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Trends and Spatial Patterns in Infant, Child and Adolescent Mortality across 285 European Regions, 1993-2023

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Abstract

Child mortality remains a key indicator of population health and social development. Although Europe has achieved substantial reductions in infant, child, and adolescent mortality over recent decades, progress has been uneven, and recent data suggest stagnation or even reversal. Most existing research has relied on national aggregates, masking regional heterogeneity. Examining subnational patterns is essential to identify structural inequalities and their determinants.

Using official mortality data from 285 regions across 30 European countries (1993-2022), we calculated mortality rates for infants (<1 year) and for children and early adolescents (1-14 years). Temporal trends, spatial variation, and associations between mortality and regional gross domestic product (GDP) were assessed using linear regression models for the periods 1993-1995, 2017-2019, and 2020-2022.

Between 1993 and 2022, infant mortality declined by 57.6% (from 4.8 to 2.0 per 1,000) and child/adolescent mortality by 60.1% (from 27 to 10.8 per 100,000). Regional disparities narrowed markedly until 2019 but have since plateaued, and in several European countries, mortality rates among infants and children/adolescents have started to rise again. The negative association between GDP and mortality persisted but weakened over time, suggesting that economic development has become a less dominant determinant of survival as social and healthcare factors may gain greater importance.

We will present analyses including additional socioeconomic and healthcare indicators, sex-stratified results, and estimates for older adolescents (15-19 years) based on updated data through 2023.

Extended Abstract

Background

Child mortality remains a key indicator of population health and social development. Although Europe has achieved major reductions in infant, child and adolescent mortality over recent decades (Kyu et al. 2018; Tunesi et al. 2023; GBD 2025; UNICEF 2025), progress has been uneven (Hucko et al. 2025). Children born in Eastern Europe are still about three times more likely to die before age five than those in Western Europe (UNICEF 2025), and recent evidence suggests a stalling or even reversal of long-term declines in infant and child mortality since 2020 (WHO 2025).

Multiple contextual factors influence child mortality trends, including economic, social, and healthcare-related variables. Across Europe, large disparities persist both between and within countries, reflecting differences in living standards, health system capacity, and social systems. Yet, most previous research has focused on aggregated national data, overlooking spatial patterns and regional heterogeneity. Understanding these subnational dynamics is crucial, as regional inequalities often reflect structural disadvantages and enable a more nuanced understanding of spatial variations in health and their underlying determinants.

This study provides the first regionally disaggregated, annually observed analysis of infant (<1 year) and child/adolescent (1-14 years) mortality across 285 regions in 30 European countries (1993-2022). By linking mortality to regional gross domestic product (GDP), we assess how the strength of the economic gradient in child survival has evolved over time. While this analysis focuses on GDP as the main contextual variable, future work will include additional socioeconomic and healthcare indicators, extend coverage to adolescents aged 15-19 years, and update data through 2023, with results to be presented at the conference.

Data and Methods

Our empirical analysis is based on death and mid-year population counts by age and sex for 285 regions across 30 European countries (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the UK). These data were obtained from the national statistical offices of the respective countries as part of the *Regional Disparities in Cause-Specific Mortality in Europe (REDIM)* project. Regions are defined according to the EU's Nomenclature of Territorial Units for Statistics (NUTS)-2 level. GDP data were sourced from the Eurostat regional database.

For the preliminary analysis, we categorized age groups into infants (< 1 year) and children and early adolescents (1-14 years), analyzing each group separately for both sexes combined. Infant mortality rates per 1,000 population and child/adolescent's mortality rates per 100,000 were computed for each region and time period. We assessed temporal trends in mortality from 1993 to 2022 and evaluated spatial variation using choropleth maps. Sigma-convergence was examined by computing the standard deviation (SD) and of mortality rates across regions over time, with declining values interpreted as evidence of convergence in regional mortality. To explore the association between economic development and mortality, we regressed regional and national mortality on GDP. Log-transformed GDP values were used in linear regression models to capture non-linear relationships. Separate regressions were estimated for infants and children as well as for different time periods to assess temporal changes in the strength of the association. All analyses and visualizations were performed in RStudio Pro version 4.5.0.

Preliminary Results

Between 1993 and 2022, infant mortality in Europe declined by 57.6%, from 4.8 to 2.0 deaths per 1,000 population, with the steepest reductions observed in Eastern and Southern European countries such as Estonia, Lithuania, Romania, Czechia, and Latvia. Countries with already low baseline mortality (e.g., France, Switzerland, Denmark) showed smaller relative declines. Mortality among children and adolescents aged 1-14 years decreased by 60.1%, from 27.0 to 10.8 per 100,000 population.

Figure 1 illustrates the spatial variation in infant (<1 year) and child/adolescent (1-14 years) mortality across 285 regions in 30 European countries (NUTS-2 level). Between 1993-1995 and 2017-2019, both infant and child/adolescent mortality declined markedly across nearly all European regions, with the highest initial rates in Eastern and Southern Europe converging towards lower, more homogeneous levels. Since 2020, however, both infant and child/adolescent mortality have increased in several regions, suggesting a potential reversal of the long-term downward trend.

Analyses of sigma-convergence show a reduction in the standard deviation of mortality rates over time, indicating narrowing regional disparities in infant and child/adolescent mortality across Europe up to 2019. Since then, the standard deviation has remained stable, suggesting that this convergence has stalled.

Figure 2 presents the relationship between mortality rates and GDP for both infant and child/adolescent mortality, using data from 30 European countries and 285 NUTS-2 regions for the periods 1993-1995, 2017-2019, and 2020-2022. Panel 1a shows an inverse relationship between GDP and infant mortality, which remains consistent across all years but has weakened over time. Compared with national-level models, regional associations are weaker and decline more rapidly, reflecting diminishing within-country economic gradients. These results suggest that economic growth has become a lesser dominant determinant of infant survival in recent decades, while other social, healthcare, and environmental factors may play a greater role. Panel 1b illustrates a similar pattern for child/adolescent mortality (ages 1-14), albeit with a weaker effect. While national differences in mortality narrowed substantially over time, regional gradients persisted, indicating that socioeconomic inequality within countries continues to shape child and adolescent health outcomes across Europe.

Conclusions and Outlook

Overall, the results highlight the role of economic development in reducing mortality, although the effect has weakened in recent decades, suggesting that other factors, such as healthcare improvements and policy interventions, may be contributing to reductions in infant, child and adolescent mortality.

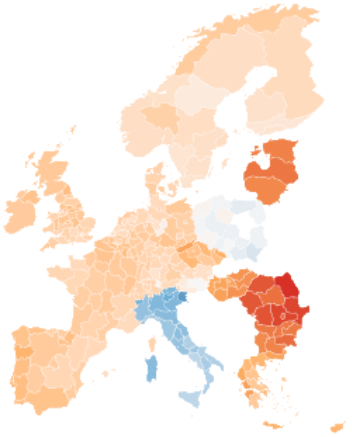
At EPC 2026, we will present extended analyses including additional socioeconomic and healthcare-related contextual variables, sex-stratified results, and estimates for older adolescents aged 15-19 years, based on updated data through 2023. These additions will allow for a more comprehensive assessment of inequalities in infant, child and adolescent mortality across Europe.

Figure 1: Spatial variation in infant mortality (< 1 year) per 1,000 population and child mortality (1-14 years) per 100,000 population across 285 regions in 30 European countries (NUTS-2 level); both sexes combined

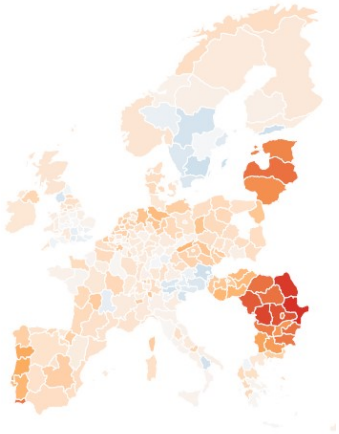
1a) Infant mortality (< 1 year)

1b) Child/adolescent mortality (1-14 years)

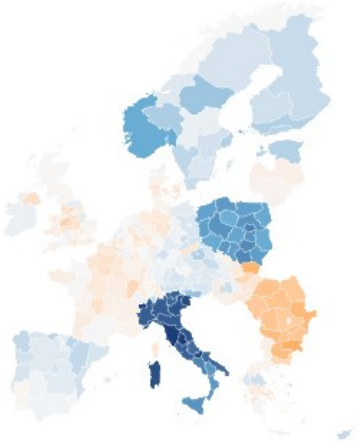
1993-1995



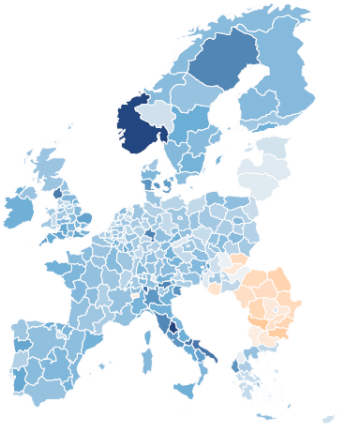
1993-1995



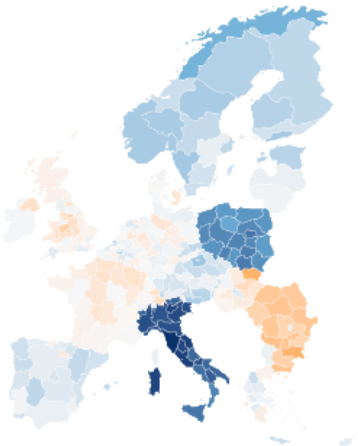
2017-2019



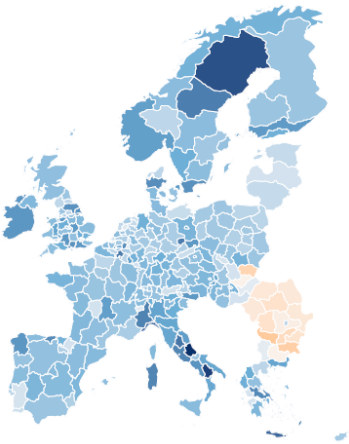
2017-2019

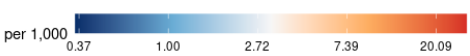


2020-2022



2020-2022



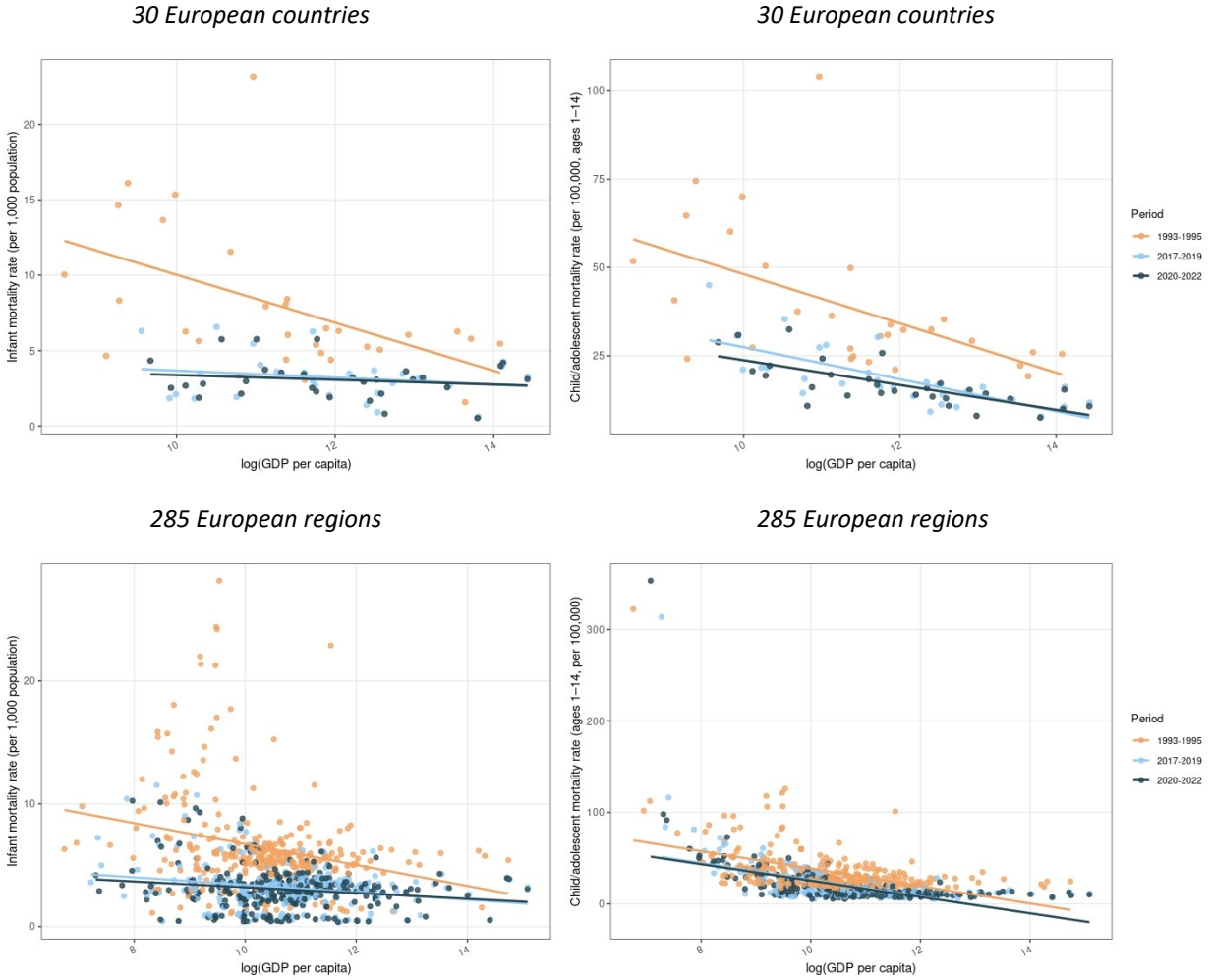


Source: Own calculations based on official mortality data from respective national statistical offices.

Figure 2: Infant mortality (< 1 year) per 1,000 population and child mortality (1-14 years) per 100,000 population regressed on GDP across 30 European countries and 285 regions (NUTS-2 level); both sexes combined; 1993-2022

1a) Infant mortality (< 1 year)

1b) Child/adolescent mortality (1-14 years)



Source: Own calculations based on official mortality data from respective national statistical offices.

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