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The impact of the COVID-19 pandemic on the median municipalities of Galicia (Spain): a geographical study on a specific territorial scale

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Abstract

The coronavirus pandemic has had an unprecedented impact on society and, especially, in cities. The concept of the city includes nuclei of very different sizes and functions. Therefore, it is necessary to ask whether the incidence of COVID-19 in the main cities and in the smaller ones has been similar. Due to their characteristics, in Galicia small cities have a series of advantages related to their size, as they are located in the average municipalities that have from 5,000 to 20,000 inhabitants, density, way of life, etc. It is also about understanding whether, as a whole, they have behaved better than the large regional urban centres with respect to the virus, or if their degree of vulnerability is the same due to a great level of compactness and very high densities. This research focuses on the period March-June 2020, with detailed data on COVID-19 infections thanks to a previous

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research project. The analysis will allow us to conclude if small cities have manifested their own characteristics compared to large ones, or if they have reproduced the same dynamics during the pandemic.

La pandemia del coronavirus ha tenido un impacto sin precedentes en la sociedad y, especialmente, en las ciudades. El concepto de ciudad incluye núcleos de muy diferente tamaño y función. Por tanto, cabe preguntarse si la incidencia de la COVID-19 en las principales ciudades y en las más pequeñas ha sido similar. Por sus características, en Galicia las ciudades pequeñas tienen una serie de ventajas relacionadas con su tamaño, ya que se ubican en los municipios medios que tienen de 5.000 a 20.000 habitantes, densidad, forma de vida, etc. También se trata de entender si, en su conjunto se han comportado mejor que los grandes centros urbanos regionales frente al virus, o si su grado de vulnerabilidad es el mismo debido a un gran nivel de compacidad y densidades muy altas. Esta investigación se centra en el periodo marzo-junio de 2020, con datos detallados de contagios de COVID-19 gracias a un proyecto de investigación anterior. El análisis nos permitirá concluir si las ciudades pequeñas han manifestado características propias frente a las grandes, o si han reproducido las mismas dinámicas durante la pandemia.

1. *Introduction*

The proliferation of news and research on the SARS-COVID pandemic shows that scientific knowledge has been used very unevenly to curb the disease. Thus, in the face of the rise of biomedical research, in particular virological and pharmaceutical, to respond in a conventional way to the challenge formulated, Social Sciences have remained in the background, although disciplines such as Geography have striven to carry out studies[1]. In Europe, poor tracking of those infected has resulted in several deadly waves of the pandemic. The possibilities of contagion in homes, classrooms or cafeterias were analysed, but factories, shopping centres and supermarkets were hardly studied, and no studies were carried out on the daily mobility habits of people and their life strategies in the crisis. The approaches focused on studying the habitat have been quite rare and general, and among the areas that have barely been addressed to better understand and combat the pandemic, except for a few notable exceptions[2].

The analysis models on habitat and human ecology have been renewed in recent times both by Geography and Ecology[3]. In both cases, the debate focuses on the compactness or dispersion of habitats as proven forms of space occupation, with all kinds of implications on environmental or health crises and their ways of dealing with them. Density becomes a key concept to understand

[1] Moon *et al.* 2021; Hasibuan *et al.* 2021.
[2] Olivera-Ranero 2020; Mishra, Gayen, Haque 2020.
[3] Bercque 2010; Forman 2014.

the urban-rural transition and the different types of cities and rural centres, in relation to the natural characteristics of the territories that host them[4]. The rapid spatial spread of COVID-19, favoured by travelling between large urban transport terminals from one region or country to another, shows that, in all the dense, compact neighbourhoods and cities of the world, the pandemic has increased its effects. Previously, this had already been observed in other widely spread infectious diseases[5]. However, the current focus on pharmacological solutions and laboratory procedures, have relegated the much-needed debate on habitat and global crises.

The objective of this article is to analyse the existing differences in the spread of COVID-19 between small cities and its evolution with respect to the rest of the Galician territory. To achieve this objective, we have analysed municipalities of between 5,000 to 20,000 inhabitants, which correspond to the administrative boundary where the category of small cities is included. Indeed, when using the demographic value as a delimiter of the territory, these figures can be translated into very different population densities between the groups of municipalities, this being one of the factors that has been shown to be relevant in the transmission of COVID-19. Therefore, in this work, we do not intend to provide new evidence on the effects of density as we did in previous works[6] but, understanding that this is a relevant factor in the comparison between urban and rural areas, we will analyse whether there are other elements that may have contributed to the differences observed between the groups of municipalities. In this sense, the interactions of the populations of rural areas, both in frequency and intensity, may be different from those of urban areas and surely had an effect on the first contagions of the virus in the different types of municipalities and the speed of its propagation. Therefore, once the behaviour and mobility patterns prior to the confinement are restored, medium size cities and rural areas to a greater extent, could still be at risk of suffering from COVID-19.

The territorial idiosyncrasy of Galicia is peculiar, so it must be clear the effort made to know the influence of COVID-19 on a specific territorial scale. In this work, we focus on the study of municipalities that have 5,000 to 20,000 inhabitants, in which all the small cities in Galicia that have these demographic values are located. Anyway, we must also emphasize, to emphasize that not all the intermediate municipalities of Galicia have some small city. In fact, there are municipalities that exceed 5,000 inhabitants, but this volume of population is scattered by a dozen population entities, so we do not find any small city in that municipality. However, these exceptions do not weaken the need

[4] Pahl 1966; Ianos 2008; UN-Habitat 2020.
[5] Wolfe, Panosian, Diamond 2007; Jones *et al.* 2008.
[6] Carballada, Balsa-Barreiro 2021; Miramontes, Balsa-Barreiro 2021.

and interest in knowing and studying how the pandemic behaved in the medium-sized municipalities and small cities of Galicia.

2. *Material and methods*

This study focuses on the first wave of the COVID-19 pandemic, including uncontaminated, verified and detailed data of each person infected by COVID-19 in Galicia. Our data contain individual and precise information on each infected person, including their physical address and show a very precise and detailed estimate of the actual transmission of the virus in this region. This information was provided to understand the spatial dynamics and impact of the pandemic, in order to predict its future behaviour and be able to plan ahead by taking the right decisions at all times. Our maps were used as a fundamental tool to control the pandemic and evaluate subsequent measures identifying the spatial behaviour of the virus. For this, various strategies for the visualisation and mapping of the data were developed. A series of aspects were taken into account including multiscale analysis, data aggregation or responsible use of data[7].

The review, analysis, and interpretation of these maps should help decision-making by health authorities.

The dataset contains information related to all individual cases reported during the first wave of the pandemic, which ranges from 1 March to 15 July 2020. This information was officially transferred to us by the Galician Health Service (SERGAS), the local health authority. This was possible thanks to an urgent public competitive call, funded by the Galician Innovation Agency (GAIN) of the Xunta de Galicia in March 2020, inviting the entire scientific community (public and private) to submit project proposals to "fight" COVID-19. As a result, the project "The risk mapping of COVID-19 in urban and rural areas of Galicia" was selected, the purpose of which was to carry out a series of territorial analysis reports of the pandemic and hand them over to SERGAS. Part of this project is the basis of this article. The data to be analysed were transferred to us after signing a confidentiality agreement.

This dataset, initially 11,070 records, included data related to each patient, such as main details, place of residence and physical address, and some relevant time data that allowed a complete monitoring of the disease for each reported case (i.e., admission, death at home/hospital). Due to the mobility restrictions during the confinement, the tracking of cases and outbreaks was

[7] Carballada, Balsa-Barreiro 2021; Carballosa *et al.* 2021; Miramontes, Balsa-Barreiro 2021.

limited in a spatiotemporal way because the health authorities recorded dates related to the first symptoms and the results of the tests. The official address of each reported case allows us to obtain a very precise graph of the real spatial behaviour of the virus.

The raw dataset was initially checked for inconsistencies and was prepared and cleaned by removing duplicates, deleting 581 records. After that, we standardised the format of the remaining records. All the study and cartographic representations were carried out using ESRI technology (ArcGIS Pro and ArcGIS Online, primarily). Finally, a complete data set consisting of 10,583 records was correctly geolocated on a map.

In the present work, we use the information that we have on each of those affected during the first wave of the pandemic, to understand, analyse and diagnose COVID- 19 in the small towns of Galicia.

3. *Study area and territorial behaviour of the pandemic*

The region of Galicia is located in the northwest of Spain (fig. 1a). It has an area of 29,575 square kilometres and 2.7 million inhabitants. Its population density is 91.4 people per square kilometre, only two points lower than the average in Spain. Administratively, the region is divided into 313 municipalities distributed in 4 provinces (fig. 1b). The two provinces located further to the west concentrate most of the population, reaching average densities above 140.9 in A Coruña and 209.7 inhabitants per square kilometre in Pontevedra[8].

Increasing levels of urbanisation took place in the 1960s and 1980s and rural depopulation has contributed to a spatial concentration in some areas of this region. Today, most of the population, economic activity and political power are concentrated in a very small number of cities.[9]. The most important ones are found along the Atlantic Urban Axis, coinciding with the high-capacity highway (AP-9) which runs from north to south of the region. This axis links the cities of Ferrol, A Coruña, Santiago, Pontevedra and Vigo. The most important cities are Vigo and A Coruña, with more than 300,000 inhabitants each. Outside of this axis, we find two cities: Lugo and Ourense. These concentrate most of the economic activity in their respective provinces and both have more than 100,000 inhabitants (fig. 1). The region presents a dual population pattern. The most important cities concentrate around 80% of the population and 75% of the regional GDP[10], while a vast part of the territory

[8] INE 2021.
[9] Lois-González 2015.
[10] Pazos Otón 2003.

is rural and with populations in decline. This general pattern is evident at the provincial level, where the two western provinces have significant economic diversity and account for most of the population. This same demographic duality is displayed between a very dynamic coastline and a depressed inland territory.

This territorial structure determines the mobility patterns. On a regional scale, flows to major cities and surrounding areas predominate. Internally, a significant number of municipal capital cities shape most of the non-urban territory. Most of the mobility flows in these predominantly rural areas cover greater distances compared to urban areas.

Most of these dynamics have changed dramatically since the beginning of the COVID-19 pandemic in mid-March 2020. In Spain, national authorities controlled the entire country to deal with the virus. On March 14, they adopted a harsh lockdown with strict mobility restrictions and stay-at-home orders for everyone. Work activity was reduced to very few essential activities related to human care and the purchase of essential products. Between March 30 and April 9, only essential workers were able to travel for work. Most of the businesses related to non-essential activities, as well as cultural and religious facilities, were closed. With a controlled management of the virus, this region was the first to ease mobility restrictions and return to a "new normality." Regarding the management of the pandemic in Galicia, before continuing with its territorial analysis, it is necessary to highlight that, from an administrative point of view, Spain is a country that has transferred the administrative powers of fundamental services, such as health or education, to each of the autonomous regions (Galicia amongst them). Therefore, there is a high level of decentralisation of services and territorial realities, management and decision-making processes that can greatly vary on a Spanish scale[11]. The location of these cases allows us to assess the spatial distribution of the disease and understand its spatial dynamics. Data are aggregated across municipalities and displayed on choropleth maps. The geographical spread of the virus was clearly more significant in the western sector of the Atlantic Urban Axis, especially in areas close to the main cities (fig. 2).

Figure 2 links the number of reported cases to the total population. The reported cases are represented by proportional circles, while the total population is distributed in five defined intervals, ranging from purely rural to urban municipalities, where we will place the municipalities in which the small cities of Galicia are located. A priori, a strong spatial correlation is observed between the total population and the number of cases reported in each municipality. We also see how the peri-urban areas that surround the main cities become more significant. The reason for this is because these areas are where most of

[11] Cruz *et al*. 2021.

the population live (residential areas), but also where industrial activities are mainly concentrated. Therefore, these spaces have a greater dynamism based on a greater number of social interactions.

4. *Results*

The objective of this work is to verify how the pandemic behaved in the municipalities where the small cities of Galicia are located, that is, those with a population ranging from 5,000 to 20,000 inhabitants, in order to know how the COVID-19 pandemic acted in these small cities. The first result that we had to obtain was to know which municipalities are home to Galician cities with 5,000 to 20,000 inhabitants. According to official data from the IGE (Galician Institute of Statistics) of the 313 municipalities and the more than 2.7 million inhabitants in Galicia, there are 90 municipalities with 5,000 to 20,000 inhabitants, which represents almost 29% of the total and comprises more than 845,000 inhabitants, 31% of the population of Galicia (see fig. 3a-b).

Regarding the territorial distribution of the pandemic in the medium size municipalities, we verify how they are present in the 4 provinces. However, we detected some singularities.

1. Firstly, how they predominate throughout the entire Atlantic urban axis, although to a lesser extent than the urban areas of Galician cities.
2. Secondly, we see how some population centres that act as municipal capitals are becoming more prominent, bringing together education, health or area services that go beyond their administrative limits. This is the case of Monforte de Lemos, O Barco de Valdeorrras or Verín.
3. In relation to these small cities, it should be noted that they are more common in the eastern provinces (Lugo and Ourense) which, among other factors, are characterised by their aging population and lower socioeconomic rates than those of the western provinces.
4. Having the location information in detail of those infected, also allowed us to detect the concentration ofthese, during the first wave, in nursing homes. Many of these residences are located outside the large Galician cities.

Therefore, there is a certain homogenization between the representation of these municipalities in relation to the number they represent and the population they compose. (see fig. 4).

The percentage of the number of people infected by COVID-19 in medium size municipalities, which is 25.2%, is slightly lower than the percentage of the number of municipalities and population volume (see tab. 1).

	No. of municipalities	No. of inhabitants	No. of COVID-19 cases
Medium size municipalities	90	845,796	2,669
Rest of Galicia	223	1,856,023	7,914
TOTAL	313	2,701,819	10,583

Table 1. Relationship of the basic differences between intermediate municipalities and the rest of Galicia during the first wave of the pandemic (Source: own elaboration from data from Galician Health Service, 2020)

Regarding the evolution of COVID-19 positive cases (see fig. 5), in Galicia we see how the cases began to be detected throughout the month of February, but it was in March when the pandemic broke out on a global, national and regional scale. In Galicia, it arrived later compared to other areas of Spain. But it did suffer the dire consequences of the pandemic from the vital, social and economic point of view as well as the lockdowns. Once the months of March and April were over, the number of those infected dropped considerably and even more the closer we got to the summer months of July and August. In fact, it was thought that the pandemic was over, only to later find out how wrong that was[12].

When differentiating between the medium size municipalities (small cities and many municipal capitals) and the rest of Galicia, we verify how the temporal evolution of positive cases has been similar, although the disease arrived later in medium size areas compared to urban ones. In fact, the first cases in February correspond to urban municipalities. However, the situation in the most difficult period of the pandemic, the month of March, was very similar throughout Galicia apart from the obvious difference of a smaller number of absolute cases in small cities.

Another temporary aspect that can be detected is that in the medium size municipalities the pandemic arrived later, but it also took longer to "leave". As an anecdote, the highest number of infected cases in a single day, within the medium size municipalities, occurred on 20 March 2020 in the municipality of Xinzo de Limia, as a direct consequence of the combination of several factors such as: "no celebration" of the carnival (the quintessential festival of this municipality) but which did not prevent meetings between family and friends, and outbreaks in nursing homes.

Without entering judicial jurisdiction, it became quite clear that, although there was a declaration by the competent authorities at regional and local level of the cancellation of any type of recreational or festive activity. Canceling the celebration of carnival. The idiosyncrasy of the population and the need

[12] IGN 2021.

to carry out commemorative act of a day as important for this territory as the carnival. It caused that, despite the security measures, there were groupings of family units and groups of closest friends that triggered an increase in those infected in this municipality.

In order to understand the factors that could be associated with this behaviour, we have also carried out studies and relationships between those infected and the percentage of the population aged 65 and over, the number of homes for the elderly or the location of the health centres. The number of days elapsed since the first confirmed case in each municipality is also included. These results were submitted to SERGAS under the confidentiality agreement, and therefore cannot be published, but we do however use them to further the knowledge and objective of this work. In fact, we can affirm that the incidence rate ratio associated with rural municipalities was statistically higher. Consequently, and contrary to the comparison of the raw data (tab. 1), and analysing the effect of the variables mentioned above, a higher contagion rate is observed in the medium size municipalities (many rural) in relation with the most urban.

A possible reason for this result could be related to the fact that during the month of March and before strict lockdown measures were adopted, interactions in medium size and rural areas were less frequent, but more intense (in the family environment, much narrower circles of friends, etc.) than in urban areas, thus contributing to a greater spread of COVID-19. The fact that movements for work or study tend to be much greater than in urban areas could also play a role. Another factor to take into account would be the possible effect of mobility for leisure reasons from urban areas to second residences, village family homes and tourist areas[13]. Many of which are found in medium size Galician municipalities. However, once the state of alarm began, social distancing and the reduction of work, study and leisure flows had an equal or greater impact than in urban areas, thus reducing its importance.

Conclusions

The results stated in this work suggest that the differences observed between the medium size areas and small cities (more rural) and the rest (more urban) could hide a much more complex reality than that shown by the comparison of the gross rates of contagion. Specifically, although rural areas have characteristics that make them more resistant to the spread of COVID-19, we saw how during the first weeks of the spread of the pandemic, the intensity of infections

[13] Davis 2020; Rao, Zhang, Mantero 2020.

was higher in rural areas compared to urban areas. Therefore, given the experience derived from the expansive phase of the disease, outbreaks should not be neglected in any rural municipality since, due to the type of mobility and interactions existing in these areas, it could spread to a significant proportion of its population, bearing in mind that the degree of aging of the rural population is notably higher than that of the urban population, and that mobility and health capacities in rural areas are clearly lower than in urban areas.

In addition, in this work we verify and confirm several Galician realities related to the pandemic in its origins, since its arrival and during the first wave:

1. The pandemic always arrived a little later and with a lower degree of incidence in Galicia than in other areas of Spain.
2. It can also be interpreted that the Galician government took the initiative of the proposals that were made from the Autonomous Communities to the Central Government to coordinate the management of the pandemic. During the first half of 2020, the Spanish government held frequent meetings with the governments of autonomous communities. With the intention of coordinating joint and coordinated actions to combat the pandemic. In any case, in Spain the health competences were transmitted and managed from each autonomous community, 17 in total.
3. COVID-19 presented a territorial distribution very similar to that of the socioeconomic variables throughout the Galician territory. There was a greater number of infected in urban areas and their areas of influence, the pandemic followed the route of the Atlantic Urban Axis.
4. While the municipal capitals that socioeconomically structure the Galician rural territory had a lower incidence. To a large extent, due to demographic and density values that are not very high.

It should be noted that the maps and analyzes presented in this work are a sample of the importance of Geography and the study of the territory in the face of pandemics such as COVID-19. In fact, part of what was exposed in this work was presented throughout 2020 to the competent authorities related to the management of this health crisis in Galicia, becoming an authentic example of Applied Geography.

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Appendix

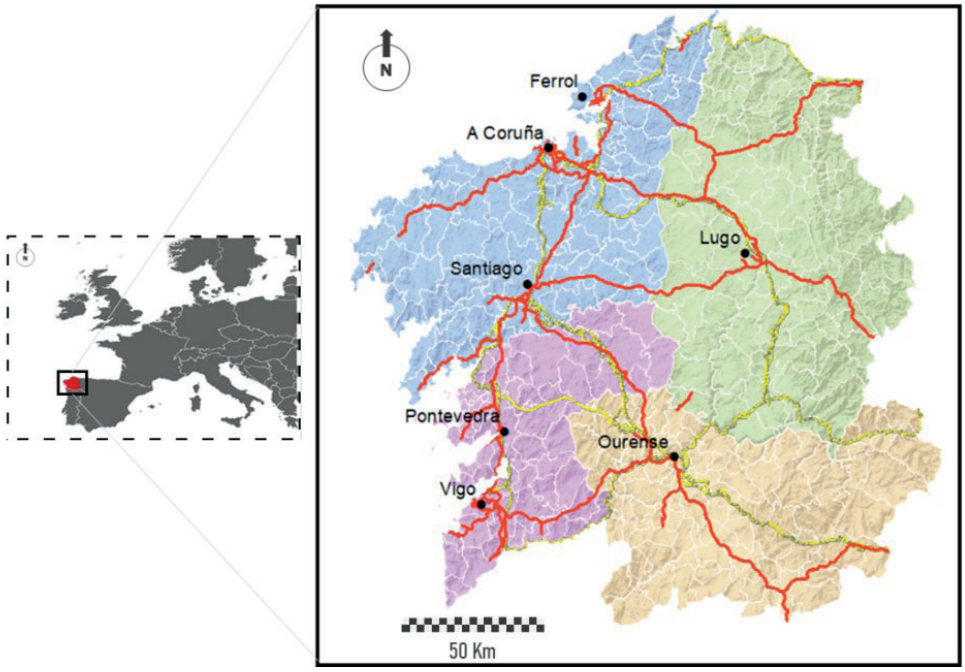

Fig. 1a. Location and characterisation of the Galician region; 1b. In coloured background, distribution in provinces (second-level administrations) and municipalities (third-level administrations). The most populated cities and industrial hubs of each province appear highlighted in bold. Red lines represent the major road infrastructures, i.e., motorways in red and railway in yellow (Source: own elaboration)

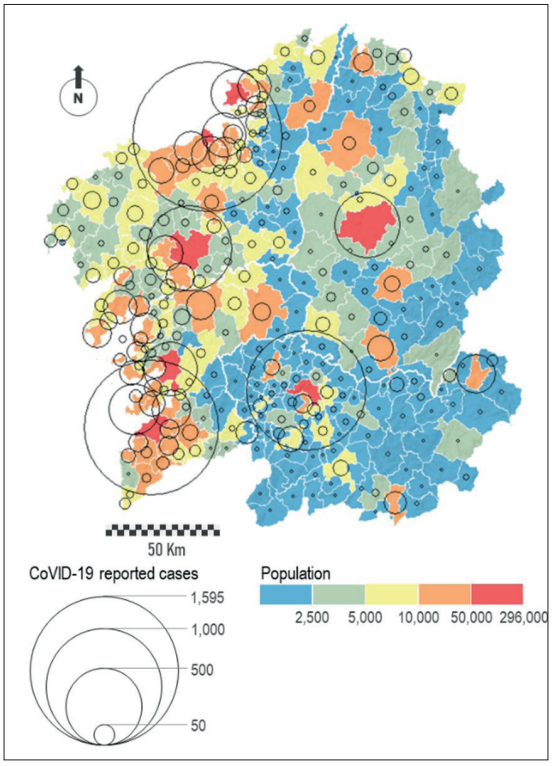

Fig. 2. Geographical spread of COVID-19 in Galicia at a municipal level: Reported cases versus population (Source: own elaboration from data from Galician Health Service, 2020)

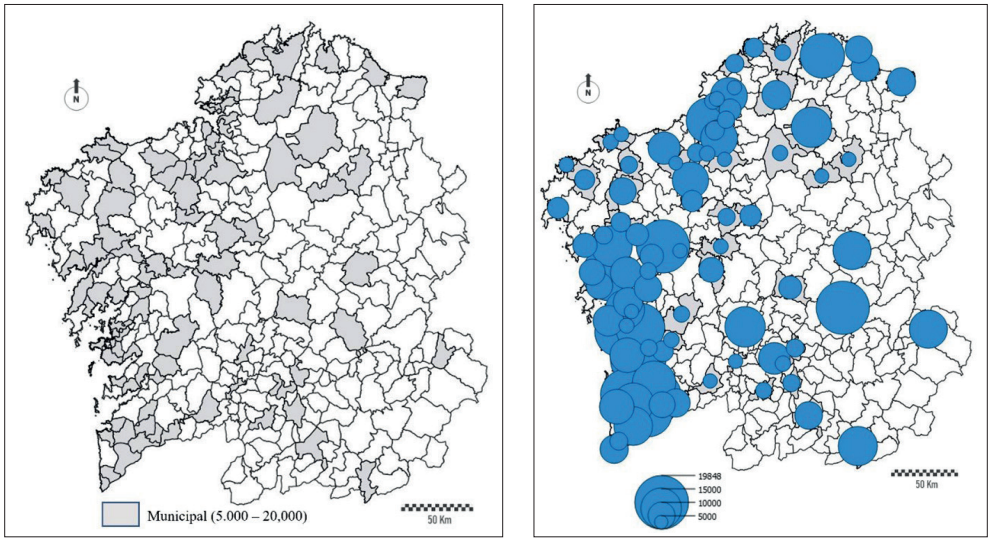

Figure 3a. Territorial distribution of the municipalities from 5,000 to 20,000; b. population volume (Source: own elaboration from data from INE, 2020)

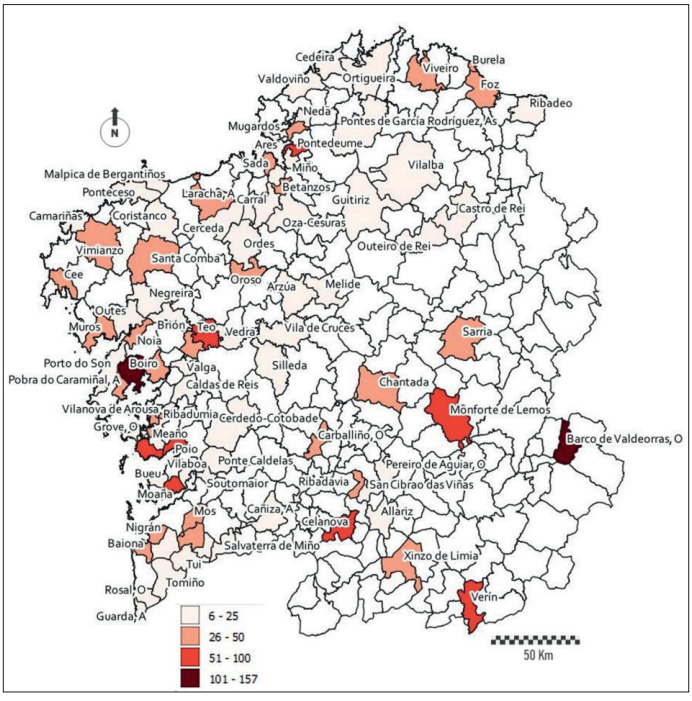

Fig. 4. Covid cases in municipalities from 5,000 to 20,000 (Source: own elaboration from data from Galician Health Service, 2020)

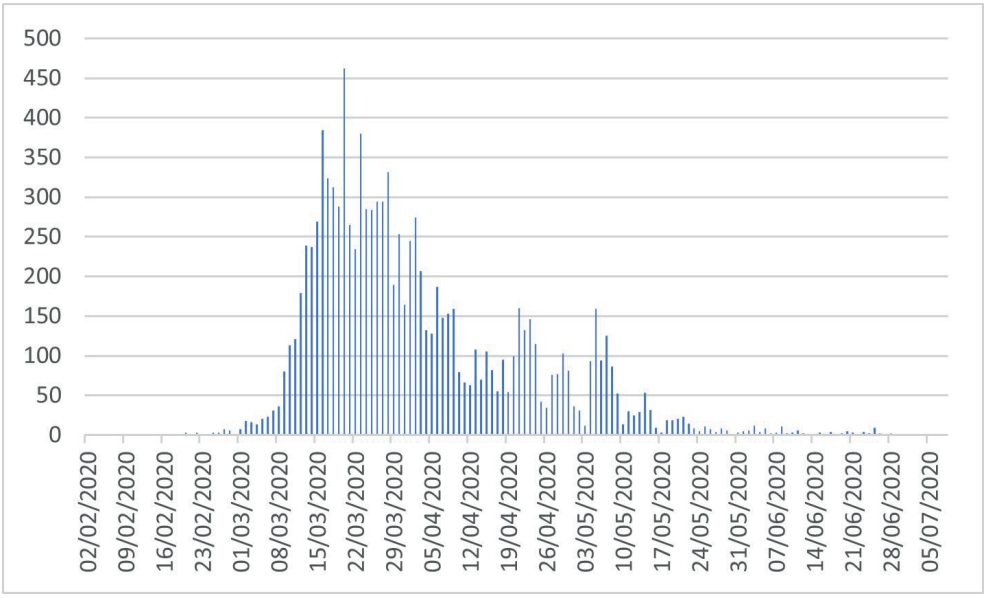

Fig. 5. Temporal evolution of positive cases of COVID-19 during the first wave in Galicia (Source: own elaboration from data from Galician Health Service, 2020)

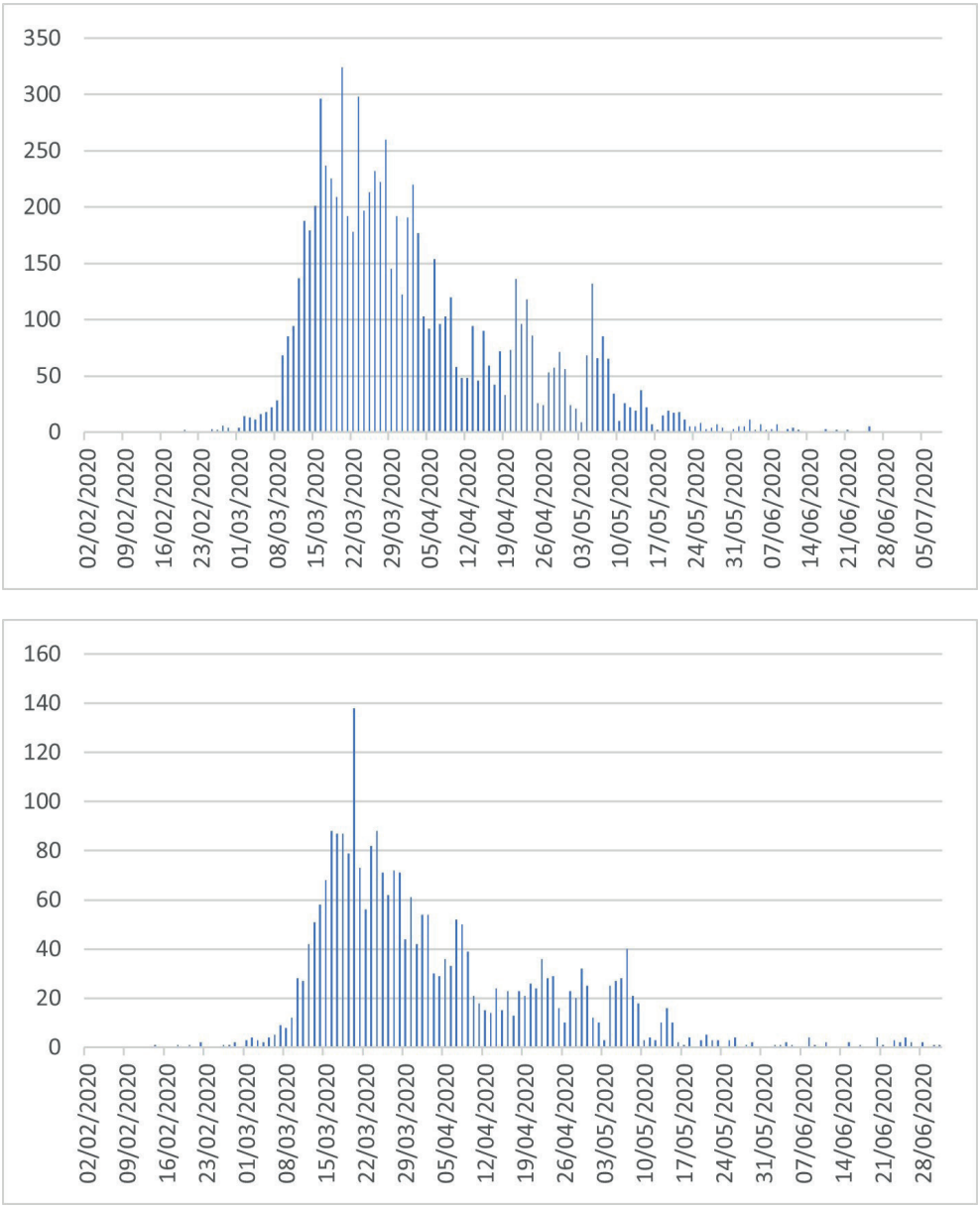

Fig. 6a. Temporal evolution of positive COVID-19 cases during the first wave in non-medium size municipalities; b. in medium size municipalities (Source: own elaboration from data from Galician Health Service, 2020)

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