broadens the understanding of Nursing professionals' vulnerability factors for COVID-19 infection (sociodemographic, occupational, and perceived health) and provides support for institutional actions and public protection policies.

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Resumo

Objetivo: *analisar a prevalência e os fatores associados à COVID-19 em profissionais da Enfermagem do Estado de São Paulo, no contexto da pandemia.* ***Método:*** *estudo epidemiológico de corte transversal com coleta remota via Google Forms®, entre outubro de 2021 e janeiro de 2022. Participaram 1.073 profissionais. Utilizou-se a amostragem por bola de neve e realizou-se a análise estatística com regressão de Poisson ajustada, considerando a infecção por COVID-19 como variável dependente.* ***Resultados:*** *a prevalência de infecção foi de 39,4%, e mostrou-se associada, no modelo ajustado, a: ter filhos (RP=1,44; IC95%: 1,12–1,86), tempo de trabalho superior a 10 anos (RP=1,42; IC95%: 1,04–1,94), atuação em setores COVID-19 (RP=1,36; IC95%: 1,08–1,70) e autoavaliação de saúde negativa (RP=1,38; IC95%: 1,07–1,79).* ***Conclusão:*** *a elevada prevalência de COVID-19 esteve relacionada aos fatores sociodemográficos, ocupacionais e à saúde percebida, indicando a necessidade de estratégias específicas de proteção e suporte direcionadas a esse grupo no enfrentamento de emergências sanitárias. Os achados evidenciaram a importância de medidas concretas, como investimentos em treinamento, protocolos de segurança, ações preventivas e políticas públicas que assegurem os direitos e valorizem esses profissionais, fundamentais para o funcionamento do sistema de saúde.*

Descritores: *Profissionais de enfermagem; COVID-19; Transtornos mentais; Fatores de Risco; Saúde Ocupacional.*

Resumén

Objetivo: *analizar la prevalencia y los factores asociados a la COVID-19 en profesionales de enfermería del estado de São Paulo, en el contexto de la pandemia.* ***Método:*** *estudio epidemiológico transversal con recolección remota de datos mediante Google Forms®, entre octubre de 2021 y enero de 2022. Participaron 1073 profesionales. Se utilizó un muestreo de bola de nieve y el análisis estadístico se realizó mediante regresión de Poisson ajustada, considerando la infección por COVID-19 como variable dependiente.* ***Resultados:*** *la prevalencia de infección fue del 39,4%, y en el modelo ajustado, se asoció con: tener hijos (RP=1,44; IC 95%: 1,12–1,86), más de 10 años de experiencia laboral (RP=1,42; IC 95%: 1,04–1,94), trabajar en sectores COVID-19 (RP=1,36; IC 95%: 1,08–1,70) y salud autoevaluada negativa (RP=1,38; IC 95%: 1,07–1,79).* ***Conclusión:*** *la alta prevalencia de COVID-19 se relacionó con factores sociodemográficos, ocupacionales y de salud percibida, lo que indica la necesidad de estrategias específicas de protección y apoyo dirigidas a este grupo para abordar las emergencias sanitarias. Los hallazgos destacaron la importancia de medidas concretas, como inversiones en capacitación, protocolos de seguridad, acciones preventivas y políticas públicas que garanticen los derechos y el valor de estos profesionales, que son fundamentales para el funcionamiento del sistema de salud.*

Descriptores*: Enfermeras Practicantes; COVID-19; Trastornos Mentales; Factores de Riesco; Salud Laboral.*

INTRODUCTION

In professional practice, Nursing workers deal daily with situations involving exposure to occupational and psychosocial risks that continuously subject them to the risk of physical and mental illness. Exposure to biological hazards is among the main factors of concern and investigation among researchers in the field of occupational health, especially in relation to exposure to human blood and body fluids, mainly due to the risk of infection by the Human Immunodeficiency Virus (HIV) and Hepatitis B (HBV) and C (HCV).[1]

However, in addition to infections through blood contact, several other procedures, such as aerosol generators, expose Nursing professionals to pathogens that cause acute respiratory infections[2], such as flu-like syndromes, acute respiratory syndromes, and COVID-19. Some procedures, such as tracheal intubation, non-invasive ventilation, tracheostomy, and manual ventilation, for example, potentially increase the risk of infection for workers involved in this care[2], including Nursing professionals.

With the advent of the COVID-19 pandemic, which began in 2020, concern about infection through contact with respiratory droplets and aerosols took on a new perspective for the population and the scientific community, due to the high risk of infection and the serious consequences for infected individuals. From the notification of the first case in China in December 2019 to December 2023, 772,052,752 cases were reported, with 6,985,278 deaths[3], many of whom were healthcare professionals who became infected as a result of their work.[4-5]

Given the severity of the public health crisis, sanitary measures were implemented in an effort to contain the pandemic's progress. Among these measures, the adoption of sanitary protocols such as the use of Personal Protective Equipment (PPE) by healthcare professionals became mandatory across all services. However, with the rapid spread of the disease, PPE became scarce, and strategies, even without scientifically proven effectiveness, began to be recommended and implemented for the general population and healthcare workers, such as the recommendation to use cloth masks[6] and reuse particulate respirators, such as N95 or PFF2 masks.[7]

Despite facing uncertainty and a high risk of infection, Nursing workers continued to work in all healthcare settings, implementing disease prevention measures, promoting and protecting health, and assisting in the recovery and rehabilitation of people affected by the virus. Despite the adoption of health measures, many of these workers were infected with SARS-CoV-2 in various contexts[4-5,8], the

consequences of which involved physical and mental illnesses, many of which are still unknown to Medicine.

Although the pandemic context has mobilized institutional and governmental actions, several weaknesses have been highlighted in public policies aimed at protecting the healthcare workforce, especially nurses. Documents such as Ordinance GM/MS No. 639/2020, which aimed at the emergency training of healthcare professionals, had a heterogeneous implementation.[9] In addition, World Health Organization (WHO) guidelines highlighted the need to ensure access to PPE, psychosocial support, and safe work environments[10], which was not always guaranteed in Brazil. Several reports from the Federal Nursing Council also indicated a lack of basic resources and institutional support, especially in the early months of the pandemic.[11]

Despite evidence of risk and exposure among Nursing staff, there are still few studies that analyze the factors associated with COVID-19 infection in this group in a regionalized and updated manner. The State of São Paulo has the largest number of nursing workers in the country and was one of the epicenters of the pandemic, which reinforces the relevance of the geographical focus. The period from 2021 to 2022, in turn, was marked by the introduction of new variants, expanded vaccination coverage, and the relaxation of health measures, which makes analysis during this interval particularly relevant.

Therefore, identifying the factors involved in infection and the development of diseases, both physical and psychological, is essential for preventive, protective, and curative measures to be adopted in new epidemics. It is known, for example, that mental disorders have specific characteristics in terms of symptom manifestations, which vary among individuals. However, in conditions of emotional overload, such as during epidemic outbreaks, healthcare professionals tend to have a higher prevalence than the rest of the population[12] which will consequently have a general impact on the health conditions of these workers. Thus, studying the impact of infectious diseases on the health of Nursing professionals is fundamental for the development of institutional actions and public policies aimed at prevention and health promotion for this population.

Considering that scientific evidence provides a solid basis for decision-making, this study aims to analyze the prevalence and factors associated with COVID-19 among Nursing professionals in the state of São Paulo, in the context of the pandemic.

METHODS

This is a cross-sectional epidemiological study conducted online with Nursing professionals in the state of São Paulo. Data collection took place during the COVID-19 pandemic, between October 2021 and January 2022.

The study included nurses, technicians, and Nursing assistants who were actively registered with the Professional Council and working in public and private healthcare facilities in the state of São Paulo, with a professional connection directly linked to professional Nursing training.

In 2022, the nursing workforce in São Paulo consisted of 749,958 workers, comprising 175,337 nurses, 317,572 Nursing Technicians, 256,705 Nursing Assistants, and 344 midwives.[13] To estimate the sample size, the sample calculation for proportions was used, considering a confidence level of 95%, a margin of error of 5%, and an expected proportion of 50%. 25% was added to the sample calculation for losses, confounding factors, and variability, resulting in a minimum sample of 482 participants. The sample consisted of 1,073 participants, representing approximately 0.14% of Nursing professionals in the state.

The research comprised all Nursing professionals aged ≥ 18 years, working professionally in the state of São Paulo during the COVID-19 context. Workers belonging to the categories of nurse, Nursing technician, and Nursing assistant who had an employment relationship with health establishments or related institutions were considered eligible, regardless of the nature of the employment relationship, the type of service, or the length of time working in the area. Workers who did not fully complete the electronic questionnaire were excluded.

The strategy for publicizing the study and recruiting participants was carried out through multiple channels. It involved posting calls on social media platforms (Facebook, WhatsApp, and Instagram) and sending emails targeted at interest groups of nursing professionals.

Additionally, collaboration was sought from Nursing representative entities and bodies to widely disseminate the invitation and the link to access the research instrument through their institutional channels. Among them, we highlight the Federal Nursing Council (*Conselho Federal de Enfermagem* - COFEN), the Regional Councils (*Conselhos Regionais* - COREN), the Brazilian Nursing Association

(*Associação Brasileira de Enfermagem* - ABEn), both the national headquarters and its state sections, as well as unions and federations in the category.

Data collection was carried out using an electronic questionnaire developed by the researchers and made available on the Google Forms® platform. At the end of the instrument, an invitation was included for respondents to share the survey link with other professionals in the field, using the non-probabilistic snowball sampling technique. In this method, each participant indicates new respondents with similar characteristics, intending to form a successive chain of invitations until the sample size predicted for the study is reached.[14]

This study used the STROBE checklist as a methodological reference, as recommended by the EQUATOR network for observational studies. The dependent variable was self-reported "COVID-19 infection" (yes/no). Independent variables included sociodemographic, economic, and occupational data, mental and behavioral disorders, and self-assessment of health status, according to the following variables and their respective response categories:

1) Sociodemographic information: gender (M or F); age group (categorized as 20–24 years, 35–41 years, 42–48 years, and ≥49 years); income from employment (distributed into ≤ 2 minimum wages, 3 to 4 minimum wages, ≥ 5 minimum wages); marital status (married/single); and presence of children (yes/no));

2) Occupational information: professional category in Nursing, classified into three levels: higher (nurse), technical (Nursing technician), and basic (Nursing assistant); Length of professional practice (in years); number of employment contracts; work in sectors dedicated to caring for patients with COVID-19 (yes/no); and, for those who answered yes, weekly working hours dedicated to care in these sectors (in hours).

3) Health status: positive test for COVID-19 (yes/no) during the pandemic; diagnoses of mental and behavioral disorders (yes/no), and self-assessment of health status (good/poor).

Statistical analysis was performed using Microsoft Excel® and Stata version 12 software. First, 5% of the completed variables were categorized and randomly checked by one of the researchers to minimize the possibility of error and ensure data reliability.

The descriptive analysis included calculation of absolute and relative frequencies for categorical variables, and measures of central tendency (mean and median) and dispersion, Standard Deviation (SD), and interquartile range for the age variable.

In the inferential analysis, Pearson's chi-square test and Poisson regression were used, which included both crude (univariate) and adjusted (multivariate) analyses. The primary outcome evaluated was COVID-19 infection (dependent variable). Prevalence Ratios (PR) and their respective 95% Confidence Intervals (95% CI) were calculated to determine the association between the outcome and the following independent variables: gender, age, skin color, education, geographic region, smoking, National Classification of Economic Activities (CNAE), type of employment relationship, and different occupational exposures.

In multiple modeling, only variables with a p-value < 0.2 in the univariate analysis remained. The level of statistical significance adopted for rejecting the null hypothesis was $p < 0.05$.

The multiple analysis was conducted using a hierarchical epidemiological model structured on three levels of determination. The first, distal level encompassed socioeconomic factors such as gender, age, income, marital status, and presence of children. The second, intermediate level brought together occupational variables such as professional category, length of experience in Nursing, number of employment contracts, work in units dedicated to the care of patients with COVID-19, and weekly workload in these sectors. Finally, the proximal level included aspects related to general health status, such as mental and behavioral disorders and self-assessment of well-being. The variables were included in the model sequentially, in order to respect the hierarchy of the blocks, until the final model with the three analytical levels was defined.[15]

Variables associated with the outcome were considered to be those that had a significant association in the adjusted model. The fit of the final model was verified using Pearson's goodness-of-fit test, according to the hierarchical modeling process presented in Table 1.

Table 1. Structure of the multiple hierarchical model adopted for analysis of the outcome and independent variables included in the study, São Paulo, SP, Brazil, 2022.

Block	Equation (set of variables)	Interpretation
Distal	Socioeconomic	The variables in this block were adjusted for one another
Intermediate	Socioeconomic + occupational	The first block helped adjust the second block
Proximal	Socioeconomic + occupational + health status	The first and second blocks helped adjust the third block

Source: Prepared by the authors (2022).

This study was submitted to and approved by the Research Ethics Committee (REC) on August 17, 2021, under opinion 4,981,627, in accordance with resolution 466/2012.

RESULTS

Among the 1,073 Nursing professionals participating in the study, 87% were female, aged between 35 and 41 years (28.7%), with a mean age of 41.8 years, median age of 41 years, SD of 9.5 years, minimum age of 20 years and maximum age of 70 years, and with a salary range between 3 and 4 minimum wages (39.1%). The overall prevalence of COVID-19 was 423 infected individuals (39.4%), with the highest proportions and significance for marital status "single" (42%) and with children (43.1%) (Table 1). The average age of professionals who reported being infected with SARS-CoV-2 was 41.9 years, and the median age was 41 years.

Table 1. COVID-19 prevalence among Nursing workers according to gender, age group, income, marital status, and children. São Paulo (SP), Brazil, 2021-2022.

Variable	COVID-19 infection		
	Yes (%) n (%)	No n (%)	p-value[X]
Gender (n = 1,073)			= 0.823
Male	56 (40.3)	139 (13)	
Female	367 (39.3)	934 (87)	
Age group (n = 1,067)			= 0.782
20 – 34 years	93 (38.6)	241 (22.5)	
35 – 41 years	126 (41.2)	306 (28.7)	
42 – 48 years	102 (40.5)	252 (23.6)	
≥ 49 years	100 (37.3)	268 (25.1)	
Income (n = 1,073)			= 0.08
≤ 2 minimum wages	134 (37.2)	360 (33.5)	
3 to 4 minimum wages	183 (43.6)	420 (39.1)	
≥ 5 minimum wages	106 (36.2)	293 (27.3)	
Marital Status (n = 1,073)			< 0.05
Single	292 (42)	695 (64.8)	
Married	131 (34.7)	378 (35.2)	
Children (n = 1,073)			< 0.005
No	93 (30.2)	308 (28.7)	
Yes	330 (43.1)	765 (71.3)	

Note: [X]Pearson's chi-square test.
Source: Survey data.

Table 2 shows that the largest category corresponded to Nursing professionals with secondary/elementary education (62.1%), with more than 10 years of Nursing experience, with only one job in the profession (75.5%), with a workload in the COVID-19 sector of up to 44 hours/week (66.8%), and with a commitment to self-assessment of health (70.8%). Regarding the prevalence of COVID-19, the highest statistically significant occurrences were observed in Nursing technicians and assistants (42.3%), between five and 10 years of work (56%), more than two employment contracts (59.7%); length of service

in the COVID-19 sector (43.8%); presence of a Common Mental Disorder (CMD) (43.1%); and poor self-rated health (43.2%).

Table 2. COVID-19 prevalence among Nursing workers according to profession, length of service, employment status, COVID-19 sector, common mental disorder, and self-rated health. São Paulo (SP), Brazil, 2021–2022.

Variable	COVID-19 Infection		
	Yes n (%)	No n (%)	p-value[X]
Occupation (n = 1,055)			< 0.05
Nursing Assistant/Technician	277 (42.3)	655 (62.1)	
Nurse	139 (34.7)	400 (37.9)	
Length of service in years (n = 1,073)			< 0.05
< 5 years	72 (31.7)	277 (21.2)	
5 to 10 years	81 (43.8)	185 (17.2)	
> 10 years	270 (40.8)	661 (61.6)	
Employment contracts (n = 1,073)			= 0.475
One	311 (38.4)	810 (75.5)	
Two	66 (43.1)	144 (13.4)	
More than two	71 (42)	119 (11.1)	
COVID-19 Sector (n = 1,073)			< 0.005
No	64 (29.4)	358 (33.4)	
Yes	359 (43.8)	715 (66.6)	
Common mental disorder (n = 1,073)			< 0.05
No	188 (35.6)	545 (49.2)	
Yes	235 (43.1)	528 (50.8)	
Self-rated health (n = 1,073)			< 0.005
No impairment (good)	95 (30.3)	313 (29.2)	
With impairment (bad)	328 (43.2)	760 (70.8)	

Note: [X]Pearson's chi-square test.
Source: Survey data

Table 3 shows the strong statistical association between COVID-19 and those who had children, both in the univariate analysis and in the final model, with an OR of 1.44 (95% CI: 1.12; 1.86).

Table 3. Crude and adjusted analysis of COVID-19 infection among Nursing workers according to gender, age group, income, marital status, and children. São Paulo (SP), Brazil, 2021-2022.

Variable	PR[c] (95% CI)[c]	PR[a] (95% CI)[c]
Gender		
Male	1 (reference)	1 (reference)
Female	0.95 (0.73; 1.29)	0.92 (0.69; 1.23)
Age group		
20 to 34 years	1 (reference)	1 (reference)
35 to 41 years	1.06 (0.81; 1.39)	0.97 (0.74; 1.29)
42 to 48 years	1.04 (0.79; 1.38)	0.93 (0.69; 1.25)
≥ 49 years	0.96 (0.72; 1.28)	0.87 (0.64; 1.17)
Income		
≤ 2 minimum wages	1 (reference)	1 (reference)
3 to 4 minimum wages	1.17 (0.93; 1.46)	1.17 (0.93; 1.46)
≥ 5 minimum wages	0.97 (0.75; 1.25)	1.0 (0.77; 1.3)
Marital Status		
Single	1 (reference)	1 (reference)
Married	1.21 (0.99; 1.49)	1.09 (0.88; 1.36)
Children		

No	1 (reference)	1 (reference)
Yes	1.42 (1.14; 1.79) ***	1.44 (1.12; 1.86) ***

Note: PR[c]: Crude prevalence ratio; PR[a]: Prevalence ratio adjusted with Poisson regression; (95% CI)[c]: 95% confidence interval; *p-value < 0.05 in the Wald test; **p-value < 0.005 in the Wald test; ***p-value < 0.0005 in the Wald test.
Source: Survey data.

The final model of the inferential analysis, performed using Poisson regression, demonstrated an adequate fit, as evidenced by Pearson's goodness-of-fit test (p > 0.05), and allowed us to verify the fit of the independent variables both within and between analysis blocks during the modeling process. As detailed in Table 4, the categories that maintained a significant association in the adjusted model were: work experience of more than 10 years, with an OR of 1.42 (95% CI: 1.04; 1.94); working in the COVID-19 sector, with an OR of 1.36 (95% CI: 1.08; 1.70); and self-assessment of health status as poor, with an OR of 1.38 (95% CI: 1.07; 1.79).

Table 4. Crude and adjusted analysis of COVID-19 infection among Nursing workers according to profession, length of service, employment status, COVID-19 sector, common mental disorder, and self-rated health. São Paulo (SP), Brazil, 2021-2022.

Variable	PR[c] (95% CI)[c]	PR[a] (95% CI)[c]
Occupation		
Nursing Assistant/Technician	1 (reference)	1 (reference)
Nurse	0.82 (0.67; 1.0)	0.93 (0.81; 1.07)
Length of service in years		
< 5 years	1 (reference)	1 (reference)
5 to 10 years	13.8 (1.01; 1.89)*	1.34 (0.97; 1.86)
> 10 years	1.28 (0.99; 1.67)	1.42 (1.04; 1.94) *
Employment contracts		
One	1 (reference)	1 (reference)
Two	1.12 (0.85; 1.47)	1.12 (0.84; 1.5)
More than two	1.09 (0.81; 1.47)	1.13 (0.83; 1.54)
COVID-19 Sector		
No	1 (reference)	1 (reference)
Yes	1.42 (1.15; 1.77)***	1.36 (1.08; 1.7) *
Common Mental Disorder		
No	1 (reference)	1 (reference)
Yes	1.21 (0.99; 1.46)	1.13 (0.91; 1.39)
Self-rated health		
No impairment (good)	1 (reference)	1 (reference)
With impairment (bad)	1.42 (1.13; 1.79) ***	1.38 (1.07; 1.79) *

Note: PR[c]: Crude prevalence ratio; PR[a]: Prevalence ratio adjusted with Poisson regression; (95% CI)[c]: 95% confidence interval; *p-value < 0.05 in the Wald test; **p-value < 0.005 in the Wald test; ***p-value < 0.0005 in the Wald test.
Source: Survey data.

DISCUSSION

The study showed a high rate of Nursing workers diagnosed with COVID-19, with the outcome associated with the fact that they had children, had been working in the profession for more than 10 years, worked in sectors caring for patients diagnosed with SARS-CoV-2 infection, and had poor self-rated health.

Close and direct contact with patients is characteristic of Nursing practice. Proximity to the person receiving care is essential for performing Nursing duties, regardless of the level of attention and degree of patient dependence. Consequently, this proximity inevitably exposes workers to various risk factors, increasing the likelihood of illness, especially infectious diseases such as COVID-19.

In addition to factors directly related to professional Nursing practice, the study also highlighted other issues that require attention. The presence of children was associated with SARS-CoV-2 infection, a finding that corroborates the results of a study conducted with healthcare professionals working in

university hospitals in southern Brazil, which showed a similar association between parenthood and infection with this virus.[15]

The association between having children and COVID-19 infection may reflect the burden faced by these professionals during the pandemic, resulting from the combination of work and family responsibilities. Studies with nurses in China have shown that those with children reported higher levels of psychological distress, lower adherence to coping strategies, and greater emotional burden, which directly impacts vulnerability to infection.[17] Having children entails responsibility, including financial responsibility, which requires paid work to be met. Nursing is an indispensable profession in the fight against COVID-19, and therefore, working in this field is directly related to greater exposure to infectious agents[18], and, consequently, at risk of getting sick.

The association between COVID-19 infection and more than 10 years of service, as evidenced in this study, contrasts with the results of studies investigating occupational exposure to biological materials, which were associated with shorter periods of professional practice.[19-20] However, when analyzing these results, one cannot ignore the context in which the studies were conducted, the methodology employed, and the population studied. This study is regional in scope and involves Nursing workers from different levels of care, whose training and experience in caring for patients with infectious diseases present unique characteristics.

Furthermore, understanding the relationship between the length of professional practice and SARS-CoV-2 infection among nursing workers must go beyond mere occupational exposure. It is necessary to broaden the analysis beyond accumulated experience and the hypothesis of resistance to adopting new practices. Studies with Nursing professionals, especially in high-demand contexts, such as in China during the pandemic, indicate that professionals with longer careers presented high levels of burnout, anxiety, and fear.[21] Such evidence shows that long-term employment in the profession may be associated with emotional exhaustion, accumulated wear and tear, and greater exposure to adverse working conditions, which contribute to increased vulnerability and illness among workers.[22]

Although several occupational health outcomes show different incidence rates between the sexes, this study did not find this difference for SARS-CoV-2 infection. Similarly, a study conducted with Nursing professionals also found no difference in virus infection between men and women.[15] However, an ecological study of healthcare workers found the highest prevalence of COVID-19 among women[23], which may be due to unequal and precarious working conditions compared to men.

The workers' age group is a variable that can influence different health outcomes. A study conducted with healthcare workers in Brazil between 2021 and 2022 identified higher rates of COVID-19 among younger workers, especially those aged 15 to 29. However, in this study, the predominant age group for workers who reported SARS-CoV-2 infection was 35 to 41 years old (mean age 41.9 years), and no significant association was observed between the age variable and the occurrence of infection. According to some scientific evidence[18], the inexperience of healthcare workers is a risk factor for occupational exposure to biological hazards. However, in the context of the COVID-19 pandemic, the lack of clarity regarding biosafety measures, as well as the lack of institutional protocols and standards, especially at the beginning of the pandemic[24], placed workers on an equal footing in terms of occupational exposure.

Regarding length of service, evidence indicates that inexperienced professionals tend to face challenges mainly related to technical safety, decision-making ability, and relationships with the healthcare team.[25] On the other hand, among workers with longer service, individual factors such as attachment to established routines and the perception of a threat to their comfort zone can act as barriers to the incorporation of new evidence and practices based on updating knowledge, which compromises not only patient safety but also that of the professional themselves.[26] This aspect was highlighted in this study, which identified a positive association between longer working hours and COVID-19 infection, a result confirmed by a survey conducted with nursing professionals in the city of São Paulo.[19]

Working in the COVID-19 sector was another factor associated with SARS-CoV-2 infection found in this study. Professionals who worked in sectors caring for patients infected with the virus had a higher infection rate than those who worked in general care. This may be since they were exposed to the etiological agent more intensely and in higher doses on a "permanent" basis, as well as the frequency of donning and doffing protective equipment required in these sectors, which are critical moments for contamination[16,19], the shortage of N95 masks, the reuse of PPE, hand hygiene practices below the recommended level, and the performance of aerosol-generating invasive procedures[27]. Moreover, the neglect of nursing workers' health in the first year of the pandemic directly impacted the illness of these individuals. This fact was

observed by the shortage of basic supplies and protective equipment such as masks, gloves, goggles, and aprons, among others.[28]

Another relevant finding observed in this study is that workers self-rate their health as poor. According to the study conducted among Nursing workers, negative self-rated health is associated with being female, being over 39 years of age, performing more than one paid activity, poor or very poor sleep quality, the presence of morbidities, aggression in the workplace, and frequent participation in domestic activities.[29] Besides these factors, they also linked negative self-rated health among Nursing professionals to the incompatibility of the activities performed, dissatisfaction with quality of life, and the occurrence of CMD.[30]

During the pandemic, CMDs were accentuated due to work demands resulting from the high infection rate and shortage of skilled labor, which aggravated the physical and mental exhaustion of these professionals and led many to give up their profession to the detriment of their health.[31]

Mental and behavioral disorders may be present in association with and concomitant with other health outcomes. For example, in chronic pain, poor mental health can influence pain intensity as an important modulator.[32-33] In challenging work environments, such as during the pandemic, CMD may arise or worsen among healthcare workers. However, in this study, no association was found in the final analysis model.

Although numerous studies highlight the problems related to the health of Nursing workers, there is a lack of systematic actions and public policies on worker safety, working conditions, and adequate resources for the performance of their duties.[31] Changing this reality is urgent, as Nursing professionals play a crucial role in the functioning of health systems and, for this reason, they need to be valued and have their rights guaranteed.

This study made significant contributions to understanding the high prevalence of COVID-19 and the factors associated with the development of this disease. The results highlight the vulnerability of this category, not only because of the nature of their daily work, which predisposes them to exposure to infectious agents, but also because of their excessive workload and consequent poor health. The association of these aspects with the presence of children and longer service time indicates conditions conducive to worker illness, as well as the importance of actions related not only to biosafety but also to their physical, mental, and social well-being.

Despite some limitations, such as conducting the study with professionals from a single region of the country, which compromises the generalization of the results; the presence of selection bias resulting from the use of self-reported questionnaires; memory bias, as this is a cross-sectional study; the possibility of reverse causality, due to the absence of temporality between cause and effect; and selection bias inherent in convenience sampling, the study showed important results related to COVID-19 infection among Nursing workers. Among these, the association with the care environment stands out, especially the sectors dedicated to treating patients with COVID-19, occupational exposure time, and aspects related to health perception. Furthermore, the study presented important advantages, such as the sample size, which allowed for more detailed analyses and brought more confidence to the results.

CONCLUSION

This study analyzed the prevalence and factors associated with COVID-19 among Nursing professionals in the state of São Paulo. The results showed that infection was significantly associated with sociodemographic and occupational variables and health perception, such as having children, working for more than 10 years, working in sectors providing care to patients with COVID-19, and negative self-rated health. These results indicate that vulnerability to infection was not distributed evenly among nursing professionals, as it was associated with characteristics involving both work organization and aspects of personal life and individual health perception.

The association between length of service and increased risk of infection, for example, reveals that accumulated experience in the profession alone was not a protective factor. Similarly, working in sectors providing direct care to patients with COVID-19 proved to be an important risk factor, reinforcing the need for constant vigilance regarding working conditions and strict compliance with protective measures, as well as the need to implement continuing education in the services.

Negative self-rated health, although subjective, proved to be statistically relevant, indicating that it may be a valuable risk marker in contexts of high physical and emotional demands.

This study's results broaden our understanding of the different factors that influence the occupational exposure of Nursing professionals in health emergencies. Moreover, they reinforce the need to adopt structural measures that promote safe work environments, such as continuous investments in training, implementation of effective biosafety protocols, evidence-based preventive actions, and formulation of public policies that ensure rights and value these professionals, whose work is fundamental to sustaining the healthcare system.

CONTRIBUITIONS

Contributed to the conception or design of the study/research: Santana LL, Haeffner R, Pedrolo E. Contributed to data collection: Brey C, Ramos, TH. Contributed to the analysis and/or interpretation of data: Haeffner R, Santana LL, Ramos TH. Contributed to article writing or critical review: Haeffner R, Santana LL, Pedrolo E. Final approval of the version to be published: Ziesemer NB, Pedrolo E.

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