# East-West mortality divide: What is the role of advanced ages?

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## Introduction

East-West mortality divide is usually explained by the exceptionally high premature mortality in Eastern Europe. Most of the scientific publications dealing with the health crisis in the post-communist have been focusing on the striking trends in mortality at adult ages (Shkolnikov, Cornia, Leon, Meslé, 1998; Leon, Chenet, Shkolnikov et al, 1997; Vallin, Meslé, 2001; Rychtaříková, 2004). Despite the rapid ageing processes in Eastern Europe during the most recent years, considerably less attention has been drawn to the increasing importance of mortality at older ages. Our study is primarily focusing on the East-West mortality differences at older ages. Using the mortality data from Human Mortality Database (www.mortality.org) we construct three typical mortality patterns relevant to Western countries, Eastern Europe and Russia. To explain how the East-West mortality gap has been expanding towards more advanced ages, we look more closely at the ages and causes of death, which are the most responsible for the divergence in the trends in the remaining life expectancy at age 65. We apply several measures of human longevity and variability of the life span.

## Data

The study mainly relies on the Human Mortality Database, which is a collaborative project by the Department of Demography at the University of California (Berkeley, USA), and the Max Planck Institute for Demographic Research (Rostock, Germany). This database provides uniform mortality surfaces for 19 industrialised countries: Austria, Bulgaria, Canada, the Czech Republic, Denmark, England and Wales, Finland, France, Hungary, Italy, Japan, the Netherlands, Norway, Russia, Sweden, Switzerland, Spain, the USA, and West Germany.

Human Mortality Database is a particularly useful data source due to the uniform procedures applied to adjust the data quality at older ages. All mortality rates for the ages above 80 presented in this database have been re-estimated on the basis of the extinct cohort method. These adjustments, along with modified data on deaths, allow avoiding some of the potential data problems relevant to mortality estimates at advanced ages (for more details see: www.mortality.org and Wilmoth et al, 2002).

The cause of death data come from the WHO Mortality database. We have selected eight major groups of causes of death for the decomposition analysis: infectious diseases, heart and other circulatory diseases, cerebrovascular diseases, neoplasms, respiratory diseases, digestive diseases, external causes of death and remaining causes of death.

Data quality issues should always be taken in consideration when dealing with mortality data for older ages. There is a scientific evidence about data quality problems in the countries of the former USSR, in particular (Shkolnikov, Meslé, Vallin, 1997; Anderson, Silver, 1997). The best documented issues are age exaggeration in the censuses, the exaggeration of age at death, the underregistration of deaths, and the age heaping in deaths at older ages.

## Methods

Major part of the analysis was performed on aggregated (typical) mortality profiles. The typical mortality patterns for Eastern Europe and Western countries were determined using the principal component analysis (PCA). The PCA decomposes the variation in age specific mortality into a set of components, which can reproduce any country-year specific mortality schedule. The first four components (accounting for more than 99% of variability in age-specific probabilities across the 19 countries) have been used to estimate typical Eastern European and Western mortality patterns for 1970-74, 1980-84, and 1995-99. The resulting patterns – East and West – are then compared to Russia.

In order to examine divergent trends in mortality at older ages, we compare the remaining life expectancy at age 65 and calculate the probabilities of survival between the ages 65 and 80 and between the ages 80 and 99. Lexis diagrams comparing the three regional age-specific mortality schedules have been plotted to identify in which particular ages the mortality gap is the most remarkable. Finally, the contributions of broad groups of causes of death to the improvement/worsening of survival after age 65 was estimated using the Andreev's (1982) method of decomposition of life expectancy.

We discuss the mortality compression to highlight the East-West differences in distributions of length of life. As analytical means we employ the mode of ages at death, interquartile range for the ages 30 and above (IQR30), the shortest age interval of deaths in which 50% deaths occur (C50), and the standard deviation above the mode.

## Results

The outcomes of the analysis based on the comparison of general life expectancy trends between the three mortality patterns (Western, Eastern European and Russian) comply with the results of previous studies on the East-West mortality divide. Over the past 30 years, the East-West gap in life expectancy at birth increased significantly for both sexes to reach the current level of 7 years for males and 5.3 years for females. In case of Russia, the male life expectancy gap was remarkable already in the 1970s and currently surpassed 14 years. Our results show that the role of the advanced ages in the growing East-West mortality divide has increased substantially. In the case of males, the age groups over 65 are currently responsible for 35% of the difference in Eastern countries and for 20% in the case of Russia. The most remarkable increase in the contributions of old ages to the East-West life expectancy gap took place among Russian females showing approximately threefold increase between 1970-74 and 1995-99 (from 13.8% to 41.4%).

According to different trajectories of the remaining life expectancy at age 65 we distinguish two periods to decompose the change into age- and cause-specific contributions. The first period (1970-1984) is marked by the stagnation or increase of old age mortality due to the circulatory, especially cerebrovascular, diseases - the main factor of the negative changes in longevity in Russia and Eastern Europe. On the contrary, success in reducing the mortality from circulatory conditions resulted in substantial gains in the life expectancy at age 65 in the West. The second period (1984-2000) is characterized by continuous deterioration in Russia and remarkable improvement in old age survival in the Czech Republic. Further longevity increases would have been expected for all the Western countries, but in case of Denmark and Netherlands the gains in the remaining life expectancy were rather small (only 0.12 years of increase for Danish females between 1984 and 2000). In the case of the Czech Republic, the increases in life expectancy at age 65 between 1984 and 2000 comprised 2.14 years for males, and 2.33 for females. The increase was almost exclusively driven by significant contributions of decreasing circulatory mortality (68% for males and 74% for females). In the most of the Western countries, the mortality reductions were expanding to more advanced ages and concerned other causes of death, such as cancer. Despite the recent positive developments of old age mortality in the Czech Republic and, to a smaller extent, in Hungary, the progress remains driven only by the younger elderly.

At the next step we examine the survival to the most advanced ages in the framework of mortality compression hypothesis. The theory suggests that in the conditions of increasing survival to more advanced ages, the interindividual variability of ages at death decreases. The latter transformations are being observed in the Western countries, whereas still rather little is known about the changing shape of the survival curve and variability of ages at death in Eastern Europe and Russia, where the premature mortality is high. We show that between 1970-74 and 1995-99 there was a rapid increase in the modal age of Western males, which contradicted to the significant decline in the modal age in Russia during the 1970s and 1990s (Figure 1). During the period 1970/74 to 1995/99, the difference in mode of age at death between Western and Russian males increased from 2.7 years in 1970/74 to a striking level of 11.6 years in 1995/99. Among females, the corresponding increase in the difference in mode at age of death was of smaller intensity (from 0.5 to 4.8 years). The shift in the mode in Western country reflects the success in reducing and postponing premature deaths to older ages. The significant drop in the modal age of the Russian males suggests of failures in eliminating premature deaths and indicates that males are dying at increasingly younger ages. Unlike in Russia, in the Eastern Europe the modal age increased during the second half of the 1990s.

We have applied three measures of variability of ages at death as indicators of compression/expansion of mortality. Low and slowly decreasing values of the IQR(30) and C50 (shortest age interval in which 50% of deaths occur) among Western males and females point at increasing inter-individual equality in age at death (Figure 1). At the same time, significantly higher and increasing IQR(30) and C50 observed in Russia suggest of rising variability in age at death due to increasing excess mortality at adult ages and failure in postponing deaths from younger to older ages. To summarize, the trends in the mode and the four applied measures of variability of ages at death confirm that mortality compression is taking place in Western countries. At the same time, as the mode shifted to younger ages and inter-individual inequality in life span increased, we conclude that mortality expansion occurred for Russian and Eastern European males. The findings are less consistent for Russian and Eastern European females, showing increase in the mode during the 1990s. Recently the Eastern European populations show slight decrease in variability of ages at death.

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**Figure 1**. Distributions of age at death for Russia, Eastern Europe and Western countries, 1970-74, 1980-84, and 1995-99.