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The Italian Paradox and The National Health System (N.H.S.): The Demographic and Territorial Characteristics of the Regions Most Affected by the COVID-19 Pandemic

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ABSTRACT

The effects of the spread of the SARS-CoV-2 virus, at the origin of the COVID-19 pandemic, on the Italian older population were devastating, giving rise to what seems to be a paradox. The number of victims among the elderly population was higher in the more developed northern regions, where the local health authorities (L.H.A.s) and, in particular, the long-term care (L.T.C.) sector are known to be more efficient with respect to those of the other regions. The focus of this article is twofold: on the one hand, it tries to find a plausible answer to the relevant question 'why was the number of victims, particularly among the older population, in the northern regions so high in Italy?' In doing so, it highlights the need for a multiple factor analysis that simultaneously takes different elements into consideration, such as the demographic, territorial and economic characteristics of the areas in Italy most affected by the pandemic, while examining whether the health policies implemented by the Ministry of Health in Italy were the most appropriate. On the other hand, it sheds light on the fact that only a few pieces of information and data on the number of victims in the L.T.C. sector in Italy are available, with few exceptions such as the Northern region Friuli Venezia Giulia, and that more data collection and research is also needed regarding other factors, such as environmental factors, that might have worsened the impact of the pandemic in Italy on the older population.

Keywords

SARS-CoV-2, Italian National Health System, Health Policy, Demographic and Environmental characteristics, Long-Term Care Facilities.

Introduction

The devastating effects of the spread of the SARS-CoV-2 virus have put in the spotlight the Italian National Health System (N.H.S.) proving, with some exceptions, its unpreparedness [1-3]. The tragic events following the pandemic tsunami that hit Italy, from the very beginning [4,5], are still under investigation. What went wrong and why was the number of victims, particularly among the older population, so high in Italy [6] compared to other nations in Europe [7]?

Were the public health policies designed from the outset by the government and the Italian health authorities to deal with the "unknown" and the "unexpected" [8] the right ones or were mistakes made [9]?

This article suggests that to find plausible answers to these questions, we need to perform a more comprehensive view of the overall situation in Italy by focusing our attention on a multifactorial analysis that simultaneously takes into consideration, on the one hand, the demographic, territorial and economic characteristics of the most important areas in Italy affected by the pandemic and, on the other hand, how the government reacted through the National Health System (N.H.S.) and what lessons can be learned from the COVID-19 pandemic [10].

In other words, the pandemic, which has given rise to a sort of terrible Darwinian selection within the older population, was the result of an alchemical reaction between different unpredictable elements.

The demographics and economic conditions in the territories in Italy most affected by the COVID-19 pandemic

A closer look at the Italian territory and at its National Health System allows us to notice that Italy:

- is a country of approximately 60 million inhabitants who are unevenly distributed throughout its 20 regions (see Figure 1), which are also quite different in terms of their size and economic conditions. The overall territory is divided into three broad areas: the more industrialized and developed northern territory, to which eight of the twenty regions belong, and the less developed and more agriculturally dependent central and southern territories, to which the remaining twelve regions belong, with four regions in the central territory and eight regions in the southern territory;
- What the data [11] show is that the Italian territory (see Tables 1, 2 and 3) was affected asymmetrically by the SARS-CoV-2 virus from the very beginning, with the more developed northern regions severely hit by the outbreak of the pandemic (in particular, the Lombardy region, which produces the largest share of approximately 22% of Italy's real gross domestic product; the number of individuals infected by the SARS-CoV-2 virus was more than 3.3 million), while the less developed central and southern regions were affected to a lesser extent.
- As of September 1, 2022:
- A total of 47,84% of the overall number of infected individuals in Italy, i.e., 10.432.244 out of 21.806.509 individuals, is concentrated in the eight northern regions, and Lombardy alone accounts for 15,89% of the overall number of infected individuals, i.e., the largest portion (3.464.377) of the pie (21.806.509);
- An exception is represented by two central regions (Lazio and Tuscany, with 2.013.945 and 1.373.873 infected people, respectively, representing approximately 9,2% and approximately 6,3% of the overall number of infected people in Italy) and by three southern regions (Campania, Sicily and Puglia, with 2.177.446, 1.616.403, and 1.450.053 overall infected people, respectively, corresponding to 9,98%, 7,4% and 6,65% of the overall number of infected people in Italy).
- Similarly, 59,06% of the overall number of people who died due to COVID-19, that is 103.566 out of 175.347 people, resided in the eight northern regions.
- The number of deaths in the central regions is 28.761, while in the southern regions, it is 43.020, which represents 16,4% and 24,5%, respectively, of the total number of victims who died (175.347) in Italy.
- At this stage, 83% of the Italian population has been vaccinated, and the Italian northern regions represent 39,4% of the overall

Italian Regions

Northern Regions
Emilia Romagna
Lombardy
Veneto
Piedmont
Liguria
Friuli Venezia Giulia
Trentino Alto Adige South Tirole
Aost Valley

Central Regions
Lazio
Tuscany
Marche
Umbria

Southern Regions
Campania
Sicily
Puglia
Calabria
Abruzzo
Sardinia
Basilicata
Molise

Figure 1: Map of Italian Regions.

Table 1: Italian Northern Regions – Relevant COVID-19 Data (The Overall Number of Infected People, Number of People Who Died and Number of Vaccinated People) as of September 1, 2022.

Northern Regions	Overall Number of Infected People	Number of People Who Died	Number of Vaccinated People
Emilia – Romagna (resident population 4,431,816)	1.817.163	17.864	3.788.997
Lombardy (resident population 9,965,046)	3.464.377	42.204	8.594.045
Veneto (resident population 4,854,633)	2.190.985	15.349	4.042.131
Piedmont (resident population 4,252,279)	1.425.769	13.595	3.563.558
Liguria (resident population 1,507,438)	558.685	5.534	1.280.210
Friuli Venezia Giulia (resident population 1,197,295)	474.112	5.355	982.420
Trentino Alto Adige - South Tirole Autonomous Province of Bolzano (resident population 535,774) Autonomous Province of Trento (resident population 542,158)	457.690	3.118	869.474
Aost Valley (resident population 123,337)	43.503	547	97.673

Table 2: Italian Central Regions – Relevant COVID-19 Data (The Overall Number of Infected People, Number of People Who Died and Number of Vaccinated People) as of September 1, 2022.

Central Regions	Overall Number of Infected People	Number of People Who Died	Number of Vaccinated People
Lazio (resident population 5,715,190)	2.013.945	11.973	4.957.304
Tuscany (resident population 3,676,285)	1.373.873	10.632	3.209.802
Marche (resident population 1,489,789)	602.770	4.091	1.225.321
Umbria (resident population 859,572)	364.633	2.065	737.660

Table 3: Italian Southern Regions – Relevant COVID – 19 Data (The Overall Number of Infected People, Number of People who Died and Number of Vaccinated People) as of September 1, 2022.

Southern Regions	Overall Number of Infected People	Number of People who Died	Number of Vaccinated People
Campania (resident population 5,590,681)	2.177.446	11.069	4.637.266
Sicily (resident population 4,801,468)	1.616.403	12.057	3.875.780
Puglia (resident population 3,912,166)	1.450.053	8.981	3.426.298
Calabria (resident population 1,844,586)	534.959	2.939	1.522.059
Abruzzo (resident population 1,273,660)	537.248	3.626	1.075.386
Sardinia (resident population 1,579,181)	437.727	2.700	1.357.996
Basilicata (resident population 539,999)	178.129	979	458.106
Molise (resident population 290,769)	87.039	669	254.807

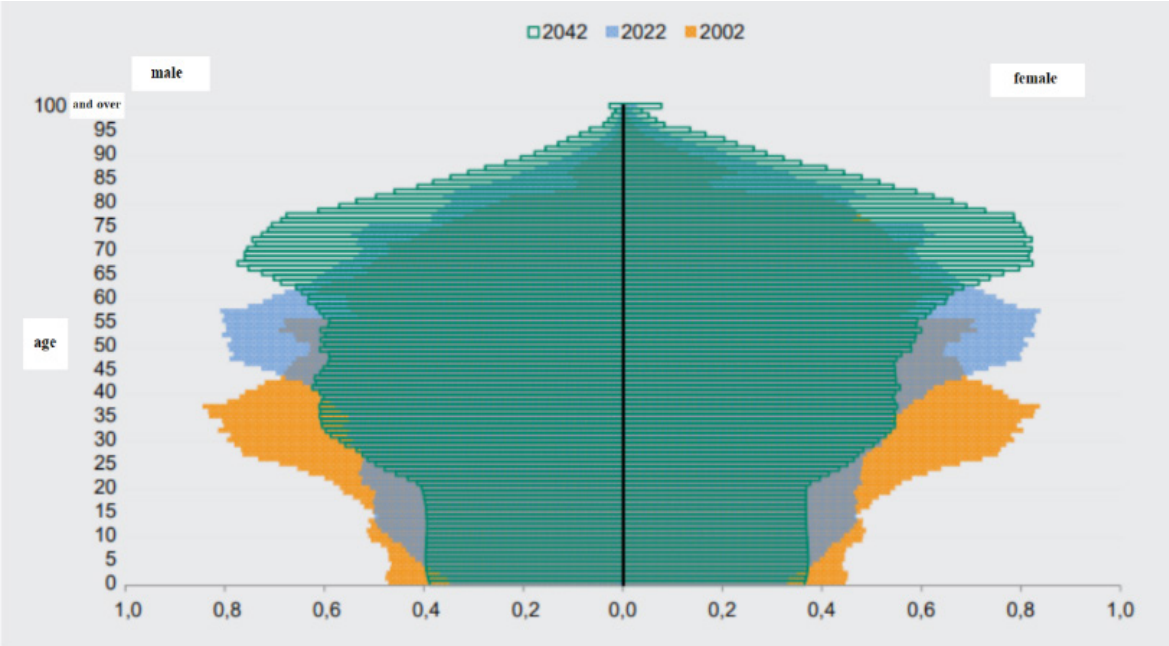

Figure 2: Italian population pyramid in 2002 and 2022 and forecasts for 2042. (Source: Italian Newspaper Il Sole 24 ore (July 16, 2022) and the Italian National Bureau of Statistics (Istat)).

population of vaccinated people (i.e., 23.218.508 individuals). The vaccination campaigns of the central and southern regions follow those of the northern regions even if at a slower pace, given that the N.H.S. in these regions is less structured and often considered, with some exceptions, not as efficient as that of the northern region.

Even at first glance, the data [11-12] reported in the three tables show that the regions of northern Italy have been most affected by the pandemic in terms of the number of infections and deaths. The number of vaccinated people is also higher in the northern regions than in the other regions.

However, what alchemy produced these results?

The explanation is not univocal, and the intensity with which the virus has manifested itself depends on multiple factors.

Italy is undergoing progressive ageing, and its age structure for 2002 and 2022 is shown by the population pyramid in Figure 2, with a forecast for 2042. Additionally, demographers expect this trend to worsen in the coming decades with a growing share of individuals, both males and females, aged 65 years and over.

In particular, it is possible to observe that:

- The Italian demography (see Table 4) indicates that the fraction of the population aged 65 years or over is higher in the northern

Table 4: By region: Italian Population, Population aged 65 years and above, Fraction of the population aged 65 years and over, Population density (source: Italian National Bureau of Statistics (ISTAT) – link Previsioni della popolazione - Anni 2021-2070 (istat.it)) (° Trentino Alto Adige includes the Autonomous Province of Bolzano and the Autonomous Province of Trento).

Regions	Total population	≥ 65 years of age	Fraction of the total population aged ≥ 65 years or over	Surface area (square kilometers)	Population density (number of inhabitants per square kilometer)
Italy	58.983.122	15.156.359	25,7%	302.068,37	195
Northern Regions					
Emilia Romagna	4.431.816	1.078.543	24,3%	22.444,54	197
Lombardy	9.965.046	2.087.026	20,9%	23.863,10	418
Veneto	4.854.633	1.154.838	23,8%	18.345,37	265
Piedmont	4.252.279	1.115.901	26,2%	25.386,70	168
Liguria	1.507.438	435.201	28,9%	5.416,15	278
Friuli Venezia Giulia	1.197.295	319.366	26,7%	7.932,48	151
Trentino Alto Adige South Tirole°	1.077.932	230.524	21,4%	13.604,44	79
Valle d'Aosta	123.337	30.430	24,7%	3.260,85	38
Central Regions					
Lazio	5.715.190	1.308.040	22,9%	17.231,72	332
Tuscany	3.676.285	955.168	26%	22.987,44	160
Marche	1.489.789	382.607	25,7%	9.401,18	158
Umbria	859.572	228.082	26,5%	8.464,22	102
Southern Regions					
Campania	5.590.681	1.131.618	20,2%	13.670,60	409
Sicily	4.801.468	1.050.653	21,9%	25.832,55	186
Puglia	3.912.166	917.233	23,4%	19.540,52	200
Calabria	1.844.586	428.898	23,2%	15.221,61	121
Abruzzo	1.273.660	318.468	25%	10.831,50	118
Sardegna	1.579.181	200.895	12,7%	24.099,45	66
Basilicata	539.999	132.394	24,5%	10.073,11	54
Molise	290.769	76.146	26,2%	4.460,44	65

regions than in the central and the southern regions;
- The population density is predominantly higher in the northern regions with respect to most parts of the central and southern regions, but this does not uniquely explain the reason for the greater impact of the pandemic on the population in terms of the number of victims, especially during the initial phase, and, in particular, of the elderly population in the regions of northern Italy.

For example:
In Sicily (resident population = 4,801,468 individuals), a southern region (see Tables 3 and 4):
- surface area (s.a. = 25.832,55) is greater than surface area of Piedmont (s.a. 25.386,70);
- population density (p.d. = 186) is greater than population density of Piedmont (p.d. 168);
- and the fraction of those aged 65 years or above (f.ag.a. 65 = 21,9%) is lower than f.ag.a of Piedmont (f.ag.a 65 = 26,2%).

In Piedmont (resident population = 4,252,279 individuals), a northern region, the number of
- infected (1.425.769) is lower than the number of infected (1.616.403) in Sicily;
- deaths (13.595) due to COVID-19 is greater than the number of deaths (12.057) in Sicily.
- Therefore, the higher population density of a region by itself does not necessarily imply a higher death toll due to the pandemic.
- A higher fraction of those aged 65 years or above seems to be a more plausible reason for the higher number of victims in the northern regions.
- There is no doubt that the COVID-19 pandemic in Italy, as shown by the data of the Italian National Health System, has affected the older population (i.e., aged 65 years and above) the most:
- As of December 27, 2020 (the starting day of the vaccination campaign in Italy), the overall number of victims who died before the introduction of the vaccines was 71.925, which is 40,9% of the cumulative number of deaths (i.e., 175.633) from the very beginning of the pandemic to September 1, 2022;
- As of September 1, 2022:
  - o Approximately 90% (i.e., 158.097) of the overall deaths (175.663) from COVID-19–19 were elderly individuals (i.e., individuals aged 65 years or above);
  - o A total of 58,9% (i.e., 103.566) of the overall deaths (175.633) were concentrated in the Italian northern regions. The data from the Italian National Health System show that the same age pattern holds in the abovementioned Italian northern regions and, as a result, that approximately 90%, (i.e., 93.209) of the 103.566 people who died in the Italian northern regions were people aged 65 years or above.

In summary, in Italy:
- There was an overall decrease in the resident population of -0.4%;

- Ninety percent of the deaths due to the COVID-19 disease occurred in elderly individuals (people aged 65 years or above);
- A total of 58,9% of the overall number of the people who died due to COVID-19 were concentrated in the northern regions, with a similar age pattern with respect to the whole territory.

Two questions at this stage arose spontaneously:
1) Why is this the case? [13]
2) How has the Italian National Health System (N.H.S) reacted to it?

The answers to the above questions will highlight the need for further research and a thorough reform of the Italian N.H.S., which suffers from a number of problems and shortcomings.

Aging, the Italian National Health System (N.H.S.) and COVID-19

The National Health System in Italy is designed as a universal and decentralized system [14], free of charge at the point of delivery and financed by the general tax revenue. Additionally, health policy decisions in Italy are essentially made at two different levels:
- The Central Government expresses guidelines at the national level, which must then be put into practice at the lowest level of government in the twenty regions (i.e., up to the municipalities) of which Italy is comprised;
- The twenty regions, of which five (Sicily, Sardinia, Aost Valley, Trentino Alto Adige South Tirole and Friuli Venezia Giulia) are autonomous according to the Italian Constitution (these five regions have greater decision-making powers in various matters including health care), apply the guidelines indicated by the central government through the Local Health Authorities (L.H.A) to the territory, adapting them to local realities.

The prerequisite for the functioning of a decentralized system such as the Italian system is an efficient communication of information and data in the periphery among the Local Health Authorities (L.H.A.), at the regional level, and between the periphery and the center and vice versa, something that, during the worst period of the pandemic, has not occurred on several occasions.

The absence of efficient communication and, above all, of a strategic pandemic plan at the national level, seem to be among the factors that have determined the high number of victims in Italy, additionally highlighting the urgent need for a systematic study and reorganization of national and regional policies dedicated to the care and assistance of elderly individuals, while taking the progressive aging of the population into consideration (Figure 2).

Furthermore, most of the older victims of the SARS-CoV-2 virus were concentrated in the regions of northern Italy, and in particular, some of their cities, such as Lombardy in the cities of Bergamo and Milan, were deeply affected by the pandemic. More research and more data (regarding other factors, such as environmental factors, that might have worsened the impact of the pandemic in Italy on the older population) need to be collected, with particular reference to the so-called long-term care (L.T.C.) sector [15-19] to study the reasons for this counterintuitive selection: the more developed and wealthy northern regions in Italy, where the health care system is thought to be the best in the country, were the regions that were most affected, with the higher number of victims among elderly individuals.

In Italy, as reported by the Integrated COVID-19 Surveillance System coordinated by the National Institute of Health – ISS (Istituto Superiore della Sanità), the median age of SARS-CoV-2-positive patients who died was 80 years, representing 60% of the overall deaths from the beginning of the surveillance period (i.e., February 27, 2020, up to January 10, 2022).

It is not new news that coronaviruses and influenza viruses have a greater impact on the elderly population and that therapeutic strategies, in the absence of vaccines, are often unsuccessful, with a high number of victims among infected individuals due to the greater fragility of elderly individuals with comorbidities [20-23].

This seems to be, in a nutshell, what has happened in Italy and other countries. The sudden emergence and fast spread of the disease among the older population in Italy [24-26] and in many European countries has occurred for a series of reasons:
- The fact that the central government [27-30], through the Ministry of Health, issues general guidelines and provides funds for the Italian long-term care (L.T.C.) sector to secure regional equity, while the twenty regions apply the guidelines in their territories using completely different methods;
- The fragmentation of the L.T.C. system in Italy resulting from the absence of legislation capable of coordinating local services throughout the national territory. In contrast, decades of stratified legislative interventions have determined a scenario in which the governance, sources of financing and managerial responsibilities of L.T.C. systems are dispersed among municipal, regional and national authorities, according to the different methods in each region. As a result, the regulation and financing of the health care services of elderly individuals are the responsibility of the regions, while in each region, the Local Health Authorities (L.H.As.) and municipalities take action in the management of older people through a complex system consisting of long-term care (L.T.C.) facilities, which range from care homes to nursing homes (in Italian Residenze Sanitarie Assistenziali (R.S.A.s)), assisting those who are not self-sufficient; these facilities had the highest number of related COVID-19 victims. The Italian L.T.C. system also includes care workers (usually unpaid by the National Health System and paid by individual households) for those who are cared for at home.

In particular, nursing homes and similar facilities presented a fertile ground (for example, as a consequence of the presence of multioccupancy rooms that facilitated the spread of the virus) for the diffusion of the SARS-CoV-2 virus, particularly before the introduction of the vaccines.

Even though the data on the overall deaths in the L.T.H.F.s in Italy are not yet available (differently for most part of O.E.C.D.

countries) [31], some data on the deaths in the resident care homes are known and show that the following:

- In Lombardy, the northern region most affected by the pandemic, the daily death rate of the municipalities with resident care homes (RSAs) in 2020, corresponding to 34% of the overall number of municipalities, was 41% higher than that of the municipalities without R.S.A.s;
- In Friuli Venezia Giulia, one of the northern regions, and in particular in the city of Trieste, on the basis of recent reports [32-34], even if there is a strong correlation between the number of COVID-19-related deaths of patients in L.T.H.F.s and the presence of multiple comorbidities (such as hypertension and chronic obstructive pulmonary disease) in these patients, there might have been an overestimation of the mortality rate. As a result, the classification of COVID-19-related deaths needs to be rethought;
- There is an uneven distribution of the number of beds available in residential care homes across Italy, with a numerical distribution of beds in favor of the northern regions compared to the central and southern regions.
- All the following factors are considered simultaneously:
- Demographic characteristics (high fraction of the population aged 65 years or above) of Italy and of its northern, central and southern regions;
- The uneven distribution of the number of beds (much more numerous in the northern regions than in the other regions) in long-term care facilities (and in nursing homes in particular);
- Unpreparedness (i.e., the lack of a strategic pandemic plan) of the Italian National Health System;
- The format of LTCFs, with a lack of coordination and communication between the center and the periphery and where the quality of care is left to local best practices rather than to a strategic national plan;
- Population density together with the previous factors;
- and, in addition, the fact that in recent years, public spending on health has decreased significantly, giving space to private health care, whose structures have not always been able to face emergencies due to the COVID-10 pandemic [35].

These are among the reasons that led to the high number of victims in the elderly population and to the Italian paradox, where the more developed northern regions proved not to be able to withstand and face the difficult conditions created by the pandemic, particularly during the initial phase when no vaccine was available.

Conclusions

The sort of Darwinian adverse selection of the older population cared for in residential care homes (both care homes and nursing homes) in Italy, and in particular in the northern regions, shows the need for a deep reform of how the long-term care sector is formatted in Italy and for a new design of health policy toward elderly individuals, considering the progressive aging of the population, as well as new policies to support families with children.

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