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# Avoidable Mortality and Socioeconomic Deprivation in Europe: An Ecological Study across 431 Regions in 22 Countries, 2002–2019

Michael Mühlichen[1], Pavel Grigoriev[1], Rok Hrzic[2], Mathias Lerch[3], Sebastian Klüsener[1]

[1] Federal Institute for Population Research (BIB), Wiesbaden, Germany

[2] Maastricht University, Netherlands

[3] Swiss Federal Institute of Technology in Lausanne, Switzerland

## ABSTRACT

The concept of 'avoidable mortality' is an approach to estimating the level of mortality related to deficiencies in health policies. While most studies on avoidable mortality focus on national outcomes, we lack evidence on subnational variation and trends across wide parts of Europe, and how this variation is associated with local socioeconomic conditions. We collected cause-specific mortality data and socioeconomic indicators for 431 regions from 22 European countries and calculated standardized death rates for avoidable mortality for the period 2002–2019. In addition, to account for local socioeconomic conditions, we created a novel deprivation index that accounts for socioeconomic deprivation in a multidimensional manner. Differences in trends and spatial gradients in avoidable mortality are then analyzed for clusters of socioeconomic deprivation. Initial analyses reveal strong north-south and east-west gradients in avoidable mortality across Central Europe and a south-north gradient in Italy, as well as a particularly advantaged area comprising Switzerland, western Austria and northern Italy. The efficiency of health policies in ensuring timely and adequate health care and preventing risk-relevant behavior has particular room for improvement in the former Communist countries. In the final version of this communication, we will analyze how these patterns differ across differentially deprived regions.

## KEYWORDS

Amenable and preventable mortality, causes of death, spatial differences, socioeconomic deprivation, Europe

## BACKGROUND

Levels of life expectancy differ not only between nations. In many countries, we also witness substantial variation across subnational regions. Previous studies have shown that differences between 'vanguard' regions of European countries are smaller than the overall differences between these countries (Jasilionis et al. 2014). However, differences between European 'laggard' regions are not only wider but the share of people living in 'laggard' regions also differs by country.

Aiming to find out more about the driving factors behind these regional variations and the involvement of certain risk factors among more and less developed contexts, we analyze harmonized cause-specific mortality data combined with area-level socioeconomic indicators at the subnational regional level for 22 European countries. To gain more insights into the specific risk factors driving the regional differences in mortality, we use the concept of avoidable mortality, thus focusing on causes that can

be attributed to lack of medical care and risk-relevant factors, such as smoking, alcohol abuse, traffic accidents and suicides.

This analysis is novel for two reasons. First, no study so far has explored avoidable mortality for many European countries at the subnational regional level. Such an approach allows to determine overall spatial patterns across Europe as well as differences within countries or between neighboring regions that belong to different countries ('cross-border regions'). Second, we develop and apply a new innovative index that allows to allocate European regions into quintiles of socioeconomic deprivation. We are currently developing the 'European Index of Socioeconomic Deprivation' (EISD) based on contextual socioeconomic variables from the Eurostat database that are available at the regional level. Using this index, we will classify European regions into quintiles according to their level of deprivation and show trends and spatial variation in avoidable causes of death for these five groups.

## DATA AND METHODS

The concept of avoidable mortality, first developed by Rutstein et al. (1976), classifies causes of death into causes amenable to health care ('amenable' or 'treatable' mortality) and causes avoidable through primary prevention ('preventable' mortality). Amenable mortality is an indicator of the effectiveness of health care through secondary prevention or medical treatment, whereas preventable mortality is an indicator of the effectiveness of inter-sectoral health policies in the broad sense and largely reflects risk-relevant behavior of the population, e.g. smoking and alcohol abuse (Nolte et al. 2002). We used the classification from Mühlichen et al. (2023b), which is to a large extent based on Nolte & McKee (2012) for amenable causes and Page et al. (2006) for preventable causes. In line with most concepts of premature mortality, we excluded the 75+ age group "as 'avoidability' of death and reliability of death certification become increasingly questionable at older ages" (Nolte and McKee 2004: 65).

We collected official data on causes of death and population counts by sex, 5-year age groups and region from the national statistical offices of the selected European countries. Moreover, we have obtained contextual socioeconomic variables for European NUTS-2 regions from Eurostat. Our initial analyses include 9 Austrian, 14 Czech, 96 German, 92 Italian and 7 Swiss regions but we also collected and prepared regional data from Belgium, Denmark, Estonia, Finland, France, Hungary, Latvia, Lithuania, Liechtenstein, Luxemburg, the Netherlands, Poland, Portugal, Romania, Slovakia, Spain and Sweden that we intend to add to the study (431 regions from 22 countries in total). Due to data availability, our long-term time series for these countries currently range from 2002 to 2019. Causes of death have been recorded according to the 10$^{th}$ revision of the International Classification of Diseases (ICD).

To show differences in amenable and preventable mortality over time and between regions and sex, we calculated standardized death rates (using the European Standard Population 2013). To assess how levels of socioeconomic deprivation are associated with levels of avoidable mortality, we classify our 431 European regions into five groups according to their level of deprivation and show trends and differences for these groups in amenable and preventable mortality. Previous attempts to build a cross-country deprivation index include the European Deprivation Index (EDI) (Guillaume et al. 2016). However, it was designed for a small number of countries and is not openly accessible or regularly updated. Therefore, we are currently creating a novel index similar to the German Index of Socioeconomic Deprivation (GISD) created by colleagues from the Robert Koch Institute (Michalski et al. 2022). Using this index, we aim to illustrate the level of socioeconomic deprivation based on contextual data on education, employment and income situations at the NUTS-2 level from the Eurostat database. Each of these three dimensions is measured by three indicators, and each of them is weighted via principal component analyses to get a composite deprivation index. Moreover, we explore differences between men and women and between age groups (0–34, 35–49, 50–64, 65–74, 75–84, 85+).

## PRELIMINARY RESULTS

At this stage, we can outline the first results on avoidable mortality at the regional level in five European countries. Analyses that include more countries in combination with area-level socioeconomic deprivation will follow in time for the International Population Conference. Figure 1 shows the results for amenable, preventable and other premature mortality in 2017–2019 in the Austrian, Czech, German, Italian and Swiss regions for men (panel graphs *a* to *c*) and women (*d* to *f*). There are strong north-south and east-west gradients in the studied area to the advantage of the south and southwest. In Italy, however, the mortality gradient is reversed with the north showing the lowest rates. This pattern is true for all three groups of causes of death, albeit to a varying degree and with the exception of preventable mortality in Italy (where the rates are highest for the northwestern and western coastal areas). In terms of regional inequality, the standard deviation is highest in preventable mortality, highlighting the significance of health-related behavior, followed by amenable mortality. In addition, the standard deviation is stronger for men than for women.

The results for amenable mortality indicate that the northern and eastern regions of Central Europe are less effective in providing adequate and timely medical care. In both Germany and Austria, the east-west gap is widely related to higher cardiovascular mortality in the eastern regions. The rural areas of eastern Germany show longer distances to health care facilities and a lower physician density per person at retirement age (BBSR 2021). In addition, the east has experienced a prolonged period of selective emigration ('brain drain') and shows lower levels in socioeconomic variables such as income and unemployment (Mühlichen 2019). Regional differences in Austria are smaller but also exhibit an east-west gradient to the disadvantage of the eastern part of the country and the city of Vienna in particular. Smoking rates as well as socioeconomic and environmental factors are likely to have an effect in this regard (Stein et al. 2011; Rau et al. 2007; Klotz and Doblhammer 2008; Klimont 2010). In Switzerland, western Austria and the central part of northern Italy, amenable mortality is the lowest, which might be related to health care advantages, influenced by beneficial socioeconomic conditions and healthier lifestyles. Czechia shows the most unfavorable rates of amenable mortality, suggesting a less efficient health care system.

The pattern of preventable mortality is very similar and indicates that the northern and eastern regions of Central Europe are less effective in reducing risk-relevant behavior. Analyses of the German Microcensus confirm that smoking rates are considerably higher in these areas (Mühlichen et al. 2023a). Likewise, the east of Austria shows higher rates of smoking and alcohol abuse (Urbas et al. 2009). In Switzerland, differences in health behaviors are rather limited across the Swiss regions, as revealed by health surveys (Wanner et al. 2012).

## CONCLUSION AND OUTLOOK

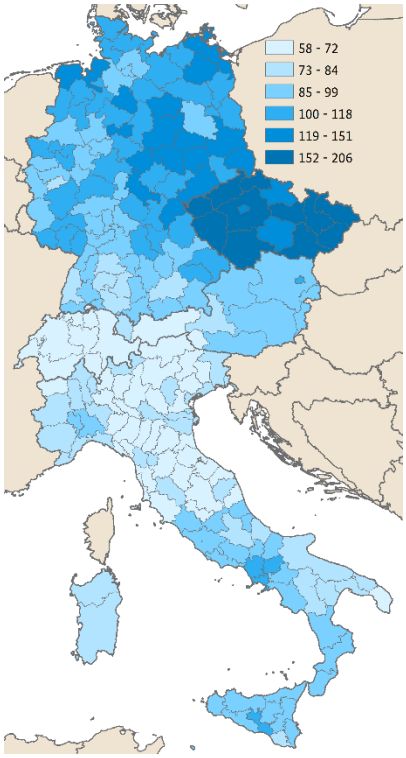
Our preliminary results show north-south and east-west divides in avoidable mortality in Central Europe as well as a south-north gradient in Italy. While we found a particularly advantaged area comprising Switzerland, western Austria and northern Italy, the highest rates of avoidable mortality are shown in the former Communist countries and regions in general that have been exposed to structural change and selective emigration. This might be an indication of varying levels in the efficiency of health-related policies in ensuring timely and adequate health care and preventing risk-relevant behavior across differentially deprived areas. Until IPC2025, we will analyze the association of avoidable mortality with socioeconomic conditions in more depth by classifying 431 European regions into five groups according to their level of deprivation and show trends and differences for these clusters in amenable and preventable mortality from 2002 to 2019.

## FIGURES

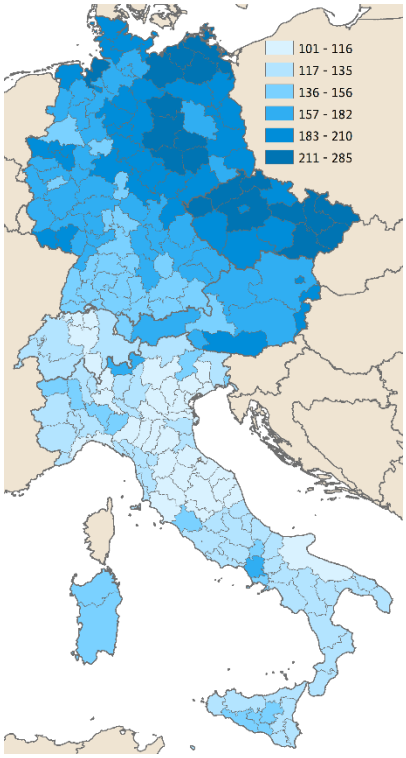
**Figure 1** Amenable, preventable and other premature mortality in Austrian, Czech, German, Italian and Swiss regions in 2017–2019; standardized death rates per 100,000; men and women, ages 0–74

MEN

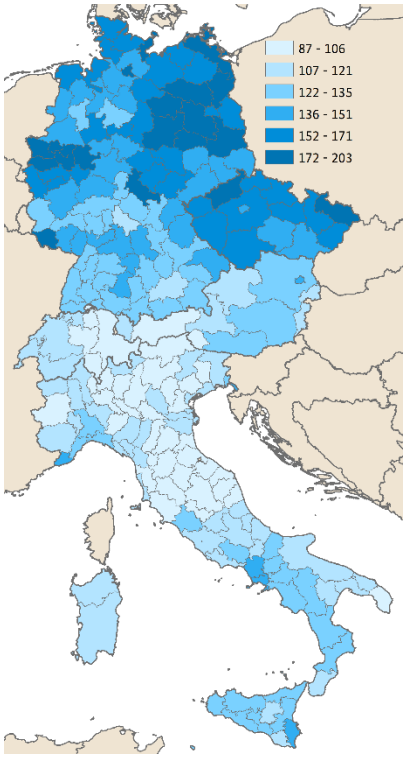
*a) Amenable mortality, men*




*b) Preventable mortality, men*

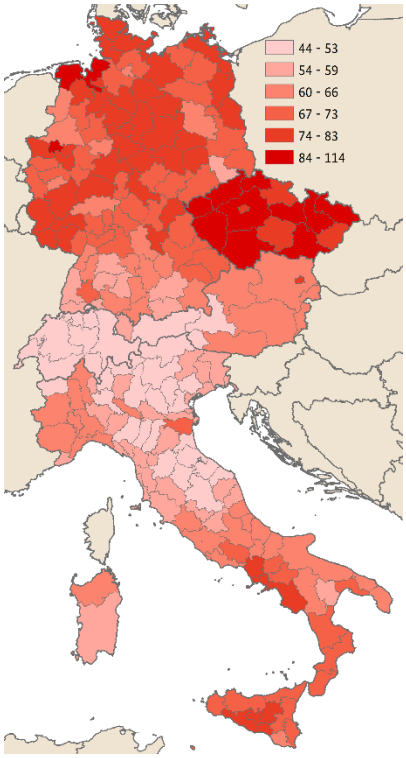



*c) Other premature mortality*

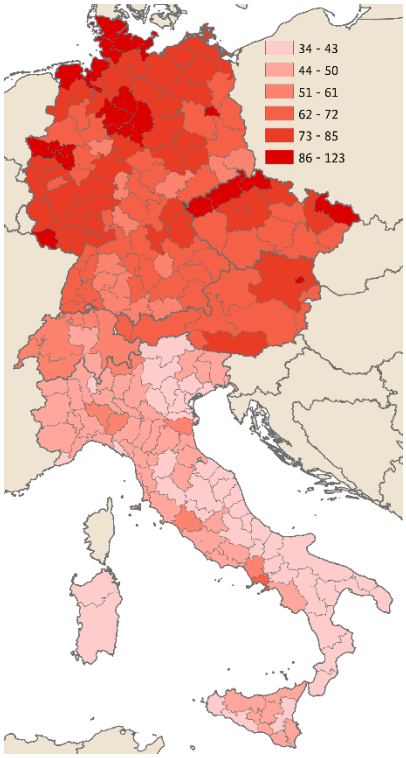



WOMEN

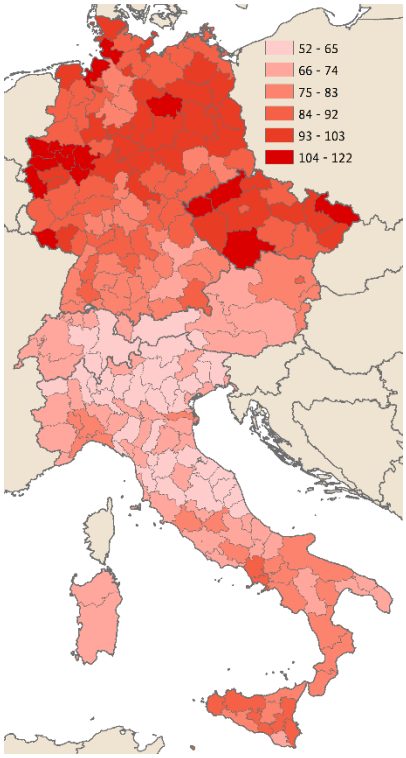
*d) Amenable mortality*




*e) Preventable mortality*




*f) Other premature mortality*




*Base map: Eurostat (for most countries) and Federal Agency for Cartography and Geodesy (for German regions only).*

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