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# **Are migration patterns and mortality related among European regions?**

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## **Abstract**

Geographical inequalities in mortality across Europe may be influenced by selective migration patterns between regions. The relationship between age- and sex-standardised death rates, 2008-2010, and population change resulting from migration 2000-2010, was analysed in 250 'Nomenclature of Statistical Territorial Units' (NUTS) level 2 regions in 26 European countries. Across Europe death rates were significantly higher in regions experiencing population loss. This association continued after adjustment for 2005 household income among all regions. This analysis suggests migration could contribute to Europe's persistent inequalities in mortality, and highlights the problems of Eastern regions with the worst health, lowest incomes and declining populations.

## **Key words**

Mortality rates, area analysis, migration, population spatial distribution, East and West Europe

## Introduction

Despite efforts to reduce health inequalities within Europe, since the beginning of the 1990s regional inequalities in life expectancies have remained broadly stable, and increased among males within Eastern Europe(1). Migration could be one factor contributing to spatial differences in mortality within Europe(2-4) as more and less healthy populations may have distinct migration patterns. This possibility is supported by analysis of net population change over ten years in municipalities and districts in Spain(5), 20 years in local authority districts in the UK(6, 7) and municipalities in Sweden(8), and 40 years in communes and cantons in France(9). These studies found a strong ecological association between death rates and population change, with higher death rates in areas with shrinking populations.

The relationship between population change and death rates has, however, not been assessed across Europe as a whole(2). Migration could be of growing significance to health inequalities in Europe because the substantial expansion of the European Union (EU) has increased rights to free movement within the continent(10). The largest single expansion of EU population took place in May 2004 when the EU grew from 15 to 25 member states with the accession of seven former Eastern Bloc countries (Estonia, Czech Republic, Hungary, Latvia, Lithuania, Poland and Slovakia), plus Cyprus, Malta and Slovenia. Furthermore, since 2007 some European countries have experienced significant new migration trends following the global financial crisis(10).

This short report considers 'migratory population change' - net change in population size resulting from migration - across the regions of Europe. It assesses if there is an association between migratory population change and death rates, whether any relationship is independent of area socioeconomic status, and compares Eastern and Western European regions.

## Methods

'Nomenclature of Statistical Territorial Units' geography level 2 (NUTS2 2010) areas were used for the analyses. All NUTS2 regions for which data could be obtained from Eurostat were included, with the exception of regions that were not situated in the European mainland or had very small populations (Åland, Ceuta, Melilla, the Canary Islands, Madeira, the Azores and the French overseas territories).

In total 250 NUTS2 regions in 26 countries were analysed (regional population in millions, annual average 2008-2010: minimum=0.13; maximum=11.72; mean =1.90; standard deviation=1.56). The analyses included 196 regions in 16 'Western' countries (Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden and UK, excluding Scotland) and 54 regions in 10 'Eastern' countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia).

Age- and sex-standardised death rates per 100,000 were obtained for the most recently available three year average period, 2008-2010. Proportional net change in population resulting from migration was calculated for 2000-2010 using total population in 2000 and 2010 (at 1 January) and annual data for births and deaths. Population change was considered over ten years as this was sufficient to capture a significant period of migration while short enough to ensure that data were available for most European regions. Socio-economic status was represented by primary income of private households in 2005 (mid-way through the migratory period). This was estimated using Purchasing Power Consumption Standard units per capita to allow for comparison between countries. Up to two years of missing data for births, deaths, population and income were imputed using straight line estimates.

The relationships between death rates and migration were first described by Pearson's correlations and then linear regression models, adjusted for income. Analyses were weighted using average population, 2008-2010.

## Results

The regions with highest death rates, 2008-2010, were concentrated in Eastern countries, in particular Bulgaria and Romania (Figure 1). The highest rates of population loss due to migratory change, 2000-2010, were also found in regions of Bulgaria and Romania and in the former German Democratic Republic regions of Sachsen-Anhalt, Mecklenburg-Vorpommern and Thüringia, and Northern French regions of Nord-Pas-de-Calais and Champagne-Ardenne. Death rates and migratory change were significantly negatively correlated ( $p < 0.001$ ), with Pearson's  $r$  of -0.487, -0.530 and -0.346 for all, East and West regions respectively.

The linear regression model, containing migratory change and household income, for all European regions combined, suggested that across European regions there was a significant and independent association between migration and standardised death rates ( $p < 0.001$ ), with a coefficient of -0.258. This indicated that for every 1% migratory loss of population there were 11.4 more deaths per 100,000. The coefficient for migration was, however, much smaller than the -0.707 found for income. In the Western regions' model the migration and income variables had similar significant coefficients of -0.354 and -0.333 respectively. In contrast, among the Eastern regions the association between migration and death rates was not statistically significant (coefficient= 0.045), but there was a strongly significant coefficient for income of -0.726.

## Discussion

Across regions of Europe after adjustment for income there was a strong association between migratory population change (2000-2010) and death rates (2008-2010) which suggests that migration could contribute to the well-established regional health inequalities(1). These findings were consistent when Europe was considered as a whole and also *within* the group of Western European regions. Hence, the association between mortality and migration is not driven solely by East-West differences in these variables. This relationship between migration and mortality may result from health selective patterns of migration. It could also indicate that population loss has contextual effects upon health, damaging social relationships and services that support well-being(4, 6, 7).

Eastern regions account for most of the areas of Europe with the highest death rates, lowest incomes and greatest population loss. An independent association between migration and population change was not found amongst these regions but income was strongly associated with death rates. This suggests that while the recent expansion of the EU has increased population decline in some East European regions(10) it is low income(4) which continues to drive poor health. Among these regions low income may also underlie population loss, which in turn could have important socio-economic consequences. It is notable however that while immigration has long been prominent within international political debates regarding EU policy the problems of sender countries, experiencing the combined effects of low income, high rates of emigration and poor health, have received less attention.

The analyses were limited by the availability of European-wide regional data. While NUTS2 regions are intended to contain approximately similar population significant variation remains. As migratory change was considered only over ten years the full impacts of migration upon population health will not have been captured. In particular, some East European countries, such as Romania and Bulgaria, have experienced major population decline since the end of communism in the early 1990s(10).

Population data error are likely to be significant in regions with substantial migration. The 'independent' associations found between migration and death rates may reflect residual socio-demographic confounding. More detailed European data describing the health characteristics of in- and out-migrants and the impacts of population loss upon the social determinants of health would aid understanding of these relationships.

This short report is the first to describe the association between migratory population change and death rates across the regions of Europe. It suggests migration could contribute to the persistent inequalities in mortality across Europe, and highlights the acute problems of Eastern regions with the worst health, lowest incomes and declining populations.

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## **Conflicts of interest**

The authors declare they have no conflicts of interest.

## **Key points**

- Among 250 European regions population loss 2000-2010 was correlated with higher death rates, 2008-2010.
- The association between migration and mortality was independent of household income among all European regions and Western regions but not among Eastern areas.
- In Eastern Europe low income may drive both high mortality and migration patterns; population loss in turn may reinforce economic disadvantage.
- Migration patterns could contribute to the persistent inequalities in death rates across Europe.
- Policies to reduce health inequalities within Europe should address the potential impacts of population loss upon health.



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Figure 1. Age- and sex-standardised death rates, 2008-2010 and percentage migratory change

2000-2010



