Original Article

Clinical and epidemiological risk factors associated with hospitalization and mortality rate of COVID-19 patients in Banja Luka County: A retrospective observational cohort study on 40,000 patients

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ABSTRACT

Context: Since beginning of the coronavirus disease (COVID-19) it became clear that severe forms of this infection have primarily affected patients with chronic conditions. **Aims:** The aim of the study was to explore clinical and epidemiological characteristics associated with COVID 19 outcomes. **Settings and Design:** The retrospective observational study included 40,692 citizens of Banja Luka County, Bosnia and Herzegovina, who were confirmed as reverse transcriptase polymerase chain reaction (RT-PCR) positive on COVID-19 at a primary healthcare centre from March 2020 to September 2022. **Methods and Materials:** Epidemiological data were obtained from Web-Medic medical records of patients. The COVID-19 data were obtained from COVID-19 data sheets comprised of patients' RT-PCR testing forms, surveillance forms for severe acute respiratory syndrome coronavirus-2 status, and a map of their positive and isolated contacts. **Statistical Analysis Used:** Differences regarding the distributions of patients between groups were analysed using the Pearson chi-square test and Mantel-Haenszel chi-square test for trends, while differences in mean values were compared using an independent sample *t*-test. **Results:** The average age of hospitalised patients was significantly higher compared to the age of non-hospitalised patients ($P < 0.001$). The average age of patients with lethal outcomes was nearly twice as high in comparison to patients with non-lethal outcomes ($P < 0.001$). Male patients had a higher hospitalization and mortality rate ($P < 0.001$). The highest hospitalization rate was in patients with chronic renal failure (CRF), diabetes and cardiovascular diseases (CVDs), while the death rate was the highest among patients with CRF and hearth comorbidities. Patients with fatigue and appetite loss had a higher percentage of lethal outcomes. Vaccinated patients had a significantly lower rate of lethal outcome. **Conclusions:** Clinical symptoms, signs and outcomes, are posing as predictive parameters for further management of COVID-19. Vaccination has an important role in the clinical outcomes of COVID-19.

Keywords: Bosnia and Herzegovina, COVID-19, hospitalization, mortality, risk factors

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Introduction

The coronavirus disease 2019 (COVID-19) is an infectious disease caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). The infection had spread rapidly from China to other countries across the Asia.[1,2] By the end of January 2020, the first COVID-19 cases were reported in the United States of America (USA), France, Germany, the United Kingdom, Italy and Russia, and the World Health Organisation (WHO) announced the outbreak of COVID-19 soon after.[3,4] In February 2020, the first cases were detected in Spain and Iran, while in the Republic of Srpska (RS) (Bosnia and Herzegovina), the first case was identified on 4 March 2020.[4,5] A few days later, on 11 March 2020, the first case of COVID-19 was reported in Turkey, and the same day, the WHO announced COVID-19 as the pandemic.[3,4] The virus spread rapidly during spring 2020 due to several factors such as a low level of disease awareness, insufficient prevention and control of the infection, a lack of laboratory testing and medical supplies, a lot of asymptomatic cases or cases with very mild symptoms, and the delay of the initial treatment. It should be emphasised that the virus was novel and the world population was immunologically naive.[5,6]

The government, health authorities and healthcare institutions in the RS undertook numerous measures to control the epidemic and manage patients with the COVID-19 infection. The activities were focused on monitoring the epidemiological situation, providing adequate information to the public, implementing precautionary measures, recruiting all available health professionals, developing a set of guidance for healthcare professionals, and reverse transcriptase polymerase chain reaction (RT-PCR) testing. Nevertheless, the city of Banja Luka became the biggest cluster in the country.[6]

Patients with mild to moderate symptoms of COVID-19, as well as contacts of confirmed and probable COVID-19 cases, were isolated at their homes and contacted by phone by family medicine (FM) teams in RS on a daily basis. Data on patients' clinical symptoms, demographic characteristics and clinical risk factors were recorded in the COVID-19 application installed in 2020 within the Web-Medic data electronic platform of the primary healthcare system. The FM teams have been assigned to evaluate symptoms and, if necessary, organise patient's transportation to a laboratory, radiological diagnostic centre, or hospital. After the epidemiological situation evolved, primary healthcare became the first line of defence obliged to deliver appropriate services and meet the needs of growing number of COVID-19 patients.[7]

Since the beginning of the COVID-19 pandemic, it has been clearly evident that severe forms of COVID-19 have primarily affected patients with chronic conditions such as cardiovascular disease, hypertension (HTA), chronic obstructive pulmonary disease, diabetes mellitus (DM), obesity and cancer, and those patients were treated in hospitals.[8–10] A systematic review of 76 studies showed a strong relationship between patients' socio-demographic characteristics, comorbidities, hospitalisation and COVID-19 outcomes. Hospitalisation and severe outcomes were more frequent in males, older than 75, and the severely obese. The most frequent risk factors for the death outcome were age older than 75 and active cancer. Concerning COVID-19 clinical symptoms and signs, myalgia, sputum production, dyspnoea, nausea, and chills were associated with severe outcomes, while oxygen saturation (SpO_2) ≤90% was shown as a strong risk factor for the death outcome.[11]

As primary healthcare is the first level of COVID-19 management, FM teams/primary care physicians take the most important role in a detailed assessment of patients' characteristics related to socio-demographic characteristics, chronic conditions and COVID-19 clinical symptoms and signs. Afterwards, the decision-making process on treatment choice could be correctly implemented raising the possibility of successful COVID-19 outcomes.

The aim of this study was to explore the epidemiological characteristics and clinical risk factors associated with the COVID-19 patients' outcomes at the primary healthcare centre (PHC) of Banja Luka County during the six waves of the epidemic.

Subjects and Methods

The study was conducted at the PHC centre during the period from March 2020 to September 2022. The study included all reported citizens of Banja Luka County who were tested and registered as RT-PCR positive for COVID-19. Banja Luka is the capital city of the RS, and the second biggest city in Bosnia and Herzegovina, with a total population of 250,000 people. The PHC centre was responsible for organising healthcare through specialised units for COVID-19 patients.

Epidemiological data were obtained from Web-Medic medical records of patients being registered with FM teams in the PHC centre. The COVID-19 data were obtained from COVID-19 data sheets comprised of patient's RT-PCR testing forms, surveillance forms for SARS-CoV-2 status, and a map of their positive and isolated contacts. Only the patients' medical records with completed testing forms were included in the study. The patients who were still on treatment and/or in the hospital were excluded from the study. Using these criteria, 40,692 participants were included in the study.

The patients' records were classified as follows: basic demographic data (age and gender), COVID-19-related data (disease beginning date, laboratory test date, disease end date, hospitalisation and disease outcome, and death date), symptoms (fever, cough, sore throat, headache, diarrhoea, and loss of smell and taste), and risk factors (smoking, obesity, cancer, HTA, hyperlipidaemia, and diabetes). The disease's beginning date was calculated from records as a date when the first symptoms started, or as a medical examination date.

The results are presented as count (percent) or mean ± standard deviation, depending on the data type. Differences regarding the distributions of patients between groups (death/alive and hospitalisation/no hospitalisation) were analysed using the Pearson chi-square test and the Mantel-Haenszel chi-square test for trends, while differences in mean values were compared using an independent sample *t*-test.

In this study, all *P* values less than 0.05 were considered significant. All data were analysed using Statistical Package for Social Sciences (SPSS) 29.0 (IBM Corp.) for Windows.

Results

The study included 40,692 patients of both genders, with minimum age of six months and a maximum age of 98 years. The distribution of patients with their demographic characteristics in total, and by regarding the hospitalisation status and the lethal outcome is presented in Table 1.

The average age of hospitalised patients was significantly higher compared to the age of non-hospitalised patients (64.2 ± 16.1 vs. 45.4 ± 18.7; *P* < 0.001). The average age of patients with lethal outcomes was nearly twice as high in comparison to patients with non-lethal outcomes (74.6 ± 11.5 vs. 45.7 ± 18.6; *P* < 0.001).

The youngest patients with lethal outcomes were in the 20–29 age group: three females and two males; four died in 2021, while one died in 2022. One person had HTA, while the other had cancer. The other three people had no significant risk factors.

Among the 30–39 age group, nine were females and four were males. Two of them had cancer, one had chronic renal failure (CRF), and two were smokers. Other patients with lethal outcomes had no serious comorbidities. As shown in Table 1, the probability of a lethal outcome significantly increases with age, being highest in the oldest group. The hospitalisation rate had a similar trend. Using the Mantel-Haenszel chi-square test for trend, a significant positive linear trend is observed across age categories regarding the hospitalisation and death rate. Hospitalisation and mortality rates were higher in male patients.

The most frequent risk factors were HTA, obesity, and hypercholesterolemia. The highest hospitalisation rate was in CRF, diabetics and heart comorbidity patients, and the death rate was the highest among CRF and heart comorbidity patients. All risk factors were significant predictors of hospitalisation and mortality, except smoking for death outcome [Table 2]. Smokers had a lower probability of lethal outcomes and hospitalization. However, after adjusting for age (older than 18), smoking becomes a favourable significant factor for the lethal outcome (odds ratio =1.260; 95% confidence interval = 1.036–1.532). Vaccinated patients had a higher rate of hospitalisation, but a significantly lower rate of lethal outcomes. However, the vaccination started during the pandemic and the number of doses significantly correlates with the protection from lethal outcome and hospitalisation.

Concerning the clinical signs and symptoms, the fever was the most common one, presented in two-thirds of patients and followed by cough and fatigue. One-quarter of patients had loss of smell and taste. The presence of fever, cough, fatigue, nausea and vomiting, chest pain, shortness of breath and appetite loss favoured hospitalisation, while patients with diarrhoea, throat pain, loss of smell and taste were less probable for hospitalisation [Table 3]. Fever, cough, diarrhoea, nausea and

Table 1: Characteristics of patients and risk factors for hospitalisation and lethal outcome in total and by year						
	Total		**Death**			
		Hospitalisation	**Total**	**2020**	**2021**	**2022**
Total		3,158 (92.2%)	1,569 (3.9%)			
Year[a]						
2020	10,724 (27.3%)	1,273 (11.9%)	479 (4.5%)			
2021	20,430 (51.9%)	1,786 (8.7%)	896 (4.4%)			
2022	8,187 (20.8%)	38 (0.5%)	194 (2.4%)			
Age[a]						
<10	819 (2%)	21 (2.6%)	0	0 (0%)	0 (0%)	0 (0%)
10–19	2,469 (6.1%)	13 (0.5%)	0	0 (0%)	0 (0%)	0 (0%)
20–29	4,490 (11%)	66 (1.5%)	5 (0.1%)	0 (0%)	4 (0.2%)	1 (0.1%)
30–39	7,550 (18.6%)	168 (2.2%)	13 (0.2%)	3 (0.1%)	10 (0.3%)	0 (0%)
40–49	7,871 (19.4%)	310 (3.9%)	36 (0.5%)	12 (0.5%)	20 (0.5%)	4 (0.3%)
50–59	5,745 (14.1%)	421 (7.3%)	103 (1.8%)	36 (2.3%)	56 (2.0%)	11 (1.0%)
60–69	6,085 (15%)	832 (13.7%)	269 (4.4%)	98 (6.2%)	146 (4.6%)	25 (2.2%)
70–79	3,830 (9.4%)	798 (20.8%)	539 (14.1%)	160 (17.8%)	325 (15.7%)	54 (7.5%)
80+	1,810 (4.5%)	526 (29.1%)	603 (33.3%)	170 (35.0%)	334 (37.0%)	99 (27.0%)
Gender						
Male	19,307 (47.4%)	1,891 (9.8%)	925 (4.8%)	317 (5.7%)	504 (5.4%)	104 (2.8%)
Female	21,385 (52.6%)	1,267 (5.9%)	644 (3%)	162 (3.1%)	392 (3.5%)	90 (2.0%)

*All differences between year, age and gender groups regarding hospitalisation and death (total and by year) are significant at the <0.001 level. [a]Total and by year and age numbers might be different due to missing data regarding the year (3.3% missing) and age (0.1% missing)

Table 2: Risk factors in correlation with hospitalization and lethal outcome			
	Total	Hospitalisation	Death
Smoking			
No	36,700 (90.2%)	2,917 (7.9%)	1,437 (3.9%)
Yes	3,992 (9.8%)	241 (6%)*	132 (3.3%)
Obesity			
No	35,751 (87.9%)	2,483 (6.9%)	1,254 (3.5%)
Yes	4,941 (12.1%)	675 (13.7%)*	315 (6.4%)*
Hypercholesterolemia			
No	35,759 (87.9%)	2,466 (6.9%)	1,258 (3.5%)
Yes	4,933 (12.1%)	692 (14%)*	311 (6.3%)*
HTA			
No	30,638 (75.3%)	1510 (4.9%)	514 (1.7%)
Yes	10,054 (24.7%)	1,648 (16.4%)*	1,055 (10.5%)*
DM			
No	37,402 (91.9%)	2,462 (6.6%)	1,131 (3%)
Yes	3,290 (8.1%)	696 (21.2%)*	438 (13.3%)*
Heart comorbidities			
No	38,567 (94.8%)	2,726 (7.1%)	1,203 (3.1%)
Yes	2,125 (5.2%)	432 (20.3%)*	366 (17.2%)*
CRF			
No	40,462 (99.4%)	3,090 (7.6%)	1,511 (3.7%)
Yes	230 (0.6%)	68 (29.6%)*	58 (25.2%)*
Cancer			
No	38,404 (94.4%)	2,804 (7.3%)	1,319 (3.4%)
Yes	2,288 (5.6%)	354 (15.5%)*	250 (10.9%)*
Vaccination			
No	29,785 (73.2%)	2,025 (6.8%)	1,319 (4.4%)
Yes	10,907 (26.8%)	1,133 (10.4%)*	250 (2.3%)*
Dose number			
1	587 (5.4%)	67 (11.4%)*	29 (4.9%)*
2	8,844 (81.1%)	856 (9.7%)	207 (2.3%)
2+ booster	1,267 (11.6%)	195 (15.4%)	14 (1.1%)
Booster only	209 (1.9%)	15 (7.2%)	0

HTA=Hypertension; DM=diabetes mellitus; CRF=Chronic renal failure. *Significant differences on 0.05 level

Table 3: Symptoms and signs in correlation with hospitalisation/death outcomes			
	Total	Hospitalization	Death outcome
Fever			
No	11,937 (39%)	906 (7.6%)	452 (3.8%)
Yes	18,635 (61%)	2,116 (11.4%)*	634 (3.4%)
Cough			
No	18,531 (60.6%)	1629 (8.8%)	650 (3.5%)
Yes	12,043 (39.4%)	1,394 (11.6%)*	436 (3.6%)
Fatigue			
No	18,407 (60.2%)	1,557 (8.5%)	591 (3.2%)
Yes	12,167 (39.8%)	1,466 (12%)*	495 (4.1%)*
Throat pain			
No	26,061 (85.2%)	2,826 (10.8%)	1,029 (3.9%)
Yes	4,513 (14.8%)	197 (4.4%)*	57 (1.3%)*
Loss of smell and taste			
No	23,652 (77.4%)	2,817 (11.9%)	1,043 (4.4%)
Yes	6,922 (22.6%)	206 (3%)*	43 (0.6%)*
Headache			
No	23,223 (76%)	2,665 (11.5%)	994 (4.3%)
Yes	7,351 (24%)	358 (4.9%)*	92 (1.3%)*
Diarrhoea			
No	28,586 (93.5%)	2,822 (9.9%)	1,019 (3.6%)
Yes	1,988 (6.5%)	201 (10.1%)	67 (3.4%)
Nausea, vomiting			
No	29,867 (97.7%)	2,899 (9.7%)	1,060 (3.5%)
Yes	707 (2.3%)	124 (17.5%)*	26 (3.7%)
Myalgia, arthralgia			
No	27,803 (90.9%)	2,795 (10.1%)	1,028 (3.7%)
Yes	2,771 (9.1%)	228 (8.2%)*	58 (2.1%)*
Chest pain, shortness of breath			
No	30,215 (98.8%)	2,961 (9.8%)	1,072 (3.5%)
Yes	359 (1.2%)	62 (17.3%)*	14 (3.9%)
Appetite lost			
No	30,014 (98.2%)	2,873 (9.6%)	1,038 (3.5%)
Yes	560 (1.8%)	150 (26.8%)*	48 (8.6%)*
Rhinitis			
No	29,520 (96.6%)	2,992 (10.1%)	1,080 (3.7%)
Yes	1054 (3.4%)	31 (2.9%)*	6 (0.6%)*

*Significant differences at 0.05 level

vomiting, chest pain and shortness of breath were not significant predictors of death outcome. Contrary, fatigue and appetite loss were symptoms significantly dominant in lethal outcome patients, while throat pain, loss of smell and taste, headache, myalgia, arthralgia and rhinitis were symptoms of a less probable lethal outcome.

The incidence rate was the highest in the 30–39 and 40–49 groups, while the hospitalisation and death rate had an evident positive correlation with age (the higher the age group, the higher the hospitalisation and death rates) [Figure 1]. Even though the 30–39 and 40–49 age groups are dominant for incidence, a significant increase in hospitalisation starts in the 50–59 groups, while a significant death rate starts in the 70–79 age groups. The age above 70 was an absolute risk factor for hospitalisation and/or lethal outcomes.

The number of newly diagnosed cases and the number of deaths by date are presented in Figure 2. There is an obvious increase in the death rate (with a few weeks delay) in the period

of six (incidence) waves. While the first/second ones were rather low, the third, fourth, and fifth waves had significantly higher incidence and mortality rates. The third and fifth waves had two peaks, but the first was significantly higher in the third wave, and similar in the fifth wave. The sixth wave was significantly lower than the previous three and more like the first wave. The number of deaths increased approximately 2–3 weeks after the beginning of each incidence peak.

Discussion

In this study, there were 40,692 COVID-19 patients, with women slightly overrepresented. A similar proportion was present in Spain, where SARS-CoV-2 positivity was higher in females.[12] Contrary to those findings, the majority of COVID-19 patients
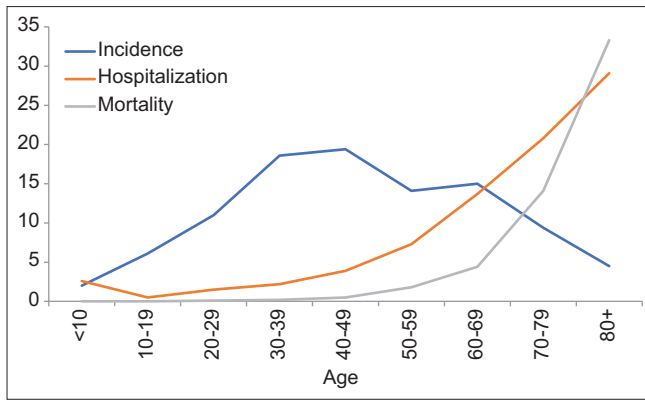
Figure 1: The distribution of patients with COVID-19 regarding the incidence, hospitalisation rate and mortality rate by age decades. The lines represent the percentage of patients (of the total sample) in each age group (decade) by examined parameter

Figure 2: The number of new COVID-19 cases (blue dots) and the number of death cases (red dots) during the period from January 2020 to September 2022. The dots represent the 7-day average number of cases.

in the United States were males.[13] Data analysis from 177 countries/territories on four continents/regions resulted in a higher incidence of COVID-19 in females, while the mortality rate was higher in males.[14]

The average age of the hospitalised patients or the patients with lethal outcomes in our study was significantly higher in comparison with the non-hospitalised patients. The lethal outcomes significantly increased with age, and were the highest among the elderly (70+ years of age), while a majority of young patients recovered successfully, which is similar to the study results from the Chongqing Three Gorges Central Hospital in China.[15] Although a majority of patients in our study were younger than 50, the highest percentage of all death cases were from the group of patients over 80. The male patients were overrepresented. Similar to our study, the results of the Spanish study, which was conducted in a primary care setting, showed that the mean age of COVID-19 patients with lethal outcomes was 83 years, mostly males.[12] Those data along with the other studies clearly showed that sex and age could be considered risk factors for COVID-19-related deaths.[16,17] Results of the nationwide study in Tunisia showed a faster recovery of younger patients as well as healthcare workers.[18] Results of the study on the seroprevalence of SARS-CoV-2 antibodies in the RS confirmed that the younger population had higher seroprevalence values and less hospitalisation.[19]

Concerning comorbidities and risk factors analysed by many authors, obesity, HTA, hyperlipidaemia, diabetes, CRF and CVD were significant predictors of hospitalisation and mortality in our study.[20-24] Smokers had a lower probability of lethal outcomes and hospitalization. However, after adjusting for age, smoking becomes a favourable significant factor for the lethal outcome. A higher proportion of smoking and comorbidities were found in males in the USA.[13] Smoking, kidney disease, obesity, pulmonary disease, diabetes and CVD were significant factors for hospitalisation in Brazil.[25] The role of cigarette smoking in COVID-19 has become a very controversial issue. Some
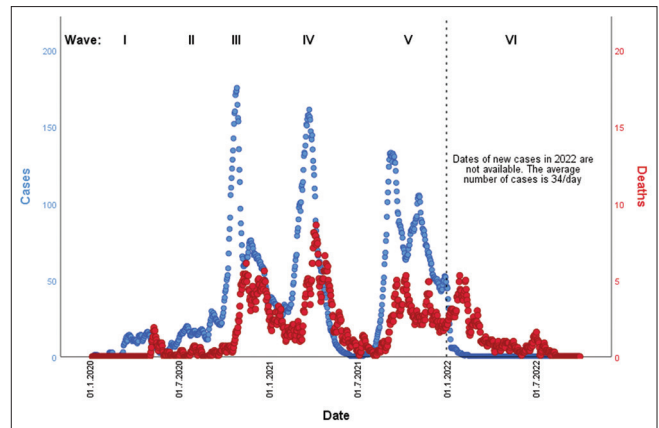
studies emphasised a positive correlation between cigarette smoking and COVID-19 because nicotine poses minor anti-inflammatory properties.[26] Other studies indicate that cigarette smoking increases the severity of COVID-19 by increasing the angiotensin-converting enzyme II (ACE2) gene expression.[27–29] All these prompted the WHO to issue a warning letter suggesting that the severity of COVID-19 infection was higher among smokers.[30]

The study from the USA found that older males with comorbidities had a higher risk of death, which is in line with the results of our study.[13] However, middle-aged females were dominant COVID-19 patients in Nanchang, China, but HTA was one of the most frequent comorbidities, as our study has shown.[31] The study in Detroit showed that coronary artery disease and chronic kidney disease were the factors for hospitalisation, while in Korea the additional factors were dementia, neurological diseases and heart failure.[32,33] In South Africa, family physicians took care of COVID-19 patients with mild symptoms in small district hospitals, where the increasing age, male sex, overweight/obesity, type 2 diabetes mellitus (T2DM), chronic kidney disease, cardiac failure, human immunodeficiency virus (HIV) and cancer were the risk factors for lethal outcome.[34] There was a strong relationship between the lethal outcome and diabetes of patients with COVID-19 in Spain.[12] The national database of patients with T2DM in the US study showed a higher risk for severe COVID-19 and lethal outcomes in older males with comorbidities such as dementia, cancer, congestive heart failure, paraplegia, and metabolic disease.[35] In Wuhan, the elderly COVID-19 patients with the combination of HTA and heart disease were at a greater risk for the lethal outcome.[36] Our results showed that a significant number of risk factors influenced hospitalisation and death rates, while results from Japan and Colorado (USA) showed that age, obesity, HTA and diabetes are predictable for oxygen requirement.[37,38] HTA, DM and coronary artery disease were the most common comorbidities in hospitalised COVID-19 patients in India.[39] Findings from the USA showed

that severe COVID-19 clinical course was more frequent in patients with autoimmune diseases, obesity, smoking and female gender. Contrary to our results, ageing was not found as a risk factor for severe presentation of COVID-19 in the American study.[40] However, increased sensitivity to immune response in aged people has raised concerns about possibly contributing to severe COVID-19 outcomes.[41]

Vaccinated patients had a higher rate of hospitalisation, compared to unvaccinated patients, but a significantly lower rate of lethal outcomes. The number of doses received significantly correlates with the protection from lethal outcomes and hospitalisation.[42] The results of the Swedish study showed that the vaccinated patients were at a low risk of hospitalisation or death. As waning more than four months after vaccination was confirmed, administration of a third vaccine dose as a booster was recommended.[43] A systematic review of 41 worldwide studies showed that most vaccines prevented people from getting infected, as well as reduced the number of people with severe disease.[44,45] Results from the study in Korea showed better outcomes for vaccinated patients with mild to severe clinical course.[46]

Concerning the signs and symptoms, fever, cough, fatigue, nausea and vomiting, chest pain, shortness of breath and loss of appetite were the most frequent reasons for hospitalisation in our study. Dyspnoea, fever and cough were dominant symptoms in hospitalised patients in India as well.[39] Findings from Detroit showed that dyspnoea, anorexia, nausea and diarrhoea were the most common symptoms among hospitalised patients.[32] Some of the symptoms like throat pain, loss of smell and taste, headache, myalgia, arthralgia and rhinitis had significantly higher favourable outcomes in our study. Contrarily, fatigue and appetite loss were symptoms significantly dominant in lethal outcome patients.

Our study contributes to general results related to the basic demographic data, the clinical risk factors and the COVID-19 outcome at the PHC level as we captured longitudinal data on outpatients' symptoms treated and followed up by the PHC professionals that were reorganised accordingly to the pandemic circumstances. This paper is relevant to the practice of primary care physicians as it shows that a detailed starting assessment and strong follow-up on a daily basis by PHC professionals provide comprehensive management of COVID-19 patients. That way, contact with and monitoring of COVID-19 patients provide early recognition and timely referring of deteriorated COVID-19 patients. Moreover, at the very beginning of the disease, the assessment of present risk factors could contribute to adequate management and influence the probability of hospitalisation.

The analysed data originates from the PHC information system. Therefore, the limitation of the study could be ascribed to the lack of data on the clinical course of the disease and the complications that appeared during hospital treatment. Only the clinical outcomes of the hospitalised patients such as recovery or death rate were used in this study.

Conclusions

The clinical symptoms and outcomes of COVID-19 have been associated with the basic demographic characteristics and clinical risk factors of patients in the RS, and that is in line with the results of many different studies worldwide. Age and sex could be considered risk factors for COVID-19-related deaths. In our study, a higher mortality rate has been shown among the oldest age group and in male patients. The most frequent clinical risk factors were HTA, obesity, and hypercholesterolemia. The highest hospitalisation rate was among the patients with CRF, diabetes and CVD, while the death rate was the highest among patients with CRF and CVD. Fever, cough, fatigue, nausea and vomiting, chest pain, shortness of breath and appetite loss favoured hospitalization. The patients with fatigue and appetite loss had a higher percentage of lethal outcomes. Therefore, permanent contact and monitoring of COVID-19 patients by primary healthcare physicians lead to better outcomes or timely hospitalization. The vaccination against COVID-19 has an important role in the clinical outcomes of the disease, clearly reducing the risk of death. The number of received doses correlates with the protection from death, with the booster dose being the most effective one.

List of abbreviations

Abbreviation	Definition
COVID-19	Coronavirus disease 2019
SARS-CoV-2	Severe acute respiratory syndrome Coronavirus-2
WHO	World Health Organisation
RS	Republic of Srpska
RT-PCR	Reverse transcriptase polymerase chain reaction
FM	Family medicine
PHC	Primary healthcare centre
CRF	Chronic renal failure
CVD	Cardiovascular diseases
ACE2	Angiotensin-converting enzyme II
T2DM	Type 2 diabetes mellitus
HIV	Human immunodeficiency virus
USA	United States of America
HTA	Hypertension

Ethical policy and institutional review board statement

This study was based on anonymous data analyses and did not involve contacts or any intervention with patients. Therefore, it was not necessary to obtain permission from the Ethics Committee.

Conflicts of interest

There are no conflicts of interest to declare.

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