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Factors associated with COVID-19 contagion in healthcare workers of a level III hospital in Bogotá, Colombia: recommendations for contagion mitigation

Abstract

Background: The COVID-19 pandemic has had a significant impact on healthcare workers who are at a greater risk of contagion given their higher level of exposure. However, the various factors contributing to this heightened risk have not been identified so far.

Objective: To identify the factors associated with COVID-19 contagion in healthcare workers. Methods Cross-sectional study using data from healthcare workers of a high complexity hospital between March 2020 and March 2021. The sociodemographic characteristics of the contagion cases were analyzed, and a Chi2 test was carried out to identify the variables to be measured as part of the multinomial regression.

Results: Overall, 382 positive cases were reported in a population of 1544 hospital workers, for an institutional prevalence of 24.74%. Of these, 71.2% were women, 65.8% worked in the clinical area, and the highest percentage of contagion cases occurred among licensed practical nurses (38.22%). A significant association was found between inhospital contagion and all the variables included in the model, with $p<0.000$ in the adjusted model.

Conclusions: The highest percentage of contagions occurred among healthcare professionals working in the clinical area. However, the majority of the cases are the result of inside and outside social contacts and not of patient care. Steps must be taken, considering that clinical staff is essential for managing the current health crisis and learning lessons for future similar circumstances.

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Introduction

The COVID-19 infection is caused by an RNA virus of the Coronaviridae SARS- COV2 family, with the spectrum of the disease ranging from asymptomatic cases to severe forms and death.[1,2] Given the recent appearance of the virus there is yet a paucity of literature in the world and at a local level regarding the risk of contagion, even among more vulnerable populations such as health personnel.[3] However, various sources of data and statistics show that COVID-19 infections among healthcare workers occur at a much higher rate than in the general population.[4,5] For example, according to data from the World Health Organization (WHO), healthcare workers represent less than 3% of the total population[6,7] but account for 14% of the cases of COVID-19 contagion reported to the WHO around the world.[8] Similarly, in Colombia, according to Newsletter No. 97 of 05 October 2021, 67,088 COVID-19 cases were reported in healthcare workers, of which 333 ended in death, with the most affected population being licensed practical nurses (LPNs) followed by administrative and medical staff.[9] Likewise, according to the data from the Bogota Health Observatory, 18,528 cases had been identified in healthcare professionals as of February 11, 2021, accounting for 2.9% of the total number of cases in the city.[10]

However, it has been found that contagion among health personnel may be due to the multi-factorial origin of the disease, either as a result of their work in the hospital or of their interactions in various community settings.[10,11] In this regard, a study conducted in Lima, Perú, found that infections acquired due to contacts with affected relatives were more frequent that those associated with clinical work.[12] Likewise, a systematic review of 64 studies that assessed the risk of contagion during purely clinical work showed that the adequate use of personal protective equipment (PPE) was a protective factor against the infection.[13] On the other hand, in a protocol registered in PLOS ONE for a meta-analysis already under way in South Africa, although there is evidence of some risk factors that drive SARS-CoV-2 infection rates among front-line healthcare workers, the full range of factors has not been considered given that factors outside the hospital setting were not identified in this population.[14] Consequently, identifying factors associated with contagion, even more so in the Colombian context where no information or similar studies are available up to now, is of critical importance for care during the pandemic.

In view of the above, it is necessary to understand the behaviors of healthcare workers, including the adequate use of PPE or compliance with physical distancing or biosafety measures, which are critical for COVID-19 prevention.[5,6] According to the risk approach proposed by Lalonde, different factors come into play when determining the health situation of a population.[15] This implies that the likelihood of any individual characteristic being associated with the probability of acquiring a disease may have repercussions for the health situation of the population.[15–18] This model helps gauge the need to focus attention on the groups at a higher risk of suffering from a disease, and thus determine health priorities.[18–20] For example, individual, time and place-related risk factors for developing COVID-19 as a potentially avoidable health event exist among healthcare workers due to their high exposure level.[21–23]

To address this knowledge gap, we present the conceptual model (Figure 1) used to conduct an analysis of the risk of acquiring COVID-19 among healthcare workers and to determine whether

contagion was attributable to physical exposure in the clinical setting or to other reasons such as social behavior, another factor which greatly influences contagion.[23] The model of social determinants in hospital workers was also taken into account, because the coexistence of both community as well as clinical contagion in the healthcare staff has not been ascertained.[24] This explains the aim of identifying potential factors associated with COVID-19 contagion in workers from all the areas of a level III hospital in Bogota.

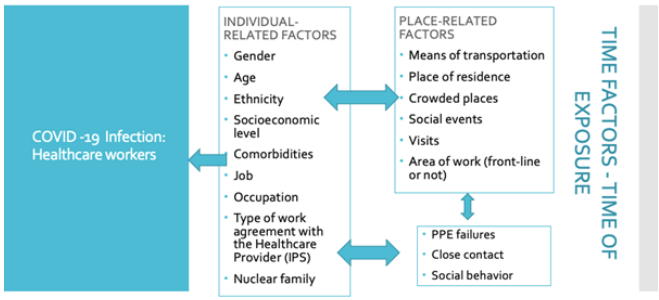

Figure 1 Conceptual model of social determinants in health personnel using the risk factor approach: individual, place and time factors present in a high complexity hospital in Bogotá, Colombia.

Source: Authors.

Materials and methods

Study population

A cross-sectional study was conducted using data sourced from the epidemiology service of a level III hospital in Bogotá D.C., Colombia. All healthcare workers of the hospital with a positive PCR and/or specific antigen test for SARS-CoV2 between March 1, 2020 and March 31, 2021 were included. Workers with a PCR test of indeterminate result were excluded.

Because this study required inclusion of all positive individuals, there was no need to calculate sample size. A total of 382 hospital workers between the ages of 18 and 64 years were included. Data available for these workers included sociodemographic (age, gender, place of residence, transportation type), comorbidities, work-related factors (job, area of work, physical setting) and infection-related factors (social contact inside and outside the hospital, adequate PPE use, presence in crowded places, other risky work).

Data collection

A hospital database was developed using the reports from the clinical laboratory for tests done in the hospital and from occupational health and safety for extrainstitutional cases.[25] After each report was received, data were collected by the epidemiology area which then called each of the participants to inform them of the result and establish the epidemiological fence using the survey, generating the variables of interest for the study.

Variables and categories

Data on sociodemographic variables (age, gender, health insurance, occupational insurance, place of residence, type of transportation), comorbidities, and work-related factors (job, area of work, physical setting) were obtained from the epidemiological fence provided by the participants during the telephone calls. Infection-related factors were obtained from the questions designed to evaluate extra-institutional social contact: Do you work at another hospital? Who do you live with? What do the people you live with do? Has any of your family members had COVID-19-related symptoms in the past 10 days? Has any of your family members had a positive PCR or specific antigen test for COVID-19 in the past 10 days?

Other questions were used to enquire about social contact: Have you visited anyone or received any visits in the past 10 days? If the answer is yes, have these people exhibited symptoms? If that is so, Do these people have a PCR test? Is it positive? Another question was, "Have you been in contact with a person with confirmed COVID-19"? If the answer was "yes," the next questions was about the place of contact: institutional, family or social. The final question was: In the past 5 to 10 days, have you been in a crowded, poorly ventilated place (public transportation, social or family gatherings, shopping mall, retailers of basic goods [supermarkets], banks, medical care [appointments, consultations, testing])?

The variables were classified in three categories: 1) Contagion hypothesis, determined according to the qualified epidemiological evaluation by a professional who rated it as likely external, internal or undetermined in those cases in which more than one variable was found (external, internal or undetermined). 2) Cause of the infection, which was reported by the patients with positive contacts (healthcare, crowded places, other risky work, public transportation, social family contact, social external contact and in-hospital social contact). 3) Sociodemographic characteristics, where the age variable was classified into six groups (18-25, 26-33, 34-41, 42-49, 50-57, 58-64 years).

Statistical analysis

A descriptive analysis was initially performed for continuous variables measured as central trend, mean, median, mode and standard deviation (SD).[26] On the other hand, a prevalence and proportion analysis was performed for nominal variables, describing distributions, frequencies and percentages.[26]

Likewise, univariate, bivariate and multivariate analyses were performed using the Chi2 test to compare the frequency of qualitative variables and test the significance of the differences in the characteristics related to the cause of the infection. When the p value of Chi2 test was ≤ 0.26, the variable was included in a multinomial logistic regression model.

Finally, multinomial regression adjusting the model by sociodemographic factors (age, gender and work area), work-related factors (job, area of work, physical setting) was performed in order to determine factors associated with COVID-19 contagion; p values of less than 0.05 were considered statistically significant.

The statistical analysis was carried out using the Stata/SE 17.0 software package for Mac (Intel 64-bit) (Copyright 1985-2021 StataCorp LLC). This study was approved by the Ethics Committee of the Andes University Governance School and by the Research Ethics Commission of Samaritana University Hospital.

Results

Characteristics of the workers

Out of the 1544 hospital associates, a total of 382 workers with positive test results were studied, for a 24.74% institutional prevalence of positive cases (absolute frequency [AF] 382, relative frequency [RF] 0.24). The sociodemographic characteristics and working conditions of these cases are shown in Table 1. The mean age of the participants in the study was 39.09±10.73 years and 71.2% were women; the majority (70.68%) had no comorbidities, and the most frequent comorbidities were vascular disease/arterial

hypertension in 26 individuals (6.81%) and hypothyroidism in 3.93%. Regarding characteristics and work conditions, the highest percentage of individuals with a positive PCR test worked in the clinical area (65.18%) and the job with the highest number of positive reports was licensed practical nursing, accounting for 35.83% of cases, followed by administrative staff (21.73%).

Table 1 Some demographic and occupational characteristics of the study population (*N* = 382)

Age	Mean (SD)	39.09 (10.73)
	Min–Max	18–64
Gender	Female	272 (71.2)
	Male	110 (28.8)
Comorbidities	None	270 (70.68)
	Vascular disease/Arterial hypertension	26(6.81)
	Hypothyroidism	15(3.93)
	Chronic respiratory disease	13(3.4)
	Immunosuppression/cancer	13(3.4)
	Diabetes	12 (3.14)
	Obesity	9 (2.36)
	Asthma	8 (2.09)
Work area	Administrative	83 (21.73)
	Clinical	249 (65.18)
	Support services	50 (13.09)
Job	Licensed practical nurse	137 (35.86)
	Administrative	83(21.73)
	General service assistant	62(16.23)
	Physician	39 (10,21)
	Nurse	37 (9,69)
	Physical therapist	17(4.45)
	Bacteriologist	7(1.83)

Source: Authors. Data are presented as n (%), unless otherwise indicated. Max, maximum; Min, minimum; SD, standard deviation.

Type of contagion

In the interviews with the epidemiology professional, 25.39% of the participants reported in-hospital contagion (AF 97, RF 0.25), 68.32% external contagion (AF 261, RF 0.68) 6.28% undetermined (AF 24, RF 0.06). Moreover, regarding contagion distribution by mean age in the groups, it was found that out of the total, social contagion accounted for 56.67%, followed by the use of poorly ventilated public transportation (12.78%), healthcare contagion (11.67%), presence in crowded places (8.61%), and close contact in another work setting (7.5%).

Figure 2 shows the distribution of contagion by work area for the administrative, clinical and support services categories, by in-hospital, external or undetermined type of contagion. All cases of front-line staff caring for confirmed or suspected COVID-19 belong to in-hospital contagion. On the other hand, infection due to presence in crowded places, use of public transportation and place of residence, correspond to external infection in administrative, healthcare and support services staff. Finally, contagion due to close social contact with an individual with suspected or positive infection in a setting outside the hospital was found in 41.34% (AF 148 RF 0.41) and in 15.36% (AF 55 RF 0.15) for the in-hospital setting. On the other hand, contagion inside and outside the hospital among health personnel working with patients was found in 43.19% (AF 165 RF 0,43) and 17.54% (AF 67 RF 0.17), respectively, while undetermined cases were found in 4.45% (AF 17 RF 0.04). Among administrative staff, external contagion was found in 15.71% (AF 60 RF 0.15), internal in 4.71% (AF 18 RF 0.04); and for support services staff, external contagion was found in 9.42% (AF 36 RF 0.09), and in-hospital contagion was found in 3.14% (AF 12 RF 0.03).

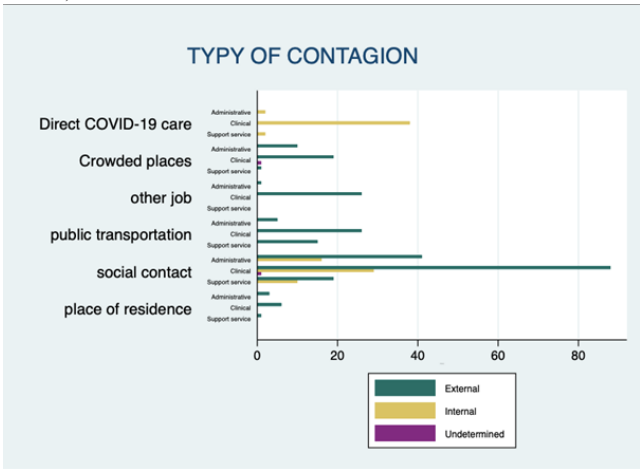

Figure 2 Probable contagion by work area, broken down by external, internal or undetermined.

Source: Authors.

Factors associated with COVID-19 in health personnel

The *Chi-2* test was used to evaluate the difference in the proportion of people with contagion by job, age, gender, comorbidities, area of work and external cause, and found a statistical relation, except for gender, comorbidity and area of work**.** The type of contagion was considered as a dependent variable, while potential causal variables were considered as independent variables. It was found that infection was associated with presence in poorly ventilated places, the use of public transportation, social contact and place of residence, with a statistically significant *p* value both in the crude and the adjusted model.

Discussion

Context

According to the risk approach used, healthcare workers are exposed to other time, place and individual factors different from those that are present in their workplace, which can make them more prone to contagion.[17,24] During the COVID-19 pandemic, measures have been implemented to slow down the speed of contagion in all population groups. Similarly, extensive protocols have been implemented for healthcare workers, in particular when it comes to caring for patients with suspected or confirmed infection.[27–30] However, there is little information and no guidance to establish in and out-of hospital protocols for healthcare workers or to glean insights regarding a higher risk of contagion based on actual results pertaining to the factors that contribute to the spread of the infection. There is literature that assesses the risk of contagion during work, and the use of PPE has been extensively studied in the healthcare setting.[12,14] Some studies state that although there is evidence regarding some risk factors that drive the rates of SARS-CoV-2 infection among front-line healthcare workers, there are gaps in terms of the identification of factors that affect this population outside the hospital setting.[14]

Implications

Based on the risk model approach, this study showed that workers of all areas in a level III hospital in Bogotá, Colombia, have place-related risk factors associated with exposure such as poorly ventilated places, working in a different site with greater exposure to COVID-19,

the use of public transportation, and the place of residence.[5,15] They also have individual-related factors that show a statistically significant association; these include job and comorbidities, considering that distribution by disease and job was different when the Chi2 test was used.

On the other hand, the highest proportion of hospital-acquired infections occurred among the clinical staff, but it was mostly due to internal and external social contact than to direct health care. Likewise, the administrative staff also experience in-hospital contagion, almost always due to social contact inside the hospital. This contact is to be understood as close contact for more than 15 minutes without personal protective equipment, usually during meals and social celebrations with colleagues and fellow workers. This shows that healthcare workers are highly vulnerable to the infection and self-care measures in non-clinical settings appear to fail in all jobs and work areas, both clinical as well as administrative. Therefore, it is important to create awareness among workers in all areas about the risk of acquiring the COVID-19 infection in external settings and during social events.

Strengths and limitations

This is the first study carried out in Colombia to evaluate risk factors in healthcare workers and their prevalence in all areas of a high complexity hospital. It was conducted in a departmental hospital with a low number of workers with a positive PCR test, which limits generalization of the findings.[11,24] Although most of our findings were consistent with previous studies conducted in other parts of the world, we recommend large-scale meta-centric studies in public and private hospitals.[12,14] Our study did not evaluate protective factors such as vaccination because the vaccination program had not started in the hospital at the time the cases were evaluated. Future publications could consider studies to assess pre and post-vaccination prevalence. Finally, the cross-sectional design of the study is a limitation.

Conclusion

I. It is crucial to include external contacts in healthcare workers in order to break the transmission chain. Existing laws and workplace policies must be strengthened in order to create safe workplaces for all hospital areas, including non-clinical settings.

II. The findings of this study provide reference evidence on the prevalence and related factors of the COVID-19 infection in a high complexity hospital in Colombia, and they can be used to drive preventing measures, including stronger enforcement of policies designed to fight this and any other future pandemics.

III. The highest percentage of contagions was found among healthcare workers in direct contact with patients. However, this contagion is predominantly driven by social contact, the use of public transportation or presence in crowded places without adequate PPE.

IV. It is important to create and implement public policies designed to reinforce awareness among healthcare workers of their critical role in managing and mitigating the pandemic and how they must implement more precautionary measures in their social and personal environments. It is also important to create public policies specifically aimed at fostering safe environments in all areas of healthcare provider institutions (IPS) (27–30), without affecting their ability to operate smoothly, given their critical role in controlling the pandemic. These include biosafety protocols for non-clinical areas where social contact among workers still occurs, such as dining halls, cafeterias, eateries and other places in the hospital where social events that pose a risk to healthcare workers may occur.

V. There is a need for public policies mandating healthcare providers (IPS) to adopt measures designed to reduce the risk of contagion among workers in unavoidable situations outside work, as is the case of public transportation. The implementation of bus routes covering the different areas of the city is an example. This could avoid exposure of healthcare workers to crowded conditions in the public transportation system.

VI. Lessons learnt from the COVID-19 pandemic must be taken into account for similar situations in the future, including these recommendations for mitigating contagion and transmission.

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Conflicts of interest

The authors declare having no conflicting financial interest or personal relations that could have influenced the work reported in this paper.

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