Mortality in the Visegrad countries from the perspective of socioeconomic inequalities.

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Abstract

Objectives: Large socioeconomic inequalities in health are still present in the Central Europe. The aim was to explore socioeconomic inequalities in mortality in Visegrad countries – Czech Republic, Hungary, Poland and Slovakia (V4), by three different socioeconomic indicators (unemployment, risk of poverty/social exclusion, education). The study was conducted within the H2020 Euro-healthy project.
Methods: The associations between selected socioeconomic indicators and the standardized mortality rates by four main causes (mortality related to cancer, circulatory, respiratory and digestive system) in the active population aged 20–64 years in the 35 NUTS 2 regions of the V4 in the period 2011–2013 were explored, using linear regression models.
Results: Lower education level was the most significant predictor of mortality in the V4. The lowest mortality rates by all causes of death were found in the regions of Czech Republic, the highest in regions of Hungary.
Conclusions: Despite the common origin, the pathways of the V4 countries in employment, poverty and education seem to be different, also having impact on health equity. Therefore, where you live in the V4 can significantly influence your health.

Keywords: health equity; measurement; mortality; socioeconomic inequalities, ecological design, regional differences

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Introduction

Despite all the efforts to combat them, health inequalities constantly present a major public health concern (Bouchard et al. 2015), as large gaps in health still persist among EU countries and their regions (Santana et al. 2017). Inequalities often go beyond the existence of differences in the health status of populations (Bouchard et al. 2015). Inequalities in health are not only those of genetic and biological or constitutional and lifestyle nature (Bosakova 2013). Socioeconomic differences also play an important role regarding health inequalities (Marmot 2010). People with low social status, wealth and education often die earlier than those who are better off and better educated (Cutler et al. 2006). Socioeconomic differences in health reflect and are caused by social and economic inequalities in society (Marmot 2010). They arise because of increasing inequalities in daily life conditions, which reflect unequal access to resources, money and power (CSDH 2008). Thus, inequalities in health are not completely inevitable and might be significantly reduced through effective addressing of other types of socioeconomic inequalities. In order to achieve this, socioeconomic inequalities need to be better understood (Bosakova 2013).

Over a period of just 15 years, the so-called Visegrad countries (Czech Republic, Hungary, Poland and Slovakia) (V4) transitioned from state socialism to membership in the EU (Balaz et al. 2016). It was expected that significant market reforms and structural changes in healthcare and social security systems since 1989 will bring these countries closer to health and health related outcomes seen in Western Europe. However, gap in health inequalities between western and eastern European countries persists (Santana et al. 2017; Mackenbach et al. 2013). Moreover, large inequalities in health are still present in most of European countries (Santana et al. 2017).

Although the origin of these countries is common, they seem to have different pathways regarding socioeconomic indicators (Skamlova Malikova et al. 2015). When comparing them with each other, unemployment is highest in Slovakia, the risk of poverty in Hungary and Poland and education the worst in Hungary, while Czech Republic is performing relatively well in all the studied variables (Euro-healthy 2017; Santana et al. 2017). These circumstances might have an impact on health inequalities in and among these countries. However, there are significant gaps in the literature for research on this topic (Vandenheede et al. 2014; Kunst 2009).

There exist only partial studies examining only one country (Scheiring et al. 2017), one socioeconomic indicator (Halliday 2013), using other socioeconomic measures (Vandenheede et al. 2014), one specific cause of mortality (Bandosz et al. 2012), or only all-cause mortality (Rosicova et al. 2016). To our best knowledge, our study is the first one to perform such a comprehensive research covering all V4 countries at NUTS2 level, all-cause mortality and four most common causes of death as well as education, unemployment and risk of poverty as a three socioeconomic indicators.

The aim of the study was to analyse the associations between selected socioeconomic indicators (unemployment, risk of poverty and social exclusion, education level) and mortality by four selected causes of death (neoplasms, diseases of the circulatory system, diseases of the respiratory system, diseases of the digestive system) in the regions of Czech Republic, Hungary, Poland and Slovakia in the period 2011–2013.

Methods

This study was carried out within the Euro-Healthy project - Shaping EUROpean policies to promote HEALTH equitY (Horizon 2020 No. 643398).

Design

To study regional differences, Czech Republic was divided into 8 regions, Hungary into 7 regions, Poland into 16 regions and Slovakia into 4 regions at the regional level NUTS 2 (Nomenclature of Territorial Units for Statistics). We used an ecological design widely implemented when looking for geographical correlations between disease incidence or mortality and the prevalence of risk factors whereas the unit of observation is the population or community (Coggon et al. 2003).

Study Population

The study population covers the inhabitants of V4 (Czech Republic, Hungary, Poland and Slovakia). The V4 was established, based on long shared history, during the meeting of leaders from Czechoslovakia, Hungary and Poland in the Hungarian town of Visegrád in 1991 for the purposes of furthering their European integration, and for advancing military, economic and energy cooperation with one another. After the dissolution of Czechoslovakia in 1993, Czech Republic and Slovakia became independent members of the group, increasing the total number of members to four. Today, it is a cultural and political alliance of four Central European states –

Czech Republic, Hungary, Poland and Slovakia. All four members of the V4 joined the EU in 2004.

We selected inhabitants aged 20–64 years in the period 2011–2013. This age group is primarily the economically active population integrated into the labour market, has the relatively lowest mortality rate, has already finished the process of education and receives certain income, either as a salary or as social security benefits.

The average number of inhabitants aged 20-64 years per year in Czech Republic was 6,716,207 people, in Hungary was 6,234,963 people, in Poland was 24,662,218 people and in Slovakia was 3,545,193 people. The average number of deaths among this age group was 22,894 deaths in the Czech Republic, 32,599 deaths in Hungary, 108,494 deaths in Poland and 14,091 deaths in the Slovakia.

Data

Mortality data

The mortality data consist of absolute population numbers and numbers of deaths by the four most common selected causes of death (neoplasms, diseases of the circulatory system, diseases of the respiratory system, diseases of the digestive system) in the regions of Czech Republic, Hungary, Poland and Slovakia aged 20–64 years in the period 2011–2013 and were obtained from Eurostat (Eurostat 2017a).

Socioeconomic data

The long-term unemployment rate, social exclusion and the proportion of population with lower secondary education attainment in a region were used as socioeconomic indicators associated with mortality. All indicators were calculated for each region in the period from 2011–2013.

The long-term unemployment rate (12 months or more) was expressed as the proportion of the number of unemployed persons aged 15-74 years seeking a job for longer than one year to the total number of persons in the labour market (both employed and unemployed). Social exclusion (proportion of people at risk of poverty or social exclusion) was expressed as the proportion of persons who are at risk of poverty (have an equivalised disposable income below 60% of the national median equivalised disposable income after social transfers), severely deprived materially (enforced inability to pay for at least four of the following items: to pay their rent, mortgage or utility bills / to keep their home adequately warm / to face unexpected expenses / to eat meat or proteins regularly / to go on holiday / a television set / a

washing machine / a car / a telephone) or living in households with very low work intensity (worked less than 20% of their potential during the past year) to the total population. Lower education level was expressed as the proportion of the number of persons aged 25-64 years who completed lower secondary level of school (ISCED 2011 levels: 0 to 2) to the total number of persons aged 25-64 years. All the data were obtained from the databases of the EURO-HEALTHY project (Euro-healthy 2017) and long-term unemployment rate also from Eurostat (Eurostat 2017b).

The description of the mortality and socioeconomic data for V4 are given in Online Resource 1 (ESM_1).

Measures of mortality

Using regional mortality data, the standardised mortality rate (SMR) was calculated. For each region the mortality by 5-year age-groups (from under 5 to the age-group 60-64 and the mortality rate aged 20-64 years were calculated. Regional mortality rates were standardised by a direct method of standardisation using the European standard population (defined by Eurostat in 2012) as the standard. Mortality rate is expressed as the number of deaths per 100,000 inhabitants.

Statistical analysis

Linear regressions were applied: SMRs were used as the dependent variables in five separate regression models; the long-term unemployment rate, the proportion of people at risk of poverty or social exclusion and the proportion of population with lower secondary education attainment were set as independent variables (factors). The crude effect of all factors was analysed. To take into account the potential spatial correlation we defined the contiguity matrix of neighbour regions and we ran the Moran test in all models to determine whether the residuals of a model are correlated based on this contiguity matrix. The test showed significant spatial correlation in all-cause, neoplasms and digestive system mortality models. In these cases, we ran the spatial autoregressive regression model with spatially autoregressive errors. We used the maximum likelihood method of estimation since the residuals were statistically significantly normally distributed. In the case of circulatory and respiratory system mortality models standard linear regression was used and the residuals were checked for normality assumption. Only the circulatory system mortality model had a problem with normality, which was caused by the outlying observation from PL34 region. However, the model including this observation is reported in the final table, since the

significance of the coefficients did not change after its omitting. The regression models were checked for collinearity. The F-test was used to check changes in the coefficients.

Analyses were done using SPSS and Stata 15.

Maps

Maps were constructed using the regional SMRs and data by socioeconomic indicators. The range of the indicators on the maps was divided into quartiles.

Maps were created using ArcView.

Results

Mortality

Regional differences in the all-cause mortality and mortality by four selected causes of death (aged 20-64 years) in regions of the V4 are shown in Figures 1–5. The all-cause mortality in the V4 regions ranged from 278.8 to 608.4 deaths per 100,000 inhabitants; neoplasms mortality ranged from 102.8 to 218.2 deaths per 100,000 inhabitants; circulatory system diseases mortality ranged from 73.6 to 187.1 deaths per 100,000 inhabitants; respiratory system diseases mortality ranged from 12.0 to 34.5 deaths per 100,000 inhabitants; and the digestive system diseases mortality ranged from 19.1 to 65.1 deaths per 100,000 inhabitants. The Czech regions are among those with the lowest mortality by all causes of death. In contrast, regions of Hungary are among those with the highest mortality rates (Figure 1–5).

--Figure 1, 2, 3, 4, 5 about here –

Linear regression

Table 2 presents the results of spatial autoregressive (for all-cause mortality, neoplasms mortality and digestive system diseases mortality) and linear regression models (circulatory system diseases mortality and respiratory system diseases mortality). The first model explained 73.1% of the variance of all-cause mortality, the second 75.7% for neoplasms, the third 72.8% for circulatory system diseases, the fourth 71.3% for respiratory system diseases and the fifth 39.6% for digestive system diseases. Long-term unemployment rate was significantly associated only with respiratory system diseases mortality. The proportion of people at risk of poverty or social exclusion showed a significant effect on circulatory and respiratory system diseases mortality. The proportion of population with lower secondary

education attainment showed a significant effect on the all-cause mortality and on mortality by all four selected causes of death.

--Table 1 about here--

Discussion

We analysed the associations between selected socioeconomic indicators and the SMRs by four main causes of death in the regions of Czech Republic, Hungary, Poland and Slovakia in the period 2011–2013.

We found a strong relationship between mortality and socioeconomic variables in V4 regions. Unemployment had a significant impact on respiratory system diseases mortality. A higher proportion of people at risk of poverty and social exclusion contributed to mortality related to the circulatory and respiratory systems. Lower education level was significantly associated with the all-cause mortality as well as on mortality by all four selected causes of death. Overall, the lowest mortality rates by all causes of death were found in the regions of Czech Republic, whereas regions of Hungary showed the highest mortality rates.

Associations between the mortality and socioeconomic variables in V4

Based on our knowledge, no comprehensive study exists that examines all V4 countries by the four most common causes of mortality and by unemployment, risk of poverty and education at the same time. Thus, comparing and interpreting our findings is a challenge, as previous studies are rather partial, mainly focused on one country (Scheiring et al. 2017), on one socio-economic indicator (Halliday 2013), using other socioeconomic measures (Vandenheede et al. 2014) or one specific cause of mortality (Bandosz et al. 2012).

Regarding unemployment, our study did not show any relationship with total SMR, which is in accordance with study of Svensson (2010) but is in contrast with research suggesting that higher unemployment is associated with higher mortality risk (Clemens et al. 2015) and with research which did find a decrease in mortality due to higher unemployment (Granados 2011). Our results may indicate that the effect of unemployment could be reflected in increased mortality over a longer period of time (Avendano and Berkman 2014) and that analysis of smaller territorial units would probably show more significant relationships. Further, our study showed a strong association between unemployment and respiratory system diseases mortality. As regards cause-specific mortality, we did not find any study suggesting similar or adverse results. Stress and lack of resources related to unemployment and smoking as a coping strategy might be

possible explanations for higher levels of respiratory related deaths. Furthermore, unemployment is more likely to occur among individuals from poorer socio-economic backgrounds, so the deleterious health effects associated with poverty may be responsible for the increase in mortality risk rather than any effects caused by the unemployment itself (Bartley et al. 2006). The effects and circumstances accompanying unemployment should be seriously considered when tackling health inequalities in the V4.

In our study, a higher proportion of people at risk of poverty and social exclusion contributed to the mortality related to the circulatory and respiratory systems. Our results might support studies suggesting that respiratory diseases are most often a link between poverty and poor health due to overcrowded and poor living conditions and/or using of open fires or traditional stoves (Stevens 2004; Healthy Power Action 2017), and also research showing that a significant share of the world's deaths related to the circulatory system occur in low- and middle-income countries and that the poorest people are the most affected (WHO 2017). Our results confirmed that despite all the efforts made up to now health inequalities caused by poverty still persist in the V4 and should present a major public health focus.

Education was found to be significantly associated with mortality rates by all causes in our study. This is in accordance with the study of Dégano et al. (2017) demonstrating that lower level of education is associated with higher risk for cardiovascular disease; as well as with the study of Murphy et al. (2006) documenting a sharp increase in educational-level mortality differentials in the Russian Federation between 1980-2001 in favour of well-educated individuals; the study of Mackenbach (2006) indicating that life expectancy is higher among those with higher education; and the study of Cutler et al. (2006) declaring that there is most likely a direct positive effect of education on health. Leinsalu et al. (2009), however, found a diverse or no trend for Hungary and Poland. Possible explanation of our results is that people with higher levels of education are able to protect themselves better against increased health risks and/or are able to benefit more from new opportunities for health gains (Mackenbach 2006). Education may affect health either directly, through knowledge and skills acquired, or indirectly, through its influence on future employment and income (Galobardes et al. 2007). Higher education also enables better working conditions and influences lifestyle (Rychtarikova 2004). Public health policies should pay extra attention to the education in the V4 in order to tackle health inequalities and reduce health gaps in this region.

Regional socio-economic disparities and their possible explanations

An important factor influencing regional disparities in the V4 countries is past development of mortality. In the 1960s, mortality rates in Europe were comparable. In the early 1970s, the convergence period was discontinued, when significant progress in the treatment of circulatory diseases occurred in the democratic countries (Bruthans and Bruthansova 2009). However, this progress was not captured by the Central and Eastern European countries (CEE), which led to a period of divergence and the creation of a significant gap in the life expectancy at birth between the "West and East" (Mesle 2002). In the 1980s, CEE experienced stagnation or increased mortality rates, and in the early 1990s, after the fall of communism, even a mortality crisis (Nolte et al. 2004). The rise of democracy and the associated changes led quickly to an increased life expectancy at birth and helped it approach the level of the Western countries (Zatonski 2007). The positive trend in mortality development followed by a significant increase in life expectancy first appeared in the Czech Republic in 1988. These positive trends continued in Poland, in Slovakia, and in Hungary (Mesle 2002). Overall, past development of mortality was in favour of the Czech Republic even before 1990. The opposite was observed in Hungary, mainly because of negative lifestyle trends, with the greatest improvement in mortality rates occurring only since 2000 (Kacerova and Novakova 2016).

Another important factor is the macro-localisation attractiveness, known as the West-East gradient (Kebza et al. 2015). Regions closer to the borders with the Western Europe have had since 1989 better conditions for economic and social development, and also for successful handling of the transformation process or critical economic development than regions in the east. The West-West regions of the V4 countries have therefore been able to revive faster than those in the east. From this point of view, Czech Republic, neighbouring with developed EU countries (Germany, Austria) and adjacent to the economically developed regions of Slovakia and Poland, has the best starting position. This is reflected in the lower differences between Czech regions and higher quality of life (faster transition of investments, innovation and developmental impulses). The effects of regional development also extend beyond the national borders of Czech Republic and penetrate mainly into the other border regions of the V4 countries. Gradually, the intensity of developmental effects towards the middle and eastern parts of the V4 region weakens, and regions can be assessed as stagnant. Thus, most of the undeveloped regions copy the eastern borders of the V4, especially the Hungarian, Polish and Slovak regions, in contrast with the most developed regions which are located in Czech Republic (Kebza et al. 2015).

Another factor is the structure and character of the settlement network, i.e. the urbanization of the territory. Core regions of the V4, which are in all cases the regions of capitals and also regions with cities of supra-regional importance, might be considered as epicentres of regional

development. The regions where large cities are located or where such centres are evenly distributed in the territory are more developed. These developed areas have greater accessibility and quality of service, which has a significant impact on the quality of life of the population as well as mortality rates and patterns (Santana et al. 2017). The absence of a sufficient number of large centres in the regions promotes the widening of regional disparities. This situation is characteristic particularly for the less developed regions of Slovakia. We can see it even more markedly in the Hungarian regions located east of Budapest (Kebza et al. 2015).

To summarize the differences in mortality between Czech Republic and Hungary, we can conclude that Czech Republic has been a champion among V4 countries and is doing well in all studied variables (Kiss 2015). Since the collapse of the socialist system at the beginning of the 1990s, the health situation in Czech Republic has improved faster than in other CEE countries. The recent favourable turnover has currently brought Czech Republic a little closer to the European average (Rychtarikova 2004). Although we can find many parallels among V4 countries (harmonious post-crisis growth trends, narrowing of the development gap, representation of common interests at the EU level, integration into global value chains, public finance stabilization, improvement of several macroeconomic indicators, etc.), there are substantial differences that might cause regional and country inequalities (non-adherence to the euro area except for Slovakia, different approaches and attitudes towards EU governance changes, insufficient interconnectedness of infrastructure networks, differences in educational systems, etc.) (Herbst 2014; Kiss 2015). Health equity policies within the V4 countries seem to be adequately anchored in strategic documents and plans; however, the actual practice in their implementation varies largely, and the results of many projects tackling health inequalities will become visible in the next ten years, if not later.

Strengths and limitations of the study

The strength of our study is that it fills the gap in spatial studies exploring the impact of political and economic changes on inhabitants and their health, which is still substantially lacking in the available literature sources. The unavailability of data for lower territorial units, which would allow us to provide even more accurate results might be seen as a limitation of this study.

Implications

Our results emphasise the importance of socioeconomic measures for understanding mortality inequalities and contribute to the studies suggesting that poor socioeconomic conditions pose health risks. The identified associations highlighted the fact that inequalities in socioeconomic

status may reflect the spatial distribution of health status in a population. The results can be used to inform prevention strategies and help plan local health promotion programs aimed at reducing health inequalities.

Results of our study suggest that unemployment should be considered in order to tackle health inequalities, mainly as regards respiratory system diseases mortality. Further, people at risk of poverty and social exclusion is also a topic which should not be omitted from public health discussions, especially in the context of circulatory and respiratory related mortality. Based on our results, education seems to be the most important issue, as regards public health. Given also its impact on unemployment and risk of poverty, we might conclude that education should be given extra attention. Public health authorities should consider actions related to the equal access to education and information; health literacy; designing curriculums for educating healthcare workers to enable them to work better with patients with low literacy, etc. These measures might help to prevent a further deepening of health inequalities.

Conclusion

Over just 15 years, the V4 countries (Czech Republic, Hungary, Poland and Slovakia) transitioned from socialist states into membership in the EU. This transition was associated with significant market reforms and structural changes in healthcare and social security systems after 1989. Despite these remarkable changes, large regional inequalities in health are still present in these countries. This is probably due to a combination of (interlinked) factors: a rise in economic insecurity and poverty; a breakdown of protective social, public health and health care institutions; and a rise in excessive drinking and other risk factors for premature mortality (Mackenbach 2006). The political and economic transition and the quality of life reflecting in mortality rates have changed dramatically in many Central European countries, sometimes for the better (e.g. in the Czech Republic) but often for the worse (e.g. in Hungary). As our results suggest, socioeconomic indicators (unemployment, risk of poverty and social exclusion, and particularly educational level) seem to be strongly associated with mortality by four selected causes of death in the regions of the V4. Despite the common origin, the pathways of Czech Republic, Hungary, Poland and Slovakia in terms of employment, poverty and education seem to be different, and also have an impact on health inequity. However, the widening of the health gap in a period of important political and economic change is not inevitable (Mackenbach 2006).
To tackle health inequalities, we need to be able to indicate those disparities that are avoidable and therefore unjust, such as socioeconomic differences in health that reflect and are caused by

social and economic inequalities in society. Thus, in order to attain health equity, it is important to perform socioeconomic measures which could be a solid base for creating and evaluating effective strategies and policies.

Compliance with ethical standards

Conflict of interest

All authors declare that they have no conflict of interest.

Ethics approval

The study was performed within the Euro-Healthy project - Shaping EUROpean policies to promote HEALTH equitY (Horizon 2020 No. 643398). The Euro-healthy project and its results are in compliance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards, fundamental ethical principles, rules and standards relevant on European legislation, international conventions and declarations, national authorizations and ethics approvals.

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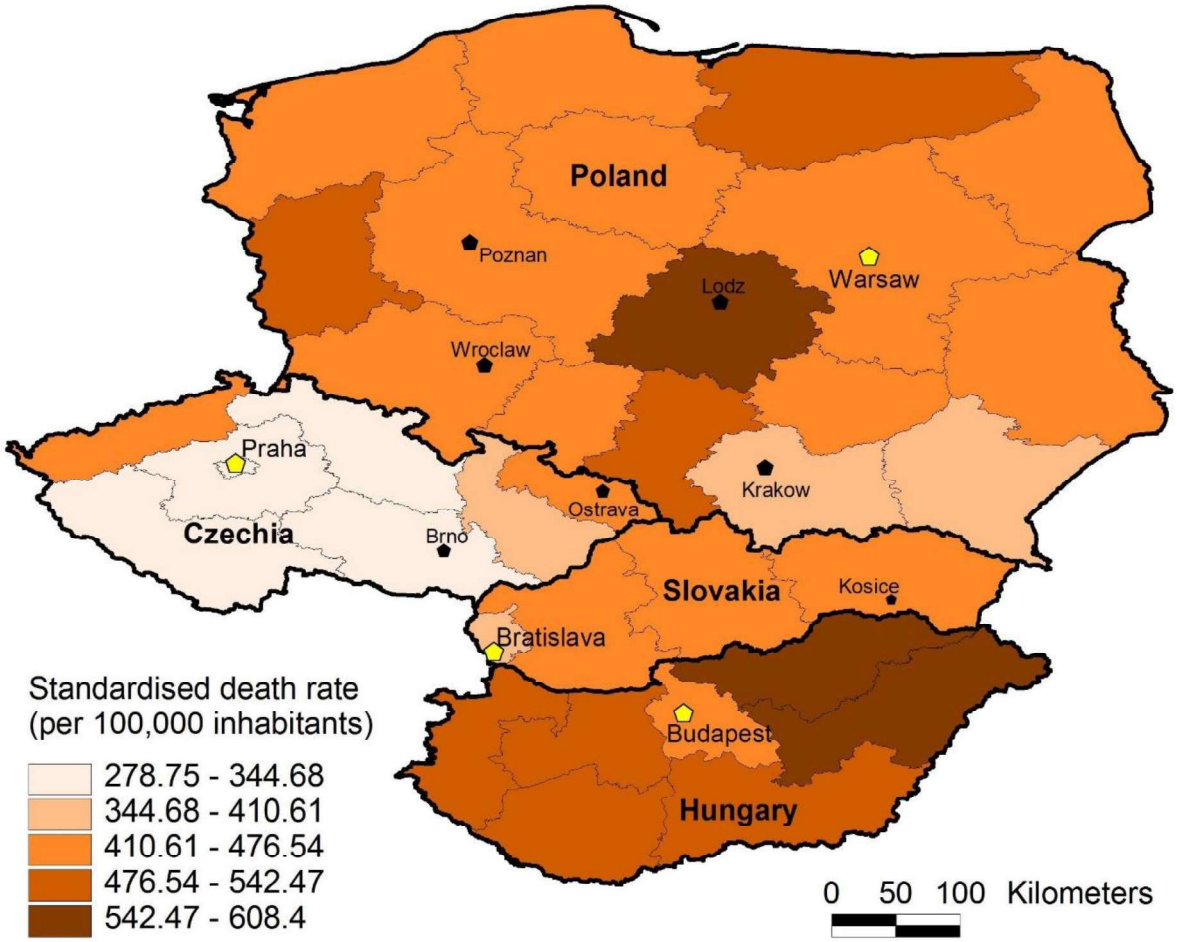
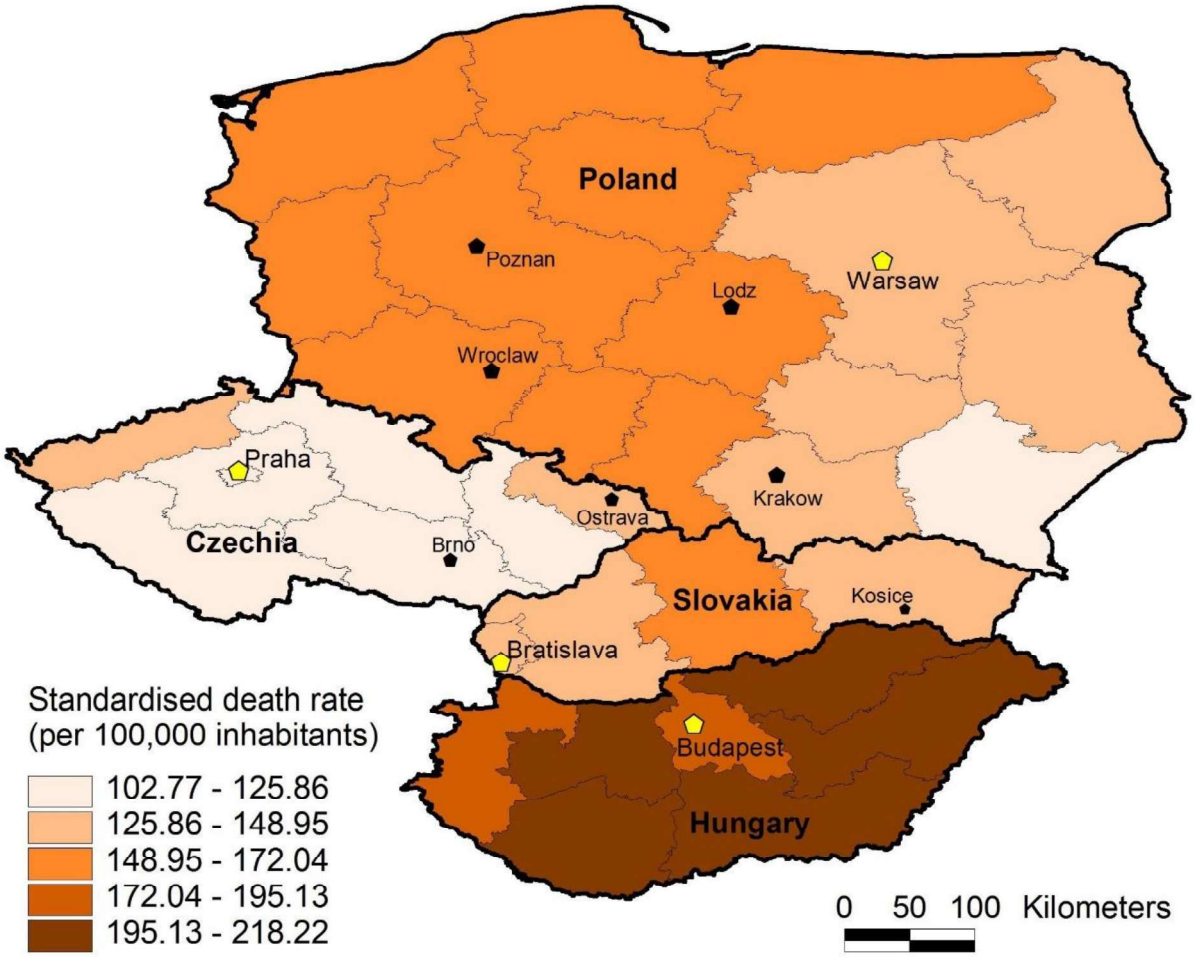
Figure 1. Standardised mortality rates in the population aged 20-64 years, in NUTS2 regions of Visegrad countries (Czech Republic, Hungary, Poland and Slovakia), 2011-2013



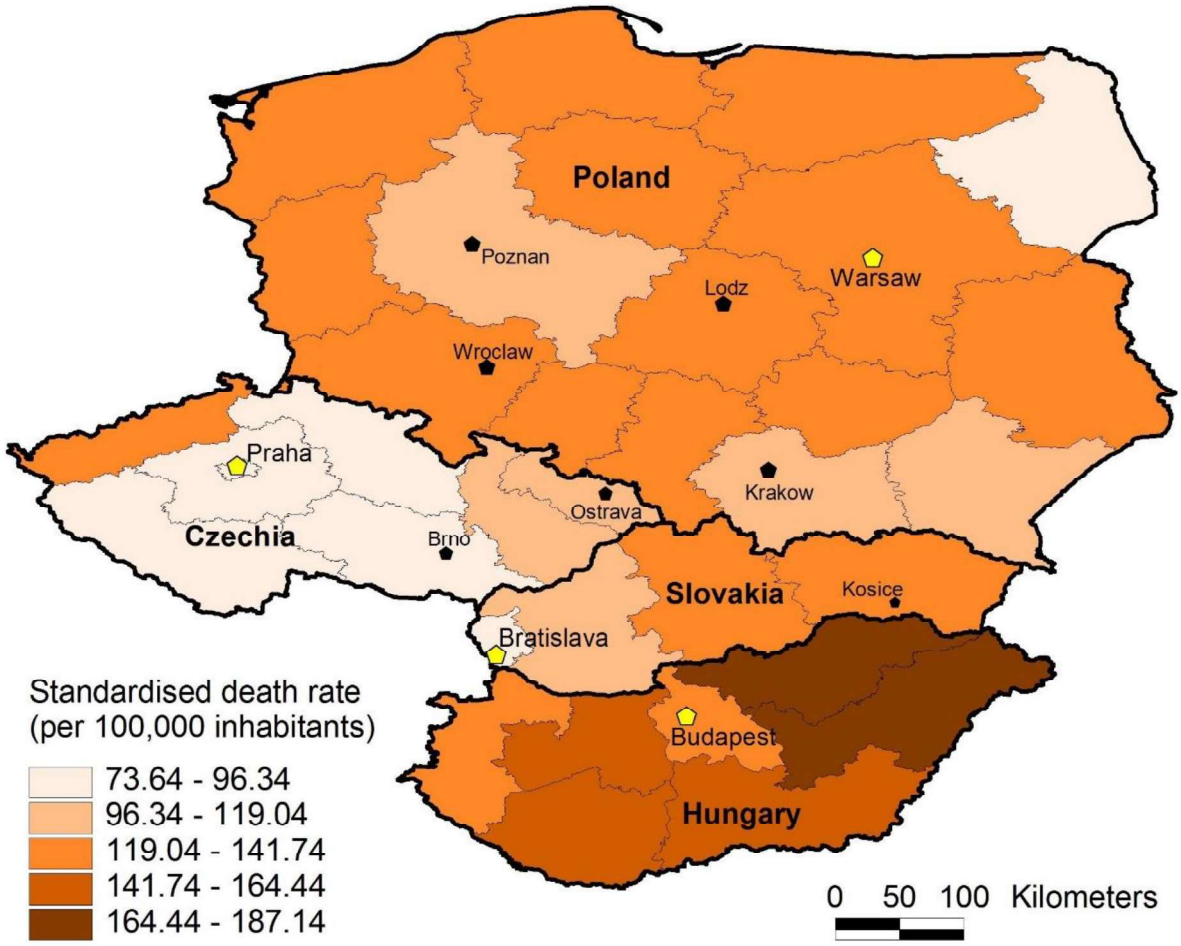
Data source: EURO-HEALTHY project, EUROSTAT
Note: NUTS2 - Nomenclature of territorial units for statistics, 2 - basic regions for the application of regional policies

Figure 2. Standardised mortality rates for neoplasms in the population aged 20-64 years, in NUTS2 regions of Visegrad countries (Czech Republic, Hungary, Poland and Slovakia), 2011-2013



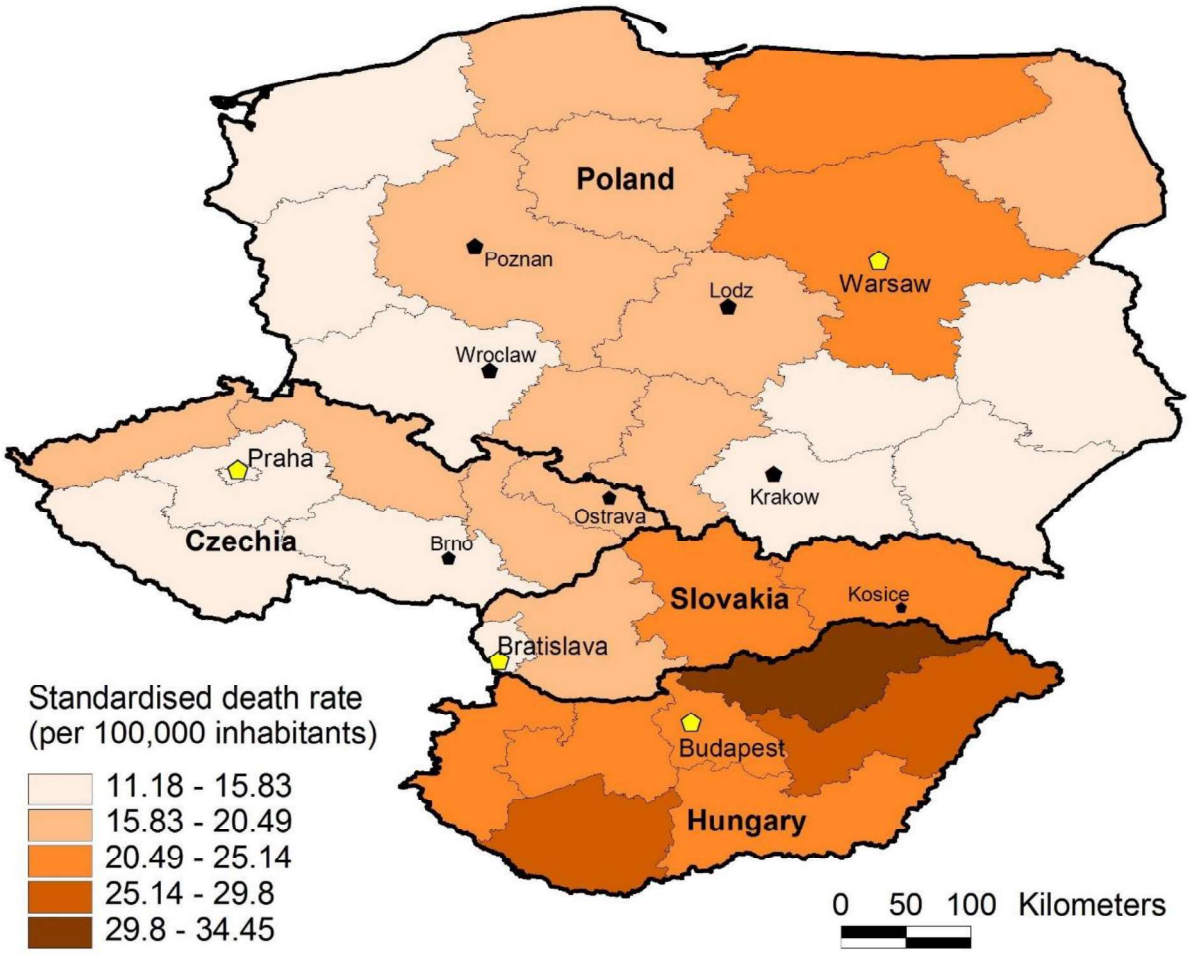
Data source: EURO-HEALTHY project, EUROSTAT
Note: NUTS2 - Nomenclature of territorial units for statistics, 2 - basic regions for the application of regional policies

Figure 3. Standardised mortality rates for circulatory system in the population aged 20-64 years, in NUTS2 regions of Visegrad countries (Czech Republic, Hungary, Poland and Slovakia), 2011-2013



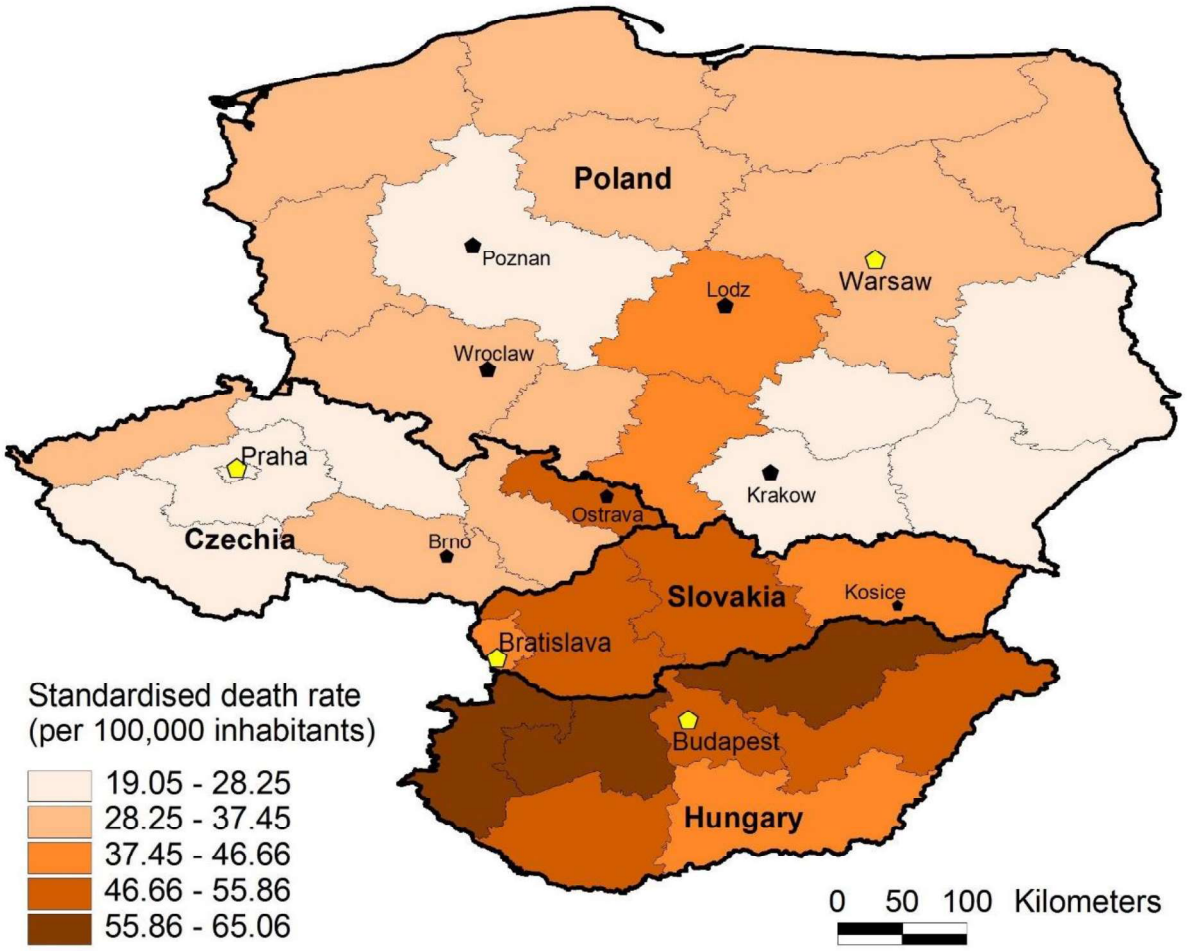
Data source: EURO-HEALTHY project, EUROSTAT
Note: NUTS2 - Nomenclature of territorial units for statistics, 2 - basic regions for the application of regional policies

Figure 4. Standardised mortality rates for respiratory system in the population aged 20-64 years, in NUTS2 regions of Visegrad countries (Czech Republic, Hungary, Poland and Slovakia), 2011-2013



Data source: EURO-HEALTHY project, EUROSTAT
Note: NUTS2 - Nomenclature of territorial units for statistics, 2 - basic regions for the application of regional policies

Figure 5. Standardised mortality rates for digestive system in the population aged 20-64 years, in NUTS2 regions of Visegrad countries (Czech Republic, Hungary, Poland and Slovakia), 2011-2013



Data source: EURO-HEALTHY project, EUROSTAT
Note: NUTS2 - Nomenclature of territorial units for statistics, 2 - basic regions for the application of regional policies

Table 1. Spatial autoregressive and linear regression models of mortality and selected socio-economic indicators in NUTS2 regions of the Visegrad countries (Czech Republic, Hungary, Poland and Slovakia), 2011–2013

Socioeconomic indicators	**All-cause mortality**		**Neoplasms mortality**		**Circulatory system diseases mortality**		**Respiratory system diseases mortality**		**Digestive system diseases mortality**	
	Coefficients	Sig.	Coefficients	Sig.	Coefficients	Sig.	Coefficients	Sig.	Coefficients	Sig.
Long-term unemployment rate - 12 months or more (%)	4.99	ns	0.444	ns	1.362	ns	0.568	p<0.05	0.865	ns
People at risk of poverty or social exclusion (%)	2.27	ns	0.810	ns	1.40	p<0.05	-0.244	p<0.05	-0.061	ns
Population aged 25-64 years with lower secondary education attainment (%)	8.14	p<0.001	2.83	p<0.001	2.09	p<0.05	1.001	p<0.001	0.752	p<0.05
spatial autocorrelation parameter ρ	0.595	p<0.01	0.854	p<0.001	-	-	-	-	0.827	p<0.001
Pseudo R^2	**0.731**		**0.757**		**0.728**		**0.713**		**0.396**	

ns - not significant ; R2 - explained variance

Data source: EURO-HEALTHY project, EUROSTAT
Note: NUTS2 - Nomenclature of territorial units for statistics, 2 - basic regions for the application of regional policies