ORIGINAL ARTICLE

Epdemiology of coronavirus disease 2020 (COVID-19) in Algeria

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Abstract

The novel coronavirus disease (COVID-19) was reported in Algeria on 25 February 2020. Since then the number of positive cases has reached 42 619, and 1465 deaths have occurred. The current manuscript aims to describe epidemiological indicators and the measures implemented to halt the spread of the COVID-19 epidemic in Algeria. This work showed that the urgency in the implementation of containment measures has been associated with relative control of the epidemic despite two peaks in the epidemic curve, at the end of April and in mid-July. Since early August, the number of daily cases has decreased and the government has started a second step in relaxing containment.

Keywords: Algeria, basic reproductive number, coronavirus disease 2019, COVID-19, epidemiological indicator, epidemiology
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Introduction

In December 2019 a new type of coronavirus disease was identified in the city of Wuhan, in Hubei province (China) [1]. Since then, coronavirus disease 2019 (COVID-19) has not stopped expanding and has been reported in almost all countries and territories of the world. With more than 24 million positive cases and a current estimated case-fatality rate of about 3.4%, the disease has exceeded all expectations and caused disruption worldwide [2]. This disruption is not only a result of its fast spread, but also its multiple clinical facets and potential risk factors that can contribute to disease severity [3]. In this context, and due to the absence of and ongoing research for an effective treatment or vaccine, the national authorities have opted for non-pharmaceutical measures to limit the spread of the disease and to reduce pressure on their health systems [4].

Like other continents and regions, Africa has not escaped this pandemic disease. The first case was reported on 14 February 2020 in Egypt. Since then, more than 1.2 million cases and more than 28 000 deaths have been reported. This represents about 5% and 3.4% of the total cases and deaths in the world, respectively [2].

Algeria, situated in North Africa, is the largest country in Africa with a total population of 43 949 908 inhabitants (the tenth most populous in Africa) [2]. Since the first case, reported on 25 February 2020 (the second country to be affected in Africa), it has currently recorded 42 619 cases, making it one of the most affected countries in Africa along with South Africa, Egypt, Nigeria, Morocco and Ghana. It is also the third country in terms of deaths, with 1465 deaths, after South Africa (13 308) and Egypt (5298) [2,5].

Materials and methods

Data collection

Data were recorded from different sources. Epidemiological characteristics regarding COVID-19 cases and deaths, and demographic characteristics of patients were obtained directly from the Algerian Ministry of Health websites dedicated to

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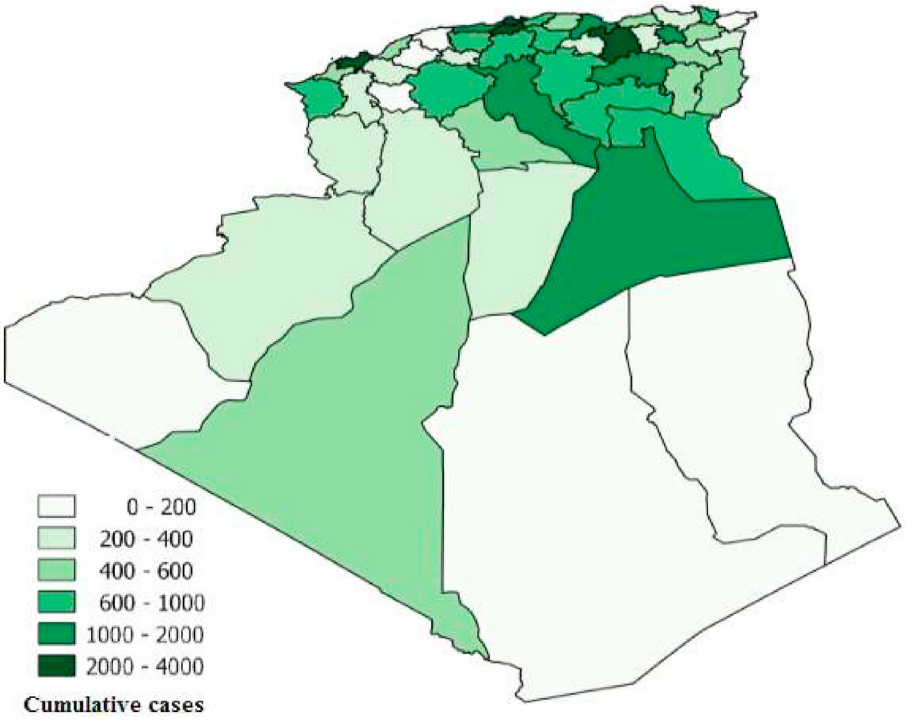

FIG. 1. Geographic repartition of COVID-19 cases in Algeria (On August 13th 2020). Source: [8].

COVID-19 information [5,6] and from the daily reports of the *Bulletin épidémiologique* published by the Institut National de la Santé Publique [7].

Some information concerning laboratory testing and preventive actions not available in the national sources or scientific publications were extracted from media reports and news.

Estimation of COVID-19 epidemiological indicators

From the daily reports of COVID-19 cases we estimated the following indices (positive cases are patient confirmed with a positive RT-PCR test):

- Morbidity rate (*M*) (per 100 000 population)

M = the total number of cases/the total population).

- Mortality rate (MO) (per 100 000 population)

MO = the total number of cases/the total number of the population.

- Case fatality rate (CFR)

CFR = total number of deaths/total number of confirmed positive persons.

- Cumulative incidence (CI) (per 100 000 population)

CI = the total number of cases/the total population at the beginning of the epidemic [8] (here we use the total population of Algeria on 1 January 2020, which was estimated at 43 216 714 inhabitants) [9].

- Epidemic Growth Rate (*r*)

$r(t_2 - t_1) = \ln(CI_2) - \ln(CI_1)$ [8].

- Doubling Time (*Td*)

$Td = \ln(2)/[\ln(CI_2) - \ln(CI_1)] = \ln(2)/r$ [10]

- The Basic Reproductive Number (R_0)

$R_0 = 1 + r\,Tg$ where *Tg* represents the mean generation time/serial interval [8] (here we used the median serial interval reported by Nishiura *et al.* [11], which was estimated at 4.6 days).

- Herd Immunity Threshold (HIT)

We used the formula of Kwok *et al.* [12] to calculate the HIT, which represents the minimum proportion of a population that needs to be immune by vaccination or natural infection to halt the spread of an infection in that community.

$HIT = 1 - 1/R_0$

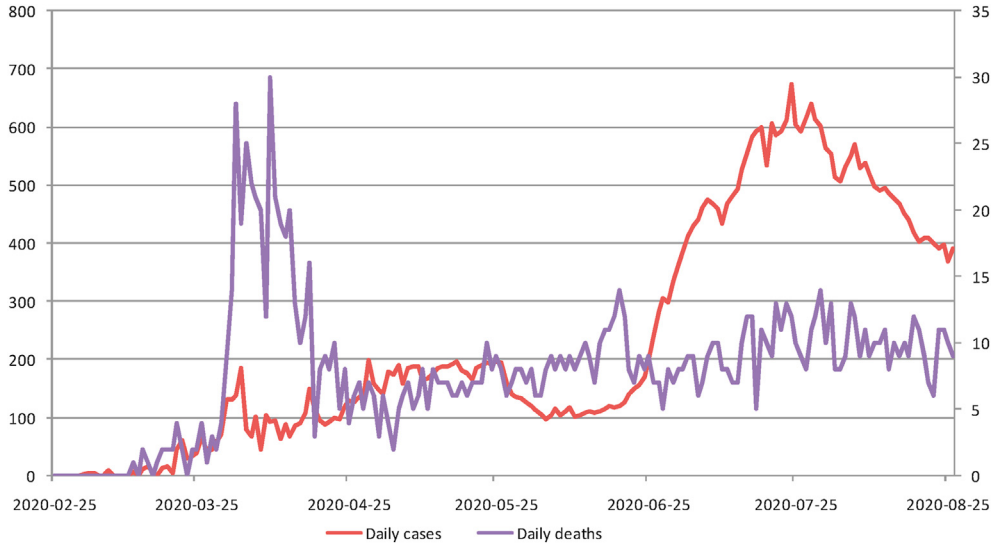

FIG. 2. Evolution of daily reported cases and deaths in Algeria.

Results and discussion

Emergence of geographic repartition and evolution

Since the first case reported in the department of Ouargla (southern Algeria), the epidemic curve has shown multiple features. There was a wait of 5 days before the true beginning of a new outbreak in the department of Blida on 1 March 2020, which became the epicentre of the epidemic [1]. This department had recorded the highest numbers until 16 July 2020, when the department of Algiers took first place [6]. After clusters were reported in early May in some departments (Setif, Constantine, Bordj Bou Arreridj and Bejaia in the east, Oran in the west and Ouargla in the south), other clusters emerged in June and July affecting especially the departments of Oran, Setif, Biskra and El Oued. Currently, the most affected departments are Algiers (4501), Oran (3407), Blida (3209) and Setif (2903) [6].

The department of Saïda (63), Relizane (189) and Chlef (194) in the western region and Illizi (124), Tamenrasset (194) and Tindouf (195) from the south are the least affected [6,8] (Fig. 1).

There are large variations not only among the different regions (centre, south, east and west) but also among departments within the same regions. Although the centre region seems to be the most affected, variations are especially observed in the western region with the department of Saïda showing the lowest number but the department of Oran reporting the second highest number in the country. The same observation is reported in the south where Illizi, Tamenrasset and Tindouf are among the least affected whereas Ouargla and Adrar recorded relatively high numbers [6,7].

Regarding national daily cases, the number of reported cases showed an increase until late April/early May. A decrease was then observed, which pushed the national authorities to start relaxing the implemented measures and containment, which was subsequently associated with an increase in the number of cases [1].

Since late May, the number of cases seemed to increase until the highest daily number (675 cases) reported on 24 July 2020; this increase was associated not only with the lightening of the prevention measures but also with the increase in screening capacities (Fig. 2).

These numbers have led to a significant increase in Cumulative Incidence (Table 1).

With a current number of 42 519 cases, the morbidity rate is estimated at about 969 cases/million [6].

Epidemic growth rate and doubling time

As shown in Fig. 3, the growth rate increased in the first 3 weeks of March, reaching a peak of 1.3. Since then, this rate showed a net decrease until the last week of June (0.1) when a slow increase was observed in the first 3 weeks of July, then another slow decrease for 3 weeks.

Doubling time showed a net increase from the first weeks of the pandemic until mid-June when the longest doubling time was observed (11.4 days). It then decreased to 6.4 days at the beginning of August but has since increased to 12 days on 25 August 2020.

TABLE 1. Epidemiological indicators of COVID-19 in Algeria

Date	Cumulative cases	CI	*R*	*Td*	R_0	HIT	CFR
25/2/2020	1	—	—	—	—	—	—
2/3/2020	3	0.0	1.1	0.6	6.1	83.5	0
9/3/2020	20	0.0	0.9	0.8	5.2	80.8	0
16/3/2020	60	0.1	1.1	0.6	6.1	83.5	6.7
23/3/2020	230	0.5	1.3	0.5	7.1	85.9	7.4
30/3/2020	584	1.4	0.8	0.9	4.7	78.5	6.0
6/4/2020	1423	3.3	0.7	1.0	4.2	76.0	12.2
13/4/2020	1983	4.6	0.3	2.3	2.4	58.0	15.8
20/4/2020	2718	6.3	0.3	2.5	2.3	55.6	14.1
27/4/2020	3517	8.1	0.2	3.1	2.0	50.8	12.3
4/5/2020	4648	10.8	0.2	2.9	2.1	52.7	10.0
11/5/2020	5891	13.6	0.2	3.5	1.9	47.5	8.6
18/5/2020	7201	16.7	0.2	4.0	1.8	44.1	7.7
25/5/2020	8503	19.7	0.1	4.9	1.7	39.5	7.2
1/6/2020	9513	22.0	0.1	7.7	1.4	29.2	6.9
8/6/2020	10 265	23.8	0.1	10.8	1.3	22.8	7.0
15/6/2020	11 031	25.5	0.1	11.4	1.3	21.8	7.0
22/6/2020	11 920	27.6	0.1	10.3	1.3	23.6	7.1
29/6/2020	13 571	31.4	0.1	5.9	1.5	34.9	6.7
6/7/2020	16 404	38.0	0.2	4.2	1.8	43.2	5.8
13/7/2020	19 689	45.6	0.2	4.5	1.7	41.5	5.2
20/7/2020	23 691	54.8	0.2	4.4	1.7	42.2	4.6
27/7/2020	27 973	64.7	0.1	4.9	1.7	39.5	4.2
3/8/2020	31 972	74.0	0.1	6.2	1.5	33.8	3.9
11/8/2020	36 204	83.8	0.1	6.4	1.5	33.2	3.7
18/8/2020	39 444	91.3	0.1	9.6	1.3	24.9	3.5
25/8/2020	42 228	97.7	0.1	12.0	1.3	21.0	3.4

Abbreviations: CFR, case fatality rate; CI, cumulative incidence; HIT, herd immunity threshold; *R*, epidemic growth; R_0, basic reproductive number; *Td*, doubling time.

Basic reproductive number (R_0) and herd immunity

Basic reproductive number, after a remarkable increase in March to a high of 7.1 in the third week, has shown a decline to 1.3 in the third week of August. As herd immunity is related to R_0, it has shown the same pattern. This proportion, which was very high in the early stages of the epidemic, especially during March (HIT between 78.5% and 85.8%) declined slowly to 21% on 25 August 2020.

This means that about one-fifth of the total population of Algeria should be infected to stabilize the spread of the COVID-19 epidemic.

Mortality, case fatality and recovery rates

Since the first death was recorded on 12 March 2020, the evolution of daily deaths has shown relative stability despite the increase in daily cases. The higher numbers were reported between 1 April (14 deaths) and 17 April (16 deaths) and the peak was reported on 9 April (30 deaths). Since 18 April, the reported number of deaths has varied from 2 to 14 cases per day (Fig. 2).

On 26 August 2020 Algeria had recorded 1465 deaths. The highest numbers of deaths was reported in the departments of Algiers (234), Blida (147) and Setif (120) while Saida had not recorded any deaths. The national mortality is about 32/million of population with the highest rates in the department of Blida (113.4/million), Setif (69.6/million) and Algiers (66.5/million).

The national case fatality rate is about 3.5%. This rate has shown a remarkable decline since 15 April, when Algeria reported the highest rate in the world (15.8%) (Table 1). The highest rates were recorded in Sidi Belabbas (9.3%), Bordj Bou Areridj (7.3), Tizi Ouzou (6%), Algiers (5.7%) and Tamenrasset (5.7) [8]. It should be noted that these high rates are especially related to the low number of realized tests (see below).

Lastly, 29 886 persons have recovered from this disease, representing a rate of recovery of 70.1%.

Demographic characteristics of COVID-19 patients

In Algeria, the categories most affected by COVID-19 are those aged between 25 and 49 years (42.1%) and older individuals of

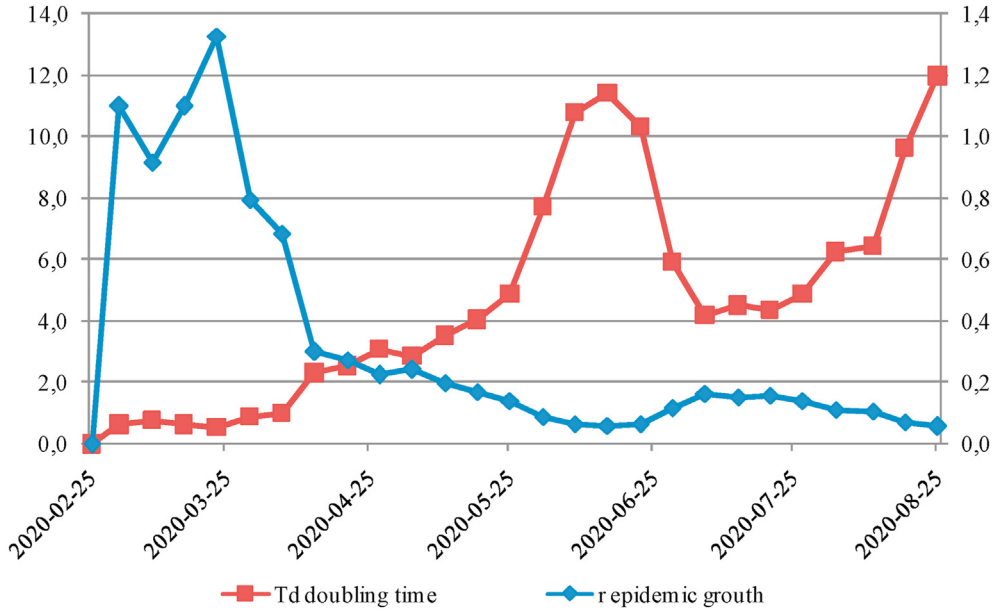

FIG. 3. Doubling time (*Td*) and epidemic growth (*r*) evolution in Algeria.

more than 60 years (34.3%). Patients less than 25 years old represent 5.3% and those aged between 50 and 59 years represent 18.3%. Men (54.2%) seem to be more affected than women (45.8%) (Fig. 4).

Regarding severe cases and deaths in Algeria, even though not precisely established, the available data indicate that 75% of the total deaths in the country were in people older than 60 years [6].

Laboratory screening

Since the emergence of COVID-19, Algeria has shown a net increase in screening capacities. From only 50 tests/day in the first days, performed exclusively by the Pasteur Institute of Algiers (the only approved laboratory to perform the tests), this number has reached about 2500 tests/day through the opening of 29 laboratories consisting of Pasteur Institute annexes (Oran, Constantine and Ouargla), and university and hospital laboratories [13]. The dilemma is however the absence of any official information about the daily numbers.

However, and despite the increased screening capacity, this number is still low when compared with the high number of samples from suspected persons exceeding laboratory capacities.

To cover this deficit, diagnosis by CT scan was adopted from 6 April and persons with positive signs on CT scan are treated with hydroxychloroquine protocols, which were adopted on 23 March. The CT-scan-positive cases will be tested later with PCR. The number of cases with positive CT scans has reached more than 100 000 cases, exceeding the number of patients diagnosed with PCR [8].

The high number of patients with CT-scan-positive disease has increased the number of hospitalizations and led to the saturation of certain health establishments in the most affected departments. For this reason, this diagnostic tool was first banned on 4 July and then recommended only for the evaluation of the evolution of the disease in patients confirmed by PCR. It has since been readopted because of the scarcity of PCR reagents, which has led to the closure of a number of diagnostic laboratories, delaying the obtaining of the analysis results for about 10 days [14].

Prevention

It is well known that that the urgent introduction of preventive actions, such as social distancing, quarantine and lockdown, is an important measure against epidemic/pandemic diseases in general and especially in the context of COVID-19 [15–17]. In Algeria, shortly after the detection of the first cases, the national authorities urgently started implementing a wide range of preventive actions to enhance social distancing and to limit the spread of the virus. These measures were first adapted and refined from the national plan for the H1N1 pandemic, put in place in 2009, which were limited by a number of essential capacities such as entry points, health monitoring, response, human resources, specific health hazards and laboratory capacities. The first most important measures were travel cancellation and isolation of repatriated citizens. At the national level, these measures varied between total and partial containment. The stringency of these measures reached a point index of 92 in a scale of 100 as classified by the Oxford Government COVID-19 Stringency Response Tracker (OxCGRT) [18] (Fig. 5).

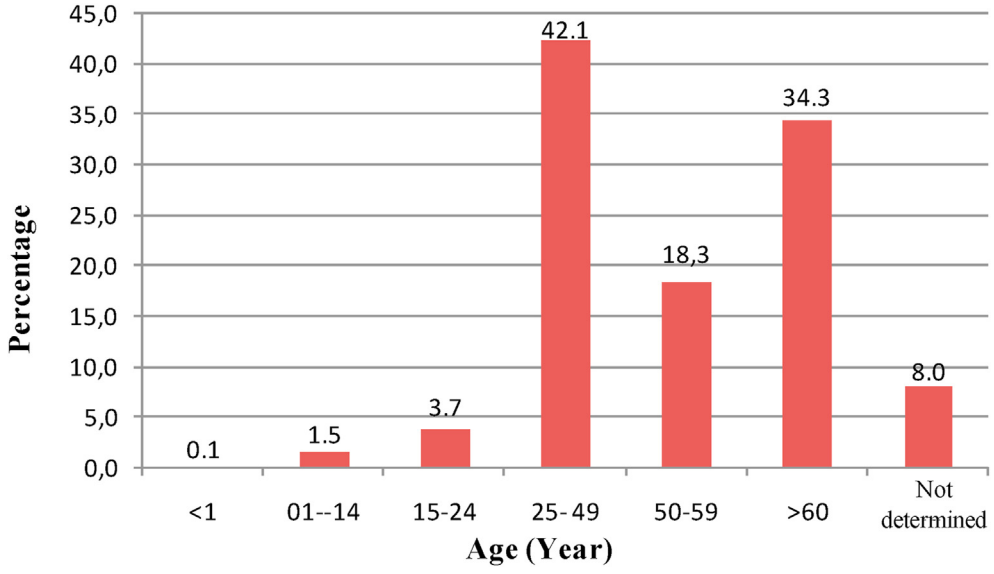

FIG. 4. Repartition of confirmed COVID-19 cases by age.

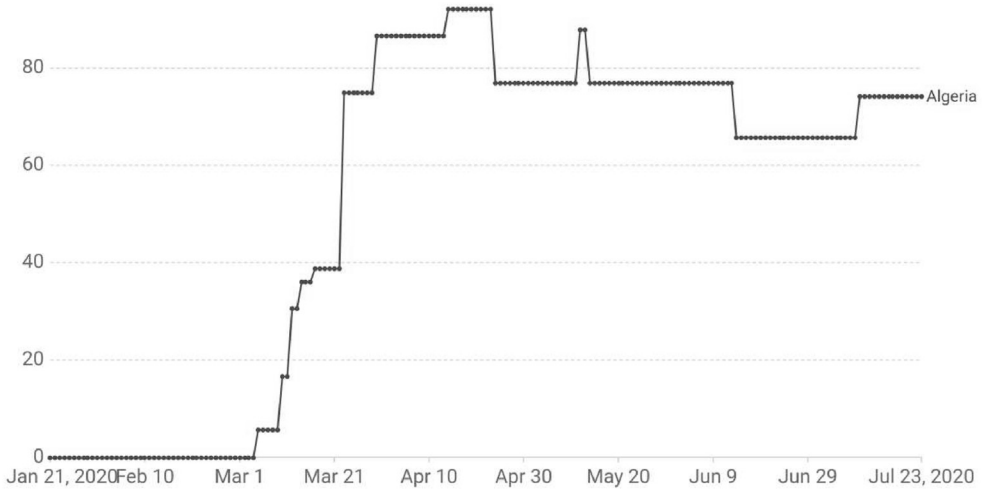

FIG. 5. Evolution of government COVID-19 response stringency index in Algeria. Source [15] published by Ourworldindata. org.

These actions were first accompanied by relative control of the situation and despite some difficulties have contributed to stabilizing the number of cases and avoiding health system capacities being exceeded. Subsequently, on 15 April, certain members declared that Algeria was past the worst phase of the outbreak and the number of persons treated has decreased by about 30% despite the 'high' number of daily reported cases [1].

Since then, variations in stringency and lightening of containment measures have succeeded, in parallel with the increasing of the number of daily realized tests and consequently the number of positive cases.

On 23 May 2020, the government made mask wearing mandatory for all persons and in all circumstances in public and work areas and in all public closed and open areas, including public establishments and administrations [8].

Since 3 August, the Algerian authorities have begun a second step of relaxing control strategies by the opening of beaches, and religious and public areas associated with a shortening of curfew in 29 departments (23pm to 5am) and on 15 August, it was decided to reopen mosques (of more than 1000 persons), cafés, restaurants and other commercial activities in association with targeted containment for certain most affected territories.

Conclusion

This manuscript describes the evolution, characteristics and implemented measures used to fight against COVID-19 in Algeria.

Results show that Algeria is still affected by the COVID-19 epidemic. However, despite some weakness regarding laboratory screening and the health system, the urgent implemented measures have avoided health system capacities being exceeded.

The epidemiological curve has shown that after two peaks in late April and July, the number of cases seems to decrease in August, which has pushed the national authorities to begin the second step of leaving containment.

Conflict of interest

None declared.

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