Descriptive Epidemiological study of COVID-19 in Maghreb and European countries

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SUMMARY
An outbreak of 2019 novel coronavirus diseases (COVID-19) has spread quickly worldwide. We performed a descriptive epidemiological study of COVID-19 in Mediterranean North African countries and South European countries. Cases data were collected through May 3, 2020 from WHO. Data analysis included: 1) geo-temporal analysis of viral spread in 6 countries (Morocco, Algeria, Tunisia, Spain, France and Italy), 2) epidemiological curve construction, 3) mortality and cured rates, 4) study factors that led to differences of the spread of the virus in these 6 countries, and 5) comparison between Morocco and three European countries. The number of infected cases between North African and Southern European countries were different, which might be related to restriction conditions, age, geographic location, and lifestyle. We observed that The COVID-19 epidemic has spread very quickly in Southern European compared to North African countries.

Introduction
An outbreak of 2019 novel coronavirus diseases (COVID-19) has spread quickly worldwide and was classified as a global epidemic on March 11, 2020. More than 3 million cases were registered through May 3, 2020 and more than 239k deaths. In some European countries, including Italy, Spain and France, this epidemic has spread...
rapidly. As the total number of cases in these countries was 587k through 3 May, and the number of deaths was approximately 79k. As for some North African countries including Morocco, Algeria and Tunisia, the number of cases is increasing slowly as the total number of cases in these countries until March 3th, 2020, is approximately 10k, deaths amounted to about 679 deaths.

1. Material and methods

2.1. Data Collection
We used a range of different sources to update and curate our database, including official government sources and peer-reviewed scientific papers that report primary data as the gold standard for data inclusion. Government sources include press releases on the official websites of World Health Organization or Provincial Public Health Commissions, as well as updates provided by the official social media of governmental or public health institutions.

2.2 Methodology
We recorded all data sources in our local database. In some instances more detailed data were available, typically through peer-reviewed research articles. (BoXu, 2020). For statistics, normality tests are used to determine if a data set is well-modeled by a normal distribution and to compute how likely it is for a random variable underlying the data set to be normally distributed.

2. Results

3.1 Epidemiological statistics in Maghreb countries

3.1.1 Total cases infected
The first case of Coronavirus was registered in Morocco and Tunisia on March 2th, 2020, while in Algeria, the first case was observed after few days on February 26 March, 2020. Up to May 3, 2020, the total number of cases in Morocco reached 4,903 confirmed cases, followed by Algeria with a total number of 4,474 cases and Tunisia with a total number of 1,009 cases. Figure 1 shows the number of cases infected by COVID-19 in Maghreb countries between February 26, 2020 and May 3, 2020 for a period of 70 days.

Some major decisions have been taken during the pandemic in those 3 North African countries. Schools closing, such as in Algeria, on March 14th, followed by Tunisia and Morocco on March 16th. Moreover, the state of emergency and quarantine was imposed on March 16th in Tunisia and on March 20th, 2020 in Morocco and in Algeria while the borders were closed first in Morocco on March 13th, 2020, then in Algeria and in Tunisia on March 17th, 2020. Finally, the mask was imposed in Morocco on April 7th, 2020 (Figure 1).

![Epidemic curve of confirmed COVID-19, by date of report in three of Maghreb’s countries through May 3, 2020.](image)

**Figure 1:** Epidemic curve of confirmed COVID-19, by date of report in three of Maghreb’s countries through May 3, 2020. The early phase of an infectious disease epidemic such as with COVID-19 is typically characterized by exponential growth in the number of cases or deaths. It seems important to characterize this exponential phase at the level of each country.

3.1.2 Total cases cured and dead in Maghreb countries

The number of cases cured is very high compared to the cases died in these three countries until May 3th, 2020. Knowing that the total number of cases cured in Morocco is 143815, out of 4903 total number of cases, the percentage of cured cases is approximately 30%, and the total number of cases died is 178, with percentage for
died cases being 3.6%. In Algeria, the number of cured cases is 193616 out of 4474 total number of cases, with a percentage of cured cases being approximately 43% and dead cases number being 4191 with a percentage for died cases of 9%. In Tunisia, the number of cured cases is 40617 out of 1009 total number of cases, the percentage of cured cases is approximately 40%, and dead cases is 431 with a percentage of 9% (Figure 2).

Figure 2: Epidemic curve of cured cases and dead cases, by date of report in three Maghreb’s countries through May 3rd, 2020.

3.1.3 Epidemiological factors

3.1.3.1 Sex

In Tunisia, men represent 51% of infected cases against 49% of women until 20th April. In Morocco, 69% of infected cases were men against 31% were women until 20th April. In Algeria, men represent 57% and women represent 43% until 2nd May, 2020 (Figure 3).

Figure 3: Distribution of infected cases of COVID-19 by sex group, in three of African countries

3.1.3.2 Age

COVID-19 affected all age groups in the three North Africans countries. In Morocco, until 20th April, 2020, approximately 50% of cases were over 40 years of age, while children under the age of 15 accounted for only 7.3% (Figure 4). In Tunisia, as of April 20th, 2020, the average age was 43 years [4 months-87 years]. The lethality is 4.21% (Figure 4). In Algeria, until 24th April, approximately 50% of cases between 15 and 44 years of age, while children under the age of 15 accounted for only 1% (Figure 4).

Figure 4: Distribution of confirmed cases of COVID-19 by age group, in three of Maghreb countries and in France by the end of April 2020.

3.1.3.3 Geographic factors

The number of cases by region in Morocco shows that Casa-Settat is the most affected region by COVID-19, followed by Marrakech-Safi, Tangier-Tetouan, Fes-Meknes, Daraa-Tafilalet, and Rabat-Sale-Kenitra. On the other hand, there are regions with fewer infected cases such as the Eastern region (Oriental), Beni-Mellal-Khenitra, Guelmim-Oued-Noun, Souss-Massa, Dakhla-Oued ed Dahab, and Laayoune-Sakia El Hamra (Figure 5).

Figure 5: Distribution of confirmed cases of COVID-19 by region, in Morocco. 

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3.2 Epidemiological statistics in Southern European countries

3.2.1 Total cases infected

The first case of coronavirus was registered in France on February January 23rd, 2020, and the first confirmed case in Italy and Spain on January 30th, 2020. Figure 9 compares the number of COVID-19 cases in Southern European countries between January 23rd, 2020 and May 3rd, 2020, for a period of 110 days. Overall, the total number of cases in France through May 3rd, 2020, was 129708, in Spain 217466 cases, while in Italy, the total number of confirmed cases was 210717.

Major decisions have been taken during the pandemic in those 3 southern European countries. Schools closed in Italy on March 4th, followed by Spain on March 12th, then France on March 16th. The state of emergency and quarantine was imposed on March 9th, 2020 in Italy, 15th March in Spain and France on 16th March. Borders closed in Spain on March 16th, 2020, France and Italy on 17th March, and the mask was imposed in Italy on April 5th, 2020.

The number of cases by location in Tunisia shows that the location of Tunis is the region most infected by SARS-Cov-2, and the least infected location is Jendouba (Figure 6).

The number of cases by Wilaya in Algeria shows that the Wilaya of Blida is the most infected region, and the least one infected is Tizi Ouzou (Figure 7).
3.2.2 Total cases cured and dead

The number of cases cured is a little high compared to the cases who died in these three countries until May 3rd, 2020. The total number of cases cured in Spain is 108947\(^{27}\) (50\%), and the cases died is 25264\(^{28}\) (12\%). In France the number of cured cases is 48228\(^{7}\) (37\%) and dead cases is 19970\(^{28}\) (15\%). In Italy, the number of cured cases is 71252\(^{27}\) (34\%), and dead cases is 22271\(^{28}\) (10\%) (Figure 9).

3.2.2 Epidemiological factors

3.2.2.1 Sex

According to statistical data from national health agencies, taken up by the “Global Health 50/50”, men died more from COVID-19 than women. In Italy, this disparity is particularly marked as men represent 67\% of deaths linked to the disease by 16\textsuperscript{th} April, 2020. In France, the trend was similar with 61\% of deaths among men.\(^{29}\) In Spain, the number of men died by COVID-19 was 63\% until 16\textsuperscript{th} April, 2020\(^{29}\) (Figure 10).

3.2.2.2. Age

In France, SARS-Cov-2 infected all age groups until 28\textsuperscript{th} April, 2020, approximately 50\% of cases were over 75 years of age, while children under the age of 15 accounted for only 1\%\(^{30}\) (Figure 4).

3.2.2.3. Geographic factor

The number of cases by community in Spain shows that the community of Madrid was most affected by COVID-19, followed by Catalonia, and the last one was Asturias\(^{31}\) (Figure 11).
COVID-19, followed by the Grand Est, and the last one was Corse\cite{22} (Figure 12).

Figure 12: Number of confirmed COVID-19 cases in France by Region until May 3rd, 2020.
The number of cases by region in Italy shows that the region of Lombardia was the most affected by COVID-19, followed by Piemonte, and the last one was Calabria\cite{33} (Figure 13).

Figure 13: Number of confirmed COVID-19 cases in France by Region until May 7th, 2020.

3.3 Epidemiological statistics between Morocco and European countries
The line graph compares the number of cases infected by the SARS-Cov-2 virus between Morocco and three Southern European countries until May 3rd, 2020. The first confirmed cases were registered in the European countries more than two months before the first case has been declared in Morocco. The number of confirmed cases in European countries was very high compared to Morocco, and the growth rate of confirmed cases in the European countries was faster than Morocco\cite{28} (Figure 14).

Figure 14: Epidemic curve of confirmed COVID-19, by date of report in three European countries and Morocco through May 3th, 2020.
The logistic regression, adjusted for age, sex, must be used to explore risk factors associated with COVID-19 disease severity.

3. Discussion

COVID-19 began in the European countries about two months before the Maghreb countries. The preventive measures taken by European countries come a little late. In Spain, the number of cases registered before quarantine was 5753 cases, and the number of cases registered in quarantine and in the state of emergency until May 3th, 2020, was about 241369 (49 days), at a rate of 4925 per day. In Italy, the number of recorded cases before quarantine was 9172 cases, and the number of cases in quarantine and in the state of emergency until May 3th, 2020, reached about 203334 (55 days), with an average of 3697 per day. France recorded the lowest number of COVID-19 confirmed cases compared to Italy and Spain, where before quarantine and state of emergency the number of cases registered was 5380 and the number recorded after the state of emergency about 124328 (48 days), at a rate of 2590 per day in quarantine and the state of emergency until May 3th, 2020.
In Morocco, the number of cases registered before quarantine and the state of emergency was 74 cases in 23 days, while in the confinement, the total number of cases was 4865 at a rate of 110 per day until May 3th, 2020 (44 days). In Algeria, the number of cases registered before quarantine and the state of emergency was 94 cases in 23 days, while in the confinement the total number of cases was 4380 until May 3th, 2020 (44 days). Tunisia recorded the lowest number of confirmed COVID-19 cases compared to Morocco and Algeria, while before quarantine and state of emergency the number of cases registered was 24 (15 days) and the number recorded after the state of emergency was about 985 (47 days), at a rate of 21 per day in quarantine and the state of emergency until May 3th, 2020.

4.1 Factors linked to the growth of COVID-19 cases

The spread of the COVID-19 is due to a number of factors, including sex, as it is in North African countries, such as Morocco and Algeria, where the proportion of men affected by COVID-19 is greater than women. The same thing was observed in South European countries where the number of men died by COVID-19 was higher than women. Other factors include Age, as most people affected by COVID-19 in Southern Europe were over 65 years old. while in Maghreb countries, most affected people by COVID-19 were between 15 and 44 years old. This could explain the increasing number of deaths in Southern European countries. Geographically, the most COVID-19 affected region were in principle regions which are the most economically active.

4.2 Comparison between Morocco and Southern European countries

The number of COVID-19 cases in Morocco was very low compared to European countries which may be due to the prevention measures in Morocco from the beginning of this pandemic, and also to other factors such as dryness, genetic factors, and geography.

4. Conclusion

COVID-19 affected the world in an unpredictable way, as it spread throughout the world, with differences in number of infected cases between countries. These differences can be linked to many factors such as the genetic factors of each population, since we have noticed that the evolution of COVID-19 in North African countries were very low compared to France, Italy, and Spain. Furthermore, the preventive measures (School closing, Confinement, Border closing, Masks obligation) and the time that these restriction conditions have been taken shows having an important impact on the spread of the Coronavirus.

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