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Summary of PhD thesis

Four decades of cause-specific mortality in the Czech Republic, West Germany and France

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Abstract

The study aims at analysis of cause-specific mortality trends in the Czech Republic, Germany (former FRG) and France over the past four decades. The major issue in the demographic study of cause-specific mortality is availability and international comparability of the data in a long-term. The backward comparability is affected by regular revisions of the international classification of diseases (ICD), while the comparability between countries suffers mainly from its divergent interpretations. The first (and main) part of the work therefore focuses at the process of reconstruction of continuous time series of mortality by cause of death in West Germany and in the Czech Republic. In the second part the obtained series are compared to the existing data for France. The results suggest that when carefully processed data are used, they provide solid base for analysis of the underlying cause-specific factors of mortality changes, and can therefore, in a broader context, be used in the evaluation of the theory of epidemiological (or more recently health) transition.

Key words: mortality, causes of death, ICD

Introduction

For long time in the past, the human life expectancy was not more than 30 years. Its length began to extend systematically along with global societal transformation processes in the 19th century. Altogether with decreases in fertility, this process took place in all industrialized countries and has later been formalized as a theory of demographic transition. Regarding mortality, the earliest determinants of these remarkable improvements were advances in nutrition and sanitation, while further mortality decline has been underlied by major advances in medical science, notably the discovery of infectious origin of diseases.

In 1971, Abdel Omran summarized what was known at that time about the epidemiology of population change, and postulated the postulated the *theory of epidemiologic transition* (Omran 1971). In his view, the transition consisted of three "ages". In the earliest times prior to the demographic transition, mortality as well its fluctuations was strong (age of pestilence and famine). In the next age (of receding pandemics), the pandemics, famine and wars cede their place to endemic infections, less fluctuant and steadily declining (mostly tuberculosis and diarrhoea). In the last – third – age, the degenerative and man-made diseases take over the epidemiologic profile. Based on the trends observed in the 1960s, which have seen a sensible slow-down of mortality progress due to stagnation or even increase in cardiovascular

mortality, he predicted a stabilization of mortality at these achieved levels.

Since the 1970s however, a further unanticipated decline of death rates was observed, which lead in 1987 to the extension of the theory by a fourth age – age of delayed degenerative diseases (Olshansky and Ault 1986).

The nature of these unprecedented declines of cardiovascular mortality was found too inconsistent with the epidemiologic transition theory and finally lead to its reassessment and postulation of a more global concept of health transition (Frenk et al. 1991). In the health transition theory, the ages described by Omran are considered as the first stage, characterized by external conditionality of mortality decline – depending, in a broad summary, on the quality and availability of information, sanitation and medicine. For the successful second stage, which begins with the *cardiovascular revolution*, apart from medical advances much more individual responsibility with respect to individual's own health is needed (Meslé and Vallin 2002).

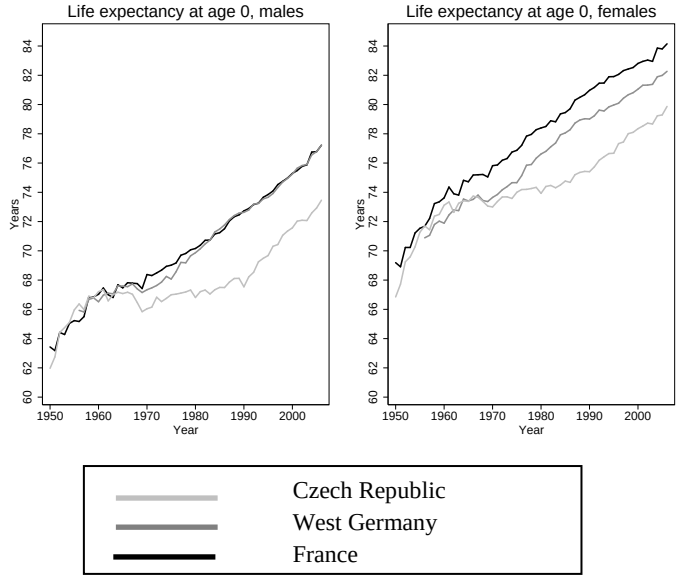
The general success of fight against infection resulted in an international homogenization (convergence) of life expectancy at birth around 1965 (Vallin and Meslé 2004), but differences in the second stage of health transition divided the Europe into East and West. Unlike for the West, in the Eastern Europe the cardiovascular mortality further stgnated or even increased. The most and longest affected and best documented is the case of Russia and ex-soviet countries (Shkolnikov et al.

1996), (Shkolnikov et al. 1996), (Meslé and Vallin 2003). In central european countries a favourable turnover was observed shortly after the fall the iron curtain; the most remarkable improvement was seen in the East Germany (Gjonça et al. 2000) and in the Czech Republic (Rychtaříková 2004).

Hypotheses and aims of the study

The presented study deals with cause-specific mortality trends observed in the Czech Republic, West Germany and France in the past four decades.

Fig. 1 – Trends in life expectancy at birth since 1950



Source: Human mortality database (www.mortality.org)

Four stages of trends in life expectancy at birth are visible from Figure 1: during the first stage (1950s) a record-breaking increases in life expectancy are found in all the three countries. Then during the critical decade of the 1960s the life expectancy increase slows down or stops at all. In the middle of this period the above mentioned convergence can be seen. The whole 1970s and 1980s are then marked by survival stagnation in the Czech Republic, which joins the favourable trend again as of the beginning of the 1990s.

Any evaluation of changes in epidemiologic profiles requires, at first, detailed, long-term and reliable cause-specific data. Unfortunately, there are three obstacles to the use of these data: revisions of the disease classification, changes in cause-of-death coding, and – finally – varying proportions of deaths with unknown or poorly defined cause.

The International Classification of Diseases and Related Health Problems (ICD), the main tool for coding and tabulating data on causes of death, is periodically revised to reflect progress of medical knowledge. Consequently, with every new revision, the time series of mortality by cause of death are interrupted.

In demography, the causes of death are used to explain the changes in life expectancy and to assess the health status of the population. There has been an increasing use in cause-specific research concepts such as avoidable mortality, smoking or alcohol related mortality.

Due to the difficulties related to ICD revisions and differences in coding habits, the information from cause-of-death data is often underexplored: studies limited their time-range to the duration of one ICD revision, or use simplistic aggregation into broad groups of causes. These limitations become even more visible with international comparisons, where hardly explainable differences may appear.

Our thesis therefre primarily aims to create a database of long-term continuous time series of deaths by stable definitions complying with the recent ICD revision. These data will be internationally compared and serve in evaluation of cause-of-death patterns observed in the three countries of out interest after 1968.

Materials and methods

Our input materials were the computerized statistics on causes of death by 5-year age groups and detailed ICD list (3-digit level) published by the German and the Czech statistical office in the frame of the population movement statistics. The period of our interest is covered by three successive ICD revisions: ICD8, ICD9, and ICD1, while the transition between ICD8 and ICD9 was our main methodological focus.

In order to link the 8th and the 9th ICD revision, a double ex-post classification must be created. The method we applied was developed and first applied at INED to reconstruct long-term time series in France for period 1925-1978 (Vallin and Meslé 1988) and basically consists of three steps.

First, a table of mutual *correspondences* between the medical content of each item of the two successive ICD revisions is created. Based on these correspondences, a list of *elementary associations* with identical medical and statistical content is created. The elementary associations then serve as a framework for estimating *transition coefficients* – the proportions of exchange between the linked ICD items from the old and the new cause-of-death classifications. At each step, the resulting series must be examined carefully.

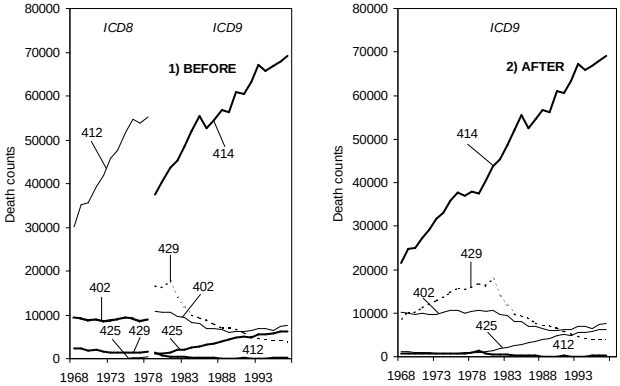
Figure 2 shows an example of application of the method to the subset of cardiovascular diseases in West Germany. It can be seen that prior to the reconstruction (left side) the series are interrupted by the change of classification, which disables for backward comparison. The reconstruction (right side) then results in long-term series defined by the terms of ICD9.

In the items displayed at Figure 2 we assume that all of them are at least partially connected with each other and that they are not (to a significant level) connected to other ICD items – therefore they form one *elementary association*.

In total, we constructed 300 of elementary associations in the case of West Germany and 600 in the case of the Czech Republic. As a result, we obtained ICD9-defined constinuous time series of approximately 900 causes of death.

For France the existing reconstructed time series were used (Meslé and Vallin 1996).

Fig. 2 – Reconstruction of selected cardiovascular diseases in West Germany, ICD8-ICD9



ICD8 items (1968-1978)		ICD9 items (1979-1997)	
402	Hypertensive heart disease	402	Hypertensive heart disease
4001	Malignant hypertension with heart involvement	412	Old myocardial infarction
412	Chronic ischemic heart disease	414	Other forms of chronic ischemic heart disease
414	Asymptomatic ischemic heart disease	425	Cardiomyopathy
425	Cardiomyopathy	429	Ill-defined descriptions and complications of heart disease
429	Ill-defined heart disease		

Source: Statistisches Bundesamt, author's calculations

In 1993 the 10th ICD revision was launched. It was adopted by the Czech Republic in 1994 (among the first ones), by Germany in 1998 and by France in 2000. The 10th revision has brought the biggest change to mortality statistics since 1948 (Rooney et al. 2002) and its impact on the statistical conntinuity is even more important than with the previous revision (Meslé and Vallin 2008). To extend the series to

ICD10, an alternative abridged transition performed on a list of 186 items was applied for all the three countries, we ended up with 186 items defined in the terms if ICD10 and covering the period from 1968 to present.

Results

For further analyses an abridged analytical list was compiled with respect to capture the most of information on causes of death leading to divergence between countries, sexes or periods, and, at the same time, to eliminate the unwanted impact of comparability problems. We selected 26 causes of well-defined and comparable causes of death, the last category was residual.

These causes of death then served as decrements in multiple decrement life tables. At first, life expectancy at birth by cause (of those eventually dying from the cause) was calculated and used as classification criterion in hierarchical cluster analysis. Quite consistent relations between age and diseases were found across the studied populations. In compliance with this finding, during examination of age-cause-specific probabilities different profiles were also found for the studied age groups. Thus, we can identify *diseases of early infancy*, diseases (accidents) of *young adulthood* (assault, traffic accidents, suicide, HIV), *premature diseases* (typically cirrhosis and smoking related cancer - purely man-made via extensive consumption of tobacco and alcohol), *modal diseases* concentrated around central measures of mortality (acute

myocardial infarction, cancer of stomach and colorectal cancer), and diseases of *old-age diseases* (chronic heart diseases, stroke, influenza, pneumonia, chronic obstructive pulmonary disease). In males, prostate pathologies (hyperplasia and adenocarcinoma) belong to the last age group as well.

Other age specifics were found in analysis of death probabilities by cause:

- compared to West Germany and France, stagnation in the period 1970-1989 was observed in the Czech Republic also for infant mortality. Infant mortality is a very sensitive indicator of health care quality and it could therefore be assumed that socialist health care system had a certain share on the general worsening of the survival;
- on the other hand, infant and young adult mortality were the lowest in the Czech Republic mainly due to lower mortality from traffic accidents;
- the age group 30-44 in the Czech Republic passed mostly unaffected by the epidemic of AIDS, which spread in the mid-1980s and touched France the most. During the years of stagnation elevated mortality from acute myocardial infartction was however observed in the Czech young adults;
- acute myocardial infarction played major role in the group of older adults as well (45-59 years). The cardiovascular crisis of the 1960s resulted in an overall increase of mortality from acute myocardial infarction. In

France, the mortality began to decrease in the mid-1970s, in West Germany since 1980, and in the Czech Republic only after the change of socioeconomic environment in 1990. In the Czech Republic moreover, hand in hand with increasing mortality from acute myocardial infarction went increasing mortality from smoking-related cancer and as a result, this age group underwent the most remarkable worsening of survival between mid-1960s and 1990: the risk of death increased by 30%. Smoking related cancer is nowadays the most important cause of death in this age group in all the three countries. Moreover, in all the three countries the smoking-related cancer mortality in males either stabilized or started to decrease, while it increases in females;

- the Czech mortality stagnation was visible in the age group 60-74 as well. After 1990, this age group promptly reacted and profited the most from the new treatments of myocardial infarction and stroke. In France and West Germany mortality in this age group gradually decreased throughout the whole period;
- the trends in the oldest old were somewhat different. Structurally the mortality trends of the elderly are more influenced by cerebrovascular and chronic heart diseases and less by acute myocardial infarction. Both of these main conditions remain – for both sexes - significantly higher in the Czech Republic than in West Germany and France.

To assess interaction between causes of death and life expectancy at birth, the latter was decomposed into cause-specific mean ages at death, and quantitative components (shares of newborns eventually dying from the given cause). Important divergences were found in both components of life expectancy at birth especially in the middle of the studied period, which was marked by previous two decades of mortality stagnation in the Czech Republic. With time the cause-specific structural differences tend to diminish and differences in life expectancy are more due to the due to differences in mean age at death (which is currently consistently lower in Czech Republic for virtually all the selected diseases).

In a probabilistic life table, as cardiovascular mortality decreases, it is replaced by increasing probabilities of death from other causes. Our data showed that both in France and in West Germany, the saved cardiovascular deaths increased probabilities of dying from residual category of diseases, which until then stood apart from our attention. Such shift was not, so far, observed in the Czech Republic, where the saved deaths from acute cardiovasculat conditions were postponed to chronic stage of the same diseases.

Summary and perspectives

The main focus of the presented thesis was to reconstruct the cause-specific mortality series in West Germany and the

Czech Republic for the period of ICD8 and ICD9. To follow the recent trends, an abridged transition to ICD10 was added.

Decomposing the mortality trends into specified diseases enabled the first insight into the mechanisms of the second stage of the health transition as it was observed in West Germany and France. We have found that acute cardiovascular conditions decline at first, followed later by chronic manifestations (chronic ischemic heart diseases, heart failure) at increasingly old age. Finally the cardiovascular diseases decline as a chapter, which reflects changes in individual's attitudes towards own health.

The case of Czech Republic then provided a unique chance to follow the course and the causes of mortality stagnation typical for the ex-communist countries. The decisive role was played by premature cardiovascular mortality, which was rapidly reduced after 1990 thanks to saving lives and postponing deaths to chronic stages of the cardiovascular pathologies.

Availability of reconstructed data opens new questions and perspectives. We are interested in the diseases which take place of the cardiovascular diseases. We would also like to know when and from which cause the mortality trends diverged prior to 1968. Finally, we would like to know more about the health transition in other countries, especially in these which have the cause-specific mortality time series already reconstructed (Russia, Ukraine, Baltic countries,

Netherlands, UK, USA, Canada), or where the reconstruction is in process (former East Germany, Poland, and Belarus).

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