BACKGROUND

The spread of the COVID-19 epidemic in Catalonia has undergone a differentiated evolution both in time and in space — initial days of the epidemic with few cases, located in different foci of the territory. As time has passed, the diffusion has been increasing, although it is possible that the intensity and location continue to be heterogeneous in the territory. The information transparency policy adopted by the Government of Catalonia has made it possible to have detailed information that allows an analysis to be made both over time and throughout the Catalan geography. This information has been made available to citizens through the portal of the Catalan Health Quality and Assessment Agency (AQuAS) using data from the COVID-19 Registry of the Department of Health of the Generalitat of Catalonia, with a territorial breakdown in what is known as Basic Health Areas (BHA) and also at the municipal level.

OBJECTIVE

This note aims to determine some characteristics of the spatio-temporal distribution of the variables associated with the monitoring and impact of the COVID-19 epidemic. The data used for its development comes from the RSAcovid19 registry of the Health Department of the Generalitat de Catalonia and corresponds to the cases that have resulted in a positive diagnostic test (PCR-polymerise chain reaction- or quick test). Likewise, the database also has information on suspicious cases that correspond to people who at some point have shown symptoms and a health professional has classified them as possible COVID-19 cases, but they are not a positive result in the performance of a test diagnostic (PCR or quick test). In fact, as specified on the Department of Health website, all these cases are cases activated by the surveillance service and the area of residence that appears on the individual’s health card has been identified. However, there is a small number of observations for which the area of residence could not be identified and, therefore, are excluded from the analysis.

The data registry is formed by a total of \( T = 57 \) daily observations for a total of \( N = 372 \) Basic Health Areas, which comprises the period from February 26th to April 22nd of 2020. Figures 1 and 2 show the temporal evolution of the accumulated positive cases and the gross rate of contagion — number of accumulated positive cases over the total population per 10,000 inhabitants — respectively. These graphs show, on the one hand, a clear growing trend and, on the other, an evident territorial correlation. This last aspect is very clear when the Video 1 is played, where the spatio-temporal process of positive cases dissemination throughout the Catalan territory is evident.

This note summarizes some of the results on the analysis of the geographical distribution of COVID-19 in Catalonia that is being carried out by researchers from the AQR Research Group of the UB (http://www.ub.edu/aqr/). Special emphasis is placed on considering geographic and territorial aspects, facts of special interest in the research for the group.

The detailed results that have been used in this note are available to the interested reader.

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A first characteristic of interest is to measure the level of temporal persistence of the epidemic during the analysed period. The models performed have considered the heterogeneity in the dynamics of the spread of the COVID-19 that has been observed in each BHA, considering a time dependence horizon up to two weeks. The specification of different dynamic models allows us to glimpse what information from the past is relevant to explain the present values of the contagion rate. In some BHAs, only data from the previous period is relevant to explain the evolution of the variable, but, in other cases, it has been necessary to specify a model that includes up to twelve previous days. For example, the models estimated for BHA of Lleida rural, El Morell, Sant Joan de Vilatorrada, La Seu d’Urgell, Granollers - 3 Centre Est and Sabadell - 4B need to include ten previous days, the cases of Sant Boi de Llobregat - 4 and Ripoll - 2 needed twelve lags and, finally, in the case of Barcelona - 07E we had to include thirteen lags. This first element already constitutes an indicator of the heterogeneity of the spread of the COVID-19.

The mean value of the estimated degree of persistence is 0.91, a very high value that is close to unity (infinite persistence), with a standard deviation of 0.04 and a coefficient of variation of 0.05. Figure 3 provides more details on the distribution of the degree of temporal persistence in BHA.
As can be seen, the estimated values for the persistence measure associated with the contagion rate show an heterogeneous and asymmetric distribution through the territory, with a value of 0.86, for the first decile of the distribution, 0.92, in the case of the median, and 0.95 for the ninth decile. We also highlight values slightly higher than unity that would indicate an infinite persistence spread of the epidemic in some areas of Catalonia. In concrete, the BHA of Seròs i Girona - 4 show the highest value.

Regarding the spatial scope, the estimation of different measures of spatial dependence indicates a low correlation between the contagion rates of each BHA. It should be noted that the calculation of these measures has considered the evolution of the idiosyncratic temporal dynamics of each BHA. The measurements carried out indicate that the mean of the absolute value of the cross-section correlations of each of the BHAs with the rest of the BHAs is 0.14, with a standard deviation of 0.015 and a coefficient of variation of 0.11. The visual representation of the distribution of these spatial correlations can be observed in Figure 4.

The statistics for the first decile, the median, and the ninth decile of the distribution are 0.12, 0.14, and 0.16, respectively. As can be observed, all the statistics calculated draw a scenario of low cross-section dependence in the spread of the epidemic, a result that could be the result of the measures to contain the epidemic carried out by health authorities, as well as the confinement of the population. This deserves a detailed analysis that will be carried out in future notes.

CONCLUSION

The results summarized in this research note highlight the heterogeneity in the spread of the COVID-19 epidemic, which has been evaluated from both a temporal and geographical perspectives. Undoubtedly, this heterogeneity must be considered when carrying out the population de-confinement process. On the one hand, the high persistence of the contagion process has been verified, detecting geographical areas where time dependence is over a week. In these cases, it would be necessary to intensify actions to control the spread of the epidemic and reduce its dependence on the past. In any case, the persistence of contagion is very high throughout the territory, to the point that infinite persistence would have been observed in some areas and special attention should be paid to avoid spreading to other geographical areas. The positive result is found in that there is a low geographical dependence in the evolution of the pandemic, reflecting the efforts of the public administrations (health services and security) and that the citizens have made since the beginning of the epidemic.

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