

Editorial for the Special Issue “Spatial and regional aspects of health”

Anna-Theresa Renner¹, Rita Santos², Benedetta Pongiglione³,
Roman Hoffmann⁴

¹ Vienna Technical University, Vienna, Austria and Harvard University, Cambridge, USA

² University of York, York, United Kingdom

³ Bocconi University, Milan, Italy

⁴ Austrian Academy of Sciences, Vienna, Austria and International Institute for Applied Systems Analysis, Laxenburg, Austria

Received: 20 June 2022/Accepted: 20 June 2022

Abstract. The health crisis caused by the COVID-19 pandemic highlights, more than ever, the necessity of scientific research to inform policy action. During such a crisis it is vital that any measure taken by policy makers mitigates the consequences on health without causing long-lasting social and economic harm. Spatial aspects play an important role here: knowledge about the spread of a disease through space and social networks, the effectiveness of different policy responses, and the economic and social implications for the population are of particular relevance. As any policy action is embedded in its institutional and social environment, not every measure is effective in all contexts. Moreover, infectious diseases can spread at different speed in different places, requiring tailored interventions. Careful evaluation and comparison of different settings, including the organization of the healthcare systems and the geographic and demographic characteristics of a region or country, are therefore essential. The COVID-19 pandemic has made manifest the importance of the spatial and geographical dimension of health, however, the relevance of this interlinkage is not limited to the spread of contagious diseases. Differences in accessibility of services between urban and rural regions, the varying costs of access to healthcare for different (socioeconomic) groups of the population, the impact of these on healthcare utilization, and environmental shocks on population health are just a few examples illustrating the close link between space, socioeconomic factors and health.

This special issue of REGION is presented in two parts. In the first part, papers explore the spread and impact of the COVID-19 pandemic on the health and economy. In the second part, papers investigate regional and spatial aspects of the healthcare sector with a focus on health disparities.

1 Introduction

Health and space are highly associated. This is reflected in the plethora of research that studies spatial aspects of health in different ways, for example, as spatial patterns of diseases and mortality (e.g. [Marshall 1991](#), [Lawson 2018](#), [Kulldorff, Nagarwalla 1995](#), [Santos et al. 2020](#), [Nowakowska et al. 2021](#)), geographical distribution of healthcare services and their utilization (e.g. [Santana et al. 2009](#), [Gravelle et al. 2014, 2019](#), [Longo et al. 2017](#), [Okoli et al. 2020](#), [Shinjo, Aramaki 2012](#), [Pongiglione et al. 2020](#), [Renner 2020](#)),

or environmental shocks on population health ([Gemmell et al. 2000](#), [Analitis et al. 2008](#), [Almendra et al. 2017](#)).

There is ample evidence that regional disparities in mortality and life-expectancy exist ([Taulbut et al. 2013](#), [Dwyer-Lindgren et al. 2017](#)), and that they are persistent or even increasing in many European countries – with the notable exception of Germany ([van Raalte et al. 2020](#)). Often these differences in health are associated with differences in economic indicators such as wealth, income levels, or unemployment. This association has been proven to be causal at the individual level, as monetary and non-monetary resources increase the ability to improve health (e.g. [Pickett, Wilkinson 2015](#)), either through healthcare utilization or through behavioural changes in life-style (e.g. [Ploubidis et al. 2019](#), [Mackenbach et al. 2019](#)). On the other hand, a reversed causal pathway is also conceivable: health as part of the human capital has been shown to positively affect regional economies ([Gumbau Albert 2021](#)).

Regional health inequalities are of interest to researchers not only because of their economic implications, but also because they constitute a form of inadmissible unfairness if they are merely due to the (rather arbitrary) place of residence ([Fleurbaey, Schokkaert 2009](#)). Policy makers oriented towards social welfare, therefore, try to attenuate regional inequities – at least within their own country. To inform respective actions, GIS-based methods, developed and established in the fields of regional science and geography, are increasingly used to generate policy-relevant evidence on the association between space and health. Additionally, the explicit modelling of spatial dependencies and spillovers between geographic regions has been shown to be of importance in quantitative health(care) research (e.g. [Tosetti et al. 2018](#), [Baltagi et al. 2018](#), [Moscone et al. 2007](#), [Atella et al. 2014](#)).

Another relevant field of study where health and space meet, is the analysis and planning of the geographic distribution of healthcare providers. A fair and efficient distribution of healthcare resources, such as hospitals, outpatient doctors, pharmacies etc., is a necessary condition for needs-based utilization to eventually reduce regional health inequalities ([Chandra, Skinner 2003](#), [Santos et al. 2020](#), [Moscone et al. 2019](#)).

The public health crisis caused by the COVID-19 pandemic highlighted, more than ever, the necessity of scientific research to inform policy action and the role played by space in our understanding of health disparities ([Bourdin et al. 2021](#), [Jeanne et al. 2022](#)). For example, [Ji et al. \(2020\)](#) show that early on in the pandemic, mortality rates differed considerably among different Chinese provinces. The authors hypothesise that those disparities can be at least partly attributed to differences in healthcare resources availability. [Rodriguez-Pose, Burlina \(2021\)](#) studied excess mortality during the first wave of the Covid-19 pandemic in 206 European regions across 23 countries. They found that in addition to health system endowment, regional factors such as pollution, climate, as well as institutional and government capacities were drivers of increased death rates. Important mediators/moderators of this relationship are pre-existing, mostly chronic comorbidities and population age structure ([Dowd et al. 2020](#)). In an extensive systematic review of the literature, it has been shown that the extent to which these affect disease severity and mortality differ substantially between geographic regions ([Thakur et al. 2021](#)).

2 Contents of this Special Issue

This special issue addresses the various links between space and health with a particular focus on the COVID-19 pandemic. In the first part, we showcase studies that examine the spread of the disease and its determinants ([Psycharis et al. 2021](#), [Uzzoli et al. 2021](#), [Wieland 2020](#)), illustrate the impact of COVID-19 on the economy ([Credit, van Lieshout 2021](#), [Artelaris, Mavrommatis 2022](#), [Herzog, Vomberg 2021](#), [Józefowicz 2021](#), [Niembro, Calá 2021](#)) as well as on mental health ([Bourdeau-LePage, Kotosz 2021](#)).

[Psycharis et al. \(2021\)](#) investigate the role of demographic and socio-economic differences in explaining Covid-19 mortality rates across Europe during the first wave in spring 2020 using a Bayesian approach. Their findings suggest that differences in mortality across 29 European countries are best explained by the degree of urbanization,

the level of economic development and number of available hospital beds. The spatial patterns of the pandemic within one country, Hungary, has been explored by [Uzzoli et al. \(2021\)](#). They examined how the disease spread during the first, second and third wave and found that while the first wave was characterised by hotspots, the latter two were due to community-based epidemic spreading. Whether and how nonpharmaceutical interventions were able to mitigate the spread of the coronavirus during the first pandemic wave in Germany, was investigated by [Wieland \(2020\)](#). The county-level analysis shows that the epidemic curve already flattened before hard lockdowns and curfews were implemented.

In their paper, [Credit, van Lieshout \(2021\)](#) explore the consequences of the first Covid-19 wave on economic activity in Chicago, USA, from March to September 2020. They find that new business license activity dropped by a third compared to previous years, and that ZIP codes with the largest declines have less dense, diverse, and walkable built neighborhoods. This is closely linked to the study by [Artelaris, Mavrommatis \(2022\)](#) on how city centers and inner-city areas with high population density emerged as the prime victims of the pandemic. They reflect on the urban paradox and how new policy perspectives on territorial cohesion and regional policy might need to take into account the strengths and merits of urban agglomeration while counteracting its negative aspects.

An explorative qualitative approach was used by [Herzog, Vomberg \(2021\)](#) to investigate the effects of the pandemic on local economies. Their results from interviews and focus groups in deprived neighbourhoods in the Middle Lower Rhine region of Germany show that while the level of uncertainty is generally high, locally embedded organisations benefit from a positive push in the areas of digitization and new life and working environments (home-based work), as well as from a strengthening of local solidarity and cohesion. [Józefowicz \(2021\)](#) used a survey to research the reaction of Polish tourists to the pandemic. The study shows that tourists mostly targeted cities during the pandemic since those are the main tourist destination for Poles. Polish tourists, who took part in the survey, were not afraid of coronavirus infection during their trips but they were mainly young adults who would likely have less adverse health consequences of a coronavirus infection. This suggests that Polish young adults planned their tourist destinations as before the pandemic. In many countries, data limitations represent a major issue in assessing the consequences of health crises and the impacts of policy measures. In their contribution, [Niembro, Calá \(2021\)](#) propose a novel approach to measuring economic impacts of the pandemic in contexts with scarce subnational data. They illustrate the applicability of their newly developed index measure for the case of Argentina which represents a context with scarce and outdated public data and find highly heterogeneous impacts of the pandemic within and across regions. They validated the index using public data sources and discuss its potential to expand the geographic and temporal scope of official statistics.

Finally, [Bourdeau-LePage, Kotosz \(2021\)](#) study the impact of the French government's social-distancing measures (including lockdown) in response to the coronavirus pandemic, on population well-being. The authors report the regional variation of French residents' vulnerability to social-distancing measures and their implication on well-being. They find that the accentuated decrease of well-being in the southern regions changed the French well-being geography considerably.

The second part of the special issue includes four papers that discuss regional and spatial aspects of the healthcare sector more broadly. Two of them investigate the impact of public investments ([Vadia, Blankart 2021](#), [Fidrmuc et al. 2022](#)), one analyses antibiotic self-medication ([Anderson 2021](#)) and one the effects of Malaria on the height distribution in Italy ([Percoco 2021](#)).

[Vadia, Blankart \(2021\)](#) investigate the role of public funding in cardiovascular device innovation. Studying 31 European countries, they find that, indeed, innovatory efforts in the form of public research investments can effectively promote innovation in the medical device industry at the regional level. The paper by [Fidrmuc et al. \(2022\)](#) assesses whether the European Structural and Investment Funds 2007-2013 improved healthcare quality in Slovakia. Results indicate that the injection of EU funds is associated with a significant but small decrease in the readmission rate in the following year, but not with a change in mortality.

[Anderson \(2021\)](#) considers drivers and consequences of antibiotic self-medication in Europe using extensive survey data from the Eurobarometer. The author explores the individual-level and national-contextual determinants of self-medication among antibiotic consumers in European countries. He shows that antibiotic consumption is higher in countries with higher levels of inequality, burdens of out-of-pocket expenditure, and corruption.

In the final paper of this issue, [Percoco \(2021\)](#) investigates the effect of malaria as a proxy for “bad geography” on the height distribution in Italy using historical evidence. He finds that malaria mortality rates can predict regional differences in height of conscripts between 1889 and 1900. Further, results from an instrumental variable approach suggest that average height increased after the eradication of malaria around 1950.

The papers presented in this special issue are heterogeneous in their content and methodologies, but they all highlight the importance and implications of regional and spatial aspects in health research. This is shown in the first part of the special issue by research analysing the spread of the COVID-19 pandemic and its consequences on the economy. That these aspects are not only relevant when studying a global pandemic, but in broader health research, is underlined by the second part of the special issue that includes papers reporting on the geography of public investment in health, medication and diseases.

References

- Almendra R, Santana P, Vasconcelos J (2017) Evidence of social deprivation on the spatial patterns of excess winter mortality. *International Journal of Public Health* 62: 849–856. [CrossRef](#)
- Analitis A, Katsouyanni K, Biggeri A, Baccini M, Forsberg B, Bisanti L, Kirchmayer U, Ballester F, Cadum E, Goodman P, Hojs A, Sunyer J, Tiittanen P, Michelozzi P (2008) Effects of cold weather on mortality: Results from 15 European cities within the PHEWE project. *American Journal of Epidemiology* 168: 1397–1408. [CrossRef](#)
- Anderson A (2021) Antibiotic self-medication and antibiotic resistance: Multilevel regression analysis of repeat cross-sectional survey data in Europe. *REGION* 8: 121–145. [CrossRef](#)
- Artelaris P, Mavrommatis G (2022) Territorial cohesion, the Covid-19 crisis and the urban paradox: Future challenges in urbanization and economic agglomeration. *REGION* 9: 135–146. [CrossRef](#)
- Atella V, Belotti F, Depalo D, Mortari AP (2014) Measuring spatial effects in the presence of institutional constraints: The case of Italian local health authority expenditure. *Regional Science and Urban Economics* 49: 232–241. [CrossRef](#)
- Baltagi BH, Moscone F, Santos R (2018) Spatial health econometrics. In: Baltagi BH, Moscone F (eds), *Health Econometrics*, Contributions to Economic Analysis. Emerald Group Publishing Limited, 305–326. [CrossRef](#)
- Bourdeau-LePage L, Kotosz B (2021) Isolation and well-being in the time of lockdown. *REGION* 8: 83–97. [CrossRef](#)
- Bourdin S, Jeanne L, Nadou F, Noiret G (2021) Does lockdown work? A spatial analysis of the spread and concentration of Covid-19 in Italy. *Regional Studies* 55: 1182–1193. [CrossRef](#)
- Chandra A, Skinner J (2003) Geography and racial health disparities. Working paper 9513. NBER working paper series
- Credit K, van Lieshout E (2021) The pandemic economy: Exploring the change in new business license activity in Chicago, USA from March – September, 2020. *REGION* 8: 29–56. [CrossRef](#)

- Dowd J, Andriano L, Brazel D, Rotondi V, Block P, Ding X, Liu Y, Mills M (2020) Demographic science aids in understanding the spread and fatality rates of Covid-19. *Proceedings of the National Academy of Sciences* 117: 9696–9698. [CrossRef](#)
- Dwyer-Lindgren L, Bertozzi-Villa A, Stubbs RW, Morozoff C (2017) Inequalities in life expectancy among US counties 1980 to 2014 – temporal trends and key drivers. *JAMA Internal Medicine* 177: 1003. [CrossRef](#)
- Fidrmuc J, Gardoňová K, Martin H, Sekelský L, Zlaczká V (2022) EU funds as a catalyst of change for the Slovak healthcare system? *REGION* 9: 29–49. [CrossRef](#)
- Fleurbaey M, Schokkaert E (2009) Unfair inequalities in health and health care. *Journal of Health Economics* 28: 73–90. [CrossRef](#)
- Gemmell I, McLoone P, Boddy F, Gordon J, Dickinson G, Watt G (2000) Seasonal variation in mortality in Scotland. *International Journal of Epidemiology* 29: 274–279. [CrossRef](#)
- Gravelle H, Santos R, Siciliani L (2014) Does a hospital's quality depend on the quality of other hospitals? A spatial econometrics approach. *Regional science and urban economics* 49: 203–216. [CrossRef](#)
- Gravelle HSE, Liu D, Propper C, Santos R (2019) Spatial competition and quality: Evidence from the English family doctor market. *Journal of Health Economics* 68: 102249. [CrossRef](#)
- Gumbau Albert M (2021) The impact of health status and human capital formation on regional performance: Empirical evidence. *Papers in Regional Science* 100: 123–139. [CrossRef](#)
- Herzog A, Vomberg M (2021) The promise of endogenous potential in times of crisis: Analysis of the effects of the Corona pandemic on the socio-economic embeddedness in local economies. *REGION* 8: 99–120. [CrossRef](#)
- Jeanne L, Bourdin S, Nadou F, Noiret G (2022) Economic globalization and the Covid-19 pandemic: Global spread and inequalities. *GeoJournal*. [CrossRef](#)
- Ji, Ma Z, Peppelenbosch M, Pan Q (2020) Potential association between Covid-19 mortality and healthcare resource availability. *The Lancet Global Health* 8: e480. [CrossRef](#)
- Józefowicz K (2021) Urban tourism and Covid-19 in Poland. *REGION* 8: 187–199. [CrossRef](#)
- Kulldorff M, Nagarwalla N (1995) Spatial disease clusters: Detection and inference. *Statistics in medicine* 14: 799–810. [CrossRef](#)
- Lawson A (2018) *Bayesian Disease Mapping: Hierarchical Modeling in Spatial Epidemiology* (Third ed.). Chapman and Hall/CRC
- Longo F, Siciliani L, Gravelle H, Santos R (2017) Do hospitals respond to rivals' quality and efficiency? A spatial panel econometric analysis. *Health economics* 26: 38–62. [CrossRef](#)
- Mackenbach JP, Valverde JR, Bopp M, Brønnum-Hansen H, Deboosere P, Kalediene R, Kovács K, Leinsalu M, Martikainen P, Menvielle G, Regidor E, Nusselder W (2019) Determinants of inequalities in life expectancy: An international comparative study of eight risk factors. *The Lancet Public Health* 4: e529–e537. [CrossRef](#)
- Marshall RJ (1991) A review of methods for the statistical analysis of spatial patterns of disease. *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 154: 421–441. [CrossRef](#)
- Moscone F, Knapp M, Tosetti E (2007) Mental health expenditure in England: A spatial panel approach. *Journal of Health Economics* 26: 842–864. [CrossRef](#)

- Moscone F, Skinner J, Tosetti E, Yasaitis L (2019) The association between medical care utilization and health outcomes: A spatial analysis. *Regional Science and Urban Economics* 77: 306–314. [CrossRef](#)
- Niembro A, Calá CD (2021) Approximating the impact of Covid–19 on regional production in countries with scarce subnational data: A proposal and application for Argentina during the first wave. *REGION* 8: 167–186. [CrossRef](#)
- Nowakowska M, Zghebi SS, Perisi R, Chen LC, Ashcroft DM, Kontopantelis E (2021) Association of socioeconomic deprivation with opioid prescribing in primary care in England: A spatial analysis. *Journal of Epidemiology and Community Health* 75: 128–136. [CrossRef](#)
- Okoli C, Hajizadeh M, Rahman MM, Khanam R (2020) Geographical and socioeconomic inequalities in the utilization of maternal healthcare services in Nigeria: 2003-2017. *BMC Health Services Research* 20: 849. [CrossRef](#)
- Percoco M (2021) Spatial health inequality and regional disparities: Historical evidence from malaria in Italy. *REGION* 8: 53–73. [CrossRef](#)
- Pickett KE, Wilkinson RG (2015) Income inequality and health: A causal review. *Social science and medicine* 128: 316–326. [CrossRef](#)
- Ploubidis GB, Benova L, Stavola BD, Grundy E (2019) Lifelong socio-economic position and later life health related behaviour: A formal mediation approach. In: Ploubidis G, Pongiglione B, De Stavola B, Daniel R, Benova L, Grundy E, Read S (eds), *Pathways to Health*. Springer, Dordrecht, 41–59. [CrossRef](#)
- Pongiglione B, Torbica A, Gusmano MK (2020) Inequalities in avoidable hospitalisation in large urban areas: Retrospective observational study in the metropolitan area of Milan. *BMJ Open* 10: e042424. [CrossRef](#)
- Psycharis Y, Tsimbos C, Verropoulou G, Doukissas L (2021) The determinants of covid-19 mortality rates across Europe: Assessing the role of demographic and socioeconomic factors during the first wave of the pandemic. *REGION* 8: 199–219. [CrossRef](#)
- Renner A (2020) Inefficiencies in a healthcare system with a regulatory split of power: A spatial panel data analysis of avoidable hospitalisations in Austria. *The European Journal of Health Economics* 21: 85–104. [CrossRef](#)
- Rodrigueze-Pose A, Burlina C (2021) Institutions and the uneven geography of the first wave of the Covid-19 pandemic. *Journal of Regional Science* 61: 728–752. [CrossRef](#)
- Santana P, Santos R, Nogueira H (2009) The link between local environment and obesity: A multilevel analysis in the Lisbon metropolitan area, Portugal. *Social Science and Medicine* 68: 601–609. [CrossRef](#)
- Santos R, Rice N, Gravelle H (2020) Patterns of emergency admissions for ambulatory care sensitive conditions: A spatial cross-sectional analysis of observational data. *BMJ Open* 10: e039910. [CrossRef](#)
- Shinjo D, Aramaki T (2012) Geographic distribution of healthcare resources, healthcare service provision, and patient flow in Japan: A cross sectional study. *Social science and medicine* 75: 1954–1963. [CrossRef](#)
- Taulbut M, Walsh D, McCartney G, Parcell S, Hartmann A, Poirier G, Strniskova D, Hanlon P (2013) Spatial inequalities in life expectancy within postindustrial regions of Europe: A cross-sectional observational study. *BMJ Open* 4: e004711. [CrossRef](#)
- Thakur B, Dubey P, Benitez J, Torres JP, Reddy S, Shokar N, Aung K, Mukherjee D, Dwivedi A (2021) A systematic review and meta-analysis of geographic differences in comorbidities and associated severity and mortality among individuals with Covid-19. *Scientific Reports* 11: 8562. [CrossRef](#)

- Tosetti E, Santos R, Moscone F, Arbia G (2018) The spatial dimension of health systems. Oxford research encyclopedias. [CrossRef](#)
- Uzzoli A, Kovács SZ, Fábíán A, Páger B, Szabó T (2021) Spatial analysis of the Covid-19 pandemic in Hungary: Changing epidemic waves in time and space. *REGION* 8: 147–165. [CrossRef](#)
- Vadia R, Blankart K (2021) Regional innovation systems of medical technology: A knowledge production function of cardiovascular research and funding in Europe. *REGION* 8: 57–81. [CrossRef](#)
- van Raalte AA, Kluesener S, Oksuzyan A, Grigoriev P (2020) Declining regional disparities in mortality in the context of persisting large inequalities in economic conditions: The case of Germany. *International Journal of Epidemiology* 49: 486–496. [CrossRef](#)
- Wieland T (2020) Flatten the curve! Modeling SARS-CoV-2/COVID-19 growth in Germany at the county level. *REGION* 7: 43–83. [CrossRef](#)

