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Epidemiology and factors associated with COVID-19 outbreak-related deaths in patients admitted to medical centers of Mazandaran University of Medical Sciences

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Abstract:

BACKGROUND: The first case of COVID-19 was reported in Iran on February 19, 2020, in Qom. Since Mazandaran is one of the high-risk provinces with many patients and deaths, this study was conducted to investigate the epidemiological characteristics of COVID-19-related deaths in Mazandaran.

MATERIALS AND METHODS: In this descriptive study, demographic information and clinical findings in patients who died following COVID-19 in the medical centers of Mazandaran University of Medical Sciences from February 8, 2020, to October 10, 2020, were extracted. Data were analyzed by using SPSS 21. Logistic regression was used to compare the data. $P < 0.05$ was considered as the significance level.

RESULTS: Out of a total of 34,039 patients admitted during the 8 months, 2907 patients died. Of these, 1529 (52%) were male, and the rest were female. In terms of age, 10 cases in the age group of fewer than 15 years, 229 cases in the age group of 15–44 years, 864 patients in the age group of 45–64 years, and 1793 people in the age group of 65 years and over died. 2206 people (more than 75%) by personal visit referred to medical centers. The mortality rate was more than 8 cases per 100 hospitalized patients. Men were 16% more likely to die from COVID-19 than women.

DISCUSSION AND CONCLUSION: Older adults over 65 have the highest incidence and death rate due to this disease. The incidence rate was higher in women, and the death rate was higher in men, which differs from the national pattern.

Keywords:

Coronavirus, COVID-19, epidemiology, hospital mortality, mortality, outbreak, risk factors

Introduction

Since December 2019, several pneumonia cases of unknown cause, induced by COVID-19, have been reported in Wuhan, China.^[1-6] According to the World Health Organization, an epidemic is an “out-of-the-ordinary” outbreak of a disease that is usually transmitted from person

to person or animal to human through an infectious disease or is caused by exposure to hazardous chemical sources and radioactive materials.^[7] The cause of this disease was a new and genetically modified virus from the family of coronaviruses called SARS-CoV2, which was named COVID-19.^[8] Most coronaviruses are not dangerous, but some of them can cause severe respiratory

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disorders.^[9] Between 2002 and 2003, SARS-CoV caused an outbreak of pneumonia in 8000 cases and spread to more than 30 countries and five continents and is now considered an eradicated disease. MERS-CoV was identified in 2012,^[10] which causes pneumonia in humans and have been reported its fatality rate more than 30%. No specific antiviral treatment is available for it, and the treatment is mainly supportive and symptomatic.^[11] The third outbreak of the virus, SARS-CoV2, spread rapidly throughout China and many countries.^[12-15]

Due to the very high transmission power, it covered the whole world in less than 4 months.^[16,17] On March 11, 2020, the World Health Organization declared the disease pandemic outbreak to make its importance more apparent to everyone. According to the World Health Organization, from the outbreak of the disease until January 17, 2021, 93,194,922 cases and 2,014,729 deaths following the disease have been recorded worldwide.^[7] The United States, India, and Brazil are the three countries with the highest rates of COVID-19, respectively. In Iran, the first case of COVID-19 was reported on February 19, 2020, in Qom.^[18] On February 20, 2020, the Ministry of Health and Medical Education approved two cases of COVID-19 in Qom as the center of this disease.^[19] There have been several issues to overcome in this unusual deal encompassing insufficient information, poor understanding of the risk of the virus, and lack of belief in vulnerability; by these issues, the disease quickly spread in Tehran as the commercial capital and in the northern regions of Iran due to their tourist attractions. In Iran, COVID-19 spread more rapidly due to the Iranian New Year.^[20] According to the report of the World Health Organization, as of January 17, 2021, 1,324,395 cases and 56,717 deaths were registered in Iran.^[7] The most essential challenge posed by this pandemic is to endanger the health and lives of people around the world, where many people are infected with this acute viral illness every day, and some of them die.^[21,22] The global spread of the virus has affected global health systems and the world economy.^[23] It also has led to political, social, psychological, and commercial consequences.^[24] To reduce the damage associated with COVID-19, public health measures are needed to promote health and control infection to limit the virus's spread worldwide.^[25] Knowledge of the epidemiological characteristics of the deceased, underlying causes, and comorbidities is of particular importance for estimating the course of epidemic diseases as well as the implementation and evaluation of death prevention methods. Based on the report issued by the COVID-19 Epidemiology Committee of Iran on October 16, increased incidence and mortality rates of the disease in the country, and third wave of coronavirus in seven provinces, including Mazandaran,^[26] this study aims to provide epidemiological characteristics of the

patients died because of COVID-19 in the medical centers affiliated to Mazandaran University of Medical Sciences.

Materials and Methods

Study design and setting

In this retrospective, analytic study (cross-sectional), demographic information, symptoms, and clinical manifestations of all patients admitted from February 8, 2020, to October 10, 2020, and died of COVID-19 in the medical centers of Mazandaran University of Medical Sciences were examined.

Study participants and sampling

All Patients who died following COVID-19 in the medical centers of Mazandaran University of Medical Sciences from February 8, 2020, to October 10 were included.

Samples were collected by hospital experts, who had received the necessary training in the field of registration and reporting of cases of disease and death by the format sent by the relevant ministry and the medical records of these patients.

Data collection tool and technique

According to the standard format sent by the relevant ministry, information including age, sex, date of hospitalization, place of residence, number of days of hospitalization, signs, and symptoms of the deceased at the time of admission (fever, cough, headache, shortness of breath, decreased level of consciousness, and so forth), history of smoking and drug use, SpO₂ level, computed tomography (CT)-scan findings concerning the patient's lungs, underlying diseases including diabetes, hypertension, heart disease, cancer, chronic blood diseases, kidney disease, liver disease, neurological disease, and acquired immunodeficiency syndrome, immunodeficiency, asthma, and other lung diseases except for asthma and other chronic diseases were examined. Finally, the patient's history of contact with a person with COVID-19 and the date of death were recorded. Inclusion criteria for this study are those who died with COVID-19 diagnosis in medical centers affiliated to Mazandaran University of Medical Sciences and in 8 months (February 8, 2020–October 10, 2020). Exclusion criteria include people whose information has not been fully registered or has been admitted in a period other than the specified range. Regarding the missing data, by the retrospective nature of the study, the review time will be increased to enhance the number of samples and bring the information closer to reality.

The obtained data were statistically analyzed in SPSS statistical software database version 21 For International Business Machines Corporation (IBM), Located in Armonk of New York. (descriptive statistics extraction).

Logistic regression was used to compare the data. $P < 0.05$ was considered as the significance level.

Ethical consideration

Personal details of patients and deceased, including name, address, and contact number, were deleted. All ethical considerations were noticed in this research. The license for this study has been issued by the Ethics Committee of Mazandaran University of Medical Sciences under the number IR.MAZUM.REC.1399.7848 and dated September 27, 2020.

Results

Out of 34,039 patients admitted to medical centers affiliated to Mazandaran University of Medical Sciences over 8 months, 17,170 female patients (50.4%) and the remaining 16,869 male patients (49.6%) were infected. Two thousand nine hundred and seven patients died; the mortality rate was more than 8 cases per 100 people. Of these (52%), 1529 were male, and the rest were female. In terms of age groups, 10 cases in the age group of fewer than 15 years, 25 patients in the age group of 15–24 years, 214 patients in the age group of 25–44 years, 864 patients in the age group of 45–64 years, and 1794 patients in the age group of 65 years and over died [Table 1]. Respiratory distress, fever, cough, muscle aches, and decreased consciousness level have been the most common clinical manifestations of the deceased people's disease, respectively. Most deaths occurred 1 day after admission, and heart disease, diabetes, hypertension, kidney disorders, and cancer were among the most common underlying disorders in deceased people. Eight hundred and eighty-six people had a history of previous contact with the infected person.

Three people by ambulance, 158 people by private ambulance, 540 people by 115 emergency ambulances, and 2206 people (more than 75%) by personal visit referred to medical centers. Two pregnant women, 22 and 43 years old, also died of COVID-19 during this period. 64.4% of the deceased had a SpO₂ level of <93% at the time of admission. CT scan was performed in 1442 cases. Symptoms of lung involvement were evident in more than 97% of these scanned cases. From February 2020 to September 2020, the highest death rate was

reported for 642 cases in April and the lowest death rate for 169 cases in June [Figure 1].

According to the results of multivariate logistic regression, there was a significant relationship between death from COVID-19 and the variables of age and gender. so that in patient (under 24 years [odds ratio (OR) =0.13, $P = 0.001$], 25–44 years [OR = 0.15, $P = 0.001$], 45–65 years [OR = 0.38, $P = 0.001$]); and about gender:(OR = 1.16, $P \leq 0.001$) ($P < 0.05$). This means that patients under the age of 24 have a lower chance of dying from COVID-19 than older people. Put differently, the chances of death from COVID-19 are higher in older people [Table 2]. Men are 1.16 times more likely than women to die from COVID-19. Men were 16% more likely to die from COVID-19 than women. The mean age of the subjects was 66.48 ± 15 years.

Discussion

The prevalence pattern of COVID-19 in Iran is such that it is spread in all cities of the country. Still, unlike the northern regions of Iran, in the southern cities, we have seen less prevalence in the first wave, which can be related to factors such as cultural differences, lifestyle, transportation, seasonal workers, tourist rate, and city population; for example, the volume of travel to the northern provinces of Iran is very high, or the high prevalence of the virus in Isfahan or Mashhad and Mazandaran province can be due to the tourist attractions cities. Beyond, the amount of

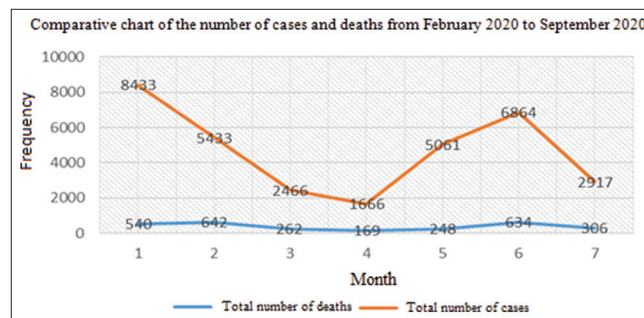


Figure 1: Comparison of cases and deaths following COVID-19 from February 2020 to September 2020

Table 2: Results of the fitting multivariate logistic regression model for coronavirus disease 2019-related death factors in hospitalized patients

Variable	Age groups	Confidence Interval		Exp (β) OR	P
		Exp(β) (95% CI)			
		Lower limit	Upper limit		
Age (years)	Under 24	0.096	0.18	0.13	0.001
	25-44	0.13	0.17	0.15	0.001
	45-64	0.38	0.45	0.41	0.001
	Over 65	-	-	-	-
Gender	Male-female	1.076	1.25	1.164	0.001

CI=Confidence interval, OR=Odds ratio

Table 1: Mortality rate by age and sex

Age groups (years)	Frequency	Female (%)	Male (%)
0-1	3	2	1
1-14	7	3	4
15-24	25	7	18
25-44	214	94	120
45-64	864	366	498
65 and over	1794	906	888
Total	2907	1378 (47.40)	1529 (52.60)

population and public transportation are significant. In metropolises such as Tehran, due to high population density and increased use of public transport, mainly subway, the virus's prevalence is high compared to other places in the country.^[27,28] A geographical analysis of the epidemiology of coronavirus has shown that the virus has been detected in areas around Tehran province and also in the northern, western, and northwestern regions of the country. Spatial and geographical studies show that the essential factors in the spread of the COVID-19 virus in the country are population concentration and geographical distance from population centers, which have accelerated the reach of this contagious disease.^[29] Paying attention to these factors can be very important in managing disease control and prevention.

According to the findings of this study, the highest incidence and death rates in Mazandaran province were reported in the age group over 65 years. The COVID-19 mortality rate in this study was 8%, and the men's mortality rate was 1.1% higher than women's. In a study entitled "Epidemiological characteristics of coronavirus disease 2019 (COVID-19) patients in Iran" conducted by Nikpouraghdam *et al.*, on 2968 patients diagnosed with COVID-19 from February 19, 2020, to April 15, 2020, it was figured out that most patients were in the age group of 50–60 years. The male-to-female ratio was 1:1.93. A total of 239 deaths (8.06%) occurred among hospitalized patients. 10.89% of the total patients had underlying diseases. Diabetes, chronic respiratory diseases, hypertension, cardiovascular disease (CVD), chronic kidney disease (CKD), and cancer were the most common comorbidities in deceased patients. Male gender, older age, and underlying diseases were associated with mortality.^[30] In a meta-analysis conducted in Iran in 2020, Keyvan Heydari *et al.* systematically investigated the clinical and paraclinical characteristics of patients with COVID-19. In the meta-analysis, 32 articles, including 49,504 patients with COVID-19, were reviewed. The most common clinical symptoms were fever (84%), cough (65%), and fatigue (42%). Further, the overall mortality rate was reported at 3%.^[28] In the study conducted by Rothan *et al.*, the most common symptoms at the onset of COVID-19 illness reported: fever, cough, and fatigue, while other symptoms include sputum production, headache, hemoptysis, diarrhea, dyspnea, and lymphopenia.^[31]

Based on the data from the Chinese National Reporting System, as of February 20, 2020, the median age of the confirmed cases was 51 years (2 days–100 years), of which 77.8% were 30–69 years. A total of 51.1% were male.^[32] Fever, dry cough, and fatigue were more commonly reported, whereas nasal congestion, rhinorrhea, sore throat, and myalgia were relatively rare.^[33]

In Bargain's review article, major comorbidities that seen in the overall population were cardiovascular diseases (8.9%), hypertension (27.4%), diabetes (17.4%), chronic obstructive pulmonary disease (COPD) (7.5%), cancer (3.5%), CKD (2.6%), and other (15.5%). Significant comorbidity specific to countries included in the study were China (HTN 39.5%), South Korea (CVD 25.6%), Italy (HTN 35.9%), United States (HTN 38.9%), Mexico (Other 42.3%), United Kingdom (HTN 27.8%), and Iran (diabetes 35.0%). Within fatal cases, an estimated 84.1% had the presence of one or more comorbidity.^[34] In the systematic review and meta-analysis study of Singh *et al.*, the pooled prevalence for comorbidities in patients with COVID-19 disease was 22.9% for HTN, 11.5% for diabetes, and 9.7% for CVD. For COPD, CKD, cerebrovascular disease, and cancer, the pooled prevalences were all <4%. Except cerebrovascular disease, all the other comorbidities presented a significantly increased risk for having severe COVID-19. Further, the risk of mortality was significantly increased in individuals with CVD, COPD, CKD, cerebrovascular disease, and cancer.^[35] Based on the Kazemi-Karyani *et al.*'s study, the case fatality rate of COVID-19 in the world by April 30, 2020, was 7.05%, which ranged from 3.74% in the African region and 9.48% in the European area.^[36]

In the present study, respiratory distress, fever, and cough were the most common clinical manifestations of the disease in the deceased people, respectively, and the overall mortality rate was 8%. One of the essential needs to prevent the disease's spread is to know the disease's epidemiology. In this article, epidemiology, information on risk factors, symptoms, and common underlying diseases in the death of patients in the North of Iran are presented in two peaks of COVID-19.

Limitations and recommendation

In this study, information about the third wave of the disease, which resulted in a higher number of deaths than the previous two waves, was not included due to time constraints.

Besides, data on the incidence and mortality of COVID-19 in nonhospitalized patients were not available. It is recommended to study all 4 waves of this disease in IRAN in the next studies for more detailed information.

Conclusion

One of the high-risk groups for COVID-19 is the elderly with underlying diseases. However, many elderly patients with COVID-19 may appear "silent" after being infected with the virus. Immune system responses are slower and less efficient in the elderly. Therefore, the elderly are more at risk for COVID-19 than other groups.

According to this study's results, the elderly over 65 have the highest incidence and death rate due to this disease. Preventive measures for this group of people help improve the health of the elderly, reduce the care burden of the treatment team, reduce treatment costs, and fight the virus. Moreover, identifying people with the disease in the shortest possible time, isolating them in homes or convalescents, examining people in contact with the infected person, and their active screening will reduce the burden caused by this disease.

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Conflicts of interest

There are no conflicts of interest.

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