

Original Research Article

Epidemiological characteristics of the healthcare workers morbidity during the COVID-19 pandemic, Central Bosnia Canton, Travnik, Bosnia and Herzegovina

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ABSTRACT

Background: Healthcare workers at all levels of the healthcare system are at the front line of the response to the COVID-19 epidemic and are consequently more exposed to risk of infection. To examine the characteristics of the healthcare workers morbidity during the COVID-19 pandemic in the area of Central Bosnia Canton.

Methods: This research includes all healthcare workers of this Canton (n=2276) in the period from March 2020 to March 2022. A total of 666 health workers tested positive (RT-PCR method) for severe acute respiratory syndrome coronavirus 2 (SARS CoV-2) in healthcare institutions.

Results: The average age of the patients was 45.16 (± 11.93) (range 18-77 years old), with a median of 45 years old. Of the total number of positive patients, 68.2% were women, 165 or 24.77% were doctors, and 57.80% were other medical workers. Interactions with infected colleagues accounted for 28.4% of infections, 22.2% of infections occurred during patient care, 36.3% outside a healthcare facility, and in 13.1% the mode of infection was not confirmed. Due to the severity of the clinical status, a total of 74 people were hospitalized with a hospitalization rate of 11.11 (95% CI 8.78-13.87). The second positivity of the test (by RT-PCR method) was after 12.34 months from the first infection (mean=12.34; SD ± 4.270 ; median=13).

Conclusions: High rates of morbidity among healthcare workers certainly have a significant, long-term impact on the healthcare provision, especially in healthcare systems where there is a pronounced lack of professional workers.

Keywords: Healthcare workers, COVID-19, Central Bosnia Canton, Morbidity rate

INTRODUCTION

In December 2019, a previously unknown respiratory disease was discovered in China, which was the cause of a large number of cases of pneumonia.¹ At the suggestion of the coronaviridae study group of the International Committee on taxonomy of viruses, on 11 February 2020, the World Health Organization (WHO) announced the official name of the virus severe acute respiratory

syndrome coronavirus 2 (SARS CoV-2), and the disease was called "coronavirus disease 2019" (COVID-19).^{2,3}

Globally, by May 2022, around 520 million patients were recorded and there were close to 6.2 million deaths from this infectious disease and its complications. However, at this moment, more than 475 million SARS-CoV-2 infected patients have recovered from this infection.⁴ A total of 391,429 confirmed cases were registered in Bosnia and Herzegovina, of which 15,956 resulted in death, which

puts it in a very high fourth place according to the Johns Hopkins University mortality rate.⁵

Healthcare workers at all levels of the healthcare system are at the forefront of the response to the COVID-19 epidemic and are consequently exposed to risks that put them at risk of infection, too. Repeated exposure during patient care, contact with asymptomatic patients and caregivers puts them at increased risk of COVID-19 infection.⁶

According to the WHO definition, healthcare workers are paid or unpaid persons involved in activities whose primary purpose is to improve health.⁷

Transmission of COVID-19 among healthcare workers is increased due to overcrowding, lack of isolation facilities, contaminated environment, and is likely enhanced by insufficient knowledge and awareness of the infection control practices among healthcare workers.⁸ This inadequate knowledge and incorrect attitudes among healthcare workers can directly affect practice and lead to delayed diagnosis, inadequate infection control measures and the spread of disease.⁹

In addition to the use of protective equipment, the main way to limit the spreading, and thus control the number of people infected with the virus, is the isolation and quarantine of the most vulnerable people.

In fact, many governments have imposed very strict and drastic measures (closure of all non-essential commercial activities, and isolation at home) to contain the potentially devastating effects of this pandemic.

However, while people must stay at home to reduce spreading of this virus, health workers are doing the exact opposite. Their work and longer working hours (due to the increased number of infected people in hospital) put them at risk of infection.

Healthcare workers should be constantly monitored because if they are infected, they can transmit the virus to colleagues, hospitalized patients, and even family members. Increased infection rates of healthcare workers could cause the collapse of the healthcare system and further worsening of the pandemic; if there are too few doctors, it is even more difficult to meet the increased demands.

Objective of this study is to examine the characteristics of the illness of healthcare workers during the COVID-19 pandemic in the area of the Central Bosnian Canton. This examination includes all healthcare workers of the Canton in the period from March 2020 to March 2022.

The COVID-19 pandemic poses various challenges that healthcare workers face during the provision of healthcare. The purpose of this paper is to point out the importance of

protecting the health of healthcare workers during the epidemic of COVID-19.

METHODS

This cross-sectional study type research was conducted among healthcare workers in the area of Central Bosnia Canton, which, according to the data from 2013, has an area of 3,189 km², with a population of 254,686 inhabitants, of which 2,276 are employees of the healthcare system, who are also the target group of this research. The research was carried out during 2022, in period from March 2020 to March 2022. Out of the total number of healthcare workers in the Canton (2276), 666 of them were included in the research. Only patients with COVID-19 whose diagnosis was confirmed by the RT-PCR method were included in the study. Healthcare workers who showed symptoms indicating COVID-19, or were in unprotected contact with a sick person, whose disease was not confirmed by the mentioned RT-PCR method, were not included in the research. Healthcare workers in primary and hospital healthcare who infected with COVID-19 are covered in this study. All healthcare workers who had symptoms indicating COVID-19, persons who were in contact with a confirmed case of the disease, routine testing when returning after an absence from a healthcare facility, planned periodic testing at the workplace underwent testing.

A swab of the nasopharynx/oropharynx was taken from each patient in a viral transport medium (BD universal viral transport (UVT) system) marked with the patient's identification number and immediately sent to the laboratory. Viral RNA was extracted using QIAamp viral RNA mini kits (Qiagen, Germany) according to the manufacturer's instructions (QIAamp viral RNA mini handbook 03/2018). Detection of the SARS-CoV-2 virus was performed by the qualitative RT-PCR method, using a kit that detects two target genes of the virus, the orf1ab gene and the N gene (PhoenixDx® SARS-CoV-2 multiplex). RT-PCR testing was performed according to the protocol established by the WHO and previous studies.¹⁰⁻¹² Approximately 29% of the target population, divided into five age groups were included. The patients were monitored in accordance with the mode of infection, vaccination status, severity of the clinical picture and the need for hospitalization.

Statistical analysis

Data entry was initiated simultaneously with data collection. Research data were checked, verified and entered into Microsoft Excel 2013. Incomplete and inconsistent data were discarded and not included in the final analysis. Finally, data for 666 respondents were used for the analysis. Data analysis was performed using StatSoft STATISTICS 8 software; Epi info 7. Categorical variables were expressed as frequencies (n) and percentages (%), while means and standard deviations were calculated for continuous variables. Comparisons

between groups for categorical and binary data were calculated using the χ^2 test or Fisher's exact test, and p values <0.05 were considered statistically significant.

The ethical aspect of research

The Ethics Commission of the Institute of Public Health, Central Bosnia Canton approved this research (no: 02-4-003/22 dated 14 February 2022). The study did not have additional ethical considerations, since it was a non-interventional study without disclosure of patient data. All participants gave their informed consent for the use of the data on their COVID-19 status.

RESULTS

During the COVID-19 pandemic, 2,276 employees were engaged in the public healthcare system of the Central Bosnia Canton. Of that number, 1225 or 53.82% in primary healthcare and 1051 or 46.18% in hospital healthcare. Women have a higher participation rate (64.2%) compared to men (35.8%). The average age is 43 and the largest number of employees is in the 35-44 group (Table 1). Employees are classified due to the profile and level of healthcare service provision into three categories: doctors, other healthcare workers involved in the service provision process, and non-healthcare workers (Table 2). The participation of doctors in the total number of healthcare workers is 20.5%, non-healthcare workers participate with 25.2%, while the majority of employees is in the category of other healthcare workers is 54.3%. Of the total number of healthcare workers who were involved in the service provision process (2276), 666 or 29.26% of

them fell sick with COVID-19, whose diagnosis was confirmed by the RT-PCR method (Table 3). Average age of infected people is 45.16 (± 11.93) (range between ages 18-77) with a median of 45. The first case among staff employed in public health institutions in Central Bosnia Canton was discovered on 03 April 2020 (1st month of observation). The main culmination of cases was observed during September and October (6-7 months from the beginning of the pandemic) of 2020, then during February (month 11) of 2021, and January 2022 (month 22) (Figure 1). The vaccine against COVID-19 is available to the health system of the above-named Canton only from April 2021. In that period, there was a pronounced lack of protective equipment with extremely low testing capacities. The average number of sick healthcare workers per month of observation was mean 27.75; median 15; $SD \pm 36.31$; min 0; max 151; $\chi^2 = 1093.06$ df=23; *p=0.00001. Interactions with infected colleagues were 28.4% of infections, 22.2% of infections occurred during the healthcare of patients, 36.3% outside a healthcare institution and for 13.1% the mode of infection is not confirmed. According to the severity of the clinical picture, 74 cases of severe clinical picture were recorded that required hospitalization (Table 4). Among them, 7 cases required some form of mechanical ventilation and 5 cases ended in death. The average age of those hospitalized was 51.77 with a standard deviation of $SD \pm 10.55$. The median is 51, while the youngest case was 18 and the oldest 77. The hospitalization rate increases with age, starting from 2.65 in people under age 34 to 43.75 in people over 65. Out of the total number of sick doctors (n=165), 27 of them were hospitalized, which is also the highest hospitalization rate (16.36) in relation to the employee profile.

Table 1: Employees of the healthcare system of the Central Bosnia Canton due to age and sex.

Age	Total (%)	Male (%)	Female (%)	Chi square	P value
<34	563 (24.7)	213 (26.2)	350 (24.0)	6.01	0.198
35-44	691 (30.3)	246 (30.2)	445 (30.4)		
45-54	527 (23.1)	172 (21.1)	355 (24.3)		
55-64	472 (20.7)	170 (21.0)	302 (20.6)		
65>	23 (1.0)	12 (1.5)	11 (0.7)		
Total	2276 (100)	813 (35.8)	1463 (64.2)		

χ^2 = Pearson Chi-squared test value; *p<0.05 is significant

Table 2: Employees of the healthcare system of the Central Bosnia Canton due to profile, age and sex.

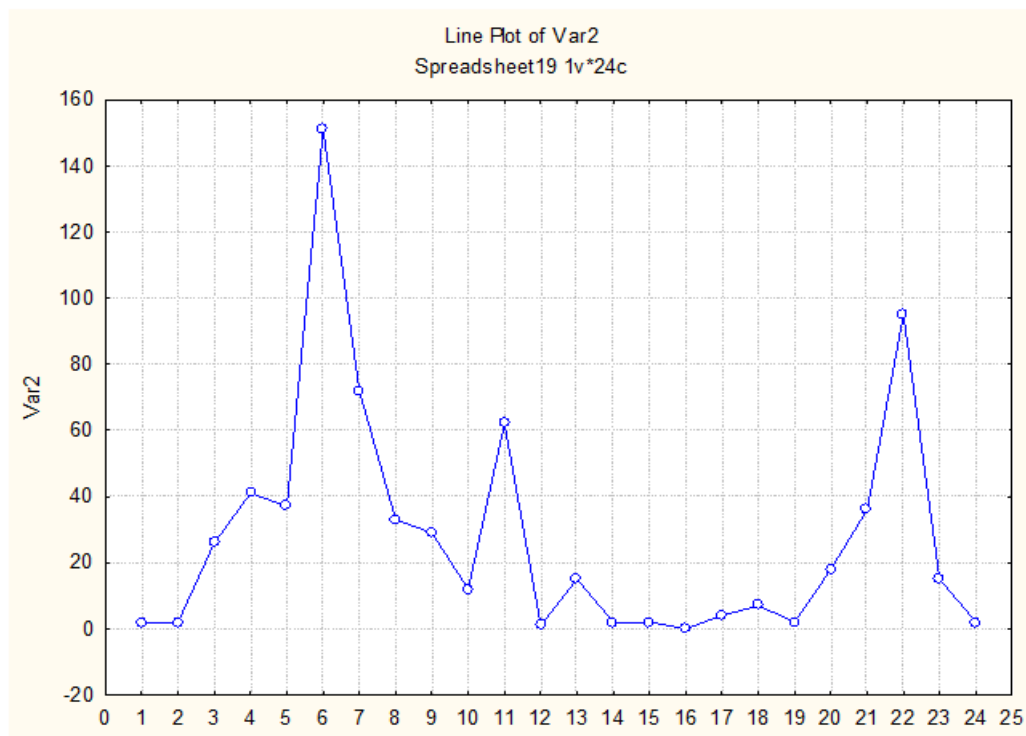
Param-eters	Doctors		Other healthcare workers		Non-healthcare workers		Total -due to sex		Total
Age	M (%)	F (%)	M (%)	F (%)	M (%)	F (%)	M (%)	F (%)	
<34	48 (10.3)	100 (21.4)	112 (9.1)	208 (16.8)	53 (9.3)	42 (7.4)	213 (9.4)	350 (15.3)	563
35-44	62 (13.2)	85 (18.2)	108 (8.7)	269 (21.7)	76 (13.3)	91 (15.9)	246 (10.8)	445 (19.6)	691
45-54	29 (6.2)	29 (6.2)	81 (6.5)	231 (18.7)	62 (10.9)	95 (16.6)	172 (7.6)	355 (15.6)	527
55-64	51 (10.9)	52 (10.9)	55 (4.4)	166 (13.4)	64 (11.2)	84 (14.7)	170 (7.5)	302 (13.3)	472
65>	5 (1.0)	7 (1.5)	6 (0.5)	1 (0.1)	1 (0.2)	3 (0.5)	12 (0.5)	11 (0.5)	23
Total due to sex	195 (41.7)	273 (58.3)	362 (29.3)	875 (70.7)	256 (44.8)	315 (55.2)	813 (35.7)	1463 (64.3)	2276
Total	468 (100)		1237 (100)		571 (100)		2276		

Table 3: Sick healthcare workers in relation to sex and age.

Age	M	F	Total	Chi	P value
	N row (%) Col (%)	N row (%) Col (%)	N row (%) Col. (%)		
<34	47 (41.6) (21.7)	66 (58.4) (14.5)	113 (100) (17.0)	16.26	*0.002
35-44	56 (33.1) (26.4)	113 (66.9) (24.9)	169 (100) (25.3)		
45-54	48 (27.7) (22.6)	125 (72.3) (27.5)	173 (100) (26.0)		
55-64	51 (26.2) (24.0)	144 (73.8) (31.7)	195 (100) (29.3)		
65>	10 (62.5) (4.7)	6 (37.5) (1.3)	16 (100) (2.4)		
Total	212 (31.8) (100)	454 (68.2) (100)	666 (100) (100)		

Table 4: Patients due to the need for hospitalization.

Category	Yes	No	Total	Hospitalization rate %	95% CI	Chi	P
Sex						3.88	0.048
M	31	181	212	14.62	10.11-20.5		
F	43	411	454	9.47	6.94-12.64		
Total	74	592	666	11.11	8.78-13.87		
Age						29.34	0.000
<34	3	110	113	2.65	0.6-7.4		
35 – 44	14	155	169	8.28	4.7-13.5		
45 – 54	22	151	173	12.71	8.1-18.9		
55 – 64	28	167	195	14.35	9.7-20.4		
65>	7	9	16	43.75	19.1-86.5		
Job designation						8.05	*0.018
Doctors	27	138	165	16.36	11.0-23.5		
Other healthcare workers	32	353	385	8.31	5.8 – 11.5		
Non-healthcare workers	15	101	116	12.93	7.51- 20.85		

**Figure 1: COVID-19 diseased healthcare workers by month of morbidity.**

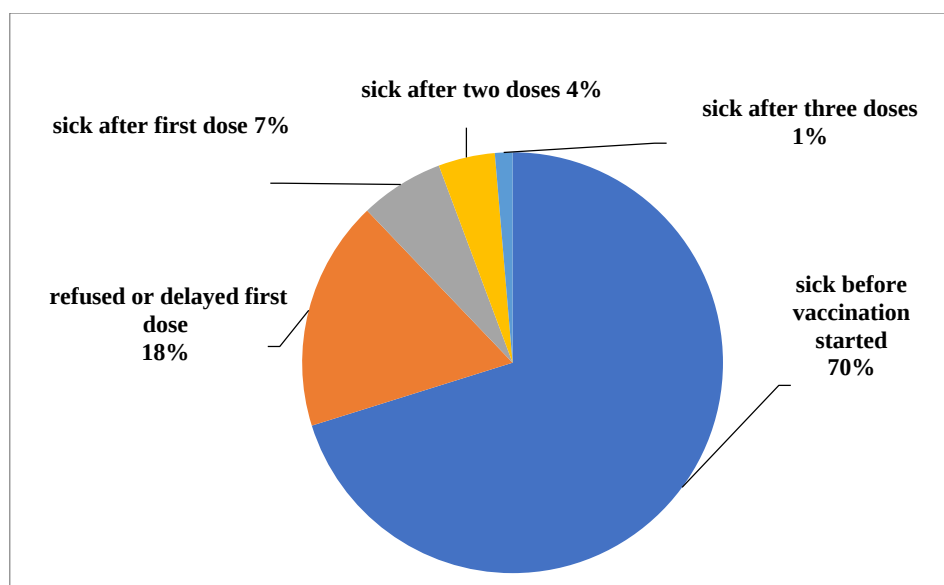


Figure 2: Patients in relation to vaccination status.

Vaccination of healthcare workers of this Canton against COVID-19 began in mid-April 2021, and monitoring of healthcare workers is still ongoing to detect pervasive infections.

Out of a total of 666 sick healthcare workers during the COVID-19 pandemic, 468 of them (70.1%) fell sick before the vaccine was available in the Federation of Bosnia and Herzegovina. Also, 118 or 17.7% refused or delayed the start of vaccination, which resulted in illness. The next 43 (6.45%) started protection but became ill after receiving only one dose. After receiving two doses, 29 (4.35%) persons fell ill, while 9 persons fell ill after receiving all three planned doses of vaccines. The first vaccines that were available to health workers as a priority group were Vaxzevria - Astra Zeneca, and it was administered according to the then valid scheme, according to which the interval between the first and second dose was 8-12 weeks, while the second phase was dominated by the Comirnaty-Pfizer vaccine.

22 cases of reinfection were recorded. In 10 (45.45%) cases, there are persons who have not been vaccinated. For 7 (31.81%) healthcare workers, reinfections were recorded after receiving only one dose of the vaccine, in four cases (18.18%) reinfection was recorded after two doses and in one case (4.55%) reinfection was recorded after the third dose. On average, the second positive test (RT PCR test) occurred after 12.34 months from the first infection (mean=12.34; SD±4.270; median=13). After reinfection, no cases of hospitalization were recorded, and CT values were low, which may indicate an infectious level of the disease.

DISCUSSION

Healthcare workers are exposed to a significant risk of infection with COVID-19 while providing patient care.

Our research showed that 29.16% of healthcare workers fell ill in the observed period. According to the conclusions of recently published systematic reviews and meta-analyses of 28 studies from different countries, more than 50% of healthcare workers are infected with SARS-CoV-2.¹³

Compared to other professions, healthcare workers are seven times more at risk for COVID-19.¹⁴

The high prevalence of positive COVID among healthcare service providers was a source of concern among countries such as Spain (11.1%), the United Kingdom (44%) and the USA (18.8%), even during the initial phase of the pandemic. This is also the period in which the lack of personal protective equipment is pronounced.¹⁵⁻¹⁷

Frontline healthcare workers were COVID-19 infected in many different circumstances, often despite adequate availability and selection of appropriate personal protective equipment (PPE).¹⁸⁻²¹

Our research showed that the dominant route of infection of healthcare workers was in hospital settings through interaction with infected colleagues or during patient care.

Multiple studies document nosocomial transmission and infection for healthcare workers, including genomic studies as tailored studies of infection control and response.²²⁻²⁴

Limited testing capacity prevents early identification and isolation of cases, which leads to unnecessary additional professional exposure for healthcare workers, especially when we know that a large number of patients with COVID-19 remain asymptomatic.²⁵

Among the healthcare workers who were the subject of this research, we note a significantly higher number of female workers (64.3%) compared to male (Table 1). Also, women got sick more often (68.2%), which is compatible with the study by Moscola et al who identified 73.7% and Guerrero-Torres et al with 61.1%.^{26,27} This also confirms the unequal share of the sexes in the field of healthcare throughout the world, since women make up 70% of the workforce in that sector, and in some regions such as America, the participation of female nurses is 86%.²⁸

Similar findings were also published in other studies.^{13,29,30} However, if we look at hospitalization rates, we see that men have higher hospitalization rates (14.62) in comparison to women (9.47). Women get sick more often, but men are at greater risk for intensive care units.³¹⁻³⁶

Regarding age, an association was observed between older age and worsening of the clinical picture, with higher mortality and hospitalization rates in the age group of 50 or older. Similar results were observed in a CDC report that showed higher rates of hospitalization and mortality among healthcare professionals aged 55 or older.¹⁷ However, there are also results that indicate that younger age groups are at increased risk. Sabetian et al found that 35 as the average age of those infected, while Gholami et al found the average age of the infected to be 38.37.^{13,37}

The scientific literature connects several factors to a higher risk of disease exacerbation in the elderly and COVID-19. Most of these studies focused on the higher prevalence of comorbidities and on immunological aging.³⁸ Among the biological changes that could be associated with higher rates of hospitalization and mortality, the gradual decrease in the number of cells and the lumen of the upper respiratory tract in aging stands out. Such changes could be partly responsible for the higher prevalence of respiratory symptoms for the elderly, which justifies the higher number of severe cases in this group.³⁹

AlGhatrif et al demonstrated the role of the enzyme angiotensin converting enzyme 2 (ACE-2) in the pathogenesis of COVID-19 and its association with cases of deterioration according to the patient's age, since this enzyme participates in the control of the immune response, especially in the respiratory system.⁴⁰ It is also known that the amount of ACE-2 gradually decreases with aging.³⁹ This evidence leads to the hypothesis that the elderly are more likely to exhibit an exaggerated and uncontrolled tissue inflammatory response to SARS-CoV-2 infection, which could lead to worsening symptoms, the need for hospitalization, and death.^{39,40}

In the professional group of healthcare workers, the most affected by COVID-19 in this study were doctors. Out of the total number of sick doctors (n=165), 27 of them were hospitalized, which is also the highest hospitalization rate (16.36) in relation to the employee profile. Also, of the five who died as a result of COVID-19, 4 of them were doctors.

This shows that clinical staff who have direct contact with patients are most at risk of infection. This pattern matches the findings of Zheng et al in a study of a London Teaching Hospital which showed that clinical staff groups had a higher infection rate of 7.3% compared to non-clinical staff at 2.8%.⁴¹ A similar pattern was also observed by Sotgui et al in a leading Italian hospital in a serological prevalence study for SARS-CoV-2 with doctors (47.0%), nurses (26.2%) and social-sanitary workers (5.5%), who had the highest prevalence of SARS-CoV-2 infection.⁴² Lombardi et al in Italy also reported that physicians, health technicians, nurses, and healthcare assistants were 10.5%, 9.4%, 8.4%, and 8% of the leading occupational groups with SARS-CoV-2 infection.⁴³

Limitations

The small sample size is a limitation of this study. During the first five months of the epidemic spread of the disease in the observed area, due to limited laboratory capacities, the number of samples was limited, and there is a possibility that some of the cases remained undetected. It was not possible to fully assess the effectiveness of the vaccine since it was not available for the first year of observation and a certain number of health workers had already been in contact/became ill and acquired some kind of immunity.

CONCLUSION

Healthcare workers, by the nature of their work, are additionally exposed to the risk of COVID-19 infection. In the observed period, almost one third of healthcare workers were infected with COVID-19. The largest number of patients was recorded in the age group of 55 to 64 years, and most cases were female. Older age has been shown to be a strong predictor of disease severity and mortality. The highest rate of hospitalization in relation to the profile of healthcare workers is recorded among doctors. High morbidity rates among healthcare workers certainly have a significant, long-term impact on the healthcare service provision, especially in healthcare systems where there is a pronounced lack of professional labor.

This is first research of this type in Bosnia and Herzegovina. The results of the research in the defined population and their comparison with the general population will help in additional understanding of the epidemiology of this disease. We also expect that the results of this scientific research could provide a theoretical, methodological and empirical contribution to the development of knowledge about the importance of the role of healthcare workers in responding to crisis situations.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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