Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2021, 10(5): 83-90

Prevalence and Epidemiological Features of COVID-19 Cases in Jeddah, Kingdom of Saudi Arabia

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ABSTRACT

Objectives: *In March 2020, the World Health Organization declared Coronavirus Disease 2019 (COVID-19) as a pandemic. This study aims to measure the prevalence of COVID-19 and epidemiological features of laboratory-confirmed COVID-19 cases in the Jeddah Region, Kingdom of Saudi Arabia (KSA).* ***Methods:*** *A multi-center, analytical, cross-sectional study was conducted on 21,272 laboratory-confirmed COVID-19 cases from March 1 to May 31, 2020, in Jeddah Region, KSA. The cases included all ages and genders with no exclusion criteria. We estimated a confidence interval of 95%, a margin of error of 5%, and a response distribution of 50%. Using this information, we calculated the sample size using Raosoft as 416 cases. Data variables included demographic data, and information such as travel history, status as healthcare workers, and others variables.* ***Results:*** *The prevalence of COVID-19 in the Jeddah Region was 4.2 per 1,000 people (0.42%). The average age was 37.80 ± 13.5 years. The majority of participants were male (76.9%). Recovery outcome classifications were observed in 95.7%. Most of the participants were non-healthcare workers (85.4%). Travel information showed that most participants had no history of travel inside Saudi Arabia (88.8%).* ***Conclusion:*** *In this multi-center cross-sectional study, the age ranged from 18-35 years, and those who are the case with no contacts are the strongest risk factor for COVID-19 outcomes. Therefore, implementing well-design strategies to break the chain of infection is necessitated. Wearing masks, social distance, and immediate patient isolation play a significant role in controlling the transmission of COVID-19.*

Keywords: Prevalence, Epidemiological features, Coronavirus, COVID-19, Jeddah, Saudi Arabia

Abbreviations: IBV: Infectious Bronchitis Virus, SARS: Severe Acute Respiratory Syndrome, COVID-19: Coronavirus Disease 2019, WHO: World Health Organization, KSA: Kingdom of Saudi Arabia, RT-PCR SARS-CoV-2: Reverse Transcription-polymerase Chain Reaction test for Severe Acute Respiratory Syndrome Coronavirus, MOH: Ministry of Health, HESN: Health Electronic Surveillance Network, SPSS: Statistical Package for Social Science, HCWs: Healthcare Workers, China CDC: Chinese Centre for Disease Control and Prevention, ICN: International Council of Nurses

INTRODUCTION

Coronaviruses are a group of RNA viruses that cause acute respiratory infection in humans and animals. In the 1930s, the first discovered coronaviruses were found in mammals and birds. Acute respiratory disease symptoms appeared in newborn chicks caused by Infectious Bronchitis Virus (IBV) in North Dakota in the United States [1,2]. In the 1960s, scientists discovered coronaviruses in humans [3]. These viruses cause an acute respiratory infection that can range from mild like the common cold to a fatal illness, as in the case of Severe Acute Respiratory Syndrome (SARS), and Coronavirus Disease 2019 (COVID-19).

In late December 2019, the first human cases of COVID-19 were discovered and reported to the World Health Organization (WHO), which led to an outbreak of acute respiratory illness in Wuhan City, Hubei Province, China [3,4]. In

January 2020, the WHO announced a public health emergency. In March 2020, the WHO declared COVID-19 as a pandemic since it had caused a global health crisis worldwide with more than 28 million confirmed cases internationally [3]. Nevertheless, the exact source of COVID-19 is unidentified [5].COVID-19 disease is likely to spread mainly from person to person, as an infected person spreads the disease through respiratory droplets. Then, the droplets can enter the mouths or noses of close contacts within about 6 feet (two meters) [5]. According to the WHO, the case definitions for a confirmed case of COVID-19 are characterized by "a person with laboratory confirmation of COVID-19 infection, irrespective of clinical signs and symptoms" [6]. However, a suspected case is defined by the WHO as "a patient with acute respiratory illness (fever and at least one sign/symptom of respiratory disease, e.g., cough, shortness of breath), and a history of travel to or residence in a location reporting community transmission of COVID-19 disease or having been in contact with any confirmed or probable COVID-19 case during the 14 days before symptom onset; in the last 14 days before symptom onset; or a patient with severe acute respiratory illness and requiring hospitalization in the absence of an alternative diagnosis" [6].Globally, more than 140 million confirmed cases of COVID-19 have been diagnosed [7,8]. The number of deaths has increased to more than 3 million worldwide. However, more than 124 million recovered cases have been confirmed as of April 24, 2021 [7,8]. On April 24, 2021, the number of COVID-19 cases in the Kingdom of Saudi Arabia (KSA) was more than 400,000 cases. Of these, more than 390,000 had recovered [9]. However, the number of deaths among confirmed cases is more than 6,800 [9].

A study reported unknown causes of pneumonia disease in a cluster of cases in Wuhan, China. China's health authority sent notifications and reports to the WHO about a strange case of pneumonia. Therefore, an investigation was needed to identify the source of the infection that came from Wuhan's Huanan Seafood Wholesale Market, which was disinfected and shut down [10,11].

In January 2020, multiple studies identified the causative pathogen as novel COVID-19. Therefore, numerous epidemiological investigations and analyses were done to discover more information about the new pathogen that has caused this public health crisis and global epidemic. Through February 11 in Wuhan, China, one of these studies included 72,314 reported COVID-19 patients aged 30-79 years (86.6%), and the case fatality was 2.3%.

A national multi-center retrospective cross-sectional study in KSA described the clinical characteristics, demographic data, and outcomes of confirmed COVID-19 cases [12]. This study included all regions of Saudi Arabia. The results showed that 54.3% of the confirmed COVID-19 cases were men. The median age in the study was 36 years [12]. Only 20.1% of the patients had underlying chronic comorbidities, mostly diabetes, and hypertension. The most common symptoms among confirmed COVID-19 cases were cough, fever, and sore throat [12].

Limited data is available to assess the current situation of COVID-19 in Jeddah, KSA. Therefore, we measured the prevalence of COVID-19 and epidemiological and socioeconomic features among laboratory-confirmed COVID-19 cases in this region. Our study aimed to build valid and robust baseline data about demographic and socioeconomic information and the outcome of death or recovery for COVID-19 in Jeddah. Also, we sought to obtain the possible exposure factors that affect the population, which could help to identify the potential risk factors of the disease. The data explored in this study could be beneficial to design and assess reliable preventive measures according to the current standards and to estimate their effect on the outcome of laboratory-confirmed COVID-19.

MATERIALS AND METHODS

We conducted a multi-center, analytical, cross-sectional study in Jeddah's hospitals and primary healthcare centers. During the COVID-19 pandemic, we included all laboratory-confirmed COVID-19 cases diagnosed by nasopharyngeal swab using a Reverse Transcription-Polymerase Chain Reaction test for Severe Acute Respiratory Syndrome Coronavirus-2 (RT-PCR SARS-CoV-2) at healthcare facilities from March 1 to May 31. Therefore, we obtained all laboratory-confirmed COVID-19 cases diagnosed at Ministry of Health (MOH) organizations, non-MOH organizations, and private healthcare facilities from the MOH through the Health Electronic Surveillance Network (HESN). We included all ages and genders in this study, and there were no exclusion criteria for the participants.

According to the MOH Saudi Arabia Statistics and Indicators 2020, the Jeddah Region's population is estimated to be 5,031,820 people. The MOH announced that the number of laboratory-confirmed COVID-19 cases in this region was 21,272 cases from March 1 to May 31, 2020. We found limited data to measure the prevalence and epidemiological features of COVID-19 in the region in 2020. Therefore, we started to assess these measures in our study.

We calculated the sample size using Raosoft software. We estimated a confidence interval of 95%, the margin of error of 5%, the population size of 21,272 cases, and response distribution of 50%. Therefore, the sample size was 416 cases after a 10% increase. We calculated sample size based on laboratory-confirmed COVID-19 instances obtained from the HESN Database.

We used a multi-stage sampling technique during this study. First, we used the stratification sampling method to divide the laboratory-confirmed COVID-19 case data in the HESN into three strata (subgroups), including MOH organizations, non-MOH organizations, and private healthcare facilities. Then, we used a proportional stratified sampling method by computer-generated random sampling in Excel software for each stratum.

The number of cases derived from each stratum is proportionate to the relative number of patients in each stratum. We used proportional stratified random sampling because the number of COVID-19 cases diagnosed in healthcare facilities is not distributed equally between healthcare sectors. Therefore, the sample size obtained using Raosoft software was 416 subjects for each stratum to be proportional.

We extracted the abstract from an Excel sheet of laboratory-confirmed COVID-19 cases from the HESN Database. However, these data need to be modified and adjusted by the authors for each data value as some data entered manually by different data entry persons from multi-center. In addition, the presence of scarce resources to conduct, analyzes, and revises all data for the entire population. Consequently, we choose to conduct this study by calculating the sample size. So, we designed and modified the abstract form of the sample size from HESN to match the aim of this study and to produce a better estimate of the population

Our study aimed to identify the prevalence and epidemiological feature variables in the Jeddah Region. The data included demographic data, socioeconomic status, and other factors. For instance, age, gender, nationality, travel history, healthcare occupation, and contact with confirmed cases of COVID-19 were examined.

RESULTS AND DATA ANALYSIS

This study was done using IBM SPSS version 23 (IBM Corp., Armonk, N.Y., USA). We used descriptive statistics to define the types of the study variables in the form of counts and percentages for nominal and categorical variables. In contrast, we used the means and standard deviations for continuous variables. Also, we used the chi-square test and fisher's exact test to establish a relationship between categorical variables. We did these tests with the assumption of a normal distribution. Otherwise, we used Welch's t-test for two group means as an alternative. A Binary Logistic Regression Model (BLRM), with Backward Conditional Elimination with Enter Criteria=0.05 and Elimination=0.10, was used to determine the significant predictors of any given dependent study variables with 95% confidence intervals. Lastly, a conventional p-value <0.05 was the criteria to reject the null hypothesis.

In this study, we evaluated the prevalence and epidemiological features of 21,272 cases with confirmed COVID-19 at healthcare facilities in the Jeddah Region in 2020. For the cases from March 1 to May 31, demographic characteristics revealed that patients had an average age of 37.80 ± 13.5 years, with nearly half of them in the age, ranges of 18-35 years old (39.4%, n=164) and 36-55 years old (44.5%, n=185), as shown in Table 1. A majority of participants were male (76.9%, n=320) and non-Saudi nationals (66.3%, n=276).

Table 1 Demographic data

Demographics	**N**	**Min**	**Max**	**Mean**	**SD**
Age in years	416	0	80	37.8	13.5
		Count		%	
Total		416		100.0	
Age in years	Less than 18 yrs	25		6.0	
	18-35 yrs	164		39.4	
	36-55 yrs	185		44.5	
	More than 55 yrs	42		10.1	

Gender	Male	320	76.9
	Female	96	23.1
Nationality	Saudi	140	33.7
	Non-Saudi	276	66.3
Region	Jeddah Region	416	100.0

Regarding laboratory-test baseline characteristics, all the participants had completed the requirements and were classified as positive for COVID-19 via screening and confirmatory tests (Table 2). All of the participants were classified as confirmed COVID-19 cases (100%, n=416), and for most of them, the confirmatory test was positive for COVID-19 (99.8%, n=415). The "recovered" outcome classification was found in 95.7% (n=398). Also, the MOH sector diagnosed most participants (51.9%, n=216), and 11.5% (n=48) underwent MOH quarantines.

Table 2 Lab test information

Variables		**Count**	**%**
Total		416	100.0
Req status	Complete	416	100.0
Sending facility Region	Jeddah Region	416	100.0
Sending facility Sector	MOH	216	51.9
	Non-Government	150	36.1
	Non-MOH Organizations	50	12.0
Confirmatory result	Positive	415	99.8
	Probable (Repeat Sample)	1	0.2
Final Classification	Confirmed	416	100.0
Outcome	Recovered	398	95.7
	Fatal	18	4.3

Table 3 shows the interaction and travel information of the patients. Most of the participants had no case-related occupation or were non-Healthcare Workers (non-HCWs) (85.4%, n=305). In addition, almost two-thirds of the patients had contacts with them (61.9%, n=221). For HCWs (N=52), about one-third of them were nurses (31.9%, n=15), while around one-fourth were physicians (27.7%, n=13). Travel information revealed that most participants had no history of travel inside Saudi Arabia (88.8%, n=316). Also, we measured the prevalence of COVID-19 among the 21,272 cases out of the total population of the Jeddah Region to be 4.2 per 1,000 people (0.42%) from March 1 to May 31, 2020.

Table 3 Interactions and travel information

Variables		**Count**	**%**
Total		416	100
Tataman Clinic	No	416	100
Travel inside KSA	No	316	88.8
	Yes	40	11.2
	Missing	60	

Case with contacts	No	136	38.1
	Yes	221	61.9
	Missing	59	
Case occupation	No (Non-HCW)	305	85.4
	Yes (HCW)	52	14.6
	Missing	59	
Case occupation=Yes		**Count**	**%**
Total		52	100
Occupation: Health Care Worker	Cleaner	3	6.4
	Nurse	15	31.9
	Physician	13	27.7
	X-ray	1	2.1
	Others	15	31.9
	Missing	5	

Lastly, all factors that showed significant differences based on Chi-square and Fisher's exact tests were further analyzed using the binary logistic regression model (Table 4). Results revealed that 18-35 years old age range (p=0.007), Saudi nationality (p=0.029), and case without contacts (p=0.010) were significant predictors of COVID-19 outcomes among patients.

Table 4 Binary Logistic Regression Model

Variables in the Equation		**B**	**Exp (B)**	**95% C.I. for Exp (B)**		**p-value**
				Lower	**Upper**	
Last Step[a]	Age in years					0.051
	Age in years (Less than 18 yrs)	-18.806	0	0		0.998
	Age in years (18-35 yrs)	-3.35	0.035	0.003	0.395	0.007[b]
	Age in years (36-55 yrs)	-1.06	0.347	0.097	1.239	0.103
	Nationality (Saudi)	-2.77	0.063	0.005	0.755	0.029[b]
	Case with contacts (No)	1.928	6.873	1.586	29.774	0.010[b]
	Constant	-1.938	0.144			0.044[b]

[a]: Variable (s) entered on step 1: Age in years, Nationality, Case with contacts
[b]: Significant using Binary Logistic Regression Model, with Backward Conditional Elimination with Enter Criteria=0.05, Elimination=0.10

DISCUSSION

The KSA government started early prevention measures across national and international levels to control the spread of COVID-19 to save people's lives. It began with a complete shutdown or a partial shutdown for all social and commercial activities except for healthcare services (for example, international and national flights, mass gatherings including Umrah, and lockdown for all cities). This study is a multi-center, analytical, cross-sectional study that addressed the epidemiological features and outcomes among COVID-19 cases in Jeddah, KSA. This study included all positive cases for COVID-19 of all ages, including quarantine cases of asymptomatic patients and hospitalized patients. The aim was to build valid and robust baseline data for demographic characteristics and outcomes, including death and survival, regarding COVID-19 in the Jeddah Region.

The mean age of patients was nearly 37.80 ± 13.5 years, which is supported by a national survey [12]. Moreover, the

age of 84% of COVID-19 patients was 18 to 55 years old. Also, 94% were older than 18 years. The Chinese Center for Disease Control and Prevention (China CDC) published data showing that 87% of the age distribution was between 30 and 79 years old among 44,672 confirmed COVID-19 cases [10,11]. Also, the age of 95% of the confirmed COVID-19 cases was between 20 and 79 years. We conducted this study without consecutive inclusion or exclusion criteria for COVID-19 patients. However, adults accounted for the majority of patients. This result can be explained as workers or become exposed to the disease. On the other hand, postponement of school attendance plays an important role in decreasing disease transmission among this age group. Additionally, the Saudi Government suspended all social activities such as the restaurant and playing areas for school-age during the full and partial lockdown. Consequently, the transmission of the disease at school age may have been due to family-based transmission.

Moreover, our results showed that the majority of these cases were male (almost 77%), in contrast with other studies [10]. These results are explained by the majority of outdoor workers being male rather than female due to cultural norms.

The global burden of COVID-19 disease on healthcare facilities has been noticeable across countries, and HCWs can be affected by disease transmission. The result of our study shows that about 14.6% of all laboratory-confirmed COVID-19 cases were HCWs. This result is coherent with the latest data released by the International Council of Nurses (ICN) from 30 countries, which show that HCWs represent between 0% and 18% of all confirmed COVID-19 cases [13]. However, the China CDC showed that HCWs account for 3.8% of all COVID-19 cases, while 63% were in Wuhan [10,11].

The recovery rate was 96% during the peak period of COVID-19. Moreover, the global cumulative recovery percentage was about 89.5% as of May 31 [7,8]. This study indicated recovery due to multifactorial causes. Examples are well-designed strategies, collaboration between multiple sectors to control the spread of this disease, and the high quality of the healthcare system and services provided to the population.

The prevalence in this study was 4.2 COVID-19 cases per 1000 people (0.42%). Nevertheless, Indiana State conducted a well-designed survey in April 2020 in the United States. Published data from the study estimated the prevalence of COVID-19 to be 2.79% [14].

Study Limitations

There are some limitations in this study that need to be considered. We conducted a multi-center cross-sectional study in the Jeddah Region. Therefore, the present results of this study cannot be generalized to the Saudi Arabia population. Moreover, our findings cannot reflect any change in the disease pattern during the COVID-19 pandemic. Furthermore, incomplete and missing data in our study are the most challenging factors to assess the epidemiological features of COVID-19.

CONCLUSION

This multi-center cross-sectional study measured the prevalence rate and epidemiological features among COVID-19 cases in the Jeddah Region without any exclusion criteria. Moreover, we build great baseline information about demographic data and possible risk factors that affect the outcome of COVID-19 that is essential information for any future study in the Jeddah Region.

In this study, the age ranged from 18-35 years, and who is a case without contacts is the strongest risk factor for COVID-19 outcomes. Therefore, implementing well-design strategies to break down the chain of infection is necessitated. Wearing masks, social distance, and avoiding social gathering plays a significant role in controlling the spread of COVID-19. Moreover, immediate patient isolation or admission is essential to control the community transmission of the disease.

Recommendations

Further studies on COVID-19 disease are needed, especially with the increasing number of cases for COVID-19. Thus, to explore the clinical features and the effect of comorbid illness and other risk factors on the outcome of the patients. Moreover, we recommend conducting studies to address the pattern of the disease, incubation period, spread of the infection, infection control measures, complications, and mortality rate of COVID-19 among people with co-

morbid illnesses, the elderly, and intensive care unit patients.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Source of Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Approval

We obtained the final research approval from the Institutional Review Board in Jeddah with IRB approval number: A00993 on 9/2/2021.

Author's contributions

Fatemah Saleh Alzaghabi provided the conception and design of the study, conducted research, provided research materials, acquisition of data, analysis and interpretation of data, initial and final draft of an article, revised it critically for important intellectual content, and final approval of the version to be submitted; and Majed Mohammed Alghamdi provided the conception and design of the study, logistic support, revised initial and final draft of an article, revised the article critically for important intellectual content and gave final approval of the version to be submitted. The manuscript is the original work of all authors. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscripte.

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