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COVID-19 Contamination in Hospital Staff: Determinism, Epidemiological Features

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Abstract: The first cases of SARS-CoV-2 were diagnosed in BENIN in early March 2020. Measures have been instituted to control its spread, including barrier measures. The objective of this study is to determine the effectiveness of self-application of these measures among hospital staff at CNHU-HKM. Methods: This is a case-control study conducted from July 1, 2020 to January 1, 2021 on the risk factors of COVID-19 contamination. Included were any CNHU-HKM staff who underwent PCR testing for COVID-19 at the CNHU-HKM triage center during the study period. Data were collected using a survey form administered to respondents. Data analysis was performed with R 4.1.0 software. Results: A total of 141 patients were included in the study. The mean age was 35.5 (±11.1) years. The sex ratio (M/F) was 1.87. Fon and Mina ethnic groups were the most represented (74.5%). Workers older than 50 years were more likely to be exposed to COVID-19 (OR=4.83). Nurses in contact with patients (87.2% of the study population) had a higher risk of contamination (OR=3.6), compared to administrative staff. The FFP2 mask was a protective factor (OR=0.35) as well as long-term chemoprophylaxis with chloroquine (OR=0.44). Conclusion: Health care workers are at high risk of contamination by COVID-19. Barrier measures and chloroquine chemoprophylaxis are indeed mandatory in controlling the spread of the pandemic.

Keywords: Barrier Measures, Caregivers, COVID-19, Risk Factors

1. Introduction

The COVID-19 pandemic is a major health crisis caused by an emerging infectious disease whose pathogen is coronavirus 2 and it has been noticed in late 2019 [1]. Human-to-human transmission of COV-2 is primarily through respiratory droplets, contact with contaminated objects and surfaces, social activities such as shaking hands and hugging [2]. WHO published in March 2020, ten simple prevention measures against COVID-19. It was declared a pandemic on March 11, 2020. Since the beginning of this pandemic, more than 160 million people have been infected, with just under 3.4 million deaths [3], including a high number of health care workers [4.5].

Health care workers are very exposed to COVID-19 and a number of recommendations have been set to protect them. Furthermore, each country has implemented a number of barrier measures according to its provisions. Benin recorded its first official case on Monday 16 March 2020 [6]. Restrictive measures to limit the spread of the virus have been taken by the government [7]. These include the systematic wearing of masks, hand washing with soap and water or hand disinfection with gel/hydroalcohol solution, and the respect of distancing. However, despite the implementation of these measures, the incidence of COVID-19 is still increasing, particularly among certain socio-

occupational groups at risk, including healthcare workers. Although, they are all exposed, many cases have been registered but others are still not infected too. The purpose of this article is to determine the effectiveness of these barrier measures implemented at the CNHU/HKM Hospital and to evaluate their compliance among health care personnel.

2. Methods

2.1. Data

The study occured at the National Teaching Hospital Hubert Koutoukou Maga (CNHU-HKM) in Cotonou. We conducted a case-control study conducted from July 1, 2020 to January 1, 2021. It focused on CNHU-HKM staff and included 85 cases and 56 controls.

Inclusion criteria: Every CNHU-HKM personnel who had a PCR test for COVID-19 at the CNHU-HKM sorting center during the study period were included. The positive diagnosis was made when the PCR test for COVID-19 was positive. (type of test)

Non-inclusion criteria: personnel who did not undergo COVID testing or who did not give their consent for the study.

The variables studied were socio-demographic data (age, gender, ethnicity, etc.) and risk factors (personal and medical history, number of services performed per day, prophylactic methods used). Data were collected through a survey form administered to the respondents. Finally, two subgroups were formed:

1. The case group: all agents with positive COVID-19 PCR.
2. The control group: all agents with negative COVID-19 PCR

2.2. Statistical Analysis

The recorded data were processed and analyzed with R 4.1.0 software. The variable of interest is binary (infected or not). And the number of cases is greater than the one of controls. Actually, it is an unmatched design which induced the computation of unconditional logistic regression. It helps to analyze odd ratios and check whether any explicative variable is a risk factor as well (OR>1). However, before the modeling, we computed the statistics about the socio-demographic parameters. In others words, for each table related to the preliminary analysis, we have mean, standard deviation, minimum, maximum, and Wilcoxon test for quantitative variables and frequency, percentage, and Khi2 test for categorical variables.

2.3. Ethical Considerations

A favourable opinion from the local ethics committee was obtained before the start of the study. Free and informed consent was required from each of the agents before submission of the questionnaire. Data were collected anonymously to ensure patient confidentiality.

3. Results

3.1. Study Population

A total of 141 agents were included in the study. The mean age was 35.5 (±11.1) years, with a minimum of 19 and a maximum 59 years old. The sex ratio was 1.87 in favor of men. There were 74.5% Fon and Mina, and 50.4% single. The level of education was secondary for 80.9% of the agents, and the socio-economic level was average for 78.7%. Health care workers represented (without administrative staff) 87.2% of the agents surveyed. On average, the agents visited 2.59±2.44 health department per day. (Table 1)

Over 141 health care workers, 85 were infected. Those who were older than 50 years were more likely to be infected with COVID-19 (OR=4.83). Nursing staff (87.2% of the study population) had a higher risk of contamination (OR=3.6), compared to the administrative staff.

3.2. Preventive Measures

Surgical masks and visors were worn by 96.5% and 21.3% of the agents, respectively. Long-term chemoprophylaxis with chloroquine was a protective factor (OR=0.44). (Table 2)

3.3. Modeling Outputs

In the multivariate analysis, wearing a FFP2 mask (OR=0.35), male gender (OR=0.36), and long-term chloroquine chemoprophylaxis (OR=0.96) were protective factors. (Table 3)

Table 1. *Caracteristics of the study population, CNHU-HKM, 2020-2021.*

	Negative (N=56)	Positive (N=85)	Total (N=141)	RC (IC)	p value
Age					
Mean (sd)	32.9 (9.5)	37.9 (11.8)	35.5 (11.1)	1.04 (1.00-1.07)	
Min – Max	23.0 - 57.0	19.0 - 59.0	19.0 - 59.0		
Age group					0.060[2]
< 20ans	0 (0.0)	2 (100.0)	2 (1.4)	$5.6.10^3$ (0.00-NA)	
[20; 30]	29 (49.2)	30 (50.8)	59 (41.8)	Ref	
[30; 40]	11 (47.8)	12 (52.2)	23 (16.3)	1.05 (0.40-2.80)	
[40; 50]	13 (33.3)	26 (66.7)	39 (27.7)	1.93 (0.85-4.56)	
≤ 50	3 (16.7)	15 (83.3)	18 (12.8)	4.83 (1.41-22.46)	
Sex					0.007[2]
Male	44 (47.8)	48 (52.2)	92 (65.2)	0.35 (0.16-0.75)	
Female	12 (21.4)	37 (43.5)	49 (34.8)	Ref	

	Negative (N=56)	Positive (N=85)	Total (N=141)	RC (IC)	p value
Ethnic group					0.517[2]
Fon et Mina	41 (73.2)	64 (75.3)	105 (74.5)	2.8 (0.4-11.0)	
Yorouba et Idatcha	9 (16.1)	11 (12.9)	20 (14.2)	1.6 (0.3-10.2)	
Bariba, Dendi, Haoussa ou Peulh	4 (7.1)	3 (3.5)	7 (5.0)	Ref	
Etrangère	2 (3.6)	7 (8.2)	9 (6.4)	4.7 (0.6-50.9)	
Marital status					0.524[2]
Single	31 (55.4)	40 (47.1)	71 (50.4)	Ref	
Married	25 (44.6)	45 (52.9)	70 (49.6)	1.4 (0.7-2.8)	
Socio-economic level					0.025[2]
Low	16 (28.6)	9 (10.6)	25 (17.7)	Ref	
High	2 (3.6)	3 (3.5)	5 (3.5)	2.7 (0.4-23.3)	
Average	38 (67.9)	73 (85.9)	111 (78.7)	3.4 (1.4-8.8)	
Education					0.249[2]
Primary	0 (0.0)	4 (4.7)	4 (2.8)		
Secondary	8 (14.3)	15 (17.6)	23 (16.3)		
High school	48 (85.7)	66 (77.6)	114 (80.9)		
Profession					0.019[2]
Administrative, Maintenance et Servicing	12 (21.4)	6 (7.1)	18 (12.8)	Ref	
Care giver	44 (78.6)	79 (92.9)	79 (87.2)	3.59 (1.3-10.9)	
Health department per day					
Mean (sd)	2.786 (2.788)	2.435 (2.254)	2.598 (2.446)	0.9 (0.8-1.0)	0.17
Min – Max	0.000 - 15.000	1.000 - 10.00	1.000 - 15.000		

[1]Wilcoxon Test, [2]Khi-2 Test

Table 2. *Distribution of agents according to preventive measures, CNHU-HKM, 2020-2021.*

	Negative (N=56)	Positive (N=85)	Total (N=141)	OR (CI)	P value
Length Chloroquine					0.037[2]
None	27 (48.2)	41 (48.2)	68 (48.2)	Ref	
≤ 2 weeks	12 (21.4)	33 (38.8)	45 (31.9)	1.8 (0.8-4.2)	
[2; 3] weeks	5 (8.9)	3 (3.5)	8 (5.7)	0.4 (0.2-1.2)	
[3; 4] weeks	12 (21.4)	8 (9.4)	20 (14.2)	0.4 (0.1-1.7)	
Length herb tea					0.023[2]
Aucune	49 (87.5)	72 (84.7)	121 (85.5)	Ref	
≤ 2 weeks	2 (3.6)	10 (11.8)	12 (8.5)	3.4 (0.9-22.7)	
[2; 3] weeks	4 (7.1)	0 (0.0)	4 (2.8)		
[3; 4] weeks	1 (1.8)	3 (3.5)	4 (2.8)	2.0 (0.3-41.9)	
Maslks					0.081
No	4 (7.1)	1 (1.2)	5 (3.5)	Ref	
Yes	52 (92.9)	84 (98.8)	136 (96.5)	6.5 (0.9-128.3)	
Wearing a visor					0.086
No	40 (71.4)	71 (83.5)	111 (78.7)	Ref	
Yes	16 (28.6)	14 (16.5)	30 (21.3)	0.49 (0.22-1.11)	

[1]Fisher Exact Test, [2]Khi-2 Test

Table 3. *Logistic regression, CNHU-HKM, 2020-2021.*

Variables	Adjusted OR (CI)	std, Error	parameters	p-value
(Intercept)	0.80 (0.19 - 3.29)	0.58	-0.31	0.759
Age	1.05 (1.01 - 1.10)	0.02	2.38	0.017
Sex [Male]	0.36 (0.15 - 0.82)	0.15	-2.38	0.017
FFP2 [Yes]	0.35 (0.13 - 0.87)	0.17	-2.22	0.026
Age *Length Chloroquine ≤ 2 weeks	1.02 (0.99 - 1.05)	0.01	1.36	0.173
Age * Length Chloroquine [2; 3] weeks	0.95 (0.91 - 0.99)	0.02	-2.09	0.037
Age *Length Chloroquine [3; 4] weeks	0.96 (0.93 - 0.99)	0.01	-2.30	0.022

4. Discussion

4.1. Risk Factors

Nursing staff (87.2% of the study population) had a higher risk of infection (OR=3.6) than administrative staff. This could be explained by the fact that, health care workers are in greater contact with potentially infected patients. Furthermore, they have insufficient means of protection in Benin. Other studies have also revealed a higher risk among health care workers [8-16]. For Eleojo et al [17], the increase in hospitalizations, long-term exposure, lack of personal protective equipment, lack of training, supervision and monitoring of infection prevention and control mechanisms are the main factors. For Sheinder et al-[18] the exposure of infection among health care personnel could be explained essentially by transmission between hospital staff.

Agalar et al [19] and Tong et al found that the risk of contracting COVID-19 increased with age. Indeed, advanced age has been highlighted as a risk factor in general [20]. A similar but not significant trend was observed in our study. This may be due to the fact that our sample was composed of mostly younger individuals.

Male gender appeared to be a protective factor in this study. Mani [10] had also noted a male predominance among the positive subjects. However, the sex ratio largely in favor of males could explain this observation. Further studies are needed to assess the influence or otherwise of factors such as gender.

4.2. Preventive Measures

4.2.1. Chloroquine Chemoprophylaxis

Long-term chemoprophylaxis with chloroquine has been shown to be a protective factor (OR=0.44). Indeed, in Africa, chloroquine has been widely used in many countries, including ours, for preventive and curative treatment. However, the evidence on the advantages and disadvantages of using hydroxychloroquine or chloroquine to treat COVID-19 is very weak and contradictory [17]. Regarding the use of chloroquine for prophylaxis, no studies have been published to date.

4.2.2. Barrier Measures

In our study, the wearing of FFP2 masks was a protective factor for health workers with an OR=0.35 (CI: 0.13- 0.82). The use of surgical masks and visors by the majority of workers, did not reveal an influence on contamination. Several studies [20] have shown that the FFP2 mask had the highest protective efficiency compared to other masks.

Limitations of the study

Only voluntary participants were included, which did not allow observations to be made with every personnel.

5. Conclusion

COVID-19 is a pandemic linked to a virus with respiratory tropism whose contamination is mainly by air. Health care personnel remain a high-risk occupation subject to contamination. The present study provides an overview of COVID-19 at the CNHU/HKM of Cotonou. Although the present results are not representative of the hospital staff, they nevertheless indicate that the staff is particularly exposed to COVID-19. It also shows the usefulness of barrier measures and actions in limiting the spread of the disease. Personal protective equipment must therefore be provided to health care personnel. They must also be well trained in their efficient use.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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