

A country divided? Regional variation in mortality in Ukraine

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Abstract

Objectives We set out to identify the contribution of various causes of death to regional differences in life expectancy in Ukraine.

Methods Mortality data by oblast (province) were obtained from the State Statistical Committee of Ukraine. The contribution of various causes of death to differences in life expectancy between East, West and South Ukraine was estimated using decomposition.

Results In 2008, life expectancy for men in South (61.8 years) and East Ukraine (61.2 years) was lower than for men in West Ukraine (64.0 years). A similar pattern

was observed among women. This was mostly due to deaths from infectious disease and external causes among young adults, and cardio- and cerebro-vascular deaths among older adults. Deaths from TB among young adults contribute most to differences in life expectancy.

Conclusions Deaths due to infectious disease, especially TB, play an important role in the gap in life expectancy between regions in Ukraine. These deaths are entirely preventable—further research is needed to identify what has ‘protected’ individuals in Western Ukraine from the burden of deaths experienced by their Southern and Eastern counterparts.

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Introduction

In the past two decades there has been a substantial expansion in research seeking to understand the east–west health divide in Europe (Brainerd and Cutler 2005; Bobak and Marmot 1996; Vagero 2010). Yet the settings for this research have been somewhat uneven with almost all studies focusing on Russia and the three Baltic states. The limited research on Ukraine focuses on the country as a single entity (Cockerham et al. 2005; Gilmore et al. 2002; Lipsitz 2005; Meslé and Vallin 2003), even though, in some ways, it can be seen as a microcosm of Europe, combining elements of both east and west (Wilson 2002).

Ukraine’s current situation reflects its history, having previously been divided between the Russian, Austro-Hungarian, and Turkish empires and the Kingdom of Poland (Wilson 2002). Ethnically very mixed prior to World War II, displacements of population then and

subsequently have created a country that can be thought of as being divided into an eastern, industrialised part with the highest population density and large numbers of ethnic Russians (Shulman 1999), a western, traditionally agrarian part (Yekelchik 2007) now peopled largely by ethnic Ukrainians (some of which was annexed by the USSR only in 1946) (Reid 2003), and an ethnically diverse Southern part, which relies economically on agro-industry as well as tourism and recreation, and which includes the Crimea, an autonomous republic that only became part of Ukraine in 1954. The three parts differ in various ways, including their sense of identity (with Russia or Europe), religion, language, customs, and to some extent political persuasion (IDDS 2005).

They also differ in terms of health. In 2009–2010, the latest years for which data are available, life expectancy differed by approximately 4.9 years for men, and 4.4 years for women, between Eastern and both Southern Ukraine and Western Ukraine (Derzhkomstat 2012). This is consistent with observations on major risk factors, such as alcohol consumption, (Bromet et al. 2005; Webb et al. 2005; Levchuk 2011) smoking, (Gilmore et al. 2001; Levchuk 2011) illegal drug abuse (Hamers and Downs 2003; Lekhan et al. 2006; Levchuk 2011) and risky sexual behaviour (Lekhan et al. 2006), all of which are more common in the South and East of Ukraine than in the West, findings mirrored by the few studies of specific causes of death such as infectious disease and violent deaths (Hamers and Downs 2003; Lekhan et al. 2006; Kondrichin and Lester 2002; Stickley and Makinen 2005).

Yet while this earlier work, collectively, provides many insights into patterns of health in Ukraine, there has been no attempt to look systematically at the changing health divide in this complex country. In this paper, we use previously unpublished data from the State Statistical Committee of Ukraine (Derzhkomstat) to examine variation in life expectancy among men and women of different age groups in three broad regions of Ukraine (East, West and South) and the contribution of different causes of death to this variation.

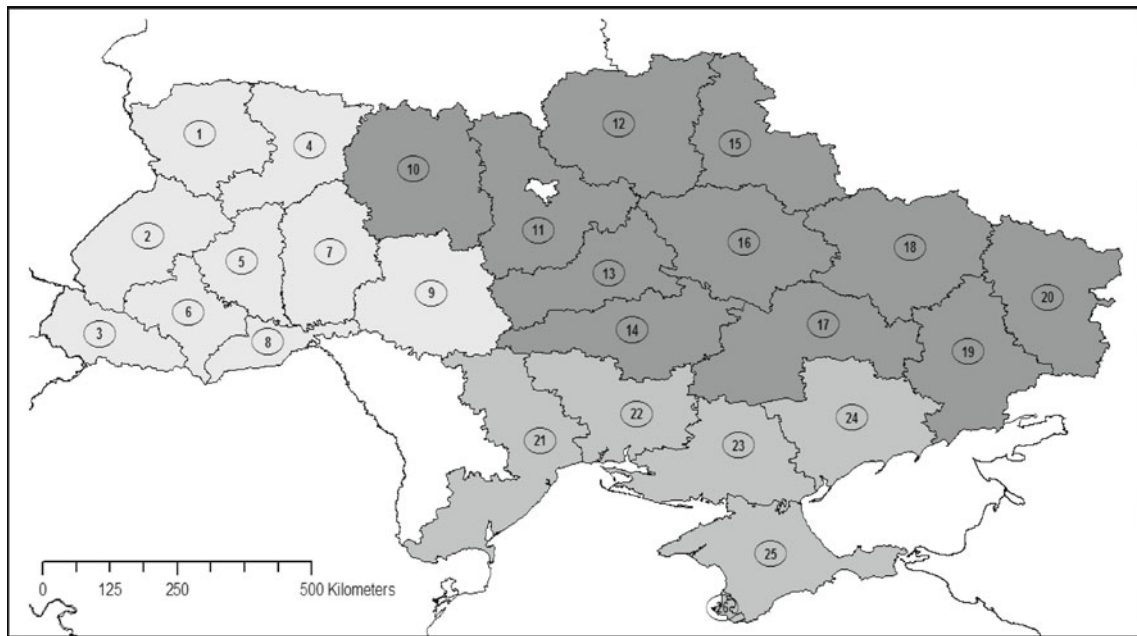
Methods

All-cause age standardised mortality rates (ASMRs) (standardised to the European Standard Population) by oblast (province) in 1990, 1995, 2000 and 2008, as well as cause-of-death data by oblast for the same years were obtained from the State Statistical Committee of Ukraine, the national agency responsible for the collection and dissemination of statistics. These years were chosen as they represent significant junctures for Ukraine: 1990 marked the final year of communist rule before the collapse of the

Soviet Union; 1995 was the highest point of mortality in Ukraine in two decades, which occurred in the wake of the market reforms introduced into the country in the early 1990s (Libanova et al. 2007); 2000 follows on closely from the 1998 financial crisis which negatively affected Russia and which thus had the potential to impact on its neighbouring countries; 2008 is the most recent year for which data are available.

The present Ukrainian territory is divided into 24 oblasts, the Autonomous Republic of Crimea, and 2 cities, Kyiv and Sevastopol, that are administratively independent from the oblasts in which they are located. Due to the need to use populations of sufficient size to avoid spurious results, we created three groups of oblasts, taking account of demographic data, historical and cultural divisions, being geographically coterminous, and similarity in pattern of ASMR over time. We recognise that, while there is widespread agreement that Ukraine is diverse, there is no consensus on the divisions, so other researchers have divided the country into two, four or five broad groupings (Wilson 2002; Shulman 2006; O'Loughlin 2001); however, these divisions have been for other purposes and discussion with Ukrainian colleagues indicates that, for our purposes, the divisions used have the greatest face validity. Life expectancy at birth in the capital city of Kyiv in 2008–2009 (68.0 years for men, 77.0 years for women) was significantly higher than that of the country as a whole (63.8 for men, 74.9 for women) (Derzhkomstat 2012). Consequently, Kyiv city was analysed separately because its inclusion in any region would have resulted in an overestimate of the life expectancy for that region. The final list of regions used in this analysis is West: the oblasts of Ivano-Frankivsk, Khmelnytsky, Chernivtsi, Lviv, Rivne, Ternopil, Volyn, Vinnytsia, and Zakarpattia; East: the oblasts of Kyiv (region), Sumy, Chernihiv, Cherkasy, Poltava, Kirovohrad, Dnipropetrovsk, Donetsk, Zhytomyr, Luhansk, and Kharkiv; South: the Autonomous Republic of Crimea, the city of Sevastopol and the oblasts of Odessa, Mykolaiv, Zaporizhzhia, and Kherson. These are shown in Fig. 1.

We calculated abridged life tables by East, West and South regions in 1990, 1995, 2000 and 2008 for males and females separately. Life expectancy at birth was used to summarise geographical variations in mortality. In order to understand how the cause-of-death mortality structure contributed to the geographical differences in life expectancy in each time period, we used the decomposition method developed by Andreev (1982), Pressat (1985) and Arriaga (1984). This method decomposes discrete differences in average life expectancy between two time points to identify the contributions of deaths in different age groups and from different causes of death. We decomposed the regional differences in life expectancy into age and



1	Volyn	8	Chernivtsi	15	Sumy	22	Mykolaiv
2	Lviv	9	Vinnytsya	16	Poltava	23	Kherson
3	Zakarpattia	10	Zhytomyr	17	Dnipropetrovsk	24	Zaporizhzhia
4	Rivne	11	Kyiv (region)	18	Kharkiv	25	Crimea
5	Ternopil	12	Chernihiv	19	Donetsk	26	Sevastopol
6	Ivano-Frankivsk	13	Cherkasy	20	Luhansk		
7	Khmelnysky	14	Kirovohrad	21	Odessa		

Fig. 1 Grouping of oblasts in Ukraine into East, South and West regions. Source: Authors’ groupings based on data from the Statistical Office of Ukraine

cause-specific mortality in 2000 and 2008, using population estimates and statistical tables of age and cause-specific mortality obtained from Derzhkomstat. Data from 1990 to 1995 were left out due to the poor quality of oblast-specific cause of death by category data from these years (e.g. missing information or inconsistent totals). Mortality data for 2000 are classified using ICD-9; while data for 2008 are classified using ICD-10 (ICD-10 was implemented in Ukraine in 2005); however, we used broad categories of causes of death (infectious diseases, neoplasms, cardio- and cerebro-vascular diseases, diseases of the digestive system, diseases of the respiratory system, external diseases and other diseases) and previous research comparing mortality trends in Russia, Estonia, Latvia and Lithuania before and after the transition to ICD-10 found no discontinuity at this level of aggregation, suggesting that the data from both periods are comparable (Stickley et al. 2007).

The cross-sectional comparisons, by definition, involve a moving target, as mortality will have changed in the

comparator region. Hence, to ascertain whether any disparities in mortality between regions associated with a given cause were due to actual variations in this cause of death in either of the regions or simply a relative increase or decrease of that cause of death within one of the regions, we also decomposed causes of death *within* regions, across years. All analyses were conducted using Microsoft Excel.

Results

Life expectancy

Life expectancy at birth in Ukraine in 1990 was 65.6 years for men and 75.0 years for women (Figs. 2, 3). Although this figure dropped significantly for men and women in all regions in 1995, the decline was more dramatic among men and women in the South and East regions of Ukraine. Life expectancy has increased slightly for men in all regions after 1995 but as of 2008 had yet to return to 1990 levels in

any region in Ukraine. Despite a decrease in male life expectancy in the West in 2008 and concurrent increases in the East and South, there remained a difference of >2 years in life expectancy between men in the West (64.0 years) and men the South (61.8 years) and East (61.2 years). While life expectancy has returned to 1990 levels for women in the West (75.4) by 2008, women in the East and South had life expectancies that were at least 2 years lower than their Western counterparts (73.3 and 73.1 years). Subsequent analyses estimated the causes of these discrepancies in life expectancy between regions.

Contribution of different causes of death to life expectancy variation

The following section presents the results of our decomposition of differences in life expectancy between regions into causes of death by age groups for men. The West was used as the region of comparison as it has the highest life expectancy of the three regions.

In 2000, life expectancy among men in East Ukraine compared to their counterparts in the West was 3.6 years lower, mostly due to a higher mortality between the ages 15 and 74 from external causes between ages 15 and 49 (responsible for approximately 1.4 years difference in life expectancy) and cardio- and cerebro-vascular diseases (approx. 0.8 years) from age 50 upwards (web appendix Fig. 1). In the same period, life expectancy among men in the South was 3.3 years lower than that of men in the West, mostly due to infectious disease among men aged 20–55 years (approx. 0.5 years), deaths from external causes among men aged 15–74 years (approx. 0.5 years) and deaths from cardio- and cerebro-vascular diseases among men aged 30–79 years (approx. 0.8 years) (web appendix Fig. 2).

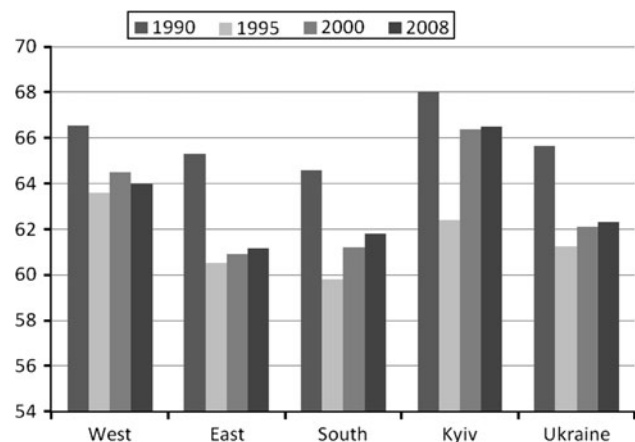


Fig. 2 Male life expectancy estimates by region in Ukraine, 1990–2008. Source: Authors’ calculations based on data from the Statistical Office of Ukraine

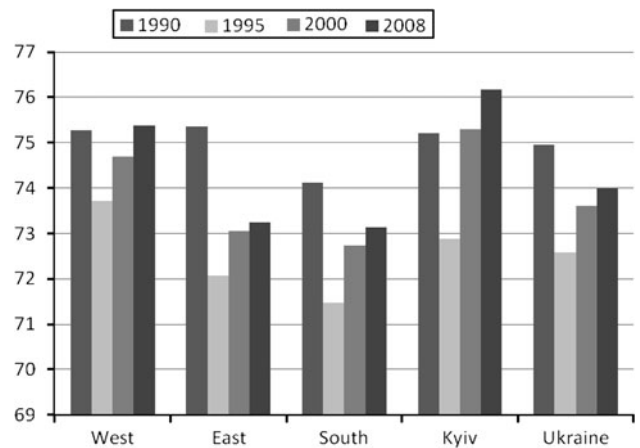


Fig. 3 Female life expectancy estimates by region in Ukraine, 1990–2008. Source: Authors’ calculations based on data from the Statistical Office of Ukraine

Results of the decomposition of differences in life expectancy for men, for 2008, between regions, by age- and cause-specific mortality are shown in Figs. 4 and 5. The size of each shaded section corresponds to the contribution it made to the difference in life expectancy for each age group in the East region compared to the West (Fig. 4) and for these age groups in the South region compared to their counterparts in the West (Fig. 5). Bars extending above the horizontal line represent contributions to increased differences in life expectancy between the East and West or South and West for each individual age group (and thus higher mortality differences), while bars extending below the horizontal line represent contributions to decreased

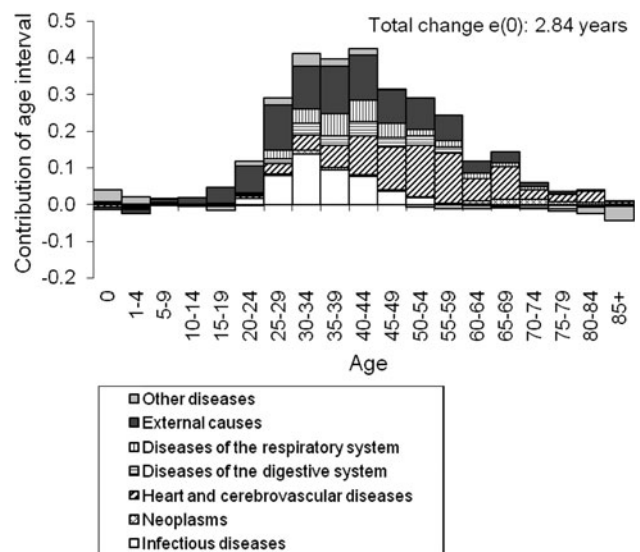


Fig. 4 Contribution of different causes of death to variation in life expectancy by age, between East and West regions in Ukraine; Males, 2008. Source: Authors’ calculations based on data from the Statistical Office of Ukraine

differences in life expectancies (and thus lower mortality differences).

In 2008, although external causes and cardio- and cerebro-vascular diseases continued to play a large part in the difference in regional life expectancy among men during this time period, a growing portion of the lower life expectancy among men in the East (by 2.8 years) and South (by 2.2 years) regions compared to men in the West was due to infectious diseases in the age group 20–54 years (approx. 0.7 years in both East and South).

As the differences in life expectancy between regions for women were less dramatic than those for men, results for women are described here but presented in more detail in the web appendix Figs. 3–6. Among women, a lower life expectancy by 1.6 years in the East in 2000, compared to the West, was predominantly caused by a higher proportion of deaths due to external causes from ages 15 to 54 (approx. 0.4 years), and from cardio- and cerebro-vascular diseases (approx. 0.9 years) and neoplasms (approx. 0.2 years) from age 45 years on. Similarly, decomposition of the variation in life expectancy between women in the South and West for the year 2000 showed an almost 2.0-year lower life expectancy among women in the South, due mostly to deaths from external causes between ages 15 and 69 (approx. 0.5 years), and cardio- and cerebro-vascular diseases (approx. 0.5 years) and neoplasms (approx. 0.4 years) from age 45 years on.

Similar to the trend observed among males, life expectancy differences in 2008 among women in the East (73.3 years) and South (73.1 years) compared to women in

the West (75.4 years) were increasingly due to deaths from infectious disease in the age group 20–54 (approx. 0.3 years in the East and 0.8 years in the South). From age 40 on, these differences were predominantly due to deaths from cardio- and cerebro-vascular diseases (approx. 0.8 years in the East and 0.4 years in the South).

A separate decomposition of differences in life expectancy between Kyiv city and East, South and West Ukraine (web appendix Figs. 7–18) showed a lower life expectancy of 5.4 (East), 5.2 (South) and 1.9 (West) years among males in 2000 and 2.2 (East), 2.6 (South) and 0.6 (West) years among females in that year. In 2008 a similar pattern was observed, with lower life expectancies of 5.3 (East), 4.7 (South) and 2.5 (West) years among males and 2.9 (East), 3.1 (South) and 0.8 (West) years among females compared to Kyiv city, mostly due to deaths from external causes and infectious diseases among younger adults and cerebro-vascular diseases among older adults in the East and South, and deaths from external causes among younger adults and cerebro-vascular disease among older adults in the West.

We also decomposed differences in life expectancy within regions to assess the contributions made by each cause of death to differences in life expectancy *within* each region between 2000 and 2008. As discussed above, this was done to rule out the possibility that the apparent driver of the lower life expectancy observed in the East and South in 2008 (i.e. infectious disease) was not simply appearing as such because of large reductions in this cause of death in the West. For this purpose, only the results of the within region decomposition between 2000 and 2008 for males in West Ukraine are presented in web appendix Fig. 19.

Although there was a decrease in life expectancy among males in the West between 2000 and 2008, this decrease was relatively small due to the effects of different causes of death in different age groups working largely to cancel each other out. The greatest contribution to decreased life expectancy in the West in 2008 came from deaths due to cardio- and cerebro-vascular diseases (0.6 years) as well as diseases of the respiratory system (0.5 years) and deaths from external causes (0.2 years). Notably, the decline in deaths due to ‘other diseases’ among infants and children aged 0–9 years would, had nothing else changed, have led to a gain of almost 0.5 years to overall life expectancy. As deaths due to infectious diseases did not contribute much to differences in life expectancy in the West between 2000 and 2008 (a reduction of 0.1 years), the large contribution of infectious disease to lower life expectancy in the East and South is due to higher infectious disease rates in those regions themselves rather than simply a decrease in infectious disease in the West.

As deaths due to infectious disease appeared to play an increasingly important role in the difference in life

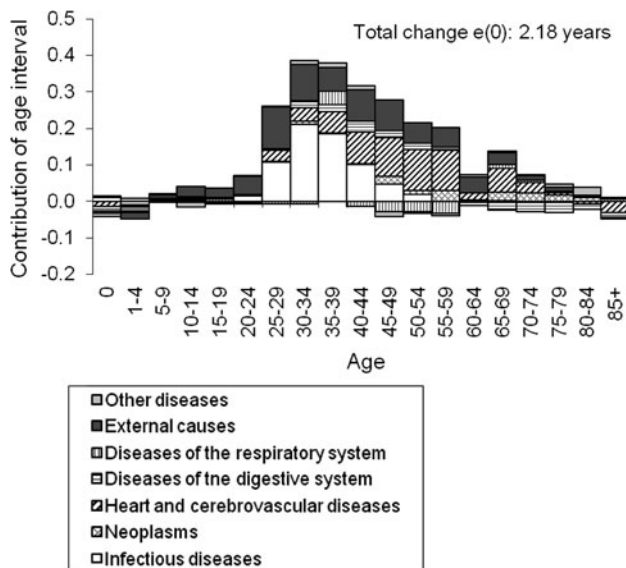


Fig. 5 Contribution of different causes of death to variation in life expectancy by age, between South and West regions in Ukraine; Males, 2008. Source: Authors' calculations based on data from the Statistical Office of Ukraine

expectancy between East/South and West Ukraine in 2008, we examined disease-specific mortality by region within this category in that year for males and found that deaths from tuberculosis (TB) occupied the highest proportion of infectious disease death counts in both the East (62 %) and South (55 %) regions. We then decomposed the difference in mortality due to TB for males by age group between East/South and West Ukraine for 2008 and found that the contribution of deaths due to TB to lower life expectancy in the East and South was highest between the ages of 25 and 44 (approx. 0.1 years in East, 0.2 years in South) (Table 1).

Discussion

What does this study add?

This study has revealed persisting gaps in life expectancy between the East/South and West regions of Ukraine. While these gaps have narrowed since 1995, a discrepancy of about 2 years remains for both men and women. Our analysis shows that, in 2000, the discrepancy was due mostly to a higher rate of deaths from external causes and cardio- and cerebro-vascular disease, consistent with the known higher rates of alcoholism and smoking in the East and South (Gilmore et al. 2002; Bromet et al. 2005; Webb et al. 2005).

By 2008 however, deaths from infectious diseases played an increasingly important role, reflecting the documented steady increase in incidence of HIV/AIDS and TB in Ukraine since the fall of the Soviet Union (Levchuk 2011). As with other countries in this region, mortality from TB remains higher in 2010 than in 1990, reflecting a combination of worsening social conditions (Coker et al. 2004), higher rates of incarceration (with prisons acting as incubators for disease) (Stuckler et al. 2008), and, increasingly, the emergence of drug resistance due to failures of policy and implementation (Atun and Olynik 2008). A closer look revealed that deaths from TB, especially among those aged 24–44 are largely responsible for the observed difference in mortality from infectious diseases between East/South and West. Almost certainly, a major factor in the higher mortality from TB in East and South Ukraine is the magnitude of the HIV/AIDS epidemic. While AIDS is the second leading cause of infectious disease death in these regions, with especially high rates among injection drug users and female sex workers (Lekhan et al. 2006; Hamers and Downs 2003), it would be expected that many of these deaths are in people with co-infection, given the increased risk of TB infection among people infected with HIV/AIDS (WHO 2012). In January of 2011, the prevalence of HIV/AIDS in the most affected regions of Dnipropetrovsk, Donetsk, Mykolaiv and Odessa was 553.8, 536.7, 519.2 and 521.3 cases per 100 thousand people, respectively, whereas the national

Table 1 Contribution of deaths from TB to variation in life expectancy by age, between East/South and West regions in Ukraine; Males, 2008

Age group	East vs. West	South vs. West
0	0	0.00000
1–4	–0.00123	–0.00139
5–9	0	0.00000
10–14	0	0.00000
15–19	0.00135	0.00049
20–24	–0.00839	–0.00838
25–29	–0.02564	–0.03291
30–34	–0.04144	–0.05541
35–39	–0.02356	–0.06021
40–44	–0.02757	–0.02390
45–49	–0.01672	–0.01770
50–54	–0.01465	–0.01438
55–59	–0.00455	–0.00159
60–64	–0.00296	–0.00287
65–69	–0.00092	–0.00223
70–74	–0.00104	–0.00008
75–79	–0.00028	–0.00026
80–84	–0.00026	0.00011
85+	0.00003	0.00007
Total	–0.16782	–0.22065

Source: Author's calculations based on data from the Statistical Office of Ukraine

average was 242.0 cases per 100 thousand people (Prevention 2011). However, the precise scale of co-infection in these deaths is difficult to judge given other evidence that TB death among people with AIDS is coded as death due to HIV, with TB as a contributory cause (WHO 2011).

Other probable factors are the known higher rates of smoking and alcohol consumption in the East and South (Levchuk 2011; Webb et al. 2005; Bromet et al. 2005; Gilmore et al. 2001). Smoking increases the risk of TB, with some estimates of the population attributable risk as high as 61 % (reflecting the widespread exposure to smoking), acting at all stages from infection to disease and death (WHO 2008b). Likewise, consumption of 40 g or more of alcohol per day has been estimated to increase the relative risk of TB by 2.94 (Lonnroth et al. 2008).

Although injecting drug use, risky sexual behaviour, smoking and alcohol, may partly explain higher rates of TB mortality in the East and South compared to West Ukraine, future research should consider other factors that may play a role such as variations in access to TB and HIV health services, which in Ukraine as a whole have yet to become effectively integrated into general health service delivery (Tarantino et al. 2011).

Our results also show that the contribution of deaths due to external causes in differences in life expectancy among men between the regions decreased after 2000. This reflects the large decline in deaths from causes such as suicide, homicide and alcohol poisoning which were associated with economic hardship and were a major cause of mortality in Ukraine prior to 2000. These deaths, which were predominantly among men, have declined as the economy in Ukraine has stabilised since the early 2000s (Levchuk 2011). For example, the age standardised death rate from suicide (all ages) fell from 28.2 to 18.5/100,000 between 2000 and 2008 while the death rate from homicide fell from 12.7 to 7.6/100,000 in the same period (WHO 2008a). As the rates were many times higher among men than women in 2000 (an eightfold difference for suicide), the benefits have largely accrued to men. However, further research is required to identify the precise drivers of the diminished role of external causes in mortality patterns in Ukraine.

Limitations

There are some limitations that must be considered when interpreting the findings of this study. The first concerns the quality of the mortality data. Recent research from another post-Soviet country (Russia) has suggested that there may have been some deterioration in the quality of vital statistics data in recent years (Gavrilova et al. 2008). Studies of cause of death in Ukraine, however, suggest that these data are of adequate quality for the broad comparisons

undertaken here (Meslé and Vallin 2003). Data quality may have been more of a problem if we had chosen to use more detailed ICD causes of death rather than broader groupings.

A second potential limitation is our allocation of oblasts into broad geographical groupings. As we note above, there was no uniformly agreed division but the groupings we used are consistent with those in previous studies and had high face validity when presented to Ukrainian researchers.

Future research

Our findings provide the first analysis of the relative contribution of deaths from different causes to the gap in life expectancy between East/South and West Ukraine, and highlight how deaths from infectious disease, especially TB, play an important role in this gap. As discussed above, evidence shows that injecting drug use, risky sexual behaviour, alcohol, and smoking may partly explain the higher rates of mortality observed in East and South Ukraine, but this may only be part of the story. Future research should aim to better understand what factors have 'protected' men and women in Western Ukraine from the burden of deaths due to infectious disease, as well as external causes and cardio- and cerebro-vascular disease, experienced by their Southern and Eastern counterparts. Socio-economic factors that are traditionally associated with lower mortality and fewer risky behaviours such as employment and education are all lower in the West and the poverty rate is highest in the West, and yet, the Western region exhibits lower rates of crime, suicide and risk factors for poor health such as smoking, drinking and risky sexual behaviour (Levchuk 2011). We have recently conducted a representative nation-wide household survey in Ukraine that will hopefully shed some light on this paradox.

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