Epidemiological state, patient’s characteristics, and COVID-19 vaccination levels in Algeria

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ABSTRACT

Since the global spread of the SARS-CoV-2 virus, responsible for COVID-19 disease, has been declared a “public health emergency of international concern” by the World Health Organization, epidemiological plans of control and investigation were established. In this study we aim to identify the epidemiological situation, mortality rates, and vaccination response in the population of Oum el Bouaghi, Algeria from March 2021 to March 2022. Clinical characteristics of COVID-19 confirmed cases, and vaccination data were collected from the Health and Population Directorate (HPD), as well as the COVID-19 unit in the Mohamed Boudiaf Public Hospital Establishment. The epidemiological profiles of the COVID-19 patients, along with cumulative number of people vaccinated depending on vaccine’s type were reported by numbers, percentages, curves and graphic histograms. The epidemiology of Covid-19 infection in Oum el Bouaghi, was similar to that recorded in many countries during the study period. It experienced two peaks, in August 2021 and in January 2022 which coincided with Delta and Omicron variants.
respectively. A total of 2068 COVID-19 cases were reported, with the average age of 54 and a female predominance (57%). Furthermore, people beyond the age of 40, especially over 65 years were the most hospitalized category (43% and 31% respectively), and presented the highest rate of morality (36% and 56% respectively). Among the 1510 hospitalized cases 169 (11%) patients passed away. They had a high profile of chronic diseases, especially cardiovascular diseases (high blood pressure/heart disease) 48% and diabetes 43%. Of a total of 84.047 people vaccinated, 59% were men, and 77% preferred Sinovac. People over 65 years had the highest vaccination rate (42%). People with chronic diseases accounted for 74% of the vaccinated population, clinicians and health professionals 7% and the rest of the population presented only 19%. In conclusion, People above 65 years with comorbidities appeared to be more susceptible to present the severe form of the infection. The quarantine adopted by Algeria and the strict precautionary measures has allowed the return to stability and a gradual reduction of positive cases. Additionally OEB had a medium participation in vaccination, with a dominance of people with chronic diseases. This perfectly meets the mechanism of COVAX and the indications of the Algerian High Authority of Health.

Keywords: SARS-CoV2, COVID-19, pandemic, vaccination, Oum El Bouaghi, Algeria.

1 INTRODUCTION

Coronaviruses are positive-sense single-stranded RNA viruses, among the fifth group of Baltimore classification, that belong to the order Nidovirals [1], the family Coronaviridae, and the subfamily Orthocoronavirinae by the International Committee On Taxonomy Of Viruses [1, 2].

There are currently 7 coronaviruses capable of infecting humans, where four are ubiquitous and responsible for respiratory infections, generally mild in the immunocompetent individuals, known as «classic» human coronaviruses (HCoV): HCoV-229E, HCoV-NL63, HCoV-OC43 and HCoV-HKU1 [1,3].

However, three are highly pathogenic and have emerged recently, causing a serious respiratory infectious disease. Indeed, this century was stamped by coronaviruses outbreaks, namely the Severe Acute Respiratory Syndrome (SARS) by SARS-CoV in 2003 and the Middle East Respiratory Syndrome by MERS-CoV in 2012-2013 [4, 5].

As well, since December 2019, a SARS has spread around the world, caused by a novel coronavirus with typical genetic differences, named SARS-CoV-2 [3]. According to the World Health Organization (WHO) official web site until July 26th, 2023 there have been 768,560,727 confirmed cases of COVID-19, including 6,952,522 deaths[6].

In Algeria, The 1st detected case was an Italian citizen, notified by a positive test of SARS-CoV-2 on February 25th, 2020, in a base of life in Hassi Messaoud in the city of Ouargla. As on March 2nd, 2020, an outbreak was detected in the city of Blida in response to an alert issued by France following the COVID-19 confirmation of two Algerian citizens residing in France who were visiting Algeria. This contamination occurred at a wedding party attended by these two individuals [7, 8]. Blida has since
become the epicentre of the epidemic in Algeria and remains, with neighbouring Algiers, the two most affected cities [8].

SARS-CoV-2 uses the Angiotensin-converting enzyme 2 (ACE2) as the primary receptor to enter the host cell [9, 10]. ACE2 is widely expressed in the nasal mucosa, bronchi, lungs, heart, oesophagus, kidneys, stomach, bladder and ileum, as a consequence, SARS-CoV-2 has a potential tropism for these organs [9].

The clinical spectrum of coronavirus disease COVID-19 extends from asymptomatic forms to severe forms, characterized by respiratory distress, requiring mechanical ventilation and life support, and can be complicated by systemic and multi-organ damage, septic shock, and multi-visceral failure [5, 10, 11].

The recovery is spontaneous in almost 80% of cases, no curative treatment is recognized thus far; and current treatments are symptomatic only [12]. Clinicians may require the use of antiviral drugs: (Remdesivir; ritonavir) [5, 10]; monoclonal antibodies (Tocilizumab) [10]; or corticosteroid therapy (Dexamethasone) to prevent passage into intensive care units, and to reduce the risk of aggravation. [5]

Therefore, vaccination seems to be the perfect solution for this pandemic virus. Indeed the WHO began research and development of COVID-19 vaccines in February 2020, following consultations with many international scientists and public health experts [13].

The WHO also created the COVAX mechanism for global access to COVID-19 vaccines, in collaboration with partners from the ACT Accelerator, the Coalition for Epidemic Preparedness Innovations (CEPI) and the Global Alliance for Vaccines and Immunization (GAVI). It aims to give equal rights to vaccines for all countries that are part of the system, regardless of their economic level. [14].

Although, Algeria was one of the most affected countries in Africa [15]; information on the incidence and clinical characteristics of patients infected with COVID-19 remains limited. Here, we describe the epidemiological situation of SARS-CoV-2 patients in Oum El Bouaghi (OEB), Algeria, and we report the hospitalization and mortality rates. We also evaluate vaccination levels which refer the population acceptance for COVID-19 vaccination in the city.
2 MATERIALS AND METHODS

This is a retrospective descriptive study of the evolution of the COVID-19 pandemic state and estimation of vaccination levels against SARS-CoV2 in Algeria, more specifically in the city of OEB from March 2021 to March 2022.

2.1 DESCRIPTION OF OEB CITY

The city of OEB is located in the north-east of Algeria. It has a population of 621,612 people over an area of 6,768 km². The population is composed of 49.5% female versus 50.5% male, and is considered young because 29% of people are less than 15 years old, 66.4% are between 15 and 65 years, and only 4.6% are over 64 years [16].

2.2 DATA COLLECTION

The analysed information in this study was collected from positive cases of COVID-19 recorded in the city’s Health and Population Directorate (HPD), as well as in the COVID-19 unit in the Mohemed Boudiaf Public Hospital Establishment. Based on screening by RT-PCR (the SARS-CoV-2 ORF 1ab and the conserved specific sequence of the gene encoding the N protein of the nucleocapsid as target regions), and chest CT scan (images involving areas of bilateral, subpleural, or basal ground glass opacities (GGO)). Data included also for each confirmed case, the epidemiological characteristics and outcomes of patients: gender, age, hospitalization, and deceased patient’s comorbidities.

The vaccination campaign began in Algeria in February 2021, after the arrival of vaccines’ first doses: Sputnik, Astra Zeneca, Sinopharm, Sinovac, and Johnson & Johnson. In addition, on September 29th, 2021, Algeria started the local production of the CoronaVac vaccine, in partnership with the Chinese Sinovac, at the Constantine site (Saïdal), and launched a major national vaccination campaign to successfully reach the 10% target [17]. Vaccination data about used vaccines, chronologic distribution and number of doses in OEB was assembled from the city’s HPD along with people’s demographic information and priority groups.

All important information was communicated with individuals to be vaccinated including vaccine protocol, recommendations, efficiency, and possible post-vaccination reactions. A pre-vaccination consultation was also realised to check for the absence of temporary or definitive contraindications. Acceptance of vaccination after these explanations is implied consent [18].

2.3 DATA ANALYSIS

The epidemiological profiles of the COVID-19 confirmed cases in OEB, presented by age and sex distribution were reported by numbers and percentages.
The evolution of the COVID-19 pandemic in OEB was described with an epidemiological curve constructed according to the chronology of positive cases in the period of study as well as patient’s final state, applying Microsoft Excel 2010. We also showed the epidemiological link between mortality rates among hospitalized patients, comorbidities and age groups with statistical analysis.

Additionally vaccination time line was expressed with graphic histograms, showing the evolution of the number of doses injected each month against Covid-19 at OEB between 28 March 2021 and 31 March 2022, and cumulative number of people vaccinated depending on vaccine’s type. We also revealed the epidemiological state of vaccinated population and distribution by priority groups.

Statistical analysis was expressed by Chi-square test for categorical variables and ANOVA test for continuous variables. Analysis was performed using SPSS software version 27. Differences were considered significant at a $P$ value of $<0.05$.

3 RESULTS AND DISCUSSION

3.1 POSITIVE COVID CONFIRMED CASES IN OEB, ALGERIA

From March 2021 to March 2022, 2,068 confirmed cases of Covid-19 in OEB were notified by the HPD. Of which 1,686 were RT-PCR confirmed cases (representing 82%) and 382 were CT scan confirmed cases (representing 18%).

3.2 DISTRIBUTION OF CONFIRMED CASES BY PATIENT’S AGE AND SEX

From the register of PCR and CT scan confirmed cases, the average age of patients was 54 years. Distributed as follows: patients under the age of 18: 37 cases (2%); patients aged 18 to 40: 744 cases (36%); patients aged 41 to 64 years: 797 cases (38%); and patients aged over 65 years: 490 cases (24%) of the total reported patients.

The most affected age rang in OEB was adults aged from 18 to 64 years ($P$ value $<.001$), since they represent the largest and most active category. In fact the population of OEB is considered a young society according to the latest demographic statistics. Additionally, many epidemiological studies from around the world have reported that the majority of patients were among this age group [19]. Moreover, the significantly lower susceptibility to infection in children under the age of 18 compared to older adults ($P$ value $<.001$), matching with preceding studies [15, 19], is related to the fact that children are assumed to be less sensitive to COVID-19 because the maturity, and binding capacity of ACE2 in children may be lower than in adults. In addition, children’s immune systems are still developing and may respond to pathogens differently, where in most cases they develop the mild form of the infection [4].

In this study, we report a female predominance in SARS-CoV-2 infected patients, where it included 1,183 women (57%) versus 885 men (43%), contrary to previous studies, including in Algeria.
[15], Oman [20], and Italy [21] where males had a higher rate of confirmed cases than females with 54.2%, 80%, and 82% respectively. Even so, sex is considered a physiological criterion without influence on infections; this was approved by surveys researches [22]. However, this minor differentiation in our study can be explained by women’s occupations, which are overrepresented in jobs exposed to the virus. For example, women are more often doctors, nurses, orderlies or teachers in schools than men. Furthermore, customs prevailed more in women than in men, such as shopping and family events gatherings was among the reasons to record the highest rate of contamination in women.

3.3 DISTRIBUTION OF CONFIRMED CASES BY CHRONOLOGY AND PATIENT FINAL-STATE

Of the 2,068 patients infected with COVID-19, 1510 cases were hospitalized according to their serious condition, defined by oxygen dependence, among which 1,341 patients (89%) healed and were discharged ($P$ value < .001), while unfortunately 169 (11%) patients passed away. However 558 patients have been managed at home, they represented less serious cases that require only medical treatment and some rest.

According to the graphic in Fig.1, the three curves (hospitalized patients, deceased patients, and patients without hospitalization) are directly proportional. The period of study carried out two phases of COVID-19 cases increase, the first was between June and August 2021 with a rapid rise in positive cases, hospitalized persons and deceased cases, mainly related to the international emergence of the Delta variant (third wave in Algeria) both aggressive and highly transmissible (40 o 60% higher) [23], which carried mutations that made it easier for the virus to adhere to human cells [24], especially pulmonary causing respiratory distress requiring hospitalization and involving the vital prognosis of patients [24, 25]. This period was considered critical because it caused an emergency due to the lack of oxygen in hospitals suitable to the increasing pressure on oxygen consumption after the gradual expand in cases.
This is the reason why the government has restored the strict precautionary measures, and has carried out national awareness companies. In addition from December 25th, 2021 the Algerian state announced the obligation to present the health certificate as a condition of entry to Algeria or to move abroad and to access certain spaces for collective use.

The second augmentation period started from the end of December 2021 to January 2022: at that point, Algeria had officially entered the fourth wave with the widespread variant Omicron. It was characterised by an elevation in positive COVID-19 cases, as well as hospitalized patients, but stabilization in deceased cases. Because the Omicron variant had a faster spread and infection rate [26], but was less lethal than the Delta variant, since it had a superior ability to penetrate the respiratory system and replicate extremely quickly in primary cultures of nasal epithelial cells, however, it was less likely to replicate in the lungs [27].

Fortunately, by the end of February 2022, the quarantine adopted by Algeria and the strict compliance of the basic rules stipulated in the health protocol: wearing protective masks, physical distancing and frequent washing of hands. As well as raising the awareness of society, has allowed the return to stability and a gradual reduction of positive cases with a number of hospitalization reaching zero.

3.4 CLINICAL INFORMATION OF HOSPITALIZED AND DECEASED PATIENTS
The analysis of the data by age groups of the medical records of patients admitted to the COVID services, showed that people whose condition required regular medical follow-up or hospital care are reported as follows: 15 (1%) patients under 18 years [40% of positive cases for the age group (PC.AG)];
381 (25%) patients aged from 18 to 40 years [51% of PC.AG]; 650 (43%) patients aged between 41 and 64 years [81% of PC.AG], and 464 patients (31%) over 65 years [95% of PC.AG]. As for the 169 deceased patients, the most affected age range was over 65 (94 cases, 56%), followed by patients aged 41 to 64 years (61 cases, 36%), also 96 cases (57%) were female (Tab. 1).

<table>
<thead>
<tr>
<th>Age group</th>
<th>Gender</th>
<th>Comorbid status</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Cardiovascular disease</td>
</tr>
<tr>
<td>18 to 40 years</td>
<td>M= 9</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>W= 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41 to 64 years</td>
<td>M= 27</td>
<td>30</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>W= 34</td>
<td></td>
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<tr>
<td>&gt;65 years</td>
<td>M= 37</td>
<td>43</td>
<td>57</td>
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<tr>
<td></td>
<td>W= 57</td>
<td></td>
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<tr>
<td>Total</td>
<td>M : 73</td>
<td>75 (43%)</td>
<td>85 (48%)</td>
</tr>
<tr>
<td></td>
<td>W: 96</td>
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</tr>
</tbody>
</table>

Source: COVID-19 unit in the Mohemed Boudiaf Public Hospital Establishment

People beyond the age of 40, especially over 65 years were significantly the most hospitalized category, and presented the highest rate of mortality (P value <.001). This was reported from diverse former research [21, 28], such as in Italy where the highest ICU mortality was described in patients above 60 years of age (322 of 405, 79%) [21].

First we need to remember that, at the same age, people with one or more chronic diseases and those with weakened immune systems are at high risk of complications. (Hospitalization, ICU admission, and death). In addition the decreased physical activity, the sedentariness and weight gain during lockdown are considered risk factors in such patients [29].

Indeed, this has been observed among deceased patients in our study, where 166 from 169 cases presented at least one comorbidity (Tab. 1), with cardiovascular diseases (high blood pressure (HBP) / heart disease) 48% and diabetes 43% being the most detected, both reported by previous studies [21, 28]. Furthermore, currently available studies indicate that cardiovascular diseases, especially heart failure, HBP, or even diabetes, treated by conversion enzyme inhibitors, and/or angiotensin II receptor antagonists are associated with an increase in the expression of the ACE2 protein (which is considered the virus’s “gateway” to the body) and hence develop the severe form of the infection [30].

3.5 VACCINATION TIMELINE BY VACCINE TYPE AND DOSES

The spread of vaccination had an important role in the decrease of severe cases. In fact, to our knowledge this is the first report of vaccination’s levels in OEB, Algeria. To date, five Covid-19 vaccines
have been distributed, and 29 vaccination centres have been designated through the city, while the shady areas have been managed by the local public health facility mobile teams.

Figure 2. Number of Covid-19 vaccine’s doses injected each month to the population of OEB from 28 March 2021 to 31 March 2022.

From 28 March 2021 to 31 March 2022, 84,047 individuals were vaccinated; the evolution of the number of Covid-19 vaccine’s doses injected each month to the population of OEB is presented in Fig. 2. Thus, after a timid start in March 2021; during the three months July-August and September 2021, the vaccination rates reached their summit, in this period, the Delta variant severely affected the Algerian population, it can be said that fear of getting sick or causing illness to one’s family, motivated the population to get vaccinated. In the same context, a slight increase in vaccination rates was reported between December 2021 and February 2022 with the emergence of the Omicron variant, which witnessed a high rate of infection but was not as dangerous as the summer variant [27].
Of the total of 84,047 people vaccinated, 77% chose Sinovac, 8.5% preferred AstraZeneca, 9% favoured the single dose of Janssen, 4.3% received Sputnik V and the rest of the population was vaccinated with Sinopharm (1%). The availability and the simple storage conditions of the Sinovac vaccine are responsible for its great use in Algeria ($P$ value < .001), in addition, the choice of this vaccine by the population is attributable to the mechanism of action that is associated with its traditional manufacturing method; Chinese pharmaceutical laboratories Sinovac uses the oldest vaccine technologies, namely inactivated virus vaccines [31]. Apparently this is more accepted by the population than the new technologies used to develop the other vaccines.

However, 90% of people who received the first dose of Sinovac received the second dose but only 5% of them completed their vaccination regimen. For Sputnik V, 80% of people who received the first dose received the second dose but only 6% completed the third dose. All individuals vaccinated with AstraZeneca and Sinopharm continued the second dose however just 11% completed the AstraZeneca third dose (Fig. 3). This can be explained by the fact that the second dose of each vaccine is started 1 to 3 months after the first dose, and the third after 4 months maximum, in other words, the vaccine regimen is still in progress. In addition, the 3rd dose called «Booster» is considered optional, not efficient with serious side effects, by the population which is why it is carried out with a small percentage. Indeed, several meta-analyses reported booster dose hesitancy among world population [32, 33].

It should be noted that the superior number of the second doses of AstraZeneca and Sinopharm vaccines, is due to the opening of the vaccination program among Algerian cities.
3.6 EPIDEMIOLOGICAL STATE OF VACCINATED POPULATION

Vaccination against COVID-19 was available for both sexes and all age groups, with the exception of children under 18 years of age where it is to be avoided, which is why no vaccines have been administered in the 0-18 age group in OEB, and in Algeria.

The distribution of vaccinated population by age indicates that the age groups are almost approximated. People over 65 years had the highest vaccination rate with 34,713 people (41%). Followed by adults aged 41 to 64 years with 29,460 persons (35%), and in the last place, young people aged 18 to 40 with 19,874 persons (24%).

The large proportion of the population vaccinated was men 59%, they are the majority probably because they fear to be less resistant to the coronavirus than women. Thus, the lower percentage of women can be explained by their worrying nature, because a disturbing rumour circulated in the society, indicating that vaccination had side effects on women’s menstruation and fertility. And, although the link is not proven, these are logical reasons why the effects of the vaccine were worrisome for women [34, 35].

The distribution of vaccination according to the priority groups of the population fully satisfied the mechanism of COVAX and the indications of the Algerian High Authority of Health, where patients with health problems (74% in our study, \( P \text{ value} < .001 \)), (Cardiovascular pathologies; type 1 and 2 diabetes; chronic respiratory pathologies; chronic renal failure; chronic liver diseases; cancer or malignant haematology; congenital or acquired immunosuppression; neurological pathologies, etc.). Along with front-line health and social services staffs (7% in our study) are the priority of the COVID19 vaccination strategy. The rest of the population presented only 19%.

4 CONCLUSION

The SARS-CV-2 pandemic is considered to be the number one global concern for scientific personnel. Here we conducted a descriptive study of the epidemiological situation, and mortality rates of COVID-19, along with vaccination levels in Oum El Bouaghi, Algeria from March 2021 to March 2022.

The epidemiology of Covid-19 infection in OEB, described for the first time in this study, is similar to that recorded in many countries during the study period. It experienced two peaks, in August 2021 and in January 2022 which coincide with Delta and Omicron variants respectively.

Based on the results obtained, from the total of 2,068 confirmed cases recorded, the average age of patients with Covid-19 was 54 years, with a predominance of women compared to men. It was also noted that after hospital admission 11% of patients died, among whom 48% had cardiovascular diseases, and 43% had diabetes. This confirms the increase in mortality rates with older age, and chronic diseases.
The population of OEB presented a good participation in vaccination, with a dominance of people with chronic diseases. This perfectly meets the mechanism of COVAX and the indications of the High Authority of Health.

Finally, Let us hope that the comprehension of COVID-19 pandemic epidemiology, especially in patients with critical conditions, serves as a lesson for future outbreaks.

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REFERENCES


