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Spatial Analysis of Risk Factors of Hospitalization and Death by Covid 19, Case Study: Oued Abdi Valley (Eastern Algeria)

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Abstract

At the end of 2019, a new corona virus disease SARS-CoV-2, later named COVID-19, emerged in Wuhan, China. The infection spread rapidly around the world. Along the rapid outbreak of new cases, WHO declared on March 11th 2020 that it was a pandemic, a global spread of a new disease. Subsequently, corona virus infection cases continued to increase and all continents were affected to varying degrees. The entire population was at risk of COVID 19; however, some people were more at risk of severe forms of the disease, leading to hospitalization or death. Within this perspective, the objective of our study is to identify the risk factors for hospitalization and death of confirmed COVID 19 cases in the Oued Abdi valley. The main results show that 49.23% of the subjects were aged 64 years and over, 55% had at least one chronic disease: diabetes was the most common (64 patients, 32%), followed by hypertension (56 patients, 28.71%), 20 had respiratory diseases and 55 had other diseases including heart disease. Men accounted for 60% of patients and 59% of deaths. Population density also played an important role in the prevalence of the epidemic. The concentration of COVID-19 cases was low in low-density municipalities

Key words: COVID-19, Age, Chronic diseases, Sex, Risk, Oued Abdi.

INTRODUCTION

The world has been confronted with a grave pandemic named COVID-19 (Corona Virus Disease 2019), caused by the new virus SARS-CoV-2 (Severe Acute Respiratory Syndrome Corona Virus 2) which has emerged in China in December of 2019. The disease has spread rapidly outside China. Thus, on March 11th2020, the World Health Organization (WHO) has declared a state of pandemic related to the global expansion of the new COVID-19 disease [1]. In Algeria, the first COVID-19 case was declared on February 25th, 2020. Subsequently, the first outbreak of coronavirus contamination appeared on March 1st, in the province of Blida, central region, following the reception of two Algerian nationals, residing in France, one of the numerous countries that were most affected by the pandemic [2]. Afterwards, from March 14th, there was an increase in the number of notified cases with extension to other provinces.

As of November 8th, 2020, the total number of COVID 19 cases confirmed by PCR in Algeria has been 62,051 cases including 2,048 deaths [3].The Wilaya of Batna ,located in the east of Algeria, was among the 9 provinces most affected by COVID19 [4], the first case was recorded on March 19th, 2020 in the Daïra of Thniet -El-Abed which represents our study area. The spread rate of SARS-CoV-2 has pushed scientists on an international level to conduct a great deal of research in order to better understand and confront this formidable virus, described by the WHO as an "enemy of humanity" [5].Accordingly, the primary objective of this study is to identify the factors likely to present a risk for hospitalization or death of COVID-19 in the Oued Abdi valley.The study results indicate that the elderly in all municipalities are by far the most vulnerable to COVID-19; in particular, people with chronic diseases (cardiovascular diseases, diabetes, respiratory diseases, etc.) or with weakened immunity.Additionally, Men are at higher risk of hospitalization and inhospital death from COVID-19 compared to women.These results are consistent with those of the literature, where the majority of studies [6], [7], [8], [9], [10], [11] had concluded that age advancement, presence of comorbidities (diseases or conditions already existing before the appearance of COVID-19), and the male sex were risk factors for complications that could lead to death.Likewise, population density also plays a major role in the expansion of the epidemic; hence,

the more people inhabiting cramped locations, the higher the risk of exposure to the disease [12]. These vulnerability factors can be employed in decision-making in regards to the nursing of those infected with the COVID-19 disease.

METHODS

This study was a descriptive one. The data was collected from the health department of the Batna province (2020-2022) and the public hospital establishment (PHE) of Theniet El Abed (The only COVID 19 hospitalization center at the level of the study area).

We statistically analyzed the risk factors for COVID-19 patients and then compared our results with others from similar studies. In addition, the cartographic representations were conducted owing to the geographical information system.

From an administrative perspective, the study area is located in the Batna province and constitutes 5 communes: Theniet El Abed, Chir, Menaa, Tigharghar, Bouzina (figure .1). The Oued Abdi region is a mountainous area, characterized by rugged terrain and a semi-arid climate.



Figure 1. Location of the Study Area

Distribution of the Number of Confirmed Covid19 Cases by Commune

Since the beginning of the pandemic (in 2020), 466 confirmed COVID-19 cases have been recorded at the level of the public hospital establishment. Two communes, Menaa and Theniet-El-Abed, located in the study area, share 260 confirmed cases (Figure.2), more than half of the hospitalized cases (55.79%), followed by Bouzina (17.60%), Chir (14.16%) and Tigharghar (12.45%).



Figure 2. Number of Confirmed COVID-19 Cases by Commune

The unequal distribution of infectation cases in the study area is a result of various socio-demographic factors. In fact, population density plays a role in the spread of the pandemic; particularly, the transmission of the disease is linked to the concentration of social contacts. Analysis of the population density maps (Figure .3) and the inpatients map (Figure .1) hints at the existence of a correlation between density and disease spread. Menaa and Thniet ElAbed, are among the valley'smost significant agglomerations (inter-municipal), this fact could therefore be another explanation for this disparity.



Figure 3. Correlation between density and disease spread

Identification of Vulnerability Factors

Majority of people infected with the virus display mild to moderate respiratory illness and recover without needing special treatment. However, certain people fall seriously ill and require medical attention. Specifically, older adults and those with an underlying medical condition, such as cardiovascular disease, diabetes, chronic respiratory disease, or cancer, are at higher risk of developing a severe form of illness [13].

Distribution of Confirmed Cases by Age Group

In the present study, the group most vulnerable to Coronavirus infection in all communes is the group of 64 years and older (figure.4).



Figure 4. SpatialDistribution of PatientsBased on Age

of spatial distribution of subjects in terms of their ages shows that 83 cases of this category were recorded in Theniet El Abed, 70 in Manaa, 39 in Chir and 44 in Bouzina.

Commune	Patient Age Range				
	<35	35-44	45-54	55-64	>64
Thniet Elabed	11	15	23	23	83
Menaa	6	12	16	26	70
Chir	4	13	5	18	39
Bouzina	5	15	15	20	44
Tigharghar	3	11	9	14	23

Table 1. Spatial Distribution of Cases by Age Range

In terms of proportion, patients aged 64 and over represent the large share with 49.23% of confirmed cases. Advanced age has been described as a risk factor for critical disease; this is due to their low immunity and infection with various diseases. Deaths are mainly observed in people aged 60 and over. They represent 80% of all deaths.

Confirmed Coronavirus Cases Based on Chronic Diseases

In addition to age, the presence of comorbidities plays an equally important role. Cardiovascular disease and hypertension, diabetes, and chronic respiratory disease are all associated with a higher potential of hospitalization, intensive care admission, and death. At the level of the public hospital establishment (PHE) of Theniet El Abed, certain patients are notably vulnerable to the consequences of the pandemic, in particular people with chronic diseases who are more at risk of COVID-19. Among the 466 inpatients, 195 (63%) had a comorbidity: diabetes was the most frequent (64 patients, 32%), followed by hypertension (56 patients, 28.71%), 20 suffering from respiratory diseases and 55 had other diseases including heart disease. Patients aged 60 represent the large proportion of people with chronic diseases (Figure .5).



Figure 5. Distribution of Confirmed Cases by Chronic Disease

Distribution of Confirmed Cases Based on Sex

Pandemics and disease outbreaks affect women and men differently. From risk of exposure and biological susceptibility to infection, to social and economic implications, individuals' experiences can vary based on their biological and sexual characteristics as well as their interaction with other social determinant factors [14]. Concerning COVID 19 patients at the hospital level, the role of gender was also observed (Table below).

Commune	Number of Hospitalized COVID-19 Patients	Patient Sex	
Commune	2020/2022	Male	Female
Thniet Elabed	141	84	57
Menaa	119	75	44
Chir	66	37	29
Bouzina	82	46	36
Tigharghar	58	42	16
Total	466	284	182

 Table 2. Number of Hospitalized COVID-19PatientsBased on Sex 2020/2022

Of the 466 hospitalized cases, 284 were men and 182 were women. Men accounted for 60% of patients and 59% of deaths(Figure.6).It should be noted that this male predominancehas been found in all communes since the start of the pandemic. Furthermore, this male superiority pertaining to the Coronavirus attack is explained by several factors related to lifestyle and biological order.



Figure 6. Number of COVID 19 Deaths based on sex (2020-2022).

RESULTS

Among the 466 patients included in this study, 383 left the hospital and 83 were deceased. The risks of hospitalization or death from COVID-19 increased exponentially with age. The risk of hospitalization was tripled in those 64 and older, compared to those within the range of 45-54. The highest proportion of deaths is seen in the communes of Menaa and Thniet Elabed where a considerable percentage of the population is aged 60 or over. Older people are likely to develop a severe condition if they are infected with COVID-19, hence requiring intensive care hospitalization [15]. Age is the prime risk factor, to which comorbidities are added. In our study, comorbidities were present in 65% of confirmed cases. Among these patients, arterial hypertension and diabetes are frequent risk factors for severity within this study, when patients are associated with these two diseases, immunity tends to decrease, which enhances progression to severe forms of the disease. Accordingly,64 of COVID-19 patients with chronic conditions had diabetes; 56 of the patients had high blood pressure, 20 had respiratory disease and 55 had other illnesses including heart disease. The presence of a chronic disease increases the risk of having severe complications from COVID-19, including death. Also, men are generally more affected than women.Out of the total 466 hospitalized cases, 284 were male (60%) and 182 were female (40%); the sex ratio is 1.56 with a male predominance. According to the data, more men die from COVID-19 than women. 59% of COVID-19 patients who died in hospital are male. This disproportion is particularly located in all communes; in Manaa for example, men account for nearly 58% of deaths linked to the disease, compared to a little over 42% of women. We observe a similar trend in Thniet-Alabed with 64% of deaths among men opposite nearly 36% among women.

DISCUSSION

Age was the leading risk factor for hospitalization and death by COVID-19. In terms of proportion, patients aged 64 and over represent the largest share of cases with 49.23%, followed by adults ranging 55-64 (19.2%).Particularly, the elderly are indeed exposed to the risk of comorbidity, making them vulnerable people who are greatly exposed to developing serious forms of the disease, and requiring intensive care as a consequence [6], [7], [15].Moreover, arterial hypertension and diabetes are frequent risk factors for severity in our study; thus, when a patient is associated with these two diseases, the body is in a permanent state of stress and immunity tends to decrease [9].In addition, the long-term history of diabetes and hypertension damages the vascular structure which prompts the progression towards severe and critical forms of COVID 19.The latter require admission to intensive care and/or the use of invasive mechanical ventilation, and are associated with high mortality rates [9].Sex is a risk factor for higher severity and mortality in patients with COVID-19, independent of age and susceptibility [10]. In our study, the overall distribution of patients by sex shows that males represented 60% (284 patients) and females 40% (182 patients) of this population.Furthermore, 59% of COVID patients who died in hospital are male. Also, among patients with chronic diseases, men predominated with 60.15% and women accounted for 39.85%.

Compared to women, the risk associated with COVID-19 in men is multiplied by: 1.5 for the risk of hospitalization and 1.4 for the risk of death.Multiple studies confirm that men were more affected than women similar to our study. Our results are akin to those of [6], [7], [8], [10], [11] which display that the majority of patients were male.Several factors can explain the domination of the male sex among hospitalized patients, such as: menare generally the financial source of the families, which promptsthem to go to work.Moreover, men are more mobile and are generally in contact with

a larger number of people than women, and they expose themselves to a higher contamination risk than women [7] which could be due to the frequent contact between men compared to women who often are housewives. According to the general population and housing census (2008) in the study area, 93% of women of working age are housewives. Additionally, females are less susceptible to viral infections than males, possibly due to X-chromosome protection and sex hormones, which play a vital role in innate and adaptive immunity [16].Smoking is also a major risk factor for non-communicable diseases such as cardiovascular diseases, cancer, respiratory diseases and diabetes, and people suffering from these pathologies are at greater risk of serious illness if they are infected with the COVID-19 virus [17]. Regarding the reason women in our study area no longer smoke, this could be explained by socio-cultural reasons which oppose women's tobacco consumption.

CONCLUSION

The COVID-19 pandemic severely impacts older people and individuals who suffer from certain chronic conditions. Our study was able to highlight advanced age, male sex and chronic illnesses as vulnerability factors that may present a risk of hospitalization or death by COVID-19. Prevention remains essential to protect public health and to combat the different epidemics such as COVID -19

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