

## Mapping health vulnerabilities: exploring territorial profiles to support health policies

Mapeamento de vulnerabilidades de saúde: explorando perfis territoriais para apoiar políticas de saúde

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**Abstract** *Vulnerability processes and effects, albeit of great importance to cohesion and territorial policies, are nonetheless still underexplored and narrowly operationalized in scientific research. In particular, most assessments rely on economic indicators and a limited territorial scale, which do not have the same analytic potential of a broader view at a national level with regional/municipal similarities, specificities, and inter-connections. This gap also applies to health-related vulnerabilities, which, stemming from a lack of socioeconomic and environmental resources, has increased during and after the economic crisis of the past decade. This paper aims to analyze the health vulnerability phenomena in Portugal from a spatial perspective. Following a Multiple Correspondence Analysis, different territorial profiles of social vulnerability associated with the population health condition and access to and use of “health services” are identified. We conclude by outlining the importance of adding the spatial context to health policies addressing vulnerabilities and suggest avenues for future research.*

**Key words** *Health, Vulnerabilities, Territorial profiles*

**Resumo** *Os processos e os efeitos da vulnerabilidade, embora de grande importância para a coesão e políticas territoriais, ainda são pouco explorados e operacionalizados do ponto de vista científico. Na verdade, a maioria das avaliações baseia-se em indicadores económicos e em contextos territoriais muito específicos, não explorando o potencial analítico de uma visão mais ampla ao nível nacional, tendo por base as especificidades e as interconexões regionais / municipais. Essa lacuna é visível nas vulnerabilidades relacionadas com a saúde, que, decorrentes da falta de recursos sociais, económicos e ambientais, aumentaram durante e após a crise económica iniciada na década passada. O principal objetivo deste artigo consiste em analisar os fenómenos de vulnerabilidade associados à saúde em Portugal numa ótica territorial. Através da realização de uma Análise de Correspondência Múltipla, são identificados diferentes perfis territoriais de vulnerabilidade social associados ao “estado de saúde” dos indivíduos e ao acesso e uso de “serviços de saúde”. Na conclusão do artigo, sublinha-se a importância de adicionar o contexto territorial às políticas de saúde que procuram encontrar respostas para fazer face aos desafios decorrentes de vulnerabilidades sociais e sugerem-se pistas para investigação futura.*

**Palavras-chave** *Saúde, Vulnerabilidade, Perfis territoriais*

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## Introduction

It is widely acknowledged in the literature that Europe has been addressing the longstanding social, economic, and political consequences of the late 2000s crisis. In particular, southern European countries, where the outcomes of the crisis have become most salient, saw such experience affect their overall quality of life<sup>1-6</sup>. The 2008 financial and economic crisis, and subsequent governmental efforts with austerity policies, have led to unemployment, declining expenditure, a deteriorated social security system, dissatisfaction, political unrest, and new types of poverty. These and other factors have contributed to increased social vulnerabilities and inequalities<sup>7-9</sup>. With the spread of the Covid-19 pandemic worldwide, structural, social, economic, and health vulnerabilities have progressively been exposed and even enhanced. Particularly vulnerable groups such as older adults, young people, the lowly qualified, or immigrants, have been most affected. As a result, major political agendas such as the UN's Sustainable Development Agenda focused, among others, on the reduction of inequalities (Goal 10), the promotion of good health and well-being (Goal 3), and the creation of sustainable communities (Goal 11). Quality of life<sup>10</sup> and cohesion agendas<sup>11</sup> support such priorities, emphasizing the need to address social inequalities and the importance of location-based approaches.

The extent to which impacts have been unfairly distributed<sup>12</sup>, and how vulnerability issues differ within countries and even within regions, has been the subject of debate among several authors<sup>8,13,14</sup>. The territorial vulnerability has become increasingly visible through events such as spatial segregation, poverty concentration, or lack of accessibility<sup>15,16</sup>. However, if social vulnerabilities have been extensively studied, the spatial dimension of exclusion and overall vulnerability in various domains has so far been mostly neglected.

Vulnerability is a multi-faceted concept<sup>17</sup>. It is intrinsically multidimensional, associated with a conceptual diversity related to the material and moral fragility of the most marginalized individuals or groups in society. This diversity should entail both internal conditions (which determine the state of defenselessness of an individual against an adverse shock) and external conditions (which an individual cannot cope with)<sup>18</sup>. When these two types of conditions occur, vulnerability means a loss of potential in human, social, or economic capital<sup>19</sup>, which translates into

an increasing difficulty coping with adversities and accessing universal benefits and rights, either because of lack of resources (such as income or health conditions) or discrimination due to age, gender, or geographical location<sup>14,20</sup>.

Because it is a complex and multidimensional concept, no consensus exists on identifying and characterizing vulnerable persons in a given society. "We can never directly observe a household's current vulnerability level", wrote Chaudhuri *et al.*<sup>21</sup>, almost two decades ago. As vulnerability derives from the cumulative overlapping of various dimensions, the use of single-type indicators to gauge vulnerability has been challenged. For example, macroeconomic indicators have not significantly correlated with the changes in social indicators<sup>22</sup>, while not fully representing conditions such as social costs, safety, or health<sup>23,24</sup>. Furthermore, as Chancel<sup>9</sup> suggests, future inequality drivers must also be factored in while designing policy responses to current inequality trends.

Hence, the literature has shifted to multidimensional approaches and the development of composite indicators<sup>23,25</sup>, which are viewed as an essential tool in regional and local planning and the interaction with decision-makers<sup>26</sup>. However, the mechanisms for developing such indices are still being debated<sup>27</sup>. Data availability has generally hindered the use of an extensive number of indicators and conditioned their selection,<sup>15,23,24,28</sup>. The different weighting of variables in multidimensional modelling also conditions results<sup>29</sup>, and these have often not been discussed from a spatial/territorial perspective<sup>23,15</sup>.

With a broad and pervasive social impact, Health is naturally one of the main topics included in the vulnerability debate. More than two decades ago, Health Affairs published a special issue on health and poverty, focusing on many population groups that would be regarded as vulnerable today, such as impoverished, uninsured, homeless, older adult, and frail, and suffering from a range of chronic diseases. While much has happened since 1987, the list would not differ from one we might arrive at today<sup>30</sup>. The vulnerability concept has been formally adopted in the academic and political arenas, featuring, for instance, as one of the main dimensions of OECD's 'How's Life' report<sup>10</sup>. Moreover, although its definitions and applications are diverse<sup>31,32</sup>, in the last decade, various authors have included health variables in their multidimensional assessments of vulnerability and well-being. For example, Lee<sup>29</sup> used the mean number of patients served by hospitals and the number of hospital beds per

1,000 inhabitants. ESPON's TIPSE project<sup>33</sup> used the access to primary health and life expectancy. Artelaris<sup>23</sup>, on the other hand, considered doctors per 100,000 inhabitants and infant mortality rates per 1,000 live births as main variables to assess vulnerability and well-being.

The most recent Health at a Glance OECD report<sup>34</sup> provides useful information on how countries differ concerning their citizens' health status and health-seeking behavior, and quality of health care and resources available for health. The report shows that, on average, across OECD countries, i) gains in longevity are stalling, ii) chronic diseases and mental ill-health increasingly affect more people, iii) smoking, drinking, and obesity continue to cause people's premature death and worsen the quality of life, iv) barriers to access persist, particularly among the less well-off, v) quality of care is improving concerning safety and effectiveness, but more attention should be placed on patient-reported outcomes and experiences and vi) countries spend a lot on health, but do not always spend it as well as they could. In this matter, while showing substantial improvements compared to previous assessments, Portugal still has inequalities among several health determinants, namely alcohol, smoking, weight, pollution, and dementia, just to mention a few. Another notable fact is the self-rated health indicator, with results showing a higher than average percentage of Portuguese citizens acknowledging having poor health.

Health-related problems in Portugal are also observed regarding mortality indicators. Table 1 shows the rates of mortality from all causes, deaths by HIV, and deaths by breast cancer diseases at the European level. Disparities amongst countries are visible, with Turkey, Ireland, Malta, Norway, and Switzerland showing the best record and, on the opposite end, Bulgaria, Latvia, Serbia, Lithuania, and Romania, with the worst record. Compared to the European context, Portugal is above the EU28 mean figure in two of the indicators – all causes of death and deaths by HIV. In this list of indicators, Portugal is in the group of countries with the most challenging problems, just as the Eastern countries, Germany and Greece. Even compared to other Southern European countries, Portugal appears as the second worst, just behind Greece. Deaths by HIV are also of concern, with Portugal standing out as one of the countries with the highest number of records, alongside Latvia and Estonia. Portugal is slightly better than the European mean regarding deaths by malignant breast cancer.

Following a Beveridge model, the Portuguese health system is based on a National Health System (NHS) to which all Portuguese citizens have access to by constitutional right<sup>35</sup>. According to the most recent Spring Report from the Health Systems Portuguese Observatory<sup>36</sup>, this right to health implies intense governmental interventions to assure equal access to healthcare and conditions for a healthy quality of life. Addressing structural vulnerabilities can equalize social and spatial opportunities and prevent specific populations and territories from achieving a healthy quality of life. Interventions on this matter should tackle the root causes of vulnerabilities, building on evidence-based research, for which more comprehensive, multidimensional assessments of vulnerabilities are required, with a more emphatic territorial scope.

The overall purpose of this paper is to analyze the health vulnerability events in Portugal from a spatial perspective. Accordingly, the paper seeks to identify territorial profiles as a health policy instrument to tackle vulnerabilities. The next section recalls the specific aims of the study and explains the data and methodological approach used. Key findings are then reported and analyzed. The paper concludes by providing additional evidence on why the territory matters when designing health policies and suggests future research avenues.

## Objectives and Methods

Vulnerability is a multilayered and multi-scalar concept<sup>14</sup> that can dynamically change over time and space. In social sciences, the term vulnerability generally describes a state relating to people, communities, and collective systems. The current health crisis has put a spotlight on already existing structural vulnerabilities linked to fundamental rights. Structural deprivations, in a situation of risk or disturbance, make people, organizations, and territories more susceptible or incapable of responding, as this decreases their ability to cope with or adapt to those situations. From a geographical and public policy perspective, the definition of different vulnerability profiles can help establish location-based strategies, identify specific actions, and reduce existing deprivations. Accordingly, this paper aims to:

i) Analyze the *population health status* across municipalities in order to identify different spatial vulnerability profiles. This includes analyzing sociodemographic variables and mortality rates

**Table 1.** Mortality indicators at the European level.

Country	All causes of death		Deaths by HIV		Death by malignant breast tumor	
	2016	average 2014-2016	2016	average 2014-2016	2016	average 2014-2016
<b>UE28</b>	<b>1004.1</b>	<b>999.8</b>	<b>0.6</b>	<b>0.6</b>	<b>19.0</b>	<b>18.7</b>
Bulgaria	1494.7	1503.7	0.3	0.3	18.0	18.6
Latvia	1443.5	1429.6	3.6	4.4	23.3	22.7
Serbia	1426.2	1434.7	0.2	0.2	24.9	24.3
Lithuania	1417.8	1398.6	1.2	0.8	17.8	18.4
Romania	1296.4	1291.2	1.1	1.0	17.9	17.5
Croatia	1237.2	1243.1	0.1	0.2	24.0	24.9
Estonia	1164.2	1170.0	3.3	3.4	18.1	18.7
Germany	1109.4	1107.0	0.4	0.5	22.8	22.4
Greece	1097.5	1084.3	0.5	0.4	20.3	19.5
<b>Portugal</b>	<b>1072.5</b>	<b>1043.5</b>	<b>3.2</b>	<b>3.7</b>	<b>17.4</b>	<b>16.7</b>
Poland	1024.5	1019.9	0.3	0.3	17.3	16.7
Czech Republic	1016.9	1023.6	0.2	0.1	16.1	15.5
Italy	1014.3	1017.8	0.7	1.0	21.0	20.5
Finland	979.4	962.7	0.2	0.1	16.0	15.3
Belgium	948.0	950.1	0.3	0.3	19.9	19.9
Denmark	918.7	915.2	0.4	0.3	19.7	19.6
United Kingdom	916.2	906.5	0.3	0.3	17.8	17.7
Sweden	911.7	916.0	0.1	0.1	14.2	14.4
Austria	909.8	921.9	0.4	0.5	18.5	18.4
France	889.0	874.4	0.5	0.6	19.4	19.0
Spain	879.0	877.6	1.1	1.3	13.9	13.7
Netherlands	869.0	850.7	0.3	0.2	18.7	18.8
Switzerland	774.3	789.2	0.3	0.4	16.8	16.9
Norway	769.7	770.3	0.2	0.2	12.1	12.2
Malta	734.2	766.0	1.5	1.0	16.0	17.4
Ireland	645.1	637.8	0.2	0.2	16.0	15.4
Turkey	517.3	501.1	0.1	0.1	5.0	5.0

Note: The color represents the values above the EU Average.

Source: Eurostat (2020); [Accessed January 2020].

by age and years of life lost due to specific causes;

ii) Analyze the *access to health services* across municipalities in order to portray distinct spatial vulnerability profiles. This comprises analyzing healthcare provision, its accessibility, existing human resources, and the level of demand (an essential factor to consider in contexts of emergency and risk);

iii) Identify territorial profiles of health vulnerabilities combining the two previous approaches to support the design of public policies that can cope with fragile social, economic, and health situations.

Beforehand, selecting the most relevant indicators concerning each aim was conducted according to the specialized literature. The list

was then analyzed by a group of health experts (researchers, heads of health institutions, and representatives of the professional class), who agreed on a final set of twenty-eight indicators to be considered at the municipal level. Regarding the first aim, the *population health status*, the indicators were organized as follows:

- Observation of mortality rates according to age groups - perinatal, infant, ages below years old, from 5 to 14 years old, from 15 to 24 years old, from 25 to 64 years old, and from 65 to 74 years old.

- Analysis of premature mortality due to specific causes, namely cervical cancer; colorectal cancer; female breast cancer; ischemic heart disease; stroke; HIV/AIDS, suicide, alcohol-use diseases; road accidents and mental illnesses.

- Assessment of the years of potential life lost (YPLL) due to conditions in the perinatal period; land transport accidents; chronic liver disease; malignant tumor of the trachea; bronchi and lungs; cervical cancer; female breast cancer (female population); colorectal cancer; HIV/AIDS infection; pneumonia; diabetes and cerebrovascular diseases;

Concerning the second aim, *access to health services*, the analysis focuses on identifying health services provision and available human resources in the territorial contexts under analysis. More specifically, an assessment of the following aspects was conducted:

- the levels of accessibility to health services (to hospitals and health centers);
- the greater or lesser availability of human resources (nurses and doctors);
- the levels of supply and use of health services (population assigned a family doctor, family medicine visits, hospital medical visits, emergency room visits, and the ratio between hospital emergencies and outpatient visits).

The data relies on official statistical information available at the municipality level and specific information requested from some official producers of geographical information. The National Statistics Institute<sup>37</sup> produces official statistical data collected and summarized from a series of primary sources (data available in 2018). Other sources of information were also used concerning the location of health infrastructures (Ministry of Health) and the road infrastructure network (*Infraestruturas de Portugal*).

The next step was to perform a statistical framework (e.g., mortality rates, years of potential life lost, levels of accessibility to facilities and services, among others), per the following criteria:

to ensure the consistency of the analysis and eliminate the influence of less frequent events, the mean data for three consecutive years was calculated as the basis of the indicators (the three most recent years for which data is available);

- the years of potential life lost (YPLL), and the standard mortality rates were calculated according to the methodologies used by the national health Plan 2012-2016;
- to calculate the accessibility to health services, the methodology applied in the National Programme for Spatial Planning Policies was used<sup>16</sup>.

All the indicators were then mapped using the “quintiles” method, to sort all the variables into five equal parts (class 1 for the “Very Low”

category, and class 5 for the “Very High” category). The results were then presented and discussed again with the experts’ team to confirm the list of indicators. Multiple Correspondence Analysis (MCA) was conducted once this phase was completed.

The MCA is an extension of the Correspondence Analysis (CA), which consists of an exploratory data analysis technique that analyzes relation patterns between the various dependent categorical variables. This can be considered as a type of factorial analysis for categorical data<sup>38-40</sup> which, by reducing the size of a specific set of data, allows analyzing the relations found therein. This analysis resulted in a set of factors subject to classification (K-means) to identify the territorial profiles.

The following profiles were extracted: (1) territorial profiles indicating the *population health status*; (2) territorial profiles of the access to and use of “health services”. The crossing of the two approaches (through a *k-means* classification) informed the design of a final spatial typology of social vulnerabilities in health. Later, the results were subjected to validation through a focus group with the team of experts.

### Territorial profiles of social vulnerability

The six territorial profiles shown in Figures 1 and 2, relating to the population health condition at the local level, disclose significant different social health vulnerabilities. Overall, findings clearly evidence a country divided into a predominantly rural and low-density territory and a mostly urban territory, more attractive to immigrant populations and whose residents manifest less healthy behaviors.

More specifically, three territorial contexts stand out in analyzing the population health condition at the local level. The first one comprises profiles 1, 2, and 3, covering 59% of municipalities and 17.2% of the population. This territorial pattern can be found in a vast area of the country, especially in low-density rural areas, where the resident population is aged, and the mortality rates are higher. With no specific health problems detected, municipalities in profile one only shows the number of disabled pensioners as a challenge. Profile 2 portrays some health problems that may imply early mortality or potential years of life lost due to chronic liver diseases or diabetes. Moreover, child mortality rates are significantly higher than other national values. In general, profile 3 shows no major specific prob-

Profiles	Population health condition
1	Profile characterized by a dispersed geographical distribution (14.6% of municipalities), mainly in inland Portugal. Health problems are associated with the elderly resident population, which is clearly ageing.
2	Geographically situated mainly in inland Portugal (15.6% of municipalities). In general, the population is aged and mortality is associated with the elderly resident population. Shows early mortality and years of potential life lost due to cerebrovascular diseases, chronic liver diseases (between 221.6 and 1015.8 years of potential life lost) and diabetes (between 133.8 and 582.5 years of potential life lost).
3	This is the most represented profile in the territory (29% of municipalities), favorable in most indicators. However, some problems are detected, especially due to high child and perinatal mortality rate, female breast cancer (between 9 and 35, per 100 inhabitants), and a high number of pensioners due to invalidity.
4	This profile is represented in 18.2% of municipalities. There are some worrying indicators (high), but also non-serious situations. Problems are expressed in cervical cancer and colorectal cancer early mortality rate (between 13.1 and 42.9 per 100 thousand inhabitants), and also in alcohol-related diseases and early mortality rates due to AIDS (between 4.2 and 16.9 per 100 thousand inhabitants). The values of the remaining indicators vary between 'very good' and 'average'.
5	This profile corresponds to 11.7% of municipalities. It is geographically represented close to metropolitan areas and expressed more in the Portuguese northwestern region. Vulnerabilities are due to cervical cancer, alcoholism and deaths in the perinatal period. A significant number of indicators show health-related vulnerabilities higher than in the previous profiles. Mortality rates for older people (+65) and total mortality rates are very low.
6	Geographically concentrated in metropolitan areas and in much of the Algarve (11.4% of municipalities). This is the profile with the most worrying health-related problems and vulnerabilities. The early mortality rates are mostly due to cervical cancer, malignant tumor of the larynx, bronchi and lung (between 113.9 and 509.4 years), colorectal cancer (between 227.6 and 347.3 years), malignant breast cancer, chronic liver diseases (between 156.4 and 220.8 years), diabetes, and cerebrovascular diseases. People die more prematurely (before the age of 65) due to alcohol-related diseases and ischemic heart disease (between 17.6 and 44.5 per 100 thousand inhabitants). In this context, child mortality and perinatal deaths are significant in the national context. Mortality rates for older people (+65) and total mortality rates are very low.

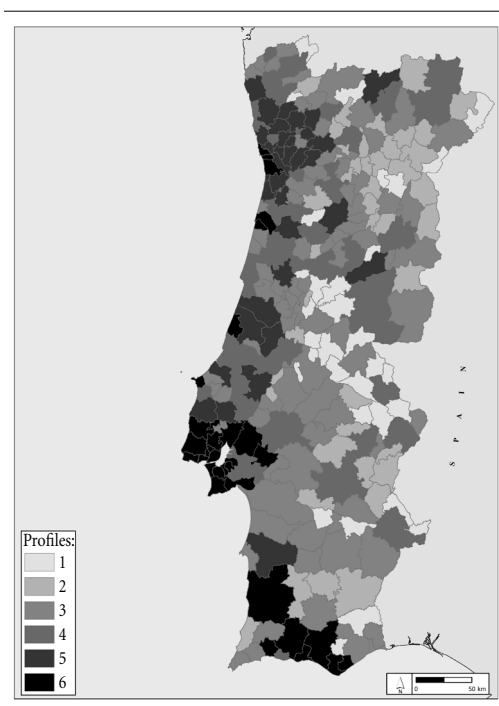
**Figure 1.** Territorial profiles of social vulnerability associated to the population health condition.

lems, but the rates for female breast cancer and child and perinatal mortality are high, as is the number of disabled pensioners.

The situation is of particular concern in the second territorial context: i) in the metropolitan areas, especially in the Lisbon Metropolitan Area and some municipalities of the Porto Metropolitan Area, ii) in Aveiro-Ílhavo, Algarve, and Alentejo coastal areas and iii) in some areas of the more peripheral regions (Madeira and the Azores). Health conditions of great concern are visible given the intensity of some diseases or some early mortality rates (before 65). These refer to the municipalities included in profile 6 (covering 28.4% of the population). Strong health-related vulnerabilities are detected, due

to the diversity of problems displayed, from malignant breast cancer and cervical cancer to malignant tumor of the larynx, bronchi, and lung, colorectal cancer, chronic liver diseases, diabetes, and cerebrovascular diseases. People also die more prematurely (before the age of 65) due to alcohol-related diseases and ischemic heart diseases. This territorial pattern also comprises Profile 5, although this one is less worrying than profile 6, showing different intensities and problems (11.7% of municipalities and 39.8% of the country's population). Mortality rates for older people (+65) and total mortality rates are very low in both profiles 5 and 6.

The third territorial context is essentially based on Profile 4, which is in an intermedi-



**Figure 2.** Map of the territorial profiles of social vulnerability associated to the population health status.

Source: CEGOT.UP; CAOP (2017).

ate position concerning the other two, and it is found mainly in the municipalities encompassing medium-sized cities (11.7% of municipalities), where 14.6% of the country's population lives. Some indicators call for a more specific intervention, such as cervical cancer, alcohol-related diseases, and also some mortality rates at younger ages.

#### **Territorial profiles associated with access to "health services"**

Based on the results above presented, three main issues are critical to identifying territorial profiles associated with the accessibility and use of health services:

- proximity to health facilities, such as hospitals and health centers, is one of the crucial aspects of improving health care, or at least the possibility of circumventing the territorial inequalities found in this scope.

- the availability of resources, in particular health professionals such as doctors and nurses,

whether in health centers or hospitals and family doctors.

- the use of health services, including appointments at health centers and hospitals, and emergency hospital care.

The six territorial profiles presented in Figures 3 and 4 portray different spatial patterns of social vulnerability. Comprising positive indicators for access to health services, including 21.7% of the national population, Profile 1 is mainly linked to medium-sized Portuguese cities and Lisbon and Porto. The outpatient visits figure in these municipalities is high, as is that of emergency room appointments, reflecting the location and concentration of hospital infrastructures. As for human resources, the number of nurses in health centers is insufficient to cater for the number of residents.

The Portuguese coastal area's situation concerning access to services is relatively positive (profiles 2 and 3, encompassing 31% and 30.7% of the population). On the other hand, human resources are scarce, especially nurses and sometimes doctors (especially in profile 3). The average number of visits per inhabitant is reasonable, and no excessive pressure on health services is detected.

On a borderline situation, 22% of municipalities (covering 7.4% of the population), along a north-south axis, have a reasonable level of accessibility to services, but clearly show scarce human resources in health (doctors and nurses).

Finally, a vast area of the country shows low levels of accessibility (profile 5, encompassing 4.4% of the population) to both hospitals and health centers. Concerning human resources, these territories are demographically aged, where the proximity to and quality of resources (especially in health centers) are essential to residents' well-being. This is the case for almost the entire Alentejo area and a large number of inland municipalities.

#### **Exploratory findings and promising avenues for future research**

The previous section showed how social vulnerabilities associated with the population health condition and to Health Services' access differ across the country from a territorial perspective. Different spatial profiles were identified and characterized. The final goal is now to cross the territorial profiles concerning the population health condition with the allusive to "Health Service" to map health vulnerabilities at

Profiles	Health services
1	This profile clearly features the municipalities of medium-sized cities (8.4% of municipalities). Accessibility to hospitals and health centres is good, and human resources are available (doctors and nurses per 1,000 inhabitants). Where hospitals exist, the number of emergency room consultations is high (between 1299.7 and 1860.4 per 1,000 inhabitants) as is the number of outpatient consultations. There is a shortage of nurses at health centres (between 3.4 and 9.1 per 100 thousand inhabitants).
2	This profile corresponds to 12% of municipalities, mostly located on the coastal area. Accessibility to hospitals and health centres is very good, but there are problems regarding the ratio of nurses per inhabitants (between 2.1 and 5.6 per 1,000 inhabitants) and nurses in health centres inhabitants (between 3.4 and 9.1 per 100 thousand inhabitants). The remaining indicators vary between good and average.
3	This is the most represented profile in the territory (26.6% of municipalities), found mainly on the Portuguese coastal area. It Shows problems regarding the scarcity of health professionals serving the resident population, in particular the number of nurses (0.1 and 2.1 per 1,000 inhabitants) and of doctors (1.7 and 2.9 per 1,000 inhabitants). There is poor availability of nurses in health centres. However, accessibility to hospitals and health centres is positive. In the municipalities with hospitals, the number of emergency room consultations and outpatient consultations seems adequate.
4	Geographically-speaking, this profile is distributed along a north-south axis, covering 21.8% of municipalities. The characteristics of this intermediate profile range between bad situations and reasonable and good ones. The number of health professionals per 1,000 inhabitants is inadequate (between 0.2 and 1.6 doctors and between 0.1 and 2.1 nurses). However, accessibility to hospitals and health centres is reasonable/good and the ratio of emergency room consultations / outpatient consultations is positive.
5	This profile dominates in inland Portugal, covering 21.4% of municipalities, is the most worrying and has the most vulnerabilities associated mainly to poor accessibility to hospitals and health centres, and shortage of doctors. On a positive note, the large majority of users have a family doctor assigned to them (between 94.9% and 99.9%).

**Figure 3.** Territorial profiles of social vulnerability associated to the “Health Services”.

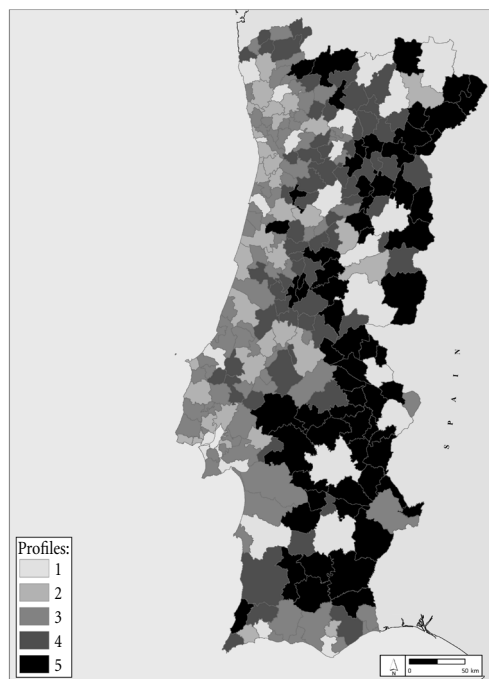
a national level, which is of utmost importance for informed public policy development. Overall, the territory is organized into three territorial profiles (Figure 5). Understanding this spatial structure is paramount to developing a more just and inclusive policy agenda for health capable of combining national guidelines with concrete measures at the local level

Profile A is characterized by territorial contexts with low or very low total mortality rates, reflecting less aged demographic structures in urban contexts. Premature mortality is mostly due to cancer (malignant breast cancer; cervical cancer; colorectal cancer, malignant tumor of the larynx, bronchi, and lung). Cerebrovascular diseases, ischemic heart disease, diabetes, chronic liver diseases, alcohol-related diseases, and HIV/AIDS infection also contribute significantly to premature mortality rates. Concerning health

services, accessibility to health facilities is good (hospitals and health centers), human resources are somewhat scarce (nurses and doctors), and there is an increased number of users at health centers, emergency room visits, and hospital visits. This profile comprises 69% of the country's population who tend to live in urban agglomerations where the pressure on health services is felt the most, having to respond to a wide variety of problems.

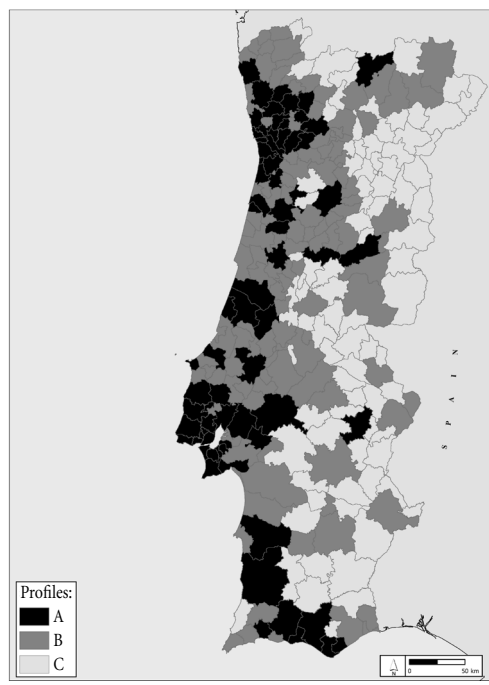
From a public policy viewpoint, this profile requires facing and overcoming structural problems, as services are already exhibiting functional problems due to their high demand level. Population aging will also have significant implications in services' demand, hence the need to increase its supply. In a health emergency context, like the one we are facing with the present pandemic, services are submitted to heavy pressure, as they





**Figure 4.** Map of the territorial profiles of social vulnerability associated to “Health Services”.

Source: CEGOT.UP; CAOP (2017).



**Figure 5.** Territorial profiles of social vulnerability associated to health.

Source: CEGOT.UP; CAOP (2017).

have to respond to a large number of users and a wide variety of issues. In this sense, it is necessary to prevent services from collapsing or failing to respond effectively. Accordingly, public policies must provide the conditions to face sizeable, very impacting health emergencies, and so it is crucial to know beforehand the social and spatial contexts related to where interventions occur.

Profile C symbolizes territorial contexts showing high or very high mortality rates due to demographically aged territories and low concentration and accessibility to health facilities (health centers, but especially hospitals). Regarding the population health condition, cerebrovascular diseases, chronic liver diseases, breast cancer, and suicide mortality rates prevail. Health services show a shortage of nurses in health centers but no intense pressure from users. Although this territory only encompasses 7% of the country’s population, its well-being depends on the quality of services provided and their accessibility.

Concerning health policies, in this spatial profile, it is essential to develop specialized services for a vulnerable elderly population and ensure fair access to services. These territories are particularly vulnerable to social, economic, and health shocks, such as the current Covid-19 pandemic. In a situation of risk, the vulnerability increases dramatically since the susceptibility of these populations is greater than the capacity of individuals and organizations to react.

Profile B outlines an intermediate territorial context, scoring better than Profile 1 in most of the population health condition indicators, and better than Profile C regarding access to “health services”. Patients’ pressure for health service delivery is more reasonable than in profile A, and accessibility to health services is more positive than Profile C but worse than that Profile A. This territory covers 24% of the country’s population. These are territories where health services are reasonably accessible to the population, and pressure on the system is not very high. Thus, in a public emergency, such as the one experienced in 2020, the system is less pressured than in Profile A, and citizens are less susceptible than those in Profile C. Emergency management will therefore be easier in these territories than the ones mentioned above.

Notwithstanding the findings achieved with this exploratory study, underlining the importance of adding a territorial perspective when addressing health vulnerabilities, this empirical research leaves room for further inquiry of the events and their causal relationships.

First of all, given these results, the team aims to apply a Delphi survey to health experts to define priorities for health policy measures according to the territorial profiles (territorial health policies; territory-based health policies).

Secondly, due to climate changes, extreme temperatures and air pollution are considered severe factors to human health, exacerbating the population's likelihood to develop some type of cardiorespiratory disease. According to the World Health Statistics Report<sup>41</sup>, respiratory diseases and ischemic heart diseases significantly reduce human life expectancy. Given these findings, our ensuing research aims to analyze the relationships between population health condition indicators and those relating to extreme temperatures and air pollution to develop new social vulnerability profiles. Today, we know that adapting to climate changes will imply the implementation of specific policies according to territorial specificities, in which health policies are also central thereto, but there is still a long way to go to achieve this.

Finally, due to demographic changes, while population aging is a reality, migratory move-

ments are more uncertain and unknown. Population projections point to losses and territorially different aging levels, the impact of which on health care needs will vary. The attractiveness of urban and rural contexts has appealed to a variety of populations from very diverse territories. Urban contexts, especially the metropolitan ones or the Algarve region, attract tourists and new residents from various countries and different cultures. Labor-intensive farming activities in low-density rural areas have attracted a temporary population from underdeveloped countries. This attractiveness is pressuring the health services differently nationwide and giving rise to new health problems associated with poverty or exclusion issues. The different territorial socio-demographic characteristics will be reflected in the future as greater incidence of cancers, chronic diseases, neurodegenerative diseases, and significant loss of autonomy. These dynamics call for more active prevention and adaptation policies, and territorial priority levels must be anticipated. As vulnerabilities are multilayered and multi-scalar, so must policies address such complexity.

## Collaborations

Conceptualization – TS Marques, M Saraiva, G Santinha. Data collection and analysis – TS Marques, M Ferreira. Discussion – TS Marques, M Ferreira, M Saraiva, T Forte, G Santinha. Writing – TS Marques, M Saraiva, M Ferreira, G Santinha. Writing – review and editing, G Santinha, T Forte, M Ferreira.

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Article submitted 10/04/2020

Approved 11/08/2020

Final version submitted 13/08/2020

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Chief editors: Maria Cecília de Souza Minayo, Romeu Gomes, Antônio Augusto Moura da Silva