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Different factors influencing the hospitalization rate due to covid-19 infection in Tunisia

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Abstract. The corona virus continues to wreak havoc with more than 1 million deaths recorded worldwide. A multi-pronged study of this pandemic is required. In this article, we propose to study the influence of certain factors such as age, gender, changing weather conditions as well as preventive health decisions on the hospitalization process due to COVID-19 infection in Tunisia.

Keywords: COVID-19, hospitalization process, factors

1 Introduction

The WHO has announced that the Covid-19 epidemic is considered a Public Health Emergency in our universe and expressed concerns about its spread worldwide, 46,434,591 cumulative cases as of October 31, 2020. [1]

The outbreak, spread and number of COVID-19 related deaths in Tunisia from March 02, 2020 has sparked many comments, primarily related to their number, growth rate and factors that influence the hospitalization rate.

In fact, analysis of data from cases reported between March 2 and October 31 during the cycle of 2020 has shown how different factors can influence the hospitalization process and development.

This article focuses primarily on individual factors such as age and sex explaining the likelihood of contracting the disease and its outcome. Then we detail local socioeconomic factors as a descriptive factor for the state of the spread of COVID 19. Finally, we shed the light on some preventive decisions in Tunisia and the way the government has been acting in the spatial distribution of the number of cases of Covid-19 that are requiring hospitalization.

2 Covid-19: Current epidemic situation in Tunisia

2.1 Evolution of the cumulative number of reported cases

In March, when the SARS-CoV-2 virus reached Tunisia, some drastic measures were rapidly taken by the Tunisian government: closing of the land, sea and air borders, curfews, quarantine... Faced with a delicate health system and a lack of infrastructure, the impact of Covid-19 may be fatal but after the rapid increase of patients in the first weeks, the situation stabilized and the epidemic seemed under control. The Covid-19 seemed far away ... until the borders reopened on June 27, 2020.

Graphically, June 10 is considered the end of the first wave knowing that no new cases had been recorded for several days and that the hospitalization rate had decreased. (Fig.1)[2][3]

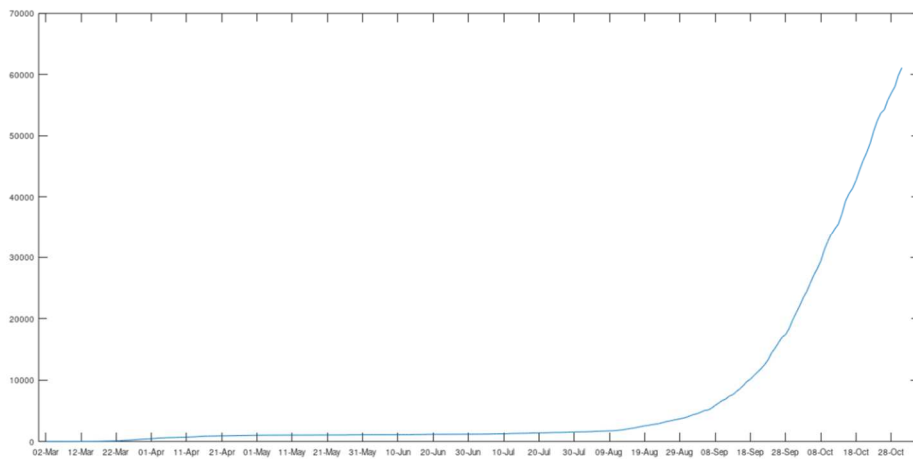


Fig. 1. Evolution of the cumulative number of reported cases

2.2 Evolution of the number of hospitalized cases

The peak of hospitalized cases during the first wave of the epidemic did not exceed a total of 144 of which 25 underwent resuscitation procedures.(Fig.2).

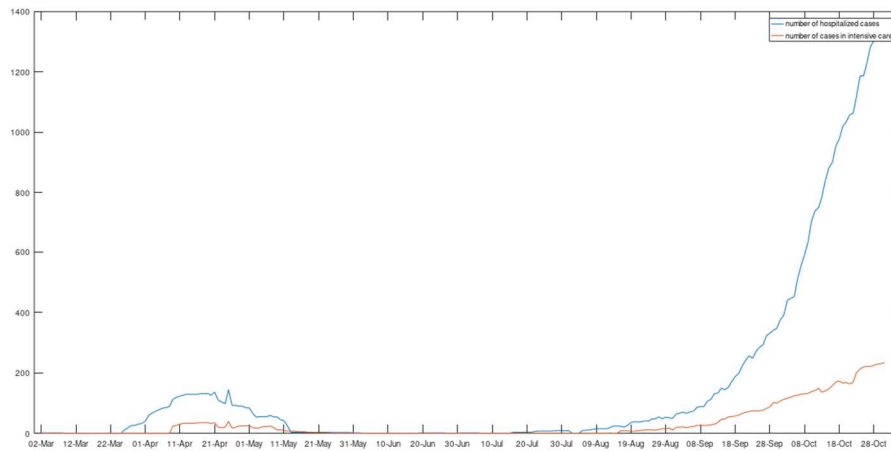


Fig. 2. Evolution of hospitalized cases and patients in intensive care

On the other hand, the section of the curve related to the second wave (we are limited to October 31, 2020) shows an increase in the cumulative number of hospitalized cases, exponentially, reaching 1,346 infected patients treated in hospitals, including 233 in intensive care an increase which tends to continue thereafter.[4]

2.3. Epidemic situation by Governorate

The following statistics limited to 10/31/2020 concern the epidemic situation by governorate. The absence of data relating to the number of hospitalized patients by region prevents the calculation of the hospitalization rate by governorate, a very important detail which must be taken into consideration by the authorities in the framework of analysis of the indicators relating to the assessment of the national and regional epidemic situation. The calculation of this hospitalization rate by region makes it easy to detect Clusters.

Table 1. Epidemic situation by Governorate in October,31 [4]

	Total cases	Active cases	Recoveries	Deaths
Ariana	533	370	152	11
Beja	231	173	55	312
Ben Arous	1183	1033	138	12
Bizerte	231	173	55	3
Gabes	1114	782	315	17
Gafsa	90	20	69	1
Jendouba	172	141	28	3
Kairouan	274	178	90	6
Kasserine	87	26	60	1
Kebeli	233	105	126	2
Kef	461	282	176	3
Mahdia	115	47	66	2
Mannouba	218	156	56	6

Medenine	308	132	166	10
Monastir	781	702	75	4
Nabeul	423	362	60	1
Seliana	62	39	23	0
Sfax	428	317	101	10
Sidi Bouzid	162	127	30	5
Sousse	943	748	169	26
Tataouine	185	173	6	6
Tozeur	45	31	13	1
Tunis	1520	1195	306	19
Zaghouan	91	77	10	4

The geographical diversification observed in this table in terms of details of the epidemic situation in each region reflects a hospitalization rate diversified between them. This refers to factors, which characterize one region from others. So it is necessary to explain the influence of these factors on hospitalization rate. This will facilitate the task of the authorities when studying a response plan to the Covid-19 epidemic in terms of the measures to be taken to mitigate its spread and subsequently reduce its harmful effects on the nation.

3 Factors influencing Covid-19 hospitalization rate in Tunisia

An econometric analysis (M. AMDAOUD, G ARCURI and N LEVRATTO (2020)) proved the correlation between the hospitalization rate related to Covid-19 cases and many demographic, economic and living environment factors. The study used the autoregressive spatial model (SAR): $Y = \rho Y + X\beta + \varepsilon$; Y represents the dependent variable (hospitalization rate,). X represents the explanatory variables used, β is the vector of parameters to be estimated e, ε is the error term, and WY is the endogenous variable shifted for the inverse distance matrix W, ρ is the autoregressive parameter indicating the intensity of I interaction between the observations of Y. [5]. For the Tunisian case, we limit ourselves to explain four major factors that significantly affect the hospitalization rate for the Covid-19 Virus [its numerical formula: (Number of Covid-19 hospitalizations / population) * 1000]. These factors are: demographic density, age of the infected people (we concentrate on the active and inactive class), the number of oxygen and intensive care beds (geographical distribution) and the effect of the measures imposed by the State in order to control the epidemic situation. [6][7]

3.1 Influence of demographic density

It seems logical that the more densely populated a city is, the more it promotes promiscuity of the virus. However, this is not really the case for Tunisia simply because many heavily populated cities have not recorded cluster cases. But many governorates were largely infected because of the close economic links they have with nearby governorates described as the epicenter of the epidemic spread. [9] We cite the examples of the governorates of Tunis, Ben Arous, Ariana and Manouba) or the Sahel governorates Sousse Monastir and Mahdia. This prove the positive role of population density, correlated with proximity to a highly infected governorates, in the increase of

the spread rate of the disease (increase in the number of cases of contamination, increase in the coefficient of propagation, etc.) and in the rate of hospitalization (rapid increase in the number of cases requiring moderate care and those requiring intensive care). The importance of population density in Covid-19 has already been closely proven from the start of the epidemic in China. The role of this variable is important due to his link with the basic reproduction number (R_0) often estimated between 2 and 4 (Roques et al., 2020), recognized as very high by epidemiologists.

3.2 Influence of infected people's age factor

The Covid-19 virus has invaded all age groups of the Tunisian population with different rates as shown by the graph in figure 3 [8].

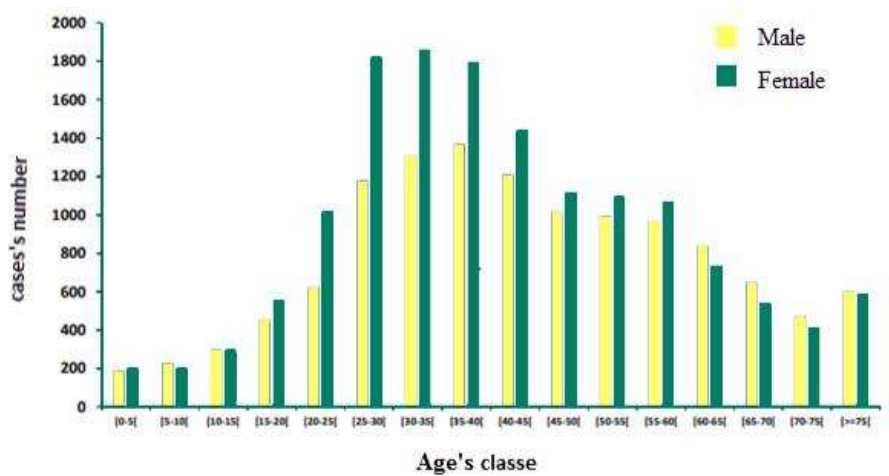


Fig. 3. Distribution of covid-19 cases by age and gender

To understand how hospitalization rate is correlated with the age classes of infected people, we propose to divide these age classes into two categories: the active class and the inactive class. The hospitalization rate is correlated with the share of manual workers in the working population. This is reflected by the increased risk of exposure of this social category (drivers of transport systems, cleaning services, emergency repairs in industries and networks, etc.) due to the absence of any possibilities for practicing teleworking and their high activities in dynamic and vital business continuity plans implemented during containment. Also, the inactive class which includes the elderly, the most affected category by the disease, and educated students who are considered as Covid-19 spread vectors.

3.3 Influence of Oxygen alimentation service and the number of resuscitation beds

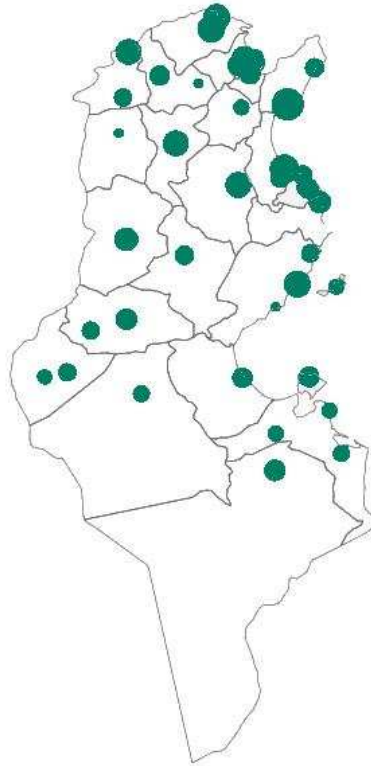


Fig. 4. Distribution of resuscitation beds according to regions [4]

The geographical distribution of the number of beds with high use during the treatment of Covid-19 patients reflects an inequity in the capacity of serving the patients requiring hospitalization in the regions of the Tunisian territory.

The number of intensive care beds and O₂, emits a significant negative influence on the hospitalization rate, and thus confirms that a good medical management makes it possible to reduce the risk of dangerous evolution of the disease and subsequently the recording of relative cases of death.

3.4 Influence of governmental decisions

To optimize the hospitalization rate for reported Covid-19 cases, the Tunisian government has imposed measures that could mitigate the spread of the epidemic and related deaths.

Some of these measures focused on the factors studied previously, including: [3][9]

- banning traffic between governorates (except for a few individual exceptions)
- night curfew to limit gatherings
- Some governors have imposed compulsory self-containment for people aged > 70 and for all other people who suffer from chronic diseases, as is the case in Monastir.

- Planning home treatment of Covid-19 patients who do not require resuscitation by providing them with drugs and oxygen and organized check-ups.
- Strengthen the geographical coverage of emergency services by installing mobile units.

These measures have succeeded in reducing some of the pressure on hospitals. Also, a trend towards stability in the number of deaths and the number of hospitalized cases has been observed.

4 Discussion

In this work, we tried to analyze the influence of various demographic, socio-economic and political factors on the rate of hospitalization in relation to the Covid-19 epidemic [5]. The unequal distribution of cases and deaths on the Tunisian territory and the “clustering” between close governorates appear clearly. The density and the workers role in the working population have a positive influence (increase reaction) on hospitalizations and deaths, but the availability of emergency services only influences the hospitalization rates negatively (decrease reaction) .

Apart from the importance of individual characteristics as factors for the probability of contracting Covid-19 and its consequences, many other elements related to the economic, demographic and social context are also involved. The political epidemic crisis management is also implicated.

These characteristics underline the complementarity between health policies on the one hand and socio-economic policies on the other. The role of emergency services as a factor in reducing the symptoms of the epidemic and the resulting related deaths is crucial.

A fair distribution of medical staff and material resources between regions and public services during this epidemic crisis will better protect the population from this disease and reduce deaths.

5 Conclusion

Like the case of the first wave of the spread of covid-19 in Tunisia, the government has taken concrete measures to curb contagion and reduce the number of deaths.

These taken measures seem to give positive signs, thus providing the possibility of returning to the phase of control of the epidemic situation in the medium term: these signs are observed in the trend towards the stability of the cases of death recorded daily between 20 and 30 deaths at the end of October. This was completed during the first days of November when the daily death cases fell below 20 and a pre-stability was observed at the level of hospitalized cases whether in intensive care or under average treatment. This suggests that Tunisia is in the process of overcoming the peak phase of the epidemic, especially before starting the winter season qualified with certain scientists as the period of "ferocious" activity of the virus, and thus move towards a state of control of the epidemic situation of the country. From an analytical point of view, this is reflected by displaying Junction between the curve of active cases in decline and the curve of recovered cases, which was increasing. The decrease of active cases was to continue until reaching the zero value and the curve of cured

cases should continue to increase until reaching its maximum, thus marking the epidemic end in Tunisia.

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