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ARTICLE

Has regional decentralisation saved lives during the COVID-19 pandemic?

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Abstract
We examine the impact of decentralisation on COVID-19 mortality and various health outcomes. Specifically, we investigate whether decentralised health systems, which facilitated greater regional participation and information sharing, were more effective in saving lives. Our analysis makes three contributions. First, we draw on evidence from several European countries to assess whether the decentralisation of health systems influenced COVID-19 mortality rates. Second, we explore the regional disparities in one of the most decentralised health systems, Spain, to untangle some of the determinants shaping health outcomes. Third, we estimate the regional loss of Quality Adjusted Life Years (QALYs) due to COVID-19 mortality, broken down by the wave of the pandemic. Our findings suggest that coordinated decentralisation played a critical role in saving lives throughout the COVID-19 pandemic.

Keywords: COVID-19 pandemic; mortality; Nomenclature of Territorial Units for Statistics-2; Spain; Quality Adjusted Life Years lost; decentralization; mortality; pandemic

1. Introduction

The pandemic has led to an extensive body of literature analysing the health burden of COVID-19 in terms of both interventions either moderating the magnitude of the spread of the virus (e.g., test availability, vaccines, lockdowns, and income maintenance strategies) or mediating the risk of contagion (e.g. physical distancing, crowded housing, and job protection, among others), and hence influencing the causal pathway between the infection and the loss of health (Mackenbach, 2020). The pandemic has been characterised by the proliferation of multitude interventions influencing health but also on economic-fiscal policies, both in its design and implementation, leading to substantial variation in outcomes across different countries and regions. However, we still know little about the effectiveness of interventions, an arguably such heterogeneity can be explained by differences in governance, and specifically in the degree of decentralisation of health systems under which public authorities operated. This is the focus of the paper.

The decentralisation of health systems can impact both the moderating and mediating effects of COVID-19, thereby influencing health outcomes through various pathways. INDEED, decentralised governance can affect the local response and the institutional management of the pandemic (Dougherty *et al.*, 2020). Similarly, health system decentralisation itself can act as mediating factor, which in turn can explain differences in health outcomes across health systems, across OECD countries and NUTS (Nomenclature of Territorial Units for Statistics) regions in the European Union. One explanation is that place-based factors can influence the effect of mediator and moderator effects of the COVID-19 pandemic, and decentralisation allows responding to such heterogeneity as proximity can facilitate both a better understanding of problems and the adequacy of response measures, and incentives to share information and cooperate with the central government (Angelici *et al.*, 2023).

This paper examines the effect of decentralisation on various health outcomes, with a focus on understanding some of its spatial and institutional drivers. Specifically, we examine whether the mentioned heterogeneity in outcomes is the result of its decentralised governance or whether they were the result of random groupings. Specifically, we measure the effect of decentralisation using the Regional Authority Index (RAI), also known as the federal index – considering both the nature of the health system and the decentralised institutions through which it operates – on the health burden of COVID-19 in Europe. We consider the type of health system (Social Security or National Health Service (NHS)), distinguishing between the first and other waves. That is we distinguish the initial months of the pandemic outbreak where politic experimentation and cooperation was needed, all the way of the latest waves when the vaccine was available and governments had more information on the effect of different interventions.

Next, we analyse provincial data from Spain, a highly decentralised health system[1] where we observe a governance shift from centralised management in the first wave of the pandemic after the declaration of the state of alarm, to a decentralised management during the second and further waves of the pandemic. This unique feature allows us to distinguish the differential regional effects of decentralisation by examining provincial heterogeneity at the NUTS-3 level[2].

We control geographical and political institutional factors that could independently influence COVID-19 outcomes on a territorial level. To do this, we use both national and regional data to account for variations between and within countries. While the regional impact of the COVID-19 pandemic has been less studied, this paper focuses specifically on the role of territorial decentralisation in shaping the health outcomes (mortality) of the pandemic in Europe, at the regional level. The two key explanatory factors we examine are the degree of fiscal and governmental decentralisation (treated as a moderator) and the type of health system in each country (treated as a mediator). Our analysis uses NUTS-2 level data from European countries, where NUTS-2 represents the basic regions for regional policy implementation ($n = 242$).

Finally, unlike previous studies, we examine the effect on governance on quality adjusted life years (QALY's), a health metric often used to evaluate the cost-effectiveness of interventions. We measure the provincial health burden of the pandemic by calculating Quality Adjusted Life Years (QALYs) at baseline (before the pandemic's onset), alongside the centralised and decentralised periods. The advantage of using QALYs is that it accounts for both life years lost and the quality of life lost due to the pandemic, and hence considers other dimensions that are typically not the focus of previous studies.

We contribute to the discussion by examining the effect of decentralisation not only in early waves of the pandemic, but across the different and across a wide range of countries, controlling for the heterogeneity of their health systems. Specifically, we explore whether the structure of the National Health Service (NHS) model – typically characterised by centralised, political governance and single provision – or the Social Health Insurance (SHI) model, which functions under multiple providers, had an impact on pandemic outcomes. To do so, we combine each country's

[1]Spain's territorial organization consists of 18 Autonomous Communities, each with full responsibility for health planning and management (Lopez -Casasnovas *et al.*, 2005).

[2]NUTS-3 are small regions designated for specific diagnoses ($n = 1166$) (Eurostat, 2021). In Spain, there are 52 NUTS-3 provinces within 18 NUTS-2 Autonomous Communities.

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health system type (classifying them as Bismarckian or Beveridgian) with an index of political decentralisation, as measured by the Regional Authority Inde (RAI)[3].

Our main hypotheses are as follows. First, we test whether the health burden of COVID-19 is influence by the decentralised nature of the health system. Decentralised health systems, given that subcentral governments tend to have the local knowledge an expertise in managing the health system, they might be quicker at adjusting and responding to local needs and preferences during the pandemic. That is the less decentralised and more dependent on central authority a territory is, the slower its response to the pandemic outbreak. Second, we examine whether the decentralised governance of the pandemic from May 2021 resulted in greater regional variation in the health burden of the pandemic. Third, we study whether there were significant regional differences in the burden of the disease (per cent of QALYs lost) in the aftermath of the epidemics in Spain was different across waves which differ in the health system governance. To our knowledge, this study is pioneering in using Quality Adjusted Life Years (QALYs) to measure the disease burden of COVID-19, accounting for varying lethality across ages and regions. QALYs offer an alternative to Disability-Adjusted Life Years (DALYs), commonly employed for such assessments (see IHME, 2024). However, the study is not without limitations.

The structure of the paper is as follows. Next section provides the background of the previous evidence on the effects of decentralisation in the pandemic. The next section reports the data and methods, followed by the results and a final section that discusses the main findings and concludes.

2. Decentralised health system governance in pandemics

2.1 Decentralised governance and COVID-19

Decentralised health system governance entails generally the subcentral allocation of the locus of the power to regulate and raise funds for health care, also known as the decentralised stewardship of the health system. In most European countries, the index of decentralisation used in this study below did not exhibit changes during the pandemic. Hence, it is possible to examine whether decentralised system fared differently than the rest. The only exception is that of Spain, which it initially responded to the first waves of the pandemic with a rapid and intense re-centralisation of decision-making after declaring the state of alarm. Following this shift, the country gradually returned to a decentralised approach as the situation evolved. This dynamic offers valuable insights into the interplay between centralisation and decentralisation in managing health crises, particularly in a country with a decentralised governance structure.

From an institutional political perspective, centralisation is often associated with more prescriptive restrictions, less flexibility in policy compliance, and greater policy standardisation, which can lead to improved initial coordination and control when information is available. In contrast, more decentralised countries tend to rely on regional cooperation, the setting of minimum (or maximum) standards, and generally adapts to local circumstances and policy learning (Lopez-Casanovas *et al.*, 2005; Costa-Font, 2012; Costa-Font and Turati, 2018). Additionally, decentralised regions may have the financial autonomy to act independently, leveraging their economic resources for a more tailored response. Thus, both centralisation and decentralisation in pandemic management offer distinct advantages and challenges (Biase and Dougherty, 2021).

[3]Some countries, such as Sweden, Germany, Spain, the Netherlands, France, Italy, and the UK, combine these features in different ways. While the distinction between Bismarckian and Beveridgian health systems is nuanced, it is useful to categorize them into two primary types based on their defining characteristics for the purpose of this analysisSee the Health Systems and Policy Monitor of the European Observatory of Health Systems and Policies: https://eurohealthobservatory.who.int/monitors/health-systems-monitor/countries-hspm.

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In a previous study, Angelici *et al.* (2023) explored the effect of decentralisation on pandemic management outcomes by comparing the responses of two otherwise similar health systems: Italy and Spain. They find that governance structure of the health system played a critical role in shaping policy responses to COVID-19, particularly the balance of power between highly centralised and more decentralised coordination. They document lower mortality, cases and hospitalisations in Italy compared to Spain in the first wave of the pandemic. While the effective management of a pandemic requires the highest level of intergovernmental coordination, such coordination can only be successful if it is supported by the exchange of crucial information and local knowledge about the specific needs of the health system.

Decentralised coordination offers the advantage of fostering information sharing and experimentation, even when guided by the central government (Angelici *et al.*, 2023). It facilitates the rapid exchange of critical data on the virus, ensuring more effective management of infected individuals and preventing further spread. Angelici *et al.* (2023) compared Spain's centralisation strategy during the first wave of the pandemic with Italy's more decentralised approach, where regional governments held regulatory power under a loosely coordinated central government[4]. As a result, Italy's health governance relied on informal cooperation and co-governance during the first wave of the pandemic, whereas Spain adopted a hierarchical, centralised response during the first wave. However, little is known about the effects of decentralisation after this initial phase of the pandemic. This paper contributes to this question.

2.2 The Spanish health system during the COVID-19 pandemic

After the first wave many countries made some change in the governance of the pandemic either by decentralising or centralising certain activities and decisions, as well as by creating new coordination and funding mechanisms. In most countries, re-centralisation of healthcare activities in confronting the pandemic was more common than decentralisation (OECD, 2021).

In Spain after the first wave of the pandemic, the central government readjusted the health system governance by returning to the regions the management of the health system. Similarly, two decentralised (federal) countries (Belgium and Germany) centralised their COVID-related public spending, while three unitary countries (Italy, Denmark, and Sweden) fully decentralised COVID spending. In Spain, it is possible to distinguish two distinct periods: the initial centralised phase (from the outbreak of the pandemic until September 2020) and the decentralised phase, where the health system followed a decentralised governance model. Indeed, due to political pressures from more capable regions eager to manage their own responses, the governance model shifted toward decentralisation beginning in May 2021. Between June 2020 and May 2021, Spain adopted a hybrid model of centralised management, with varying restrictions across regions based on specific pandemic indicators such as infection rates and hospital occupancy (Gonzalez Lopez-Valcarcel and Hernandez-Aguado, 2024).

Previous studies have explored the potential minimal differences in COVID-19 mortality impacts between National Health Service (NHS) models and Social Health Insurance (SHI) systems (Lopez Casasnovas *et al.*, 2006; López Casasnovas and Pifarré i Arolas, 2021). Differences are expected because NHS models tend to be more hierarchical and centralised, making them easier to re-centralise during a crisis. In contrast, SHI systems operate through a network of multiple providers, which are more segmented in terms of health functions and job roles. This decentralisation gives SHI providers greater autonomy, potentially allowing them to respond more swiftly to a crisis like COVID-19 by adapting their internal operations independently.

[4]While Spain's Constitution defines the conditions for a "state of emergency," Italy's allows the national government to legislate through temporary decrees in cases of "necessity and urgency," without specifying which level of government should take the lead.

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Although coordination among providers may be minimal, SHI systems are theoretically better positioned for rapid, localised responses to emergencies.

In NHS systems, however, providers have less autonomy. Centralised purchasing and uniform service provision limit flexibility, and salaried physicians typically wait for directives from the central government. The public sector oversees the entire value chain of NHS systems, from planning to service delivery, resembling an administrative service where various public departments manage priorities, healthcare workers, budgets, and evaluation protocols. Civil servants in NHS systems, organised hierarchically, have salaries and responsibilities determined by the legislature, not directly by healthcare authorities. The efficiency of NHS systems relies on the integration of services, constrained only by the system's organisational capacity. Centralised purchasing and uniform service delivery, with limited individual choice, are intrinsic to such systems (Rovira-Forns, 1991). However, despite this centralisation, NHS systems may struggle with coherent prioritisation of services and planning for vulnerable populations, as rigid structures and a lack of incentives for efficient programme management can lead to inefficiencies. Additionally, political pressures and vulnerabilities at the managerial level can undermine effective governance in such systems.

2.3 Decentralisation phases

The initial lockdown **(Phase 0)** in Spain lasted from March 14 to June 21, 2020, under a state of emergency declared by the "State of Alarm" law. This imposed strict movement restrictions, allowing travel only for essential purposes. Commercial, cultural, recreational, hospitality, and restaurant activities were severely limited, and public transport operations were reduced. During this period, a national-level lockdown was implemented uniformly across all Autonomous Communities, with centralised and identical restrictions applied throughout the country.

We can distinguish two key phases in the response to the pandemic:

- **Centralised Management (Phase 1):** This phase lasted from June 2020 to May 2021, during which centralised control of the pandemic was maintained through successive states of alarm. National-level restrictions were imposed based on a common set of regional indicators, such as incidence rates and hospital bed occupancy. The severity of restrictions varied depending on the specific levels of these indicators in each region or province, but the overall framework remained centralised and uniform.
- **Decentralised Management (Phase 2):** Beginning in May 2021, the management of the pandemic shifted to a more decentralised approach. While the response remained coordinated, it no longer relied on alarm states. Instead, regions had greater autonomy in managing the pandemic, though within a framework that ensured coordination at the national level.

3. Data and methods

3.1 Cross-country data

Our data are cross-sectional, covering regions across 16 countries and distinguishing two key periods: the outbreak period (March–September 2020) and the vaccination period (January–December 2021). We have collected data from European countries at both the national and NUTS-2 levels using Eurostat, where NUTS-2 regions serve as basic units for regional policy implementation ($n = 242$). The 2021 NUTS regions have been in effect since January 1, 2021.

It's important to note that not all European countries are members of the European Union, and therefore, they are not subject to Eurostat's data reporting and sharing requirements. While all countries maintain correspondence tables between their regional definitions and the NUTS system, providing NUTS-level data is not mandatory for non-EU countries. This includes the UK (post-Brexit), Norway, and Switzerland.

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In our study, countries with a social security-based health system include Austria, Belgium, France, Germany, Luxembourg, the Netherlands, Poland, Romania, Slovenia, and Switzerland. Countries under a National Health System (NHS) model include Denmark, Greece, Italy, Norway, Portugal, Spain, Sweden, and the UK (López-Casasnovas and Pifarré i Arolas, 2021).

3.2 Spanish dataset

We have collected provincial-level data (NUTS-3, $n = 52$) from 18 Autonomous Communities in Spain, this incudes weekly mortality data from the experimental statistics published by the National Institute of Statistics (INE, 2020). Mortality serves as our key variable of interest, as it is a direct proxy for the health burden of COVID-19. While COVID-19 incidence is an intermediate outcome, mortality is the ultimate endpoint in assessing health outcomes. Most territorial studies focus on comparing incidence rates, but fewer compare mortality directly.

The relevant measure of mortality is total mortality, including both deaths attributed to COVID-19 and those from other causes. This is important as some deaths that are categorised under other causes can be considered secondary effects of COVID-19, such as those resulting from delayed healthcare, restricted access to care, or the broader impacts on mental health and quality of life (e.g., suicides, worsening mental health, or diseases aggravated by sedentary lifestyles or economic hardship). Therefore, it is essential to compare not just deaths directly attributed to COVID-19, but also total excess mortality ("from" and "with" COVID-19) in relation to the officially recorded COVID-19 deaths.

An alternative and complementary measure of the disease burden is the number of lost Quality Adjusted Life Years (QALYs). QALYs account for not only the number of lives lost but also the time of life lost (due to age-related deaths) and the quality of life lost. We calculated QALY losses across the NUTS-3 provinces for three distinct periods: the initial lockdown, the centralised management phase, and the decentralised management phase. This provides a more comprehensive view of the pandemic's impact on health beyond simple mortality figures.

3.3 QALY losses

Next, we have calculated the percentage of total QALY losses in the 52 NUTS-3 provinces in Spain for the three distinct periods: the initial lockdown, centralised management, and decentralised operation. The process for calculating QALY losses involved the following steps:

1. **Estimating QALYs in 2019 by province:**
   - We merged province-level population data by sex and five-year age groups with life expectancy data, also disaggregated by age and sex, for each province.
   - We then calculated the expected years of life for each age-sex group, using life expectancy data.
   - These life years were weighted by the average quality of life score (on a 0–100 scale) for each age-sex group in Spain, as obtained from the National Health Survey of Spain (2011).
   - After applying these quality-of-life weights, we aggregated the results across all age-sex groups to estimate the total number of QALYs in each province for the year 2019.
2. **QALYs losses estimates by province from weekly mortality data:**
   - Using the same methodology as in Step 1, we applied the life expectancy and quality of life weights to the weekly mortality data for each province.
   - This allowed us to calculate the QALYs lost due to deaths in each province during the pandemic.

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3. **Percentage of QALYs lost relative to the human capital available:**
   - For each period (initial lockdown, centralised management, and decentralised operation), we calculated the percentage of QALYs lost by dividing the QALYs lost (calculated in Step 2) by the total QALYs available (calculated in Step 1).
   - This provided an estimate of the proportion of the health capital (in terms of QALYs) that was lost in each province during each period of the pandemic response.

These steps allowed us to assess the impact of the pandemic on the health capital of each province, not only in terms of mortality but also considering the quality of life lost due to premature deaths.

3.4 Empirical strategy

Our analysis lies running multivariate regression models to examine the effect of decentralisation and control for geographical, political, and institutional variables that might have independently influenced the impact of COVID-19 on mortality at the territorial level. These independent variables vary between the NUTS-2 models for Europe and the NUTS-3 models for Spain, due to the availability of different regional indicators at these levels[5]. The regression models include a first specification estimating the rate of COVID-19 mortality in the NUTS-2 regions during Phase 1 (March-September 2020). After that, a second specification estimates the change in mortality from Phase 1 (March–December 2020) to Phase 2 (2021), with the dependent variable being the difference in COVID-19 mortality rates between the two steps.

3.4 Model specifications

3.4.1 Country level specifications

We examine the factors influencing both the initial mortality rates during the outbreak period and the variations in mortality trends between the first and second phases of the pandemic, accounting for factors such as regional governance structures, healthcare system characteristics, and other territorial influences. The models for phase 1(outbreak) for region i of country j ($j = 1 \ldots 16$) are:

$$Y_{ij0} = \boldsymbol{X}'_{ij}\boldsymbol{\beta} + \sum_{j=1}^{16} \delta_j D_j + \varepsilon_{ij0} \qquad [1.1]$$

$$Y_{ij0} = \alpha RAI_j + \boldsymbol{X}'_{ij}\boldsymbol{\beta} + \varepsilon_{ij0} \qquad [1.2]$$

$$Y_{ij0} = \gamma SS_j + \boldsymbol{X}'_{ij}\boldsymbol{\beta} + \varepsilon_{ij0} \qquad [1.3]$$

$$Y_{ij0} = \alpha RAI_j + \gamma SS_j + \boldsymbol{X}'_{ij}\boldsymbol{\beta} + \varepsilon_{ij0} \qquad [1.4]$$

Y_{ij0} refers the COVID mortality ration in region i belonging to country j, defined as the cumulative cases per 100,000 population from March 1st, 2020, to September 1st, 2020 (Omrani, 2021) and we corrected specific errors when detected with other sources as for Spain. D_j depicts specific

[5]More specifically, we estimated two regression equations for the EU NUTS-2 regions, each corresponding to one of the pandemic phases:

- **Phase 1 (Outbreak Period):** This phase spans from the onset of the pandemic in March 2020 to September 2020, when the first wave of COVID-19 took hold across Europe.
- **Phase 2 (Vaccination Period):** This period covers the year 2021, during which vaccination campaigns were implemented and other pandemic responses were in place. The first vaccinations in Europe began on December 27, 2020. In 2021, massive vaccination campaigns started, the COVID-19 progression was better understood, and decentralization-based policies were implemented in some countries.

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Table 1. Definition of the independent variables of the regression models

Name	Definition
RAI	Regional Authority Index
SS	Dummy = 1 for Social health insurance systems SHIS
Density	Population/surface (population per SqKm)
Surface	Surface of the región in SqKm
Land_develop	Per cent of land development
Delay	Lag (number of days) from the first case to the lockdown or other restrictive measures
Older60	Per cent of population older than 60
Older70	Per cent of population older than 70
High_school	Per cent of population with secondary education or more
Unemployment	Unemployment rate
Agriculture	% of agriculture on the active population
Construction	% of construction on the active population
Services	% of services on the active population
No_sector	% of persons that never worked before on the active population
GDP	GDP per capita (1,000 €)
RAI	Regional Authority Index
SS	Dummy = 1 for Social Health Insurance systems

dummies for country j (to include country fixed effects), and $\boldsymbol{X}'_{ij}$ is the matrix of data of independent control variables in region i of country j, and ε_{ij0} is the random noise assumed independent of the regressors.

The four models for region i of country j ($j = 1 \ldots 16$) in phase 2 have identical structure as equations (1.1–1.4) but the dependent variable is $\frac{Y_{ij1}}{Y_{ij0}}$, where 1 means second phase and 0 is first phase. It measures the increase in mortality rate from all causes in 2021 (January–December), when pandemic was established and vaccination was running, compared to the pre-vaccination initial phase of the pandemic (period March–December 2020). We adjusted for the difference in the number of weeks considered in both pandemic periods (43 weeks in 2020, 52 in 2021). The source of this endogenous variable is Eurostat, Weekly Death Statistics (Eurostat, 2024).

3.4.2 Regional level specification for Spanish regions

The dependent variable of the models for Spain refers to the per cent of the total QALYs losses in the 52 NUTS-3 provinces in the three periods (initial lockdown, centralised management, and decentralised operation). The baseline model is the random effects model as below:

$$Y_{ijt} = \beta_{0t} + u_{jt} + \varepsilon_{ijt}; i = 1, \ldots 52; j = 1, \ldots 18; t = 0, 1, 2 \qquad [3.1]$$

Where Y_{ijt} is the endogenous variable defined above, u_{jt} is the unobserved effect of the Autonomous Community j and ε_{ijt} is the province random noise, assumed independent from u_{jt}[6]. The control variables as defined in Table 1, and we then consider a specification with fixed effects for the Autonomous Communities:

[6]Once estimated [3.1] for t = 0,1 and 2, we then calculated intraclass correlations: $\rho_t = \frac{Var(u_{jt})}{Var(u_{jt}) + Var(\varepsilon_{ijt})}$ $(t = 0, 1, 2)$. We expect that $\rho_2 > \rho_1$

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$$Y_{ijt} = \beta_0 + \boldsymbol{Z}'_{ij}\boldsymbol{\beta} + \sum_{j=1}^{17} \mu_j D_j + \varepsilon_{ijt} \qquad [3.2]$$

The independent variables of interest are (i) the continuous value for the Regional Authority Index (RAI), referred to as the federal index, which serves as a proxy for the degree of decentralisation of the country where the NUTS are registered, and (ii) the binary classification of the health system (either a Social Insurance-based system or a National Health Service model). The RAI estimates regional authority in the country by combining five dimensions: law-making, executive control, fiscal decision-making, borrowing, and constitutional reform (Hooghe and Marks, 2016). Country scores are zero for countries with no regional government; there is no predefined maximum RAI. The RAI also estimates regional tax authority and evaluates whether residual powers rest with the region or the central state. Additionally, the RAI assesses the authority co-exercised by a region and regional tier within the country across the five mentioned dimensions. Health systems are divided into two broad organisational forms: NHS, under which healthcare provision is a public sector service, and SHIS, which are publicly regulated health insurance systems with multiple providers[7].

Table 1 reports a description of the control variables which include the demographic age structure, the unemployment rate, the level of adjusted per capita income (as an indicator of income and fiscal capacity), and two explicit geographic variables of dispersion (percentage of built-up land) and/or concentration (population density). Land extension has also been included. Additional controls include delays in the political response from the first COVID case (measured in days) and the high school ratio. We expect that delays in the response would positively impact mortality; the unemployment rate, all else being equal, should reduce mortality since a lower percentage of workers may be exposed to the infection. Similarly, the ratio of the working population in the hotel sector and the share of jobs in advanced technological services, relative to total sectoral occupation, are expected to influence mortality: the former due to drastic lockdown measures and the elimination of travel reducing job exposure, and the latter due to the ability to perform remote tasks. The share of the population over sixty and population density are likely to increase the mortality ratio, as are per capita GDP and the high school population ratio. In a robustness analysis, some controls, specifically surface and land, are used as instrumental variables as regional authority might be endogenous.

The total number of observations (NUTS-2) is 252. After dropping missing data, the final sample for regression analysis is $n = 177$. In Model 2 below, we have excluded Germany due to the lack of data; mortality data for 2021 at the NUTS-2 level for Germany has not yet been published. The sample size for this model is $n = 141$.

4. Results

4.1 Baseline

Our descriptive estimate suggests significant regional variability in COVID mortality rates during the first phase (up to September 2020) of the pandemic, especially in Italy and Spain (Figure 1). We find that the countries with the highest median mortality rates (UK, Sweden, Spain, and Italy) also exhibited substantial regional variations. France had a relatively low median rate but displayed considerable regional variability.

Another empirical regulatory we observe is that the increase in mortality between 2020 and 2021 in the European NUTS-2 regions (Figure 2) has been quite heterogeneous across countries. All regions in Belgium experienced a decrease in mortality rates, whereas all regions in five

[7]In our sample, this categorization is as follows (SHIS = 1, NHS = 0): Austria 1/Belgium 1/Denmark 0/France 1/Germany 1/Greece 0/Italy 0/Luxembourg 1/Netherlands 1/Norway 0/Poland 1/Portugal 0/Romania 1/Slovenia 1/Spain 0/Sweden 0/Switzerland 1/UK 0 (see López-Casasnovas and Pifarré i Arolas, 2021).

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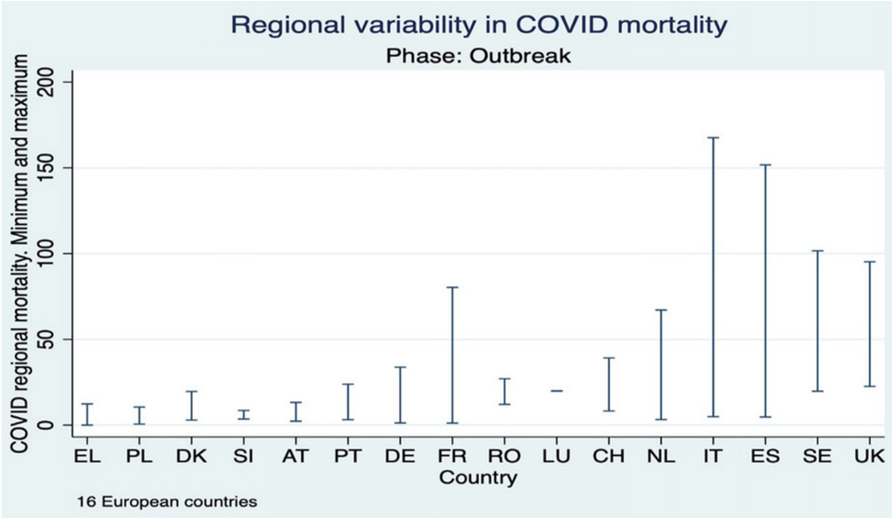

Figure 1. Regional variability in COVID mortality in the EUR NUTS-2 regions in the first phase (outbreak). Countries: Greece (EL), Poland (PL), Denmark (DK), Slovenia (SI), Austria (AT), Portugal (PT), Denmark (DK), France (FR), Romania (RO), Luxemburg (LU), Switzerland (CH), Netherlands (NL), Italy (IT), Spain (ES), Sweden (SE), and United Kindom (UK).

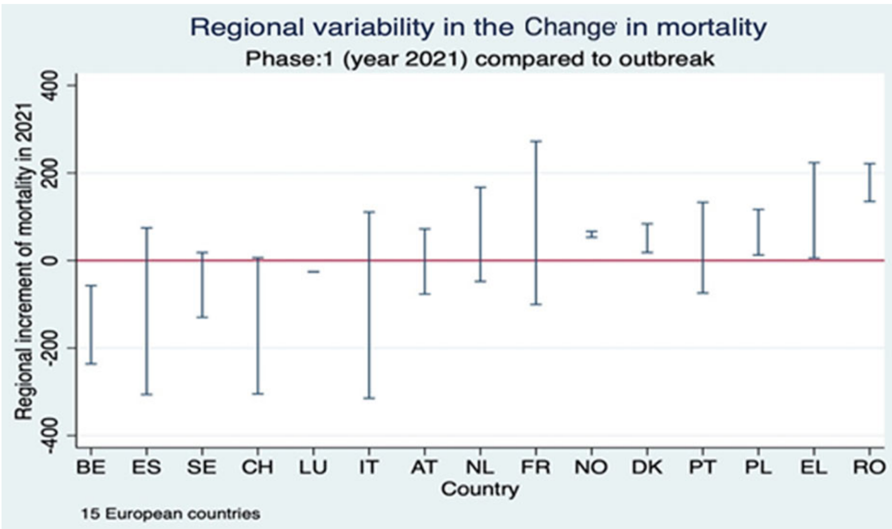

Figure 2. Regional variability in the increment of mortality in the EUR NUTS-2 regions in 2021 compared to the first phase (outbreak). Countries: Belgium (BE), Sweden (SE), Denmark (DK), Slovenia (EL), Spain (ES), France (FR), Italy (IT), Luxembourg (LU), Netherlands (NL), Poland (PL), Portugal (PT), EL (Greece), and Romania (RO).

countries (Romania, Greece, Poland, Norway, and Denmark) saw an increase in mortality. Within countries, the increase in mortality varied significantly, with Italy, Spain, France, and Czechia reporting the largest differences among regions.

4.1.1 Cross-country analysis: multivariate regression models

Table 2 displays the results of models (1.1–1.4) predicting mortality rates in the first wave of the pandemic. The model with fixed country effects (1.1) has a determination coefficient of 0.56,

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Table 2. Regression results NUTS-2 COVID mortality ratio from March 2020 to Sept 2020

Variable	Model 1.1 Country fixed effects	Model 1.2 RAI	Model 1.3 Social Security System	Model 1.4 RAI and Social Security System
RAI		0.436 (1.29)		−0.528 (1.56)
SS			−43.776 (6.40)**	−48.997 (6.46)**
R^2	0.56	0.18	0.33	0.34
N	177	177	177	177

Note: Confidence levels expressed as it follows: * $p < 0.05$; ** $p < 0.01$. *t*-values included in brackets. Dependent variable is mortality rate in the first phase of the pandemic. Independent variables as defined in Table 1. The first regression includes country fixed- effects. Countries: Germany (DE), Denmark (DK), Greece (EL), Spain (ES), France (FR), Italy (IT), Luxembourg (LU), Netherlands (NL), Poland (PO), Portugal (PT) and Romania (RO). Fixed-effects estimates in model 1.1 not shown. The model includes density, extension, land development, delay, older60, high school, unemployment and GDP as controls. Goodness of fit-test (R^2) and sample size (*N*) are included. Own elaboration (Mathieu *et al.*, 2020).

Table 3. Regression results NUTS-2. Increase in mortality (all causes) from 2020 to 2021

Variable	Model with country-fixed effects	Model with RAI	Model with Social Security System	Model with RAI & Social Security System
RAI		−5.779 (4.30)**		−3.191 (2.43)**
SS			168.602 (6.62)**	144.621 (5.38)**
R^2	0.59	0.34	0.43	0.46
N	141	141	141	141

Note: Confidence levels expressed as it follows: * $p < 0.05$; ** $p < 0.01$. *t*-values included in brackets. Dependent variable is an increase in mortality (all causes) from 2020 to 2021. Explanatory variables as defined in Table 1. The first regression includes country fixed effetcs. Countries: Belgium (BE), Denmark (DK), Greece (EL), Spain (ES), France (FR), Italy (IT), Luxembourg (LU), Netherlands (NL), Poland (PO) and Romania (RO). Fixed-effects estimates not shown. Fixed-effects estimates not shown. The model includes density, extension, land development, delay, older60, high school, unemployment and GDP as controls. Goodness of fit-test (R^2) and sample size (*N*) are included. Own elaboration (Eurostat, 2024).

which drops to 0.18 for the model including RAI (1.2) and 0.21 for the models including the SS dummy (1.3 and 1.4). Interestingly, we find that the Regional Authority Index is not statistically significant in any model, while the dummy for the Social Security health system consistently shows a negative sign. However, such results unmask that presence of other knock-on effect on other causes of death across courtiers.

Next, we examine the estimates of models predicting the increase in mortality from all causes from 2020 to 2021 are reported in Table 3. In such specification, we find that RAI is negative and significant in both models (2.2 and 2.4), and SS is also significant, and positive, in the models 2.3 and 2.4 which include it. Hence, decentralized health systems were, ceteris paribus, exhibit lower mortality in 2021. In contrast to the outbreak phase, the model suggests that in 2021 social security systems were less effective than national health systems.

4.2 Robustness analysis

One potential concern of the previous estimates in Tables 3 and 4 is that the Regional Authority Index (RAI) is potentially endogenous. Hence, we present instrumentals variable models where

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Table 4. Robustness analysis. IV estimation NUTS2 COVID mortality ratio in 2020 and increase in 2021

Variable	Mortality in 2020. Model with RAI	Mortality in 2020. Model with RAI & SS system	Increase in mortality in 2021. Model with RAI	Increase in mortality in 2021. Model with RAI & Social Security System
RAI	−3.425 (1.53)	−1.074 (0.97)	−11.312 (0.98)	−15.498* (1.94)
SS		−54.237 (4.62)**		52.293 (0.84)
Wu-Hausman endogeneity test	4.74 (0.03)*	0.214 (0.64)	0.236 (0.63)	3.74 (0.06)
Sargan test overidentification	3.49 (0.06)	7.94 (0.005)**	5.096 (0.02)*	4.20 (0.04)*
N	177	177	141	141

Note: Confidence levels expressed as it follows: * $p < 0.05$; ** $p < 0.01$. *t*-values included in brackets. Dependent variable is an increase in mortality (all causes) from 2020 to 2021. Explanatory variables as defined in Table 1. Countries: for 2020, Germany (DE), Denmark (DK), Greece (EL), Spain (ES), France (FR), Italy (IT), Luxembourg (LU), Netherlands (NL), Poland (PO), Portugal (PT) and Romania (RO). For 2021, Belgium (BE), Denmark (DK), Greece (EL), Spain (ES), France (FR), Italy (IT), Luxembourg (LU), Netherlands (NL), Poland (PO) and Romania (RO). The models include density, extension, land development, delay, older60, high school, unemployment and GDP as controls. Sample size (N) are included. Own elaboration (Mathieu *et al.*, 2020).

Table 5. Univariate descriptives of the QALYs lost per week per 10,000 QALYs in the Spanish provinces in phases 0,1 and 2, and within group correlations of the percentage of QALYs lost in the Spanish provinces in the three phases of the pandemic (groups are the Autonomous Communities)

Phase	Observations	Mean	Standard deviation	Minimum	Maximum	Within group correlations of the percentage of QALYs lost in the Spanish provinces
0 (outbreak)	52	.6419477	.2013748	.3640242	1.124277	0.5718
1 (centralised)	52	.5571274	.1100826	.3938878	.8334566	0.5583
2 (decentralised)	52	.51309	.0960868	.2943197	.7593811	0.5650

Note: Summary of univariate descriptives of the QALYs lost per week per 10,000 QALYs in Spanish provinces in the three phases (0, 1 and 2). For the definition of the phases, see methods section. The within group correlations are calculated according to [3.2]. Own elaboration (Mathieu *et al.*, 2020).

surface and land development are used as instruments the effect of which was above the standard cut-off for an F test. The results do not differ substantially from those in Tables 2 and 3, although the Social Security system variable in the model for 2021 is not significant. The Wu-Hausman endogeneity test suggests that RAI might be endogenous in some of the models. Hence, we can conclude that health system decentralisation at the country level, before the pandemic did not influence the mortality and reduced total mortality.

4.3 Extensions: from centralisation to decentralisation - the case of Spain

Next, we focus on Spanish data and Table 5 reports the descriptive statistics comparing QALYs lost in the provinces distinguishing the three phases of the pandemic. Since province averages are not comparable among phases - due to different durations ($T = 15$, 46, and 43 weeks respectively), Table 5 adjusts for the duration of each phase, reporting QALYs lost per week per 10,000 QALYs in the 52 provinces.

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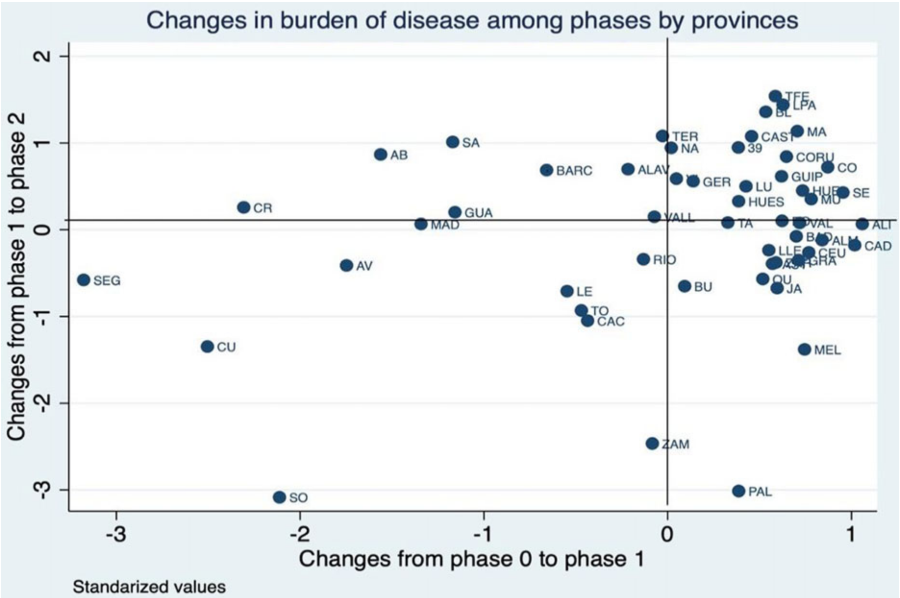

Figure 3. Changes in burden of disease among phases by provinces. Own elaboration (Mathieu *et al.*, 2020).
Note: Horizontal axis reflects changes from phase 0 to phase 1. Vertical axis reflects changes from phase 1 to phase 2. Standardized values.

Estimates from Table 5, suggest a reduction in the average health burden of the pandemic across the three phases considered, along with its variation. We find a high correlation (0.92) between QALYs lost in phases 1 and 2. Phases 0 and 1 are also positively correlated (0.6). Figure 3 visually corroborates these positive correlations. Table 5 also reports the estimation of intraclass correlations [3.2] from the empty model [3.1]. Notably, the differences among phases are negligible; between 56% and 57% of the variability among provinces in QALYs lost is associated with the Autonomous Community. This effect is quite similar in both the centralised and decentralised phases of pandemic management.

However, Table 6 reports estimates for each phase. The dependent variable being the percentage of QALYs lost in each phase. The control variables considered include demographic variables (percentage of the population older than 70), population density, GDP per capita, and the distribution of the active workforce among economic activity sectors (agriculture, construction, services, and no sector for those who have never worked before). The models also contain fixed effects of the autonomous communities, with the main interest being the joint significance of the regional effects in each phase of the pandemic. Our estimates suggest that only in the first phase of uniform and centralised management of the pandemic under a "state of alarm" law does the joint significance of the regional fixed effects (dummies) reject the null hypothesis. Hence, we find that there were significant regional differences in the burden of the disease (per cent of QALYs lost) in the aftermath of the epidemics. That is, we find variation in the centralised phase, whilst in the final decentralised phase, regional differences in the disease burden became negligible. These results are consistent with the idea that decentralisation allowed regions to adjust their policies to their regional-specific needs.

5. Discussion

We have examined the impact of the type of the decentralised health system governance on COVID-19 mortality and health loss. That is, whether decentralised health systems that

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Table 6. Regression results model [3.3]. QALYs lost in each phase. Provinces of Spain (NUTS-3)

Variable	Phase 0 lockdown	Phase 1 centralised management	Phase 2 decentralised management
Test F joint significance of regional effects	3.69 (0.001)**	0.84 (0.64)	1.72 (0.10)
R^2	0.87	0.92	0.94
N	52	52	52

*$p < 0.05$; **$p < 0.01$.
Note: The dependent variable is QALYs lost per week per 10,000 QALYs in Spanish provinces in the three phases (0, 1 and 2). Confidence levels expressed as it follows: * $p < 0.05$; ** $p < 0.01$. *t*-values included in brackets. Dependent variable is the share of QALYs lost per phase (0, 1 and 2). The model includes as controls older70, GDP, density, agriculture, construction, services and no sector, as defined in Table 1. Autonomous Communities fixed effects are included.

stimulated greater regional participation saved more lives in Europe during the different phases of the pandemic. We have proxied the degree of decentralisation of each country with the Regional Authority Index (RAI), also known, and we have controlled for type of the health system financing, distinguishing between the two main types: Social Insurance-based Systems and National Health Services. We have exploited regional information on health and income at the NUTS-2 level across European countries.

Our findings suggest that at the beginning of the health crisis, with the chaotic onset of the infection, the richer, more populated NUTS and countries with hierarchical NHS systems, exhibited worse mortality ratios. In those first weeks, from the crisis outbreak until August 30, 2020, decentralisation did not appear to make a difference (low significance for RAI). However, it is also true that the more populated and wealthier regions generally suffered a higher incidence at the onset of the pandemic, likely due to their greater external connectivity. We then focused on the differences in overall mortality in our NUTS-2 sample between 2020 and 2021, regardless of the cause of death (COVID or otherwise). In these models, RAI is statistically significant, but the nature of the systems is not. It seems that an idiosyncratic, close-to-the-problem regional response to the pandemic diluted the differences between national health systems.

Next, we switch to examine data from Spain, a highly decentralised country, where healthcare is the responsibility of the regions. Spain was heavily affected by the COVID-19 outbreak and in the initial wave, a state of emergency was declared in 2020, which entailed a sudden centralisation that only was reverted in 2021. Thanks to the availability of disaggregated data for the Spanish provinces (NUTS-3), we have been able to compare the pandemic's burden of disease across different stages of centralisation and decentralisation in pandemic management. The first stage involved immediate home confinement reactions, followed by centralised management, and finally decentralised management.

Our methodological approach is novel in examining these effects. We have calculated the burden of COVID-19 in terms of life years lost and health-related quality of life. Using data sources that provide province-level disaggregation by age structure and life expectancy, we quantified the total number of Quality Adjusted Life Years (QALYs) lost during the three defined periods.

The health burden is measured in relative terms, and we find that it decreased across all three phases, with reduced significantly the variation among provinces. The QALYs lost in phases 1 and 2 were strongly correlated within each province, whereas the correlation between phase 0 and phase 1 is comparatively lower. As anticipated, we find large unobservable heterogeneity in explaining our estimates which was similar during both the centralised and decentralised phases.

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6. Conclusion

The impact of COVID-19 on European health outcomes has varied across different phases of pandemic management. The territorial dimension has proven significant, with the degree of centralisation/decentralisation in health service management and the type of healthcare system—Health Insurance versus National Health Service—significantly influencing health outcomes across countries. Initially, during the early phase without decentralisation, these differences were less apparent; however, generally, National Health Service systems, which are more centralised and hierarchical, exhibited poorer health outcomes. Conversely, in 2021's, the implementation of decentralisation-based policies across many countries revealed substantial improvements in health outcomes, regardless of healthcare system type. In the specific case of Spain, the analysis of provincial data for the three phases (state of alarm, centralised management and decentralised management) shows that the average health burden has decreased across the three phases. Contrary to expectations we found significant regional differences in the burden of the disease (per cent of QALYs lost) only in the aftermath of the epidemics ("state of alarm" centralised management).

This study suggests that governance plays a role in management of pandemic, and specifically decentralised governance can reduce mortality at the beginning of the pandemic consistently with Angelicii *et al.* (2023), however, this paper extends the results by examining cross-country variation. Furthermore, we find that when we look at QALY's lost during the pandemic, there is significant regional variation in the initial phases, which then disappears, and generally we don't find a significant difference in the dispersion of the results by level of governance, consistent with the idea that decentralised health system give rise to specific forms of coordination that limit the emergence of regional inequalities (Lopez-Casanovas *et al.*, 2005; Costa-Font and Turati, 2018). However, it's important to note that our estimates are limited by the availability of regional data for all 252 NUTS-2 European regions, which has been incomplete, potentially biasing results. Similarly, the cross-sectional nature of the regression models and observational data might limit the causal reinterpretation of our estimates.

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References

Angelici M, Berta P, Costa-Font J and Turati G (2023) Divided we survive? Multilevel governance during the COVID-19 pandemic in Italy and Spain. *Publius: The Journal of Federalism* **53**, 227–250.

Biase P and Dougherty S (2021) Federalism and public health decentralisation in the time of covid-19. *OECD Working Papers on Fiscal Federalism*. Paris: OECD Publishing.

Costa-Font J (2012) Myths of health care decentralization. *Journal of Health Services Research & Policy* **17**, 252–253.

Costa-Font J and Turati G (2018) Regional healthcare decentralization in unitary states: equal spending, equal satisfaction? *Regional Studies* **52**, 974–985.

Dougherty S, Vammalle C, De Biase P and Forman K (2020) Covid-19 and fiscal relations across levels of government. *OECD Policy Responses to Coronavirus (COVID-19)*. Paris: OECD Publishing.

Eurostat (2021) Background – NUTS. Nomenclature of territorial units for statistics. Available at https://ec.europa.eu/eurostat/web/nuts/background (accessed 30 September 2023).

Eurostat (2024) Weekly death statistics. Statistics Explained. Available at https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Weekly_death_statistics&stable (accessed February 15th, 2024).

Gonzalez Lopez-Valcarcel B and Hernandez–Aguado I (2024) Independent evaluation of the COVID-19 crisis. Lessons to be learned. *Gaceta Sanitaria* **38**, 102375

Hooghe L and Marks G (2016) Measuring regional authority. *Community, Scale, and Regional Governance*. Oxford: Oxford Academic, pp. 24–43.

Institute for Health Metrics and Evaluation (IHME) (2024) *Global Burden of Disease 2021: Findings from the GBD 2021 Study*. Seattle, WA: IHME.

INE, Instituto Nacional de Estadística (National Institute of Statistics) (2020) Estimation of the Number of Weekly Deaths. Last data. Available at https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736177074&menu=ultiDatos&idp=1254735573175 (accessed 30 September 2023).

López-Casasnovas G and Pifarré i Arolas H (2021) Health care systems: organization and response to COVID-19 with a focus on Spain. *Forum for Social Economics* **51** 175–191.

López-Casasnovas G, McDaid D and Costa-Font J (2006) Health care management autonomy: evidence from the catalonian hospital sector in a decentralised Spain. *Working Papers Universitat Pompeu Fabra. Department of Economics and Business, 993*.

Lopez-Casasnovas G, Costa-Font J and Planas I (2005) Diversity and regional inequalities in the Spanish 'system of health care services'. *Health Economics* **14**, S221–S235.

Mathieu E, Ritchie H, Rodés-Guirao L, Appel C, Gavrilov D, Giattino C, Hasell J, Macdonald B, Dattani S, Beltekian D, Ortiz-Ospina E and Roser M (2020) Covid-19-Data/Public/Data at MasterOwid/Covid-19-DATA. GitHub. Available at https://github.com/owid/covid-19-data/tree/master/public/data (accessed 30 September 2023).

Mackenbach J (2020) Re-thinking health inequalities is necessary. *European Journal of Public Health* **30**, 622.

OECD (2021) *Making Decentralisation Work: Fiscal Federalism 2022*. Paris: OECD Publishing.

Omrani H (2021) *Coronavirus (COVID-19) in Europe: Dataset at a Subnational Level*. New York, NY: Statista.

Rovira-Forns J (1991) Incentives for healthy consumer behaviour and intersectoral measures for health targets. In López G (ed.) *Incentives on Health Systems. I European Conference on Health Economics*. Heidelberg: Springer Verlag.

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