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Svitlana Poniakina

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UNIVERSITE PARIS I – PANTHÉON SORBONNE

École Doctorale de Géographie



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par

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5 décembre 2014

**CAUSES ET ÉVOLUTION DES DISPARITÉS RÉGIONALES DE  
MORTALITÉ EN UKRAINE**

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**CAUSES AND EVOLUTION OF MORTALITY DISPARITIES ACROSS  
REGIONS IN UKRAINE**

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# Abstract

The aim of this study was to investigate regional mortality differences in Ukraine, cause-of-death patterns and trends at different spatial scales.

First of all, general contrasts were established: for males between the west and east of Ukraine, while for females between the west and south-east. Study of regional disparities in respect of different age groups revealed that regions that succeeded the most are those characterized by decreased mortality at older ages.

As for big cities, for the most of cases of death (except cancer and infectious diseases) living in a big metropolis is an advantage to surviving. The special case of the city of Slavutych that suffered the most from Chernobyl accident was studied.

Second, special attention was given to regional patterns of mortality for different medical cause of death, and which showed that Ukrainian regions are at different stages in the fight against man-made and degenerative diseases.

Lastly, peculiarities of dynamics over last two decades were investigated. During this period life expectancy has experienced a sharp decrease, followed by stagnation, and recovery. This evolution was accompanied by transformation of regional cause-specific mortality patterns.

These changes, larger and smaller, were not actually accounted for by public authorities and no important breakthroughs happened in any Ukraine region. There were no efficient strategies, measures or reforms implemented that would allow substantial improvements in the health of the population.

**Key words:** mortality analysis, spatial analysis, regional differences, lifespan disparity, causes of death, Eastern Europe, Ukraine, post-Soviet countries.

# Résumé

L'objectif de cette étude était d'étudier les différences de mortalité régionales en Ukraine, les structures par causes de décès et les tendances à différentes échelles spatiales.

Tout d'abord, des contrastes géographiques nets ont été mis en évidence : pour les hommes, entre l'ouest et l'est de l'Ukraine, et pour les femmes - entre l'ouest et le sud-est. L'étude des disparités régionales en fonction de l'âge révèle que les régions les plus avancées sont caractérisées par une diminution de la mortalité chez les personnes les plus âgées.

Dans les grandes villes, pour la plupart des causes de décès (à l'exception du cancer et des maladies infectieuses) vivre dans une grande métropole est un avantage pour survivre. Le cas de la ville de Slavoutytch qui avait particulièrement souffert de l'accident de Tchernobyl a fait l'objet d'une analyse spécifique.

Deuxièmement, une attention particulière a été portée aux schémas régionaux de mortalité par causes médicales de décès et a montré que les régions ukrainiennes se trouvent à différents stades de la lutte contre les maladies dégénératives.

Enfin, les particularités de la dynamique de deux dernières décennies ont été étudiées. Pendant cette période l'espérance de vie a connu une forte baisse, suivie d'une stagnation, puis d'un début de reprise. Ces évolutions se sont accompagnées d'une transformation des schémas régionaux de mortalité par cause.

Ces changements, qu'ils soient majeurs ou plus modestes n'ont pas été réellement identifiés par les pouvoirs publics et aucune avancée sanitaire décisive ne s'est produite dans aucune des régions de l'Ukraine. Il n'y a eu ni stratégies, ni mesures ou réformes efficaces mises en œuvre pour permettre une amélioration substantielle de la santé de la population.

**Mots clés :** analyse spatiale, différences régionales, disparité de durée de vie, causes de décès, Europe de l'Est, Ukraine, les pays post-soviétiques.

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## List of abbreviations:

AIDS	Acquired Immunodeficiency Syndrome
AR Crimea	Autonomous Republic of Crimea
ASDR	Age-Specific Death Rate
CA	Correspondence Analysis
CI	Confidence Interval
CNPP	Chernobyl Nuclear Power Plant
CSD	Circulatory System Diseases
CVD	Cardiovascular Diseases
DHS	Demographic and Health Survey
DMM	Dispersion Measure of Mortality
ESDA	Exploratory Spatial Analysis
EU	European Union
ICD	International Classification of Diseases
IHD	Ischaemic Heart Disease
IMR	Infant Mortality Rate
LE	Life Expectancy
LISA	Local Indicator of Spatial Association
MOH	Ministry of Health
NMR	Neonatal Mortality Rate
PMR	Proportionate Mortality Ratio
PNMR	Post-Neonatal Mortality Rate
SDR	Standardized Death Rate
SMR	Standardized Mortality Ratio
SSS	State Statistics Service
TB	Tuberculosis
TFR	Total Fertility Rate
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
URHS	Ukrainian Reproductive and Health Survey
USSR	Union of Soviet Socialist Republics
WHO	World Health Organization
WWII	World War Two

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## Introduction

After World War II, the massive spread of antibiotics and generalized immunization improved health everywhere in Europe. In the mid-60s, all the countries had completed the stage of fighting against infectious mortality and entered the stage in which mortality became more prevalent from man-made and degenerative diseases, i.e., the diseases of the circulatory system, alcoholism, traffic accidents, etc. (Meslé, 2002). On the Western side, countries managed to achieve some success in reversing trends in these diseases; while in all the Eastern European countries, life expectancy - which is a summary mortality measure - began to plateau or even decrease.

This divergence was not only a matter of trends in the levels of life expectancy, but a result of important changes in age structure and cause-of-death structure as well. In most of the region, this crisis caused a number of avoidable deaths and threatened to erode social stability. The worst case was observed in the republics of the former USSR, namely: Estonia, Latvia, Lithuania, Russia, and also in Ukraine (Meslé, 2002).

Mortality crises of various intensities are not new to the region. In 1932-1933, Ukraine was hit by a severe famine, which took the lives of between 2.4 to 7.5 million Ukrainians, according to different estimates. There was another major Soviet famine of 1946-1947, which impacted grain-producing countries the most, such as occurred in Ukraine. The Second World War caused between 2.5 and 5.5 casualties in Ukraine, which makes 40-44% of total losses of Soviet Union.

The recent surge in mortality occurred in peacetime and has not been accompanied by outbreaks of death by starvation, infection, and exhaustion (Cornia and Paniccia, 2004; UNICEF, 1994). The increase in mortality in Ukraine was combined with a decrease in fertility, which took on a spontaneous character and led to a demographic crisis. The main consequence of this was depopulation – a sharp decrease in the population number. The mean annual natural decline in population in 1990-2010 amounts to approximately the size of a city like Strasbourg

or Bordeaux - around 280 thousand people. In addition, for many years (up to 2004), emigration exceeded immigration and caused further losses in population.

Known for being the second largest country in Europe in terms of total area (603 700 km<sup>2</sup>), Ukraine once occupied only the sixth place in terms of population number (after Russia, Germany, France, UK and Italy). In 2009, Ukraine moved to even seventh position as Spain surpassed it, even though the Ukrainian population exceeded that of Spain by 13 million only two decades before. At the moment it declared independence from the Soviet Union in 1991, the population of Ukraine was roughly 52 million, while at the beginning of 2014 it amounted to only 45.2 million people (a loss of 13%).

Ukraine is by no means a new nation. With a millennium-long history, a distinct language, literature, architecture, and church institutions, together with bouts of short-lived independence, the Ukrainians rank among the oldest peoples of Europe (Wolchik and Zviglyanich, 2000). Ukrainian history lays exclusive claim to Kyiv Rus as a proto-Ukrainian state, based on ethno-cultural and territorial reasons (Kuzio, 2006). However, the process of building an effective Ukrainian state has been complicated by the country's ethnic composition and history of foreign domination (Wolchik and Zviglyanich, 2000). The standard Soviet nationality doctrine permitted only some limited recognition of Ukrainians, while the Russophile school denies the very existence of Ukrainians as a separate ethnic group (Kuzio, 2006). For the Ukrainians, whose culture and identity have been threatened by Russia for centuries, independence has fuelled the process of rediscovering their national identity as Ukrainians.

History matters to historians as well as to politicians or sociologists since it has a direct impact on a country's integrity, domestic politics, foreign policy orientation, and on its demographic development. Because Ukraine was a large country partitioned by its neighbours early on, several profound scars were left on Ukraine's national identity, which persist to this day. One consequence of the partitions is the diversity of Ukraine's population. Geographic dissemination results in divergence of demographic characteristics, and mortality in particular.

The variation in regional mortality in Ukraine is the subject of this thesis. According to the 2001 census, the difference between maximum (usually observed in the west) and minimum (observed in the Ukrainian east) life expectancy reaches 5 years, which is a lot from a broader European perspective. This gap is even more pronounced for males (almost 7 years), and to a lesser degree for females (3.6 year). The crisis of recent years deepened the situation in already vulnerable regions, though 2008-2011 have been marked by recovery.

Health is a key human right, and health equity is a central principle in social justice (Kibele, 2012). By irony of fate, Ukraine has such a health care system that it does not account for the disparities in the health status of the population at all. Approaches to capacity planning in the

Ukrainian health care sector have remained almost unchanged since Soviet times. The mechanisms currently in place neither reflect the health care needs of the population in regions nor account for regional characteristics of health service provisions. Large differences between areas cause alarm about socioeconomic problems. Priority of action is not given to those regions with the most unfavourable mortality profile in order to amortize the imbalance.

Today more than ever, information about the whole country is not sufficient for many purposes. Demographic data are needed for smaller subdivisions and for other classifications of areas. The increasing divergence in life expectancy among Ukraine's sub-divisions points toward the necessity of detailed research on mortality at a new level.

Data availability is one of the major obstacles that prevented researchers from studying geographical variations of mortality in Ukraine. Many statistical sheets became available in computerized form only recently, and this data is still incomplete. Besides, some new forms were brought into usage after the census of 2001. Furthermore, given a set of rules about the registration of people and events, there are usually errors in applying these rules at the regional level.

This thesis is a first attempt to analyze mortality and its evolution beginning from 1988 at the level of large regions of Ukraine as well as at the level of a more profound administrative subdivision, such as districts, which will allow shining light on the tendencies that are invisible at the level of large regional units. Additionally, it involves explaining regional differences in mortality and their evolution on the basis of medical causes of death. Therefore, the main research questions raised to research were:

1. How large are geographical variations in mortality in Ukraine?
2. What are the main medical causes of death behind geographical variations in mortality?
3. How have mortality variations been changed since the collapse of the USSR?

The thesis consists of seven chapters.

Chapter 1 describes peculiarities of the geographic, economic and demographic situation and tendencies in Ukraine. It presents the general framework, research questions raised and hypothesis set; and it explains attention brought to the retrospective span.

A literature review follows the introductory chapter. It provides a critical appraisal of existing knowledge on mortality in Ukraine, its neighbours and in Europe. The review of literature about Ukraine is structured in chronological order, from the sources found on the earliest period, through the Second World War, to contemporary studies of Ukraine's mortality as well as of its regional patterns.

Chapter 3 describes the unit of analysis, which is a territorial entity, a region or a district. It reviews in detail the availability and quality of the information employed to detail existing problems and approaches to resolve them. Chapter 4 presents the methodological tools used in Chapters 5, 6 and 7.

The next three chapters contain the results of the original research. Chapter 5 describes the mortality variation across regions observed around the 2001 census, as data for this year was the most reliable. It deals with an aggregated age-specific and cause-specific analysis of Ukraine's regions. Chapter 6 enriches such exploration by analysing the dynamics of cause-specific death rates from the last 1989 Soviet census to present. Chapter 7 goes further in detail and presents spatial and temporal mortality variation across small-area units, i.e., districts. Special attention is paid also to infant mortality, because it decreased while the adult mortality increased. A separate section is also dedicated to estimating some mortality consequences in a city that was most hit by the Chernobyl catastrophe.

The work ends by providing a general conclusion and discussion of the findings. The research questions are assessed in light of the empirical results from different regional levels outlined in the three preceding chapters.

## Chapter 1

# Justification of the study

### 1.1 Historical and geographical context

Ukraine is an Eastern European country, situated strategically at the crossroads of Europe and Asia. It has an area of 603,628 km<sup>2</sup> — including Crimea, which is claimed and controlled by neighboring Russia—making it the largest country entirely within Europe. It is bordered by Belarus on the north, the Russian Federation on the north and east, Poland on the west, and Moldova, Romania, Hungary, and Slovakia on the south-west (*Figure 1.1*). It is a varied country with the Carpathian Mountains in the west, forests in the north, fertile plains in the center, industrial basin in the east, and the Black Sea and Azov Sea to the south

In the Middle Ages, the area became a key center of the East Slavic culture, as epitomized by the powerful state of Kyiv Rus. In the 13th century when Mongol raiders razed Kyiv, Ukraine was contested, ruled and divided by a variety of powers.

Most of the territory of what is modern Ukraine was annexed by Poland and Lithuania in the 14th century, but during that time, Ukrainians began to conceive of themselves as a distinct people, a feeling that survived subsequent partitioning by greater powers over the next centuries. Ukrainian peasants who fled the Polish effort to force them into servitude came to be known as Cossacks and earned a reputation for their fierce martial spirit and love of freedom. In 1667, Ukraine was partitioned between Poland and Russia. In 1793, when Poland was partitioned, much of modern-day Ukraine was integrated into the Russian Empire.

The 19th century found the region largely agricultural, with a few cities and centers of trade and learning. The region was under the control of the Austro-Hungarian Empire in the extreme west and the Russian Empire elsewhere. When World War I and the Russian revolution shattered the Habsburg and Russian empires, Ukrainians declared independent statehood. In 1917 the Central Rada proclaimed Ukrainian autonomy and in 1918, following the Bolshevik seizure of power in Petrograd, the Ukrainian National Republic declared independence under President Mykhaylo Hrushevsky.

In 1919, the Ukrainian People's Republic, led by journalist Simon Petliura, formally united with the West Ukrainian People's Republic (which was part of the Austro-Hungarian Empire) based in Lviv. This union of Ukraine's lands proved to be short lived as the West Ukrainian National Government's Army lost the war against Polish expansionists, while the Kyiv- based Ukrainian Army was forced out of Ukraine by the Red Army. Soon after, Ukraine was officially incorporated into the Soviet Union. Under Stalin rule, Ukrainian political, social, economic and cultural fabric was atomized through totalitarian terror, involving massive purges, executions, and the exile of millions to the infamous labor camps of Siberia's "Gulag".

During World War II, Ukraine again was heavily damaged. The post war years in Ukraine were marked by intensive restoration of the destruction caused during the war. The Kremlin intensified its policy of "Russification", barring the Ukrainian language from government, education, courts and so on. With so many economic and social disincentives at work, the policy itself worked well, especially in Kyiv and other large cities of central and eastern Ukraine.

The 1980's were marked by increasing political impotence of Soviet leadership. The Chernobyl Nuclear Power Plant accident of April 26, 1986, brings back painful memories for all Ukrainians. This disaster caused number of deaths and health related problems, and inflicted enormous ecological and economic damage.

On July 6, 1990, the legislature proclaimed Ukraine's sovereignty. On August 24, 1991, the Verhovna Rada (Parliament) declared the Independence of Ukraine. On December 1, in a nationwide referendum, 90.3% of Ukraine's citizens voted for an independent Ukraine and chose their first democratically elected President.

Ukraine covers an area of 603 700 km<sup>2</sup> and is the largest country entirely within Europe. The country consists mainly of flat lowland and gently rolling uplands, with about 5% of the country covered by mountain and sub-mountain regions.

The western edge of Ukraine lies within the Carpathian mountain range, which stretches from the Czech Republic to Romania. On the south-eastern coast of the Crimean peninsula is the Crimean mountain range.

There are many large rivers in Ukraine, such as Dnieper, Danube, Dniester, Desna, Donets, Pivdennyi Bug<sup>1</sup> etc., of which the first three are among the largest rivers in Europe.

The territory of the country can be divided into three main geographic zones. In the north is the forest zone, covering 20% of the country. The forest-steppe zone in the centre, covering about 35% of the country, is a mixture of forest and steppe. The remaining 40% of the country in the South and East is within the steppe belt.

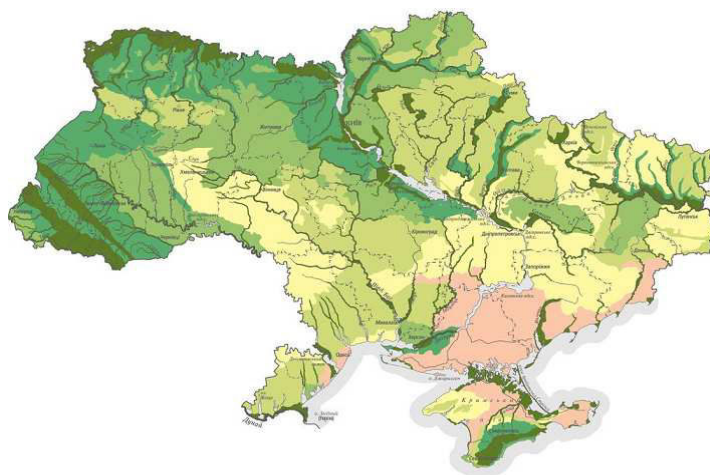
Only 3% of this zone is forested, while 80% consists of arable land. Most of the land in the forest-steppe and steppe zones is covered by chernozem, a particularly fertile type of soil. The climate in Ukraine is continental except for the south coast of Crimean peninsula, where the climate is sub-tropical.

Ukraine has long been a global breadbasket due to its extensive, fertile farmlands. As of 2011, it was the world's third-largest grain exporter. Additionally, the country has a well-developed manufacturing sector, particularly in aerospace and industrial equipment.

Figure 1.1: Map of Europe



Figure 1.2: Landscape of Ukraine



Source: National Atlas of Ukraine

<sup>1</sup>As for the translation of proper names, the priority was given to existing terms in the English language (for example, Black Sea, Crimea, Sebastopol, Chernobyl) and verified in accordance with Oxford Dictionaries (<http://oxforddictionaries.com>) and ABBYY Lingvo dictionary (<http://www.lingvo-online.com>). The exception was made for the official names: of a country ("Ukraine" rather than "the Ukraine") and of a capital ("Kyiv" rather than "Kiev"). In the remaining cases, a method of transliteration from Ukrainian to Latin (accorded by Decree №55 from 27 January 2010 of the Cabinet of Ministers of Ukraine) was applied.



## 1.2 Peculiarities of the economic and political situation

For many years, Ukraine's economy was an integral part of the national economic complex of the USSR, which was state-governed and highly militarized. Throughout the Soviet period, social cohesion was provided by powerful ideological propaganda, obligatory employment of all individuals of working age, wage leveling, strict regulation of prices, free education and health care services etc., all of which were financed from the state budget and public funds (Libanova, Makarova et al. 2009).

The first signs of stagnation in such a relatively inefficient economic system showed up in the middle of the 1980s. After the ineffective governmental initiative named *perestroika* aimed at combatting a crisis, the Soviet Union fell apart, which led to an abrupt decrease in production, hyperinflation, unemployment and a drastic decline in living standards (Grigoriev, 2011).

In the 1990s Ukraine passed through a painful period of transition from a closed totalitarian society to an open civilian society with a market oriented economy. Looking behind now one may conclude that economic reforms were applied unsuccessfully.

During the years of independence, socio-economic transformation in Ukraine has gone through several stages. In the 1990s, the situation in Ukraine (as well as in other former Soviet republics) was characterized by the deterioration of the economic situation and living standards for a majority of people accompanied by poverty as well as material and social inequality. Measured gross domestic product in 1999 stood at 45% of its official level in 1991, and at 39% of 1989 level (Boss, 2000). After 2000, tendencies for the improvement of the situation started to be reflected in GDP growth, enhancement of the business environment and rising incomes (Libanova, Makarova et al., 2009). However, even under conditions of economic improvement, inequality was still growing. According to Libanova, income inequality also increased within regions, urban and rural areas, and among workers in different sectors of industry.

The polarization of society according to political, national and religious creeds appeared as well. According to sociological monitoring, almost 30% of people believe it is necessary to strengthen relationships with Russia and Belarus, 18% of people indicate the necessity to strengthen relationship with European Union, and about 20% of people have an opinion that Ukraine should enhance its independence (Libanova, Makarova et al. 2009).

Under such circumstances, Ukraine slipped into situation in which society lost its ability to reproduce its population at the same level and to maintain it in a good health condition.

### **1.3 Peculiarities of the health care system**

Health care in Ukraine has changed very little since independence, and it is still largely based on the Semashko model, which was implemented in the Soviet health care system. This model envisaged centralized planning and administration, with resource allocation based on capacity (Lekhan *et. al.* 2004). The Ministry of Health acts as the main body, and regional health departments are responsible for the organization and funding of primary and secondary care services in the regions. This system was originally developed for episodic care for acute illness and is not properly oriented toward meeting the needs of patients with chronic conditions (World Bank, 2006).

In 1992 the Ukrainian parliament adopted the Principles of Legislation on Health, regulating all aspects of the development and implementation of health policy with the aim of meeting international standards (Lekhan *et. al.*, 2004). Nevertheless attempts at reform have failed to have a substantial impact. The health care system continues facing problems of inefficiency in financing, planning and regulation that cannot be fixed by cash infusion alone.

Governmental spending on health care in Ukraine is low by regional and European standards and slightly above average internationally when normalized by GDP (3.7% of GDP in 2006, according to the World Bank). This number includes governmental expenditures but not (formal and informal) payments. Private out-of-pocket payments are on the order of 2-3 percent of GDP (World Bank, 2008). The majority of outpatient care is financed by out-of-pocket payments, mostly due to the cost of pharmaceuticals, which are not covered by government funding.

The lion's share of Ukraine's health budget allocation is to hospitals, sanatoriums and specialized health facilities. Preventive and primary health care remain largely neglected. Around 70 percent of expenditure is to hospitals. Of the hospital allocation, 80-90 percent is to staff salaries and utilities. Key areas such as supplies, equipment, maintenance, and repairs of deteriorated infrastructure are neglected (Menon *et. al.*, 2009).

Reforms undertaken in 2001 and 2002 to change how resources are allocated were only partially implemented and local spending continues to be based on supply-side norms established by the Ministry of Health, which determines the number of doctors, nurses and other staff that are required, which itself is based on population size, bed numbers, and other indicators (World Bank, 2008).

In 2000 there were also initiatives to remodel primary care on the principles of family medicine. Family ambulatories have been established rapidly in some areas; however, lack of economic incentives has hampered further reform (Menon *et. al.*, 2009).

Finally, Ukraine lacks an established and accountable physician gate-keeping mechanism. Patients may directly seek care from specialists with no need of a formal referral by their physician. Patients therefore visit specialists directly for primary health care needs. According to a recent survey, 60 percent of first visits are to specialists (Lekhan *et. al.* 2007). Moreover, more than half of all direct specialist visits are to inappropriate providers. Accordingly, almost two-thirds of all visits result in improper care for the patient's condition (Menon *et. al.*, 2009).

Summarizing, current approaches to capacity planning in the Ukrainian health care sector do not reflect the health care needs of the population, no do they account for regional characteristics. Even though the system has been decentralized (with local government funding and local facility ownership) extensive regulation by the centre gives regions very little flexibility in the administration of services and facilities, which accounts for the current morbidity and mortality situation.

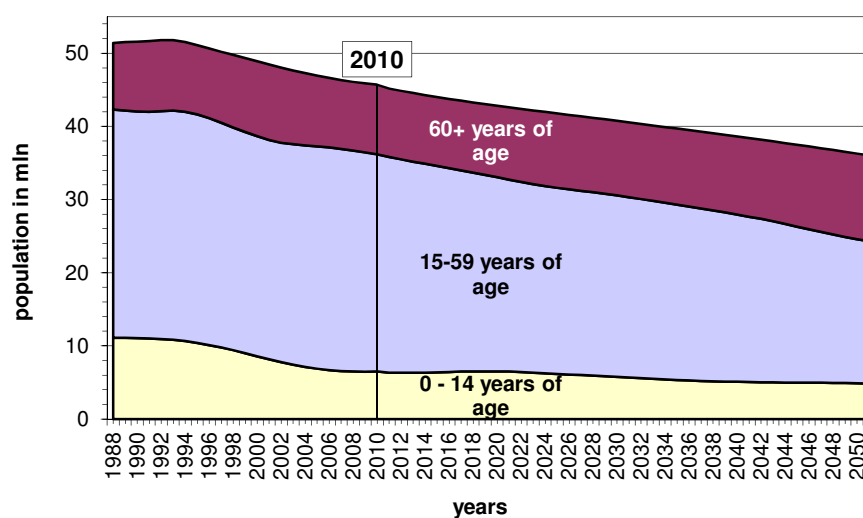
## **1.4 Peculiarities of the demographic situation**

### **1.4.1 General trends**

In the XX century, Ukraine suffered serious demographic crises and social catastrophes, such as the First World War, the civil war, famine and epidemics, repressions, the Second World War, deportations etc. (Pirozhkov, 2004). These processes had a negative effect on the population age structure and on its reproductive capacities.

In the 70s through the 90s, Ukraine entered a new phase of demographic transition characterized by declining fertility and high mortality, ageing and depopulation (Pirozhkov, 2004). At the moment of independence, Ukraine had a population of 52.2 million and was the sixth largest country in Europe. However, for 20 years the population of the country has decreased by 6.7 million persons (13%) and in December of 2011 it was equal to 45.5 million people. If current trends continue, by 2050 the population is projected to decline to 36.2 million (*Figure 1.3*).

Figure 1.3: Ukraine's population forecast (2011- 2050) based on current trends (1988-2010)

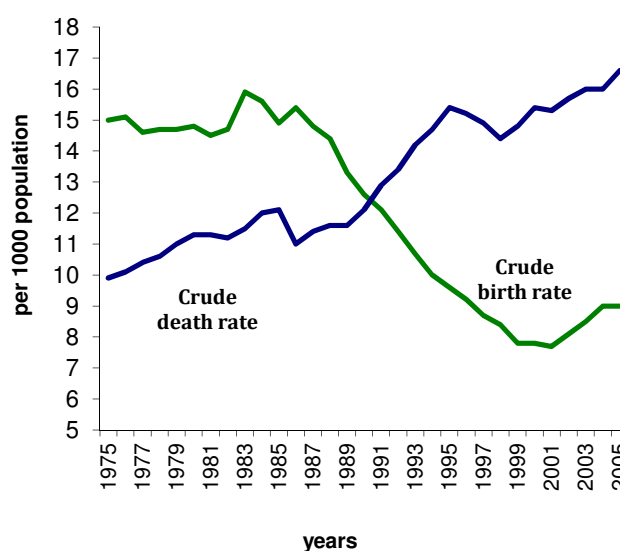


Source: Projection of IDSS based on the data of the State Statistics Service of Ukraine.

A variety of key factors have influenced this decline: increasing emigration, declining fertility, and rapidly increasing mortality, particularly among working age males. However, a fundamental factor in population size in Ukraine is its natural growth. The phenomenon of a sharp fall in fertility and an increase in mortality is typical for other ex-Soviet republics and is sometimes referred to as Slavic Cross (Figure 1.4).

The process of depopulation began in Ukraine's villages in 1979 (Levchuk et al., 2001), and things have worsened under the conditions of socio-economic crisis. In 1991 the number of deaths for the first time exceeded the number of births for Ukraine as a whole (by 39,000). In 2002 the natural population loss reached a level of -7.6 per 1000, the highest rate in the European Region. The annual decline of population amounted to the size of a big city (around 300 thousand people). For now Ukraine has succeeded in reducing negative natural population growth, and in 2010 it amounted to -4.4 per 1,000 of population (there were 10.8 births compared to 15.2 deaths per 1,000).

Figure 1.4: Crude birth rate and crude death rate, 1975-2005

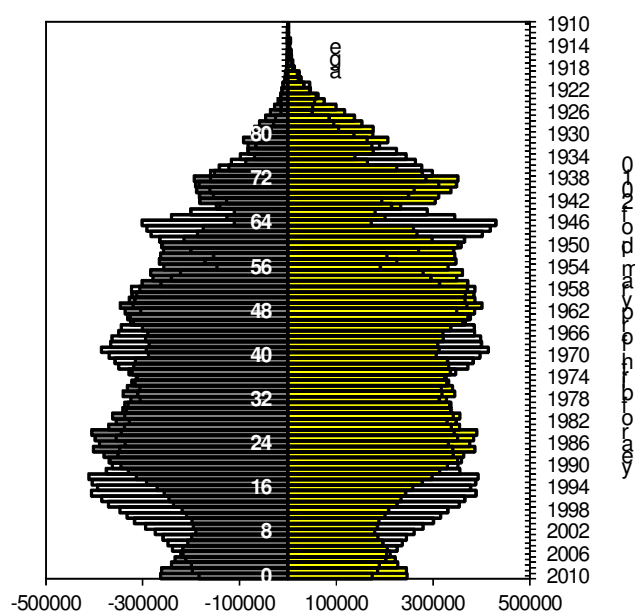


Source: data of the State Statistics Service of Ukraine

### 1.4.2 Age structure

The demographic changes of the last 20 years have had a strong impact on the age-structure of Ukraine's population. The population of Ukraine is now one of the oldest in Europe. 20.8% of the population is age 60 or older (15.5% of the population ages 65 or older), and only 14.2% of the population is under the age of 15. In developed countries, the aging of the population typically occurs due to an increase in longevity. In Ukraine, the aging of the population has been caused by a dramatic decrease in the birth rate and an increase in the death rate of the working-age population. As a result of population ageing, the old-age dependency ratio increased from 18.5% in 1990 to 22% in 2010.

Figure 1.5: Age-sex pyramid for population of Ukraine in 2001 and 2010



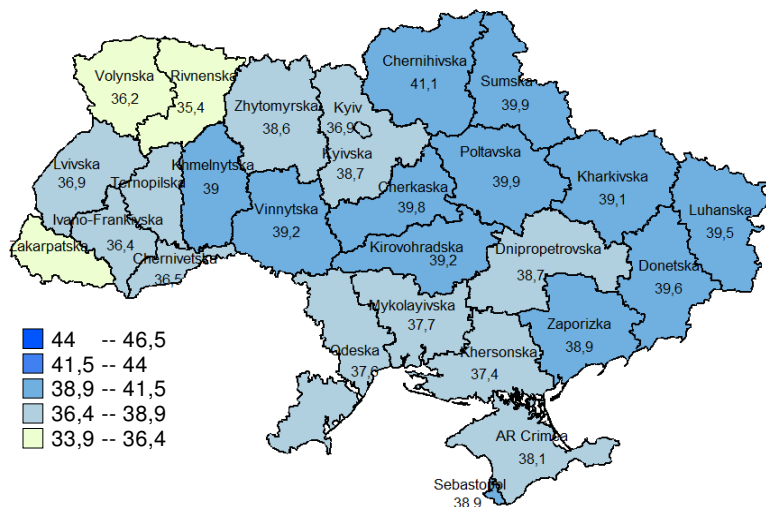
Source: data of the State Statistics Service of Ukraine

However, it should be noted that since the beginning of the XXI century a tendency toward improvement has been observed. When comparing population pyramids from the 2010 and 2001 censuses (*Figure 1.5*), one may observe that in 2010 the bottom of the pyramid started to widen, indicating an increase in the number of births, though the general configuration is still very much distorted.

Another measure of ageing is the mean age of the population, which is the average age of all its members. Massive movements of population to the East during the epoch of industrialization caused shifts in the population structure. One can see on the map (*Figure 1.6a*) that the population of Ukraine is old: its average age is above 38 years (around the age of the population in Italy); and the difference between the youngest and the oldest regions is almost 7 years. The urban population is somewhat younger, around 34 years, and interregional difference is a bit smaller – 5.6 years (*Figure 1.6b*). In the East, urbanization rejuvenates the old population, while the West still remains even younger because of higher fertility.

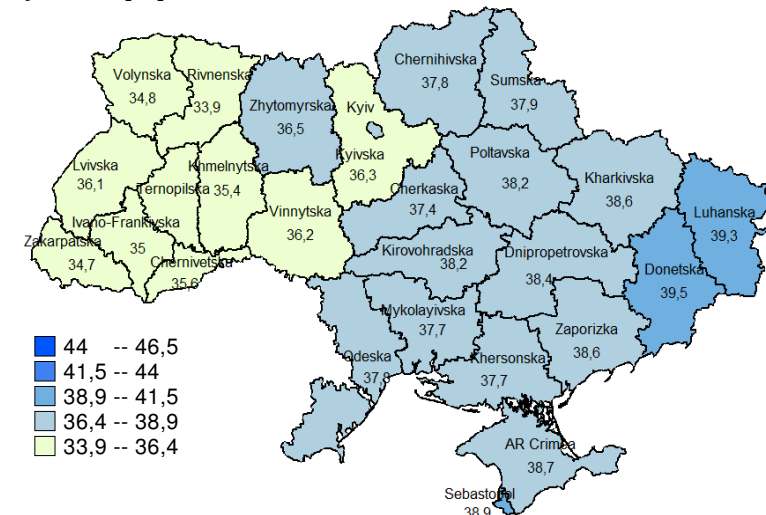
Figure 1.6: Mean age of population, census of 2001

a) total population



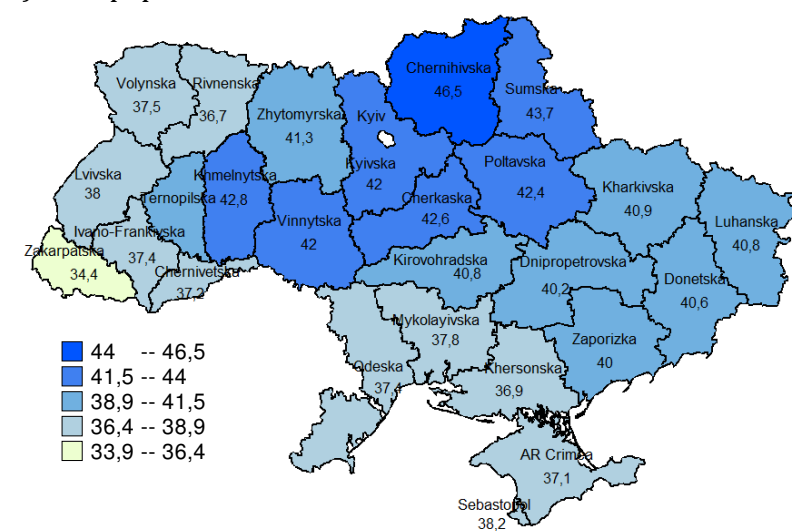
Ukraine – 38.4 years  
 max – 41.4 years  
 min – 34.5 years  
 difference – 6.9 years

b) urban population



Ukraine – 33.7 years  
 max – 39.5 years  
 min – 33.9 years  
 difference – 5.6 years

c) rural population



Ukraine – 39.7 years  
 max – 46.5 years  
 min – 34.4 years  
 difference – 12.1 years

Source: data of the State Statistics Service of Ukraine

On the other hand, the rural population is very old (*Figure 1.6c*). The variation is also large, 12 years for the oldest inhabitants in the North. This is because the northern regions of the former evacuation zone (after the Chernobyl disaster) are populated solely by returned elderly. Therefore, the least painful ageing problem is in the West Ukraine.

The changing age and gender structure of the population has significant social consequences. If

current trends persist, not only will the elderly make up a larger proportion of the population in the long run, but the absolute number of those over 60 will be greater than today. In the short term, the decline in Ukraine's population may imply a lower overall health expenditure. However, these will be offset by a rise in demand for health services for the ageing in the long run.

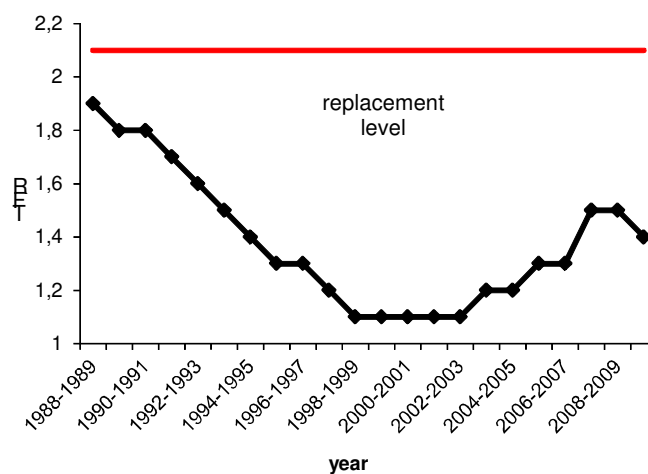
The ethnic composition has changed as well. In the 1989 census, Ukrainians formed the largest ethnic group, comprising 72.7% of the total population, while 22.1% were Russians. In the 2001 census, these figures were 77.8% and 17.3% respectively. Alternatively, the proportion of non-Slavic nationalities increased, namely: Tatars – by 5.3 times, Armenians – by 1.8 times, and the proportion of other minorities either decreased or remained stable.

The official state language is Ukrainian, an Eastern Slavonic language written in the Cyrillic script. At the same time Russian is widely spoken by Ukrainians and by minorities, particularly in urban areas of the East and South.

### 1.4.3 Fertility

The total fertility rate (TFR) in Ukraine is way below the replacement level. It declined from 1.9 in 1988 to its minimum, 1.1, in the beginning of the 2000s (*Figure 1.7*). Several theories have been proposed to explain this sharp decline. Sergii Pirozhkov (2004) believes that such a low fertility level is the result of a deep economic crisis and changes in social and psychological stereotypes. This point of view is supported by others (Franatsuz, 2008), who consider the

Figure 1.7: Total fertility rate in Ukraine, 1988-2009

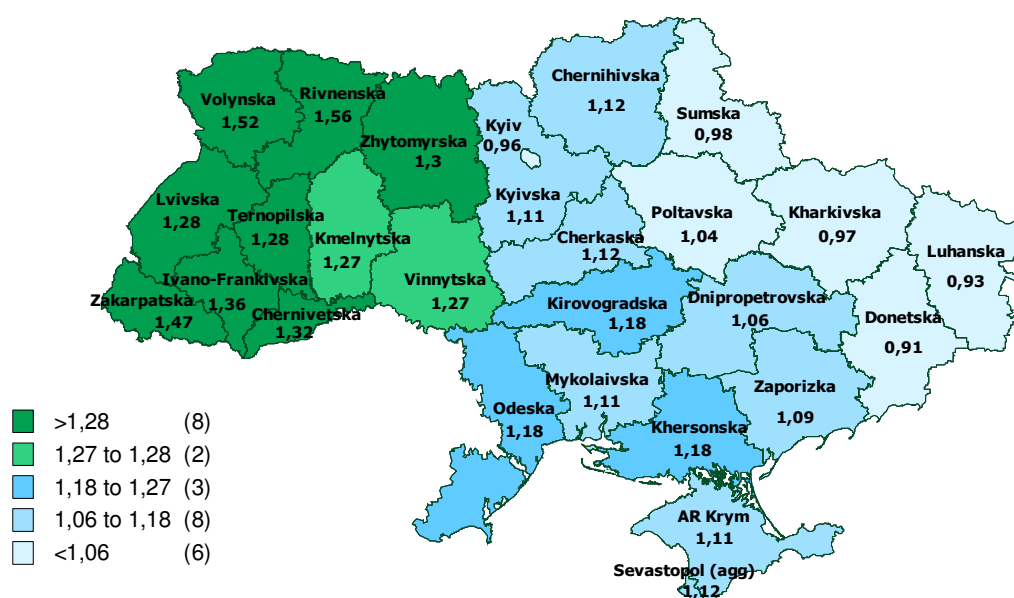


Source: Calculation of the State Statistics Committee of Ukraine.

transitional crisis - with its political, moral and economic consequences – to be the main reason for the decline in fertility. At the same time, Pirozhkov argues that the decline in fertility cannot be solely a result of economic changes. Ukraine experiences the same dynamics as more developed countries, and declines in fertility may be a consequence of a second demographic transition similar to that experienced in the developed West. The tendency of having small families will most likely continue as women become more educated, move towards having children at an older age, and with increased access to contraception and other family planning information.

When looking at the regional variation of TFR (*Figure 1.8*) one can see some clear cut-off between the western part and the rest of Ukraine, which is similar to the one identifying level of urbanization (*Figure 1.4*). It shows that birth rates remain relatively high in rural area while, in cities, women's empowerment and obstacles to creating a family have a negative impact on fertility.

Figure 1.8: Total fertility rate by region, 2002



Source: data of the State Statistics Service of Ukraine

#### 1.4.4 Migration

Migration has always played an important role in shaping the demographic and socio-economic situation in Ukraine. One of its characteristics in the Soviet period was its large scale. The annual migration exchange among the Ukrainian population and others republics sometimes reached 1.5 mln persons (Pirozhkov, 2004). The high level of migration mobility was a consequence of



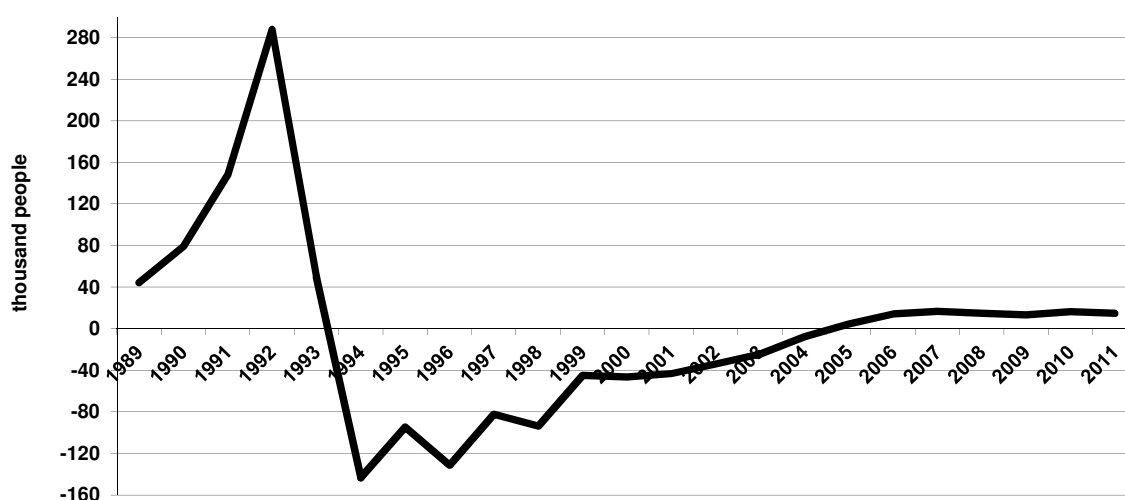
unifying life conditions and guaranteeing work throughout the entire Soviet Union (Pozniak, 2007). Another characteristic was that the number of arrivals to Ukraine was usually larger than number of departures.

During the 1960s-80s net migration was around  $\pm 100$  thousand persons per year. For most of this time it was positive, providing around 5-10% of the total increase in population. According to the last Soviet Union census of 1989, 44.4% of Ukraine's population had changed their place of living at least once during their life. At the same time around 14% were born outside of Ukraine (Pozniak, 2007). At the end of the 20<sup>th</sup> century there was also a tendency of decreasing interregional differences in the migration situation.

One may divide the period of independence into several phases (*Figure 1.9*). In the years before the collapse, migration processes were inert, due to the Soviet system, though positive net migration was higher than the 80s and was accelerating. In 1991 the incoming stream increased by 3.3 times, and in 1992 by 6.5 (Pirozhkov, 2004).

During the period of transition to market economy, migration processes underwent changes as well. The main characteristics of these changes were: a decrease in population mobility, a reduction in migration connections with former republics of the Soviet Union, the emergence of new destinations, the acquisition of family migration characteristics, an increase in the mean age of migrants, negative net migration and increasing interregional differences (Pozniak, 2007).

Figure 1.9: Net migration in Ukraine, 1990-2007



Source: data of the State Statistic Service of Ukraine.

Beginning in 1994, international migration started to contribute to the decrease in the population of Ukraine. During the ten years from 1994 to 2004, Ukraine lost 745 thousand people due to an excess in emigration, according to official statistics (Pozniak, 2007). This

number, which may be underestimated, represents almost twenty percent of the total population decline during the same years.

In general, migration mobility (internal and international) has decreased in comparison to Soviet times, which is explained by the economic crisis and caused by fears of unemployment and feeling of insecurity. With the emergence of independent states, legislations, currency, and the official language became more barriers for those willing to move.

The most active migration exchange of Ukraine in all times was with its neighbours, primarily Russia and Belarus. Migration connections with the Baltic States almost disappeared; and with the Caucasus Republics, it became one-way (to Ukraine). With the fall of the “iron curtain”, three main destination countries (among non-CIS countries) for emigrants from Ukraine became Israel, Germany and the USA. Fourth place was occupied by Canada until 2004, when it was pushed behind by Poland, Czech Republic, Hungary, and China (Pozniak, 2007).

As for arrivals to Ukraine, the main streams are currently coming from Moldova, Russia, Hungary, Israel, and Belarus (Pozniak, 2007).

Having fewer employment opportunities in Ukraine, people are also embarking on a vast labour migration to the neighbouring countries. Western inhabitants are heading to the European Union, while industrial workers from the east are mostly seeking for higher salaries in the Russian Federation. According to the survey on labour migration from 2008 (Pozniak, 2012), 40% of Ukrainians go to Russia, 22.3% to Italy, 9.1% to Poland, 8.7% to the Czech Republic and the remaining workers are hosted by Portugal, Spain, Hungary and other countries of the EU. Men are usually employed in construction, and women in housekeeping, construction, and commerce. Only a small percent of Ukrainian emigrants work in an intellectual activity. Most importantly, the representation of all regions in this type of migration is uniform.

## **1.5 Mortality patterns and justification for a study**

Given the low fertility and prevailing out-migration Ukraine faces a problem of maintaining its population size. This is a difficult task, because even though indirect losses are high, direct losses are even higher. Mortality rates are high, particularly among the most economically important group: the working age population. The health of the population is worsening. These processes are reflected in life expectancy at birth, which is a summary measure of a population’s ability to survive. Amartya Sen (1998), the Nobel economist, also insists that mortality is a key indicator of economic success.

Ukraine failed to achieve the target life expectancy (LE) of 70 years by 2005, set by the Program of Action adopted by the International Conference for Population Development (MOH & UNFPA 2003). However, for the first time during the entire period of independence, life expectancy in 2010 exceeded 70 years (70.3 years). Considerable effort will be required to achieve the next target of 75 years by 2015.

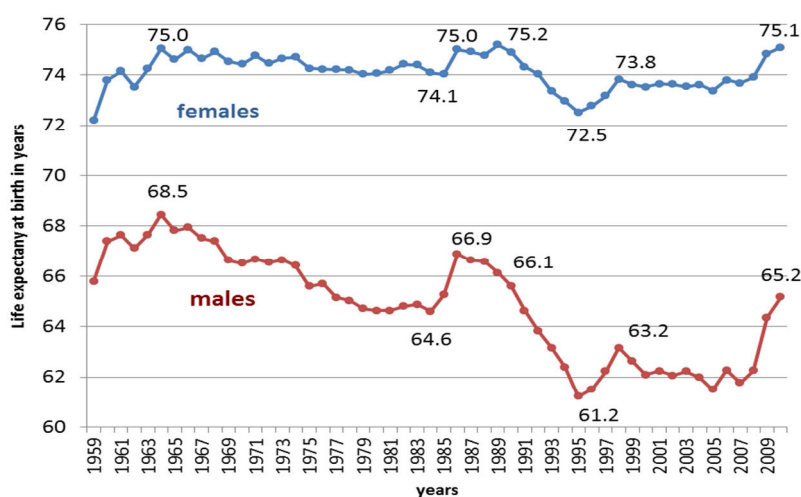
Mortality problems are the most acute among all demographic problems of modern Ukraine, and the health of the population has been constantly worsening since Ukraine gained independence. However a close look at the data verifies that deterioration started even earlier and gradual disparities between the USSR and economically developed countries appeared half a century ago.

The current level of mortality rates is a result of numerous fluctuations that happened over the last few decades. Before the Second World War, life expectancy in Ukraine was much lower than in developed countries. However, thanks to success in medicine and large-scale preventive measures that didn't require considerable efforts it was possible to catch up with those states.

Nevertheless, beginning in the 60<sup>th</sup>, these reserves exhausted themselves and mortality started to gradually rise. In fact, Ukraine is one of the few countries in the world that had higher life expectancy in the 1960s than it has today. By the early 1960s, life expectancy in Ukraine was much higher than in the United States and nearly equal to that observed in France.

In the mid-1980s, Ukraine started lagging behind European countries as a large result of increased mortality due to cardiovascular diseases and injuries, especially among working age males (*Figure 1.10*). Death rates were constantly increasing with the exception of the short period marked by Gorbachev's anti-alcohol campaign (Pirozhkov, 2004; Meslé and Vallin, 2012).

Figure 1.10: Life expectancy at birth for males and females, 1959-2009, Ukraine



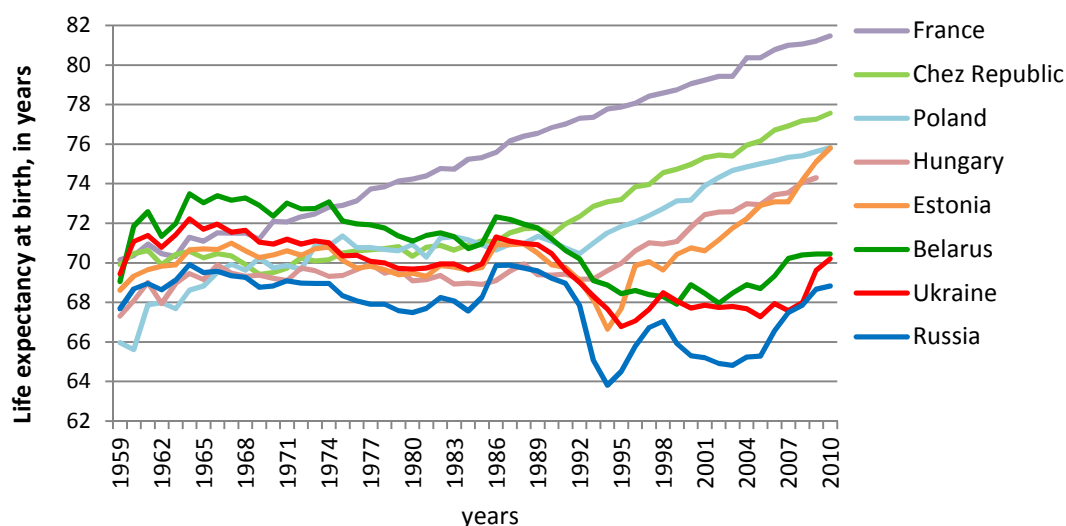
Source: data from the Human Mortality Database

Before the proclamation of independence, life expectancy among males in Ukraine was 5-7 years shorter than in developed European countries. An immense transformation crisis at the end of the XX century, which enveloped the entire Ukrainian society and destroyed traditional lifestyles, critically aggravated the situation.

The hardest period, in the first half of the 1990s, was associated with the end of the favourable impact of the anti-alcohol campaign followed by the brutal change to market economy. The initial shock caused life expectancy to fall sharply. In six years (from 1989 to 1995), life expectancy was shortened by four years (4.9 for men and 2.7 years for women). Few improvements occurred between 1996 and 1998. In 1999, after recovering from a deep economic crisis, life expectancy for both sexes combined was equal to 68 years: the same was still observed in 2008, meaning that life expectancy had been stagnating for a decade. The increasing dynamics of the last two years gives a reason for optimism, though the figure attained in 2010 (70.2 year) is something that was observed in Ukraine in 1990 (70.4 year).

The picture looks much less optimistic if Ukraine is compared to other European countries especially to those that belonged to the socialist block and had a similar start as Ukraine (*Figure 1.11*). The large gap in life expectancy between Ukraine and the rest of Europe is a fairly recent phenomenon.

Figure 1.11: Life expectancy at birth in Ukraine and selected countries, both sexes, 1980-2010



Source: data from the Human Mortality Database, for 2010 for Ukraine – author calculation

Until the late 1980's, the pattern of life expectancy in Ukraine was pretty close to that in other formerly socialist countries or even higher. In 1974, life expectancy in Ukraine was higher than in Estonia, Latvia, Hungary, Poland, the Czech Republic, and in Russia. However, in the years that followed, a large gap rapidly emerged between Ukraine's life expectancy and that observed in

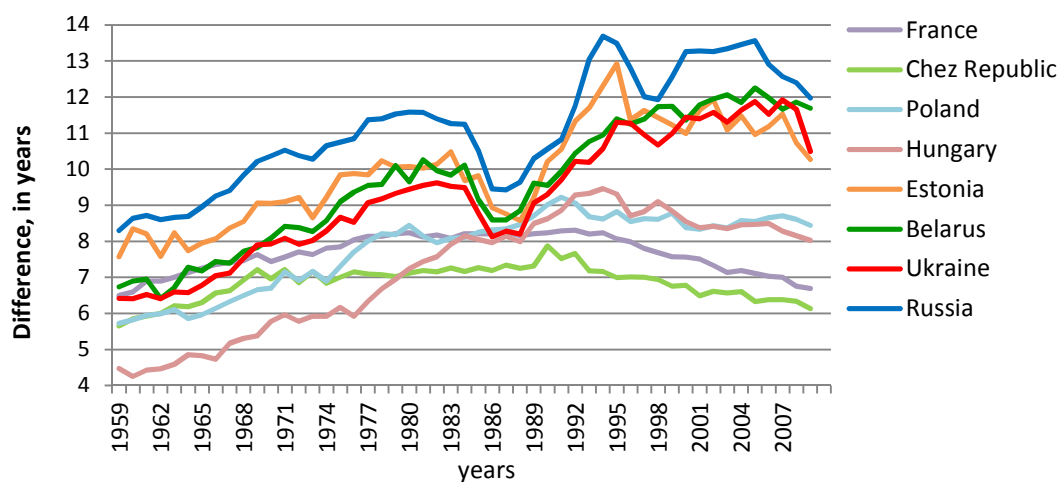
Central and Western Europe. As early as in 1988, the Czech Republic experienced rapid positive trends in life expectancy - followed by Poland in 1992, Hungary in 1993, and Slovenia in 1997 - while in Ukraine it remained stagnant. In 2008, Ukraine's life expectancy at birth was seven years lower than Estonia's and Hungary's, eight years lower than Poland's, nine years lower than the Czech Republic's, and more than thirteen years lower than France's life expectancy at birth.

On the other hand, the dynamics of this indicator in Russia and Belarus was similar to that observed in Ukraine. Changes were happening more or less simultaneously except in the very last few years when Russia managed to make a big jump and surpass the values observed in Ukraine for the first time, though a small gap emerged again in 2010.

The gap between female and male life expectancy is large as well. It increased from 9 years in 1989 to 10 in 2010. On the other hand, during the same period, the average female-male difference in LE for EU countries decreased by one year and amounted to six years. Whereas Ukrainian life expectancy is 7.7 years lower than the corresponding EU average for females, it is 12 years lower for males. After the age of 60, the difference in life expectancy between Ukrainian males and females is reduced to around 5 years, though this may be due to a survivorship effect whereby the males that survive are the healthy ones.

It is also visible in the *Figure 1.12* the gap between female-male life expectancy decreased a lot in Ukraine, Russia and Belarus during a period when life expectancy increased (i.e., the period of the anti-alcohol campaign). Conversely, the gap increased during the years of the crisis, when life expectancy fell sharply.

Figure 1.12: Difference in life expectancy at birth between males and females in Ukraine and selected countries, 1980-2009



Source: data from the Human Mortality Database

*Figure 1.13* provides an overview of the geographical diversity of mortality in Ukraine in 2001. There are substantial differences in life expectancy across regions in Ukraine - life expectancy is high in the west and low in the east and south. The interregional difference between max and min life expectancy reaches 5.3 years. This difference is even more pronounced for the male population - almost 7 years (*Figure 1.16a*) - and to a lesser extent for females (*Figure 1.16b*) - 3.6 years.

Three regions in the west named Galicia (Lvivka, Ivano-Frankivska and Ternopilska oblasts), differ significantly from others, which may be explained by their distinct historical development. This part never belonged to the Russian Empire and, as said above, joined Ukraine only during the Second World War. Two other regions (Vinnytska and Volynska oblasts) in the northwest were annexed to Ukraine together with Galicia, though they did not exist separately from the rest of Ukraine for a long time. As a result, the mentality of the population in all these regions (especially the rural population, which tends to be more conservative) is different from the mentality of the population in other regions.

On the other hand, there are the eastern regions. This is an industrial and overpopulated zone. It is characterized by high pollution and dangerous working conditions that eliminate the advantages of being rich and seriously threaten the health potential (Shevchuk 2007).

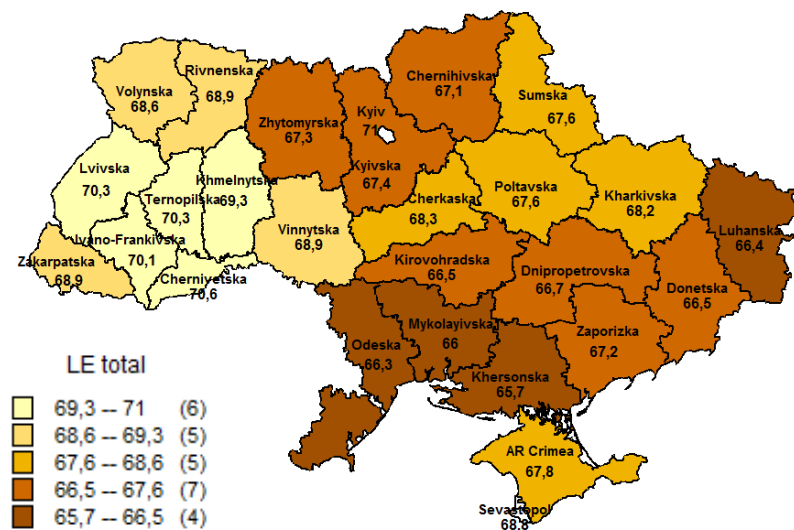
Special treatment is needed for the regions in the north that suffered the most from the explosion at the Chernobyl Nuclear Plant. This area is characterized by low population density (result of evacuation) and by a large proportion of elderly, especially widows. The extent of the impact of the Chernobyl accident has been a highly controversial issue. Most studies state that the disaster in 1986 has left a perceptible mark on the population's health (Vlasenko, Libanova et al. 2006); (Kurilo and Libanova 2007). Some researchers have asserted that more than 200,000 people died from radiation in Belarus, Russia, and Ukraine during the 15 years after the accident (Grigoriev, 2011). However, this assessment appears to be highly exaggerated, as it tends to attribute diverse health outcomes to the impact of radiation (Chernobyl Forum, 2006).

Ukraine is characterized by a strong concentration of political, economic and social capacities in the capital of Kyiv. Therefore Kyiv and Sebastopol are the only cities that experienced demographic gain even during the years of the crisis.

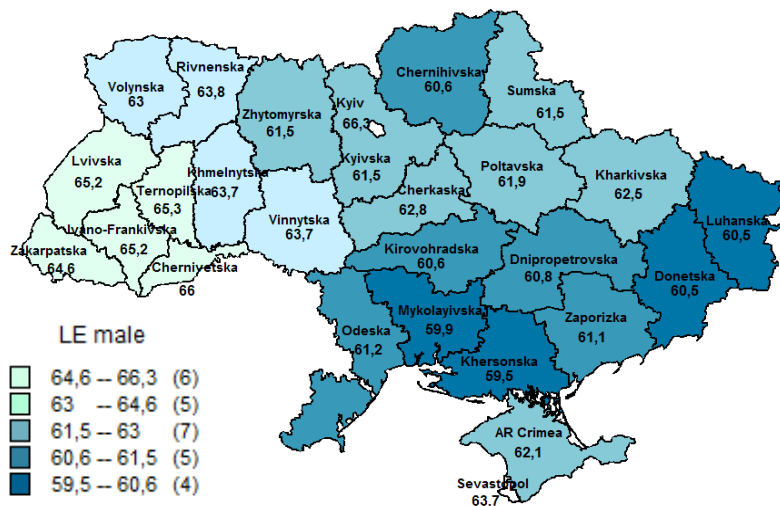
The population structure and composition also differs a lot among regions. The gender gap in life expectancy has led to a high proportion of single women and widows in the northern regions of Ukraine. Cultural, linguistic and religious differences exist between the eastern and the western parts. Differentials in fertility, mortality, population growth, and life expectancy in different regions and among social and ethnic groups could also further exacerbate existing disparities.

Figure 1.13: Life expectancy at birth in Ukraine, 2001

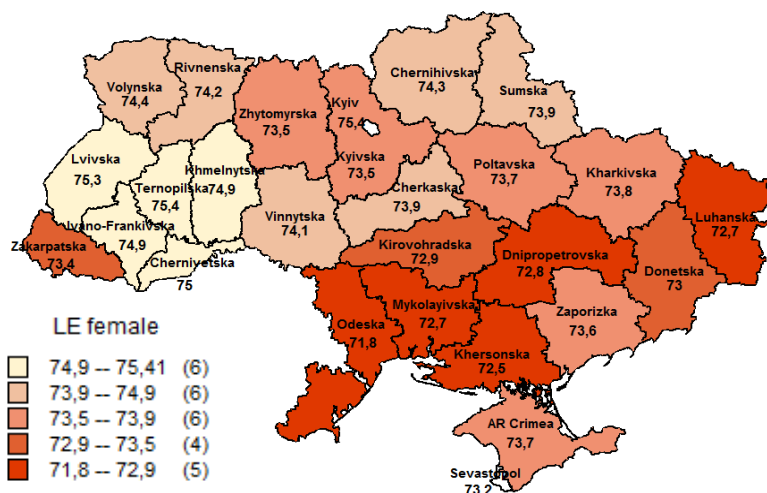
a) both sexes



b) males



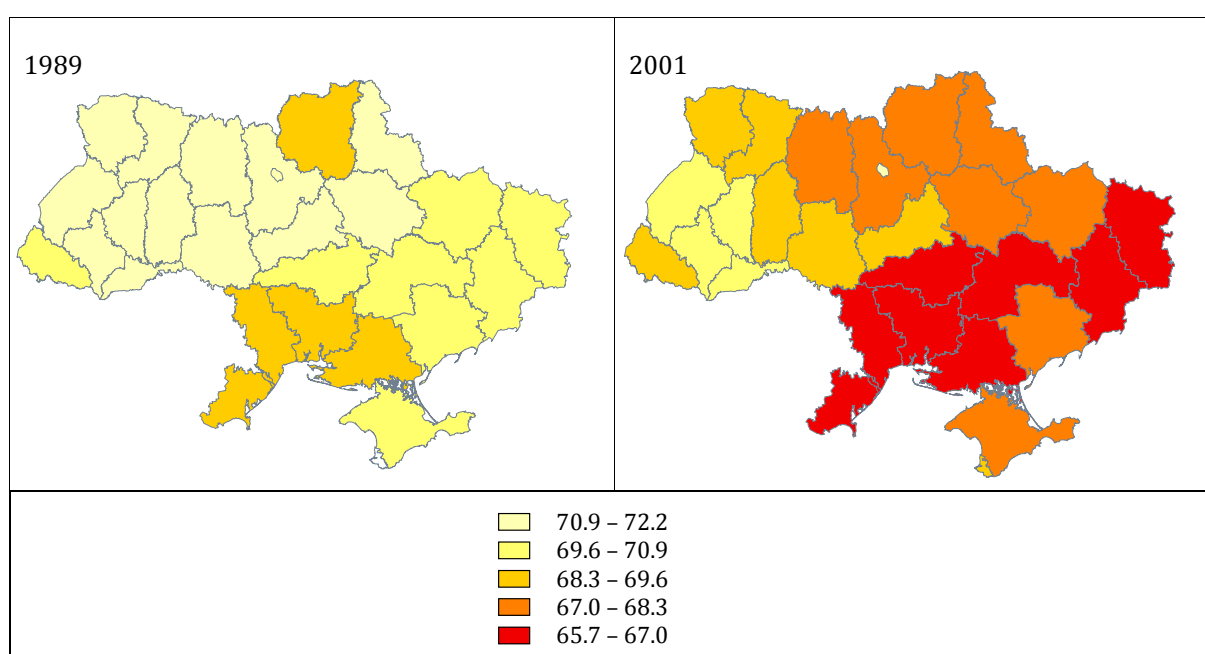
c) females



Source: Author calculation based on the data of the State Statistics Service of Ukraine

Geographical variations in mortality are partly linked to the particular history of each region. For this reason, geographic patterns do show some constant features even if they change over time. When looking at the situation observed in Ukraine at two points of time (two censuses), three main conclusions can be drawn (Figure 1.14). First, variations in mortality in 1989 were smaller, at 3.7 years compared to 5.3 years in 2001. Maintaining an interval division for 1989 that is the same as for 2001, no region would fall into the last two categories. From this we can draw a second conclusion that regions experienced changes at a different pace; in some regions the decline in LE occurred faster than in others. And the final important conclusion is that the opposition between west-north and east-south can be seen even at that time. This highlights the importance of including a time dimension in the study.

Figure 1.14: Life expectancy at birth in Ukraine, 1989 and 2001



Source: Author calculation based on the data of the State Statistics Service of Ukraine

Unfavourable dynamics in population health are also explained by the preservation of archaic (for the XXI century) nosological (by disease) structures of morbidity and mortality, which combine features of traditional and modern structures of pathologies (Pirozhkov, 2004). Namely they are characterized by the simultaneous high mortality rates from endogenous diseases (cerebro-vascular diseases, cancers) and exogenous diseases (infectious and parasitic diseases, respiratory and digestive system diseases, violent deaths). This is evidence that, at some moment in the past, Ukraine did not manage to strategically implement different methods in medicine.



## 1.6 Research framework

The problem described above launches the following research questions:

1. How large are geographical variations in mortality in Ukraine? (to assess and confirm differences with my calculations; to estimate the importance of variations)
2. What are the main medical causes of death behind geographical variations in mortality?
3. How have mortality variations been changed since the collapse of the USSR?

Based on the research questions, the research hypothesis can be formulated as:

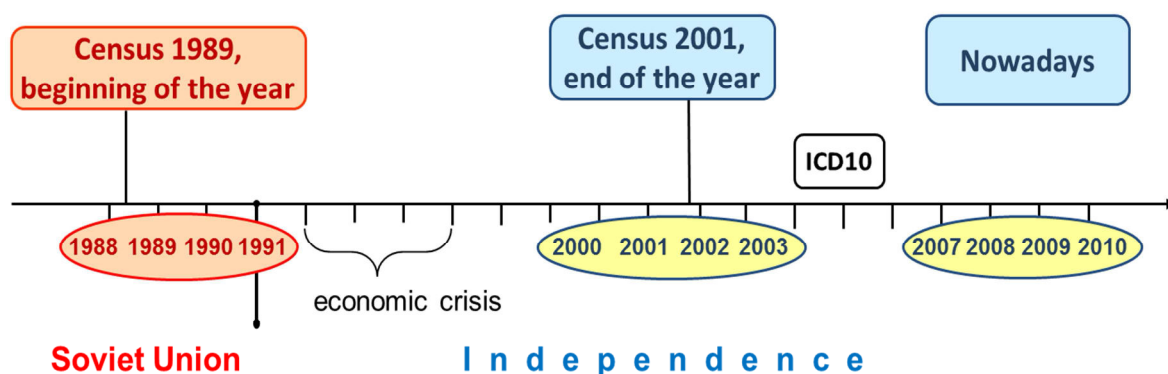
1. The variation in mortality among regions is significant
2. Geographical variations are different for different components of mortality (age, sex, and cause)
3. Variations in age-sex-cause-specific mortality change over time.

The study unit in the analysis is a territorial unit, which can be a region, a district or a city. The study period is divided into three parts, as in the scheme below (*Figure 1.15*):

- Around the census of 1989 (1988-1991);
- Around the census of 2001 (2000-2003);
- Beginning from 2005 up to modern times (2007-2010).

The study period will refer mostly to years around censuses, as the population estimates by region are the most reliable then. The last census was taken in Ukraine in 2001. It was the first census in independent Ukraine. The census preceding it was in 1989, and it was the last one in Soviet Ukraine. Therefore these two points will be the references.

Figure 1.15: Visualization of three time periods used for the analysis



Unfortunately there have been no censuses taken in recent times, even though ten years have already passed. The next census was scheduled for 2012, and even this census was postponed to 2013 (according to the Decree of the Cabinet of Ministers #581-p from 2008), which was justified by parliamentary elections and the Euro cup organized for the same year. A sample census was organized in the Kharkiv region. However, there was another change and the year was changed to 2016. Therefore, one may not be sure that this is definitive date, and the situation in regards to organizing a census is alarming.

## Conclusions

This chapter is devoted to describing the current politico-economic and demographic situation in Ukraine in order to understand in which context mortality trends have been developing. One may not say that situation was ever favorable. The 20<sup>th</sup> century was marked by numerous catastrophes, political transformation, economic crisis, the Chernobyl disaster, significant migration drainage, and a remarkable drop in fertility that distorted the course of mortality processes as well. Every region adapted itself to new circumstances differently, depending on its geographical approximation and internal characteristics, which in the end resulted in increased interregional disparities in mortality.

The last decade has been relatively stable, with mortality indicators stagnating near the same level, which permits some analysis at the regional level and avoiding the problem of fluctuations. A large regret is that no census has been organized since 2001, and all calculations must be based on estimated figures.



## Chapter 2

# Literature review

### 2.1 Historical perspective

The investigation and explanation of large variations in mortality across regions in Ukraine introduce challenge for researchers. Not many studies on geographical variations of mortality in Ukraine can be found so far. The reasons for disregarding this problem are mostly related to data availability. There are difficulties in working with huge dataset that exist only in paper form, limited access to data, and its inconsistencies. Also, such studies were not welcomed by the Soviet state, which pursued an ideology of social homogeneity. Pavel Grigoriev in his thesis on mortality in Belarus (2011) notes that there has been a generally misleading tendency to treat all of the countries of the former USSR as one homogeneous unit for analysis disregarding enormous differences existing even among republics not concerned with internal diversity. Anyway, in reviewing the existing literature, some records of existing geographical differences in Ukrainian mortality can be found.

Thus, Nikolai Markevich (1842) noticed that in the middle of XVII century, mortality in the Left-bank Ukraine (the eastern part) was driven up by high death rates among peasants. The same observations were made by the Ukrainian geographer Vasili Karazin (Bantysh-Kamenskii, 1822) in the beginning of the XIX century. Valeria Lekhan and colleagues (Lekhan *et al.*, 2004) note that before the revolution of 1917, the Russian Empire, which included what is now East Ukraine, was an agrarian land with mortality levels considerably higher than those of other European countries. At the end of the XIX century life expectancy at birth was around 35 years

(Kurkin, 1938), compared with about 37 years in Hungary (Novoselskii, 1916) and 42 years in the Baltic States (Vishnevskii and Volkov, 1983).

Sergei Novoselskii tried to compare mortality levels between European Russia (50 guberniyas<sup>2</sup>) and western-European countries for the years around the 1897 census (Novoselskii, 1916). He stressed that Russian figures are behind European ones because of the high proportion of the rural population (87%), which drove up overall mortality rates when compared to industrialized countries. Unfortunately, he did not perform estimates for each guberniya separately; however, he calculated death rates by religious confessions. At that time religious entities played a role in statistical registers, so such a breakdown was quite reliable. He refers to the Polish, Lithuanian and partly Belorussian population of Catholics. If to assume that the majority of ancient Ukraine's population was orthodox, a Catholic-orthodox comparison within European Russia might roughly approximate a west-east comparison of modern Ukraine. It appears that, as a rule, mortality of Orthodox was higher than that of Catholics, except for females of working age.

Frank Lorimer (1946), in his volume "The population of the Soviet Union", gives mortality figures for the period around the 1926 census. According to life tables prepared by Novoselskii and Payevskii, Ukraine had the lowest infant mortality in the Soviet Union after Belarus, leaving the European part of the Russian Republic far behind (even big cities such as Moscow and Leningrad). From the author's explanations "this region has been most subject to western European influences and it contained a large Jewish minority" (Lorimer, 1946, p.80). The same observation was made by Anatolii Vishnevskii and Andrei Volkov (1983), who argued that the Baltic States, Belarus and Ukraine experienced a faster decrease in mortality within the European territory of Russia in the beginning of the 20th century. The authors suggest that territorial differences in mortality were tightly connected to the ethnic differentiation: however, some elements of "new demographic relations" and "new everyday culture" could have been behind the ethnic factor (Vishnevskii and Volkov, 1983, p. 65).

In Lorimer's study Ukraine was analyzed by dividing it into six subregions: Forest, Dnepr Prairie Right Bank, Dnepr Prairie Left Bank, Steppe, Dnepr Industrial and Mining Industrial regions - with a breakdown between urban and rural areas (*Table 2.1*). According to the data, the lowest mortality was observed in the Dnepr Industrial region. The highest crude and infant mortality rates were registered on the right bank of the river Dnepr and in the Forest zone. This is surprising, because these are western-northern areas neighbouring Poland and Belarus, which were distinguished by low mortality. In addition, these are presently areas of low mortality. However, the reason might lie in the unstandardized (for age structure) nature of the indicators.

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2 A guberniya was a major and principal administrative subdivision of the Russian Empire

Per capita income was the lowest in the north-west, while the “eastern districts of Ukraine and the Crimea show the most favourable situation as regards agriculture with relatively large land holdings and high average income” (Lorimer, 1946, p.76). In all regions, the gradient was the same between urban and rural areas; still, urban inhabitants enjoyed much longer lives than rural (not shown in table).

Table 2.1: Crude death rate, infant mortality rate and estimated per-capita income by large regions of Ukraine, 1926-1927

Region	1926		1927		Conventional net income per year per capita in rubles, 1925-1926
	Death per 1,000 population	Infant death per 1,000 live births	Death per 1,000 population	Infant death per 1,000 live births	
Ukrainian S.S.R.	18.1	141	17.8	148	104
Urban	13.9	126	13.4	121	
Rural	19.0	144	18.8	152	
Subregions:					
Forest	19.1	141	19.1	150	98
Dnepr Prairie Right Bank	19.2	152	18.8	154	92
Dnepr Prairie Left Bank	18.4	142	17.7	147	111
Steppe	16.7	133	16.9	143	104
Dnepr Industrial	16.3	123	16.1	137	119
Mining-Industrial	16.4	145	16.5	147	132
Crimean A.S.S.R.	13.2	113	15.5	124	143
Urban	15.7	139	16.6	143	
Rural	11.2	99	14.5	114	

Source: Lorimer, 1946, p. 76, 81-82

Lorimer also gave figures for the Crimean Republic, which did not belong to Ukraine at that time. These figures present the best situation in the Soviet Union, a situation that Ukraine achieved only 10 years later. However, the author seriously doubts the validity of these results himself.

In summary, Lorimer stated that explaining regional variations in mortality at that time was almost impossible, owing to inaccuracies in the data. However, he also mentioned “that the morbidity statistics do not indicate any great epidemics, and they do not show sufficiently high frequencies of specific children’s diseases in particular areas to contribute much to an understanding of regional variations in general or in infant mortality at that time (1926-1927)” (Lorimer, 1946, p.85).

Data on the demographic development of Ukraine's areas that were in Poland and the Austro-Hungarian Empire are not available, and there is only some knowledge at the level of the whole countries. Mortality in Hungary and Austria, which were also agricultural states at the end of 19th century, was somewhat close to Russian pattern, though death rates were lower in most age groups and especially in infancy (Novoselskii, 1916; Vishenskii and Volkov, 1983). However, what distinguished European Russian mortality from other countries were the low death rates at a very old age. Instead of a constant increase, they would freeze at some point for a while. This was typical also for Serbia and Bulgaria (Novoselskii, 1916). It is, however, very probable that the roots of this visible underestimation of mortality in the elderly lie in age heaping.

A deep retrospective span in analyzing past mortality was chosen by Omelian Rudnitskyi (Libanova et al., 2007). He computed life expectancy for Ukraine beginning from 1897 (the first census in the Russian Empire) and limited it to its current modern borders. Because boundaries changed many times, numerous archived documents from other countries were involved. The main focus of this study was on population losses due to cataclysms at the beginning of the 20th century. The author also concluded that a positive contribution to life expectancy was made by lower child and maternal mortality rates.

France Meslé and Jacques Vallin (2008) have reconstructed a mortality time series, which allows following the evolution of life expectancy in Ukraine from as early as 1926.

## **2.2 General trends after WW2**

After the Second World War and until the mid-60s a decrease of major mortality indicators was observed in USSR as well as in Ukraine. This was mainly thanks to the state sanitary and hygiene policy, which envisaged a disinfection of drinking water, prophylactic immunization against main infectious diseases, effective anti-epidemiological work by medical personal, wide-use of refrigerating equipment, etc. (Libanova, 1991; Meslé, 2002). There were reinforced efforts in combating infectious diseases, particularly tuberculosis, which is usually provoked by unsatisfactory living conditions. As a result, the losses from the so-called exogenous component of mortality were minimized.

Moreover decreasing maternal and child mortality also contributed to this decline, which was pointed out by Ella Libanova (1991) and was also numerically measured by France Meslé and Jacques Vallin (2008) after decomposing the total change in life expectancy.

According to the classification proposed by Nobel laureate Amartya Sen and his colleague Jean Drèze (1998), there are two types of successes in the rapid reduction of mortality. They call them “growth mediated” and “support-led” processes. In the first case, increase in life expectancy is associated with fast economic growth (like in South Korea or Hong Cong). And the “support-led” process works through priority being given to providing health care services that enhance the quality of life. The increase in life expectancy that was happening in Ukraine in the 60s seems to be thanks to “support-led” measures rather than an economic burst.

However, the prevention of diseases was later modified. While anticipation of infectious and parasitic diseases was achieved by mass measures, which in fact do not require individual efforts, the success in combating endogenous etiologies is possible only under conditions of common cooperation and individual efforts. The self-preserving behaviour of people and the spread of healthy life-styles have crucial importance. This envisages change in values and a rational attitude toward one’s own life and health, as well as the life and health of one’s children. In the same period the domination of public over individual interests doomed the Soviet society into a backlog (Libanova, 1991).

The first negative features of developing mortality appeared in the second half of the 60s. However, given the background of general success, the increase in death rates in old-age groups did not attract much attention. Moreover, one could have expected that such an increase was just a temporary fluctuation. However, beginning in the 60s these reserves exhausted themselves and mortality started gradually to rise (Libanova, 1991; Meslé, 2002; Meslé and Vallin, 2012).

In the middle of the 80s, a short-term increase was observed in life expectancy. This was due to the intensive counteraction of alcohol consumption known as Gorbachev’s anti-alcohol campaign (Libanova, 1991; Pirozhkov, 2004; Meslé and Vallin, 2012), and it led to a decrease of violent mortality. However, at the end of the decade this indicator decreased again and a reduction was more pronounced for males than for females.

Lastly, recent studies (Levchuk et al., 2001, 2007; Pirozhkov, 2006; Libanova et al., 2007) are usually divided into three periods: 1) have typically divided the times since Ukraine gained independence into three periods: 1) accelerated increase in mortality from 1990 to 1995; 2) period of positive changes from 1996 to 1998; and 3) period of stagnation – from 1998 till 2007.

Sergii Pirozhkov (2006) argues that negative tendencies in mortality in Ukraine in the 90<sup>th</sup> were mostly due to high mortality in the working age population, especially from external causes. The decomposition by place of residence revealed that rural inhabitants were at a greater disadvantage when compared to urban ones.



The hardest period was observed in the first half of the 1990s. Under initial shock of transition from a command to a market economy, life expectancy fell sharply: in six years (from 1989 to 1995) the expected life duration was shortened by four years. This was a consequence of a combination of factors increasing, such as: the favourable impact of the anti-alcohol campaign exhausted itself (Grigoriev, 2011; Meslé, 2002); the transition to the market economy provoked psychosocial stress; and the health care system deteriorated (Grigoriev, 2011). It has been suggested that the acute health crisis emerged as a second phase of a long-standing health crisis that has been observed in the USSR since the mid-60s (Grigoriev, 2011).

During the period of positive improvements from 1996 till 1998, it was still impossible to determine whether it was due to a moderate recovery after a very sharp decline, or perhaps the first stage of a more fundamental improvement in health status. The mortality improvement may be the result of a selection effect: those with the worst health died during the crisis and, as a result, the remaining population is on average healthier than the pre-transition population (Foight N. 2002).

However, after 1998 and until very recently, life expectancy was stagnating with no sign of dynamics. In 1999, after recovering from a deep economic crisis life expectancy for both sexes combined was equal to 68 years. And it needs to be said that in 2008, a decade later, it was still 68 years.

Omelian Rudnitskyi, in his long retrospective study (Libanova et al., 2007), noted that negative tendencies of the 90s brought mortality indicators in Ukraine for females to the level of 1950, and for males to that of 1912. He also found that, aside from generally negative trends, there were observed negative tendencies in sex inequalities – the difference in male and female life expectancy at age 25 was less than 1 year in 1900 but became equal to 11 years in 2006.

Lastly, any mortality analysis is incomplete without understanding a cause behind the deaths. France Meslé and Jacques Vallin (2004, 2008, 2012) performed the most complete analysis of the evolution of mortality by causes in Ukraine since 1965, and they did so by relying on a reconstitution of a consistent series of death by causes. They found that the main killers that account for most of the decrease in life expectancy in Ukraine are circulatory system diseases and violent deaths. The former have been successfully treated in the ex-Soviet current-members of the EU, which was not the case for Ukraine.

After analyzing mortality trends they concluded that Ukraine exhibited the “accelerated” model of the epidemiological transition, where the change in life expectancy and disease patterns occurred late and very quickly.

The same opinion is expressed by Natalia Foight, who explains that epidemiological transition arrived late to Ukraine in comparison to Western-European countries because its demographic

potential had been already exhausted from systematic ruination and weakened by an armament drive. “A perspective historical perspective excursus on the formation and reformation of spatial characteristics in mortality and its divergence within national borders of Ukraine could cast light on the mechanism of attenuation of epidemiological progress. However, unfortunately, now it is difficult to restore the concrete historical mechanism of development of regional heterogeneity in population health and life expectancy in Ukraine, and it is not because of the enclosed information on structural and dynamic characteristics in mortality in the 70s. The main obstacle to understanding the diversity of the current mortality profile is an absence of ideas expressed by analysts who were contemporary to those processes, carriers of empirical and historical memories of the course of events under those conditions” (Foight N., 2005b, p.127).

### 2.3 Recent studies on interregional trends

The most comprehensive research on mortality variation by region was conducted by Ella Libanova in her doctoral thesis (1991). At that time she highlighted that - being relatively low in comparison to other European countries - life expectancy in Ukraine was shaped by large interregional variations. Performing typology (for 1988-1989) according to the level of mortality she distinguished four main demographic zones (*Figure 2.1*) and indicated that the worst picture was not in the polluted industrial eastern region, but in the south. The longest life was enjoyed by the Kyiv male population and females from Chernihiv oblast in the North, and not by western Ukrainians.

Natalia Foight (2005b) notes in turn that not only levels are important, but also disparities. In her opinion, the western regions of Ukraine were in the best situation because mortality inequalities between males and females or between rural and urban areas were the smallest there.

Nevertheless, there were all signs of steady convergence of mortality indicators during the intercensal period of 1979-1989 and therefore most demographic projections of mortality in Ukraine were based on optimistic scenarios. It was the mistake, however, to rely on 1989 as a reference point because it arrived just after anti-alcohol campaign, which caused a sharp but a short effect.

Inspired by positive trends scientists did not predict that within a couple of decades they would be speaking about: a large divergence in mortality by sex, by place of residence and by region (Levchuk et. al, 2001); that all demographic projections would fail (Vlasenko et al., 2006); and that a deep scar from the Chernobyl disaster would appear on the Chernihiv oblast (*Figure 2.2*).

Figure 2.1: Mortality zones of Ukraine according to set of indicators for 1959-1970



Source: Libanova, 1991

Figure 2.2: Mortality zones of Ukraine according to set of indicators for 2000



Source: Shevchuk, 2007

Ella Libanova concluded that regional inequalities in mortality can be principally explained by socioeconomic differences rather than by biogenetic and ecological factors.

Besides Libanova's works, many similar studies on demographic typology and mapping were performed for Ukraine, using different indicators to classify regions. Oleksandr Homra (1990), Sergii Pirozgov (2005, 2006), Pavlo Shevchuk (2005, 2006), and Valentina Steshenko (2005) categorized regions according to their structure by age and sex. After analyzing shapes of age pyramids in every region (their contours, lengths, widths), researchers classified regions into four groups: West (smoothed-shaped), North-Central (distorted shape, old population), South-East (distorted shape, young population), and Kyiv.

Vladimir Piskunov and Valentina Steshenko (1975), Nataliia Levchuk and her colleagues (Levchuk N. et al 2001), and Oleksii Rogozhin (2005) produced a complex analysis that incorporated a wide range of demographic as well as economic variables. Vladislav Shishkin (2001) developed a methodology for computing the Regional Human Development Index (RHDI), which accounts for more than 40 components. Comparing RHDI calculated by Shishkin with LE, the index appears to be low in regions where LE is low, but it has the highest values in the central part of Ukraine (rather than in the west). This can be explained by the education and labor market components of the index.

Pavlo Shevchuk (2007) proposed modern zoning based on the current mortality profile (Figure 2.3). Complementing life expectancy by indicators of infant mortality, mortality of working age population and mortality from causes of death, he distinguished seven areas: 1. City of Kyiv; 2. Zakarpatska oblast; 3. Crimea; 4. Northern oblasts; 5 South-eastern belt; 6. Oblasts around

Carpathian mountains; and 7. The remaining central and northern oblasts. This division is pretty fair and it stresses the fact that particular regions in Ukraine are so much different from others that assigning them to a larger area would be a mistake. And such a conclusion leads to reasoning about the deeper decomposition rather than an aggregation of regions into groups.

Figure 2.3: Zones of Ukraine according to modern mortality profile



Source: Shevchuk, 2007

The necessity of looking beyond administrative borders has been discussed from time to time by researchers (Rogozhin, 2005; Shevchuk, 2007) who argue that administrative limits do not always allow taking into account a large heterogeneity of population that can exist within oblasts, especially between the populations of rural and urban settlements. It is true that data available by districts is, as Pavlo Shevchuk (2007) notes, “too general and, therefore, is influenced by structural factor”. He adds that the use of general indicators (without proper standardization) leads many researchers to wrong conclusions, one of which was expressed in “Population of Ukraine-2004” about the division of Ukraine’s demographic space into south-western and north-eastern parts, while the true vector of change is from the North-west to the South-east.

The amplitude of spatial differences in mortality greatly depends on the age group. As a rule, relative differences are the smallest for old age, while the largest ones concern working ages. For Ukraine, variation is larger for males at a young age and for females at working ages, and shows no particular pattern at old age (Foight, 2005b). There are regions that show extreme situations. The worst indicators in all age groups were observed in the Chernihiv, Zhytomyr, Kirovohrad and Dnipropetrovsk regions, and the best situation in all age groups was in the Lviv region, Kyiv and Sebastopol. It should be noted, however, that even though Foight compared age-specific

death rates, the age groups she chose were quite large, and the results would have been more correct if she had standardized them.

In her doctoral thesis Natalia Foight (2002) proposed a comprehensive analysis of mortality variations across regions for the elderly. In 1989, life expectancy at age 60 was the highest in the Chernihivska oblast in the North (19.2 years) and in some central regions, while it was the lowest in the Zakarpatska oblast in the West (17.2).

As for causes of death, the sword of Damocles that hovers over the lives of Ukrainians is circulatory system diseases. Libanova (1991) estimated that in some central regions their share reached 75% of all deaths among females. In Vinnytska, Lvivska and Rivnenska oblasts the proportion of women dying only from ischaemic heart disease was from 53 to 63%, while in developed countries it did not go over 37%. According to Levchuk and colleagues (2007), the relative role of cardio-vascular mortality over twenty years has changed, but mostly due to the increase in “external” mortality in young and middle-aged groups.

Similarly to the age profile, there has been a significant change in the geographical profile of cardio-vascular mortality. Its localization shifted from the centre to the north during last two decades, occupying regions affected by the Chernobyl disaster (Shevchuk, 2007). It is difficult to explain such a phenomenon; however, the most reliable hypothesis put forth in the literature was a negligent registration of medical cause of death (Libanova, 1991, 2006). In such cases, a death would be assigned to diseases of the circulatory system instead of neoplasm. Such a hypothesis is supported by a high negative coefficient of correlation between these two classes of causes of death.

In its turn, higher than average death rates from cancer were observed in the following locations as: Kyiv, the industrial area of Donbas, Pridneprovje and the South Economic Region (Libanova, 1991). This distribution has not changed over time, supporting a thesis of the WHO that 80% of neoplasms are caused by environmental factors.

It is significant that at the time of Libanova’s study the third place belonged to respiratory system diseases that prevailed in western Ukraine, rather than to external causes of death. Mortality from violent deaths was fourth at that time; it was decreasing, and did not show much regional variation. Drastic socio-economic transformations brought Ukraine to the situation when violent deaths became a second important group in the male mortality profile. This was responsible for disrupted lifespans and distorted the death scope across regions. As for the spread of violent deaths, most researchers link them to the abuse of alcohol. Adding high lethality from infectious diseases, Ukraine appears under a triple-burden.

Nevertheless, this triple burden is distributed unevenly across regions. Natalia Foight (2005b) distinguished three epidemiological subregions of mortality in Ukraine based on the

epidemiological type C proposed by WHO<sup>3</sup>. These types are: C(a) progressive (with prevalence of neoplasms); C(b) medium; and C(c) regressive (with prevalence of infectious diseases). She concluded that types are changing from the West to the East and from the progressive to regressive type correspondingly.

Demographic typology, zoning, classification, and epidemiological subdivisions prove, first that there is a growing concern for the necessity of a flexible demographic policy. Olexandr Rogozhin (2005) states that demographic zoning might become a powerful tool in the regionalization of a demographic policy if it were purposely adapted to such a goal. In this case classification (groups with similar characteristics) is more appropriate than zoning (requires neighbouring). Second, there is a need for a detailed, by-district analysis in order to open “administrative curtains”. Third, there is a necessity to study the latest developments of mortality by cause and their place in the historical evolution.

## 2.4 Similar studies in Europe

A large and comprehensive collection of papers on regional disparities in mortality is offered by the volume “Espace, populations, sociétés”, which was dedicated to the International Geographical Unit (IGU) symposium held in Lille in 1990. It takes a close look at the mortality situation in France (including Paris), as well as in Belgium, Netherlands, Germany, Ireland, Spain, Italy, Czechoslovakia, and Poland.

The unfavourable long-term trends in Eastern and Central Europe have been largely studied by French researchers (Bourgeois-Pichat, 1985; Meslé, 1991; Meslé and Hertrich, 1997). The large fluctuations of life expectancy, which have occurred in the republics of the former USSR since 1985 were also discussed by Russian authors (Shkolnikov and Nemtsov, 1997; Gavrilova et al., 2001).

A group of French-Russian researchers (Vallin et al., 2005) conducted a comprehensive analysis of the geographical diversity of mortality in Russia. They investigated what links may be found between geographical variations in cause-specific mortality, the negative general trends observed since 1965, and the wide fluctuations of the last two decades. One of their conclusions, which is quite important for this research, is that there is the strong contrast between the south-western and north-eastern areas in European Russia, both in terms of total mortality and of cause-of-death patterns. From the study of Olga Antonova (2007) on external causes of death in

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3 The World Health Report 2004. Changing history. – Geneva: World Health Organization, 2004. – <http://www.who.int/whr/2004/en>

Russia it could be added that disadvantages within the European territory grow from the south to the north as the alcohol component increases, while from the west to the east there is an uneven increase in violent mortality.

Features of Belarusian mortality were explored by Pavel Grigoriev (2011). Unlike in Ukraine and Russia, life expectancy trends in Belarus did not exhibit large fluctuation in the early 1990s; rather, they had been continuously falling at a slower pace since the late of 1980s. On the other hand, the similarity with Ukraine is in the principal role of diseases of the circulatory system and external causes. Mortality among middle-aged men has been driven by external causes of death, while mortality among elderly men has been more influenced by CVD. The other close resemblance of Belarus with Ukraine is that the trends in female life expectancy were not subject to large fluctuations.

Geographical patterns of mortality among the Baltic States were studied by Juris Kruminis and his colleagues (Krumins et al., 2000). Researchers concluded that geographical patterns appear to be influenced more by the gradual transitions between different socio-economic and/or cultural areas than by the fact of belonging to a particular national territory. The influence of the Russian type of mortality transition is rather strong in the eastern parts of Latvia and Estonia, while the Lithuanian profile finds some extension in eastern Poland and western Belarus.

The possibility of using measure of life expectancy exclusively in describing geographical variations by local areas is proven by Michel Isnard (1992) for French départements, and by Lynsey Kyte (2006) for local areas of the United Kingdom. The latter offers interesting references regarding methodological options when constructing life tables for small populations.

In the book "Demography: Analysis and Synthesis", Graziella Caselli and Jacques Vallin (2006) give examples of the situations in Italy, China and France. They illustrate how the picture can be distorted or refined depending on the level of territorial division studied.

The conclusion drawn by Graziella Caselli and Jacques Vallin (2006), after studying geographical variations in mortality worldwide, is that the mostly populated areas are generally zones of high-mortality.

Inequalities in adult mortality for selected causes of death and across regions of England and Wales are described in the article by Ann Langford (2009). She focuses on females of age 25-59 years in 2001-2003. Known for having high-quality data, England is again distinguished by having mortality data linked to socio-economic characteristics. Regional differences in mortality were smaller for the most advantaged classes and greater for the least advantaged ones. The findings of other studies prove that there is an association between deprivation and suicides as well as with alcohol-related mortality in England and Wales. Compared to those in the least deprived areas, suicide rates in deprived parts were double (Brock et al, 2006) and alcohol-

related death rates were five times higher for males and three times higher for females (Breakwell et al., 2007).

A recently defended dissertation by Eva Kibele (2012) was devoted to an analysis of spatial differences in mortality in Germany, which were not actually that large. Even in the worst years (late of 1980s) the gap in life expectancy reached 3 years among women and 2.5 years among men, favouring West Germany over East Germany. The author performs comparison of mortality profiles between large parts of Germany as well as among Länder, which are Federal states, and regional subdivisions. This is a hard task, as different factors are involved in shaping mortality trends at different levels of division. Moreover, individual data were used in order to investigate micro-level determinants, and their interplay with macro-level factors.

The main finding of the research confirms the general knowledge about the East-West and North-South gradient in mortality. The lag of East behind West Germany was determined by the excess in mortality at age 40, and for women – at older ages (Kibele 2012, p.12). At the same time, the author outlines new facts on the emergence of some healthier areas in the East as well as some poorly performing areas in the West (Kibele 2012, p.vi).

## **Conclusions**

This chapter provided some overview of literature about mortality trends in Ukraine since the beginning of the 20<sup>th</sup> century. Though data is scarce for the beginning of the period one may still be convinced that - being an agricultural country with a high proportion of peasantry - Ukraine had high mortality rates. The situation changed considerably in the middle of the century: most studies agree that the success in achieving high life expectancy was thanks to preventive measures applied on a large scale. It was a period of steady increase in life expectancy and its convergence among regions. This period was replaced by a new phase of decrease, for which different researchers find different explanations, suggesting a direct influence (shortages in the health care system, lack of individual efforts) as indirect (exhausting potential reserves that work only in the short-term).

As for interregional differences, the situation several decades ago did not differ principally from that observed nowadays: the main killer was and is circulatory system diseases that cause most of the deaths in all regions. The hierarchy of other causes, however, was a bit different.





## Chapter 3

# Data and its assessment

One of the demographer's basic tasks is to produce reliable demographic estimates. For this purpose one requires data of high quality or an awareness of possible errors. To understand and analyze the issues of mortality, one must have access to appropriate statistics. An information database on population is collected using a method of statistical surveillance. Organizational methods of surveillance in Ukraine are: current registers, specially organized observations (census, sample surveys, monitoring), and population registers (Palian, 2003).

In this chapter, I will review three main types of information that I need for analysis: population numbers (which come from censuses and population registers), death counts (which come from current registers), and health information (which comes from various types of surveys and other sources). Before coming to the data sources, I will introduce units of territorial division for which data is collected.

### **3.1 Arrangement of territorial division**

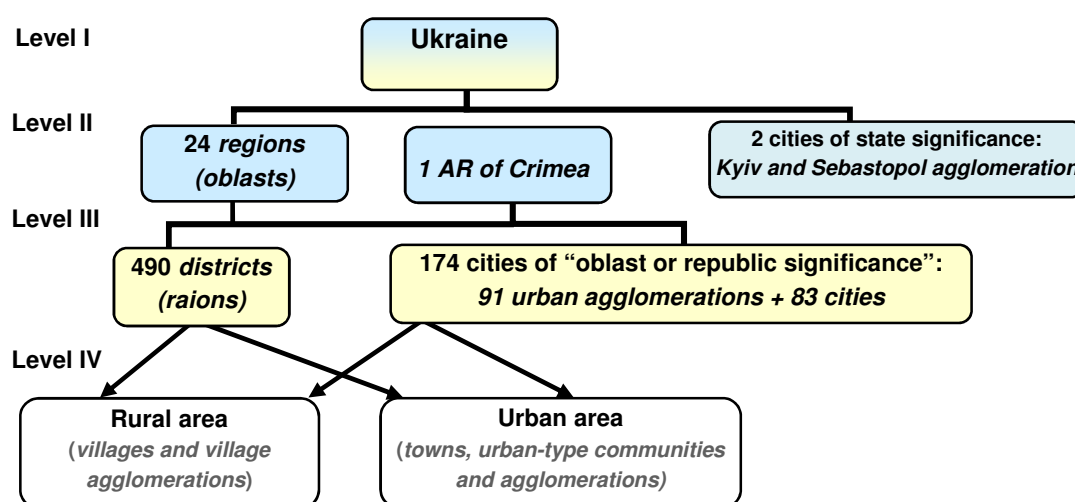
As a study unit in analysis is a territorial entity, particular attention needs to be paid to the territorial and administrative arrangement of Ukraine, especially because it is very complex.

In accordance with Article 132 of the Constitution of Ukraine (Supreme Council of Ukraine 1996), "a territorial system is based on the principles of a country's unity and territorial integrity, the combination of centralization and decentralization in exercising government

authority, and the balanced social and economic development of the regions that takes into account their historical, economic, ecologic, geographic and demographic features, as well as ethnic and cultural traditions”.

Hence, administratively, Ukraine is divided into 27 territorial units: 24 regions (*oblast*), the Autonomous Republic of Crimea (AR of Crimea), and two cities with special status: Kyiv (the capital city) and Sebastopol agglomeration (*Figure 3.1*). Most of Ukraine's oblasts are named after their capital cities, officially called "centers". Further for the sake of simplicity all the second level subdivisions will be called “regions”. The average population of one region is around of 1.8 million people.

Figure 3.1: Administrative and territorial division of Ukraine at the moment of census 2001



Source: ukrcensus.gov.ua

Out of 27 regional entities, there are 25 that are further subdivided into territorial units named districts (*raion*) and cities with a special status of “the oblast or republic (for AR of Crimea) significance”. The latter are urban agglomerations (*miskrada*), which consist of a core town and suburban area or cities alone. Some cities of oblast significance act as oblast centres. There are 490 districts, and 174 cities and urban agglomerations in Ukraine. The average population of a district is around 50 thousand people.

The lowest link in the administrative-territorial system of Ukraine is: towns, urban-type communities and agglomerations; and villages and village agglomerations.

Such administrative division poses problems for those who have to deal with data. The first difficulty concerns cities that have a special status and are extracted from districts. They act as independent units and do not belong to any district formation. The point is that their number is not fixed and is constantly growing: it has increased from 145 in 1990 to 179 in 2010. This is

logical, as the status “of oblast/republic significance” gives a city an opportunity to keep a large share of city revenues in a local budget instead of forwarding them to a state budget. The existence of territorial formations (districts) and of autonomous settlements with the status “of oblast/republic significance”, and their concurrent listing creates a mixture of two basic structures - territorial and administrative - and of two basic terms - “administrative-territorial unit” and “settlement”.

The other problem is proportionality. Albeit the Constitution of Ukraine claims that the territorial division of Ukraine is harmonized with geographical, economic and ethnical aspects, this has not been the case historically. The skeleton of existing administrative division was inherited from the administrative reform of 1775 in the Russian Empire (initiated by Catherine the Great). The main administrative subdivisions were *guberniya* (province) and *uyezd* (district). In the territory of modern Ukraine there were around eleven *guberniyas* with a population from 300 to 400 thousand people; the average size of an *uyezd* was around 30 thousand people (Isaev, 1996). Therefore, the main criterion on which the territorial subdivision was based was solely the population number, and the boundaries were rather arbitrary.

Areas that belonged to Poland, Lithuania and the Austro-Hungarian Empire were divided according to the principles of those countries. In general, the western part of modern Ukraine was divided into *voevodstvos* (voivodeship), and their borders were generally fixed. It should be noted that many cities in western Ukraine had Magdeburg autonomy, which regulated the degree of internal autonomy within cities by a local ruler<sup>4</sup>.

However, administrative and territorial structure changed somewhat, beginning from 1917. Between 1917 and 1919, several separate Ukrainian republics declared independence: the anarchist Free Territory, the Ukrainian People's Republic, and the West Ukrainian People's Republic. As the area of Ukraine fell into warfare, it was also fought over by German and Austrian forces, the Red Army of Bolshevik Russia, the White Forces of General Denikin, the Polish Army, and the anarchists led by Nestor Makhno. A formal peace treaty, the Peace of Riga, was signed on 18 March 1921, dividing the disputed territories between Poland and Soviet Russia, according to which the part of Ukraine to the west of Zbruch had been incorporated into Poland. The east became part of the Soviet Union and was known as the Ukrainian Soviet Socialist Republic<sup>5</sup>.

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<sup>4</sup> The Law of Magdeburg (or Magdeburg rights) was a set of German town laws named after the laws of the German city of Magdeburg. It was implemented in a hundred cities in Central and Eastern Europe. The rights were primarily targeted at regulating trade to the benefit of the local merchants and artisans, who formed the most important part of the population of many such cities. In Poland (which included part of Ukraine) it was combined with a set of civil and criminal laws, and adjusted to include urban planning. [http://en.wikipedia.org/wiki/Magdeburg\\_rights](http://en.wikipedia.org/wiki/Magdeburg_rights)

<sup>5</sup> History of Ukraine - [https://en.wikipedia.org/wiki/History\\_of\\_Ukraine](https://en.wikipedia.org/wiki/History_of_Ukraine)

After Hitler's invasion of western Poland, in accordance with secret clauses in the German-Soviet Pact of 1939, the Red Army invaded eastern Poland, of which two provinces, Volhynia and Eastern Galicia (territories lost by the Peace of Riga), were annexed to Ukraine. A year later Ukraine also annexed the Romanian provinces of Northern Bukovina and Southern Bessarabia. In the course of the war Ukraine lost some of these regions. However in 1945 it has not only recovered its territory of 1940 but also annexed Subcarpathian Ruthenia retaking it from Hungary (Meslé and Vallin, 2012, p.42).

These numerous transformations resulted in a situation when the number of regions and districts became significantly larger in the western part of Ukraine. The intensive fragmentation took place after the Second World War. It happened because a larger number of administrative units allowed for the creation a corresponding number of governmental/security (KGB) bodies for controlling partisan and clandestine movements there (Tkachuk, 2009). Therefore, some disproportions in the regions' area appeared. Nowadays western regions are two times smaller than other regions on average (2.7 vs. 4.3 % in total area of Ukraine). And the tiniest Chernivetska oblast occupies an area 4 times smaller than the largest Odeska oblast does (*Table 3.1*).

The shape and compactness of regions differ as well. Compactness means centralization on the local level and a presence of the centre that fulfils the functions of a coordinator and serves its services to contiguous areas for their synchronized development. One measure of compactness is a territorial accessibility from the periphery to the centre. According to Karpinskyi (2005), the most compact regions are Volynska, Kharkivska and Zaporizka oblasts. The most awkward configuration is peculiar to Kirovohradska, Odeska, Cherkaska oblasts and AR Crimea (for administrative division, see *Annex A*). The complex configuration of territory, complemented by a low development of transportation network, creates serious obstacles for people to reach regional centres. This results in uneven access to health, social care facilities, specialized medical centers, sources of information, etc. There are around 25% of districts that are remote from regional centres on a distance greater than 100 km. In some regions like Odeska, Khersonska, Poltavaska, Chernihivska, Luhanska and Sumska oblasts, proportion of such districts reaches almost half (Karpinskyi 2005).

There are also some enclave zones. One of these is the Kremenchug district in Poltavaska oblast, which fits perfectly into the configuration of Kirovohradska oblast, however. Some oblasts (Cherkaska, Zaporizka, Khersonska, Dnipropetrovska, Kyivska) are split into parts by the river Dnieper.

Another example is the city of Slavutych, which is the youngest city in Ukraine. Its population consists of inhabitants from Prypiat, who were evacuated from the Chernobyl zone. Slavutych is

physically located in Chernihivska oblast, however, and it administratively belongs to Kyivska oblast (as Prypiat was). Also, the village Kotsiubynske is entirely located in the territory of Kyiv city. Karpinskyi explains this phenomenon by subjective factors in land division.

Table 3.1: Administrative and territorial structure of Ukraine and some characteristics of regions at 2001 census

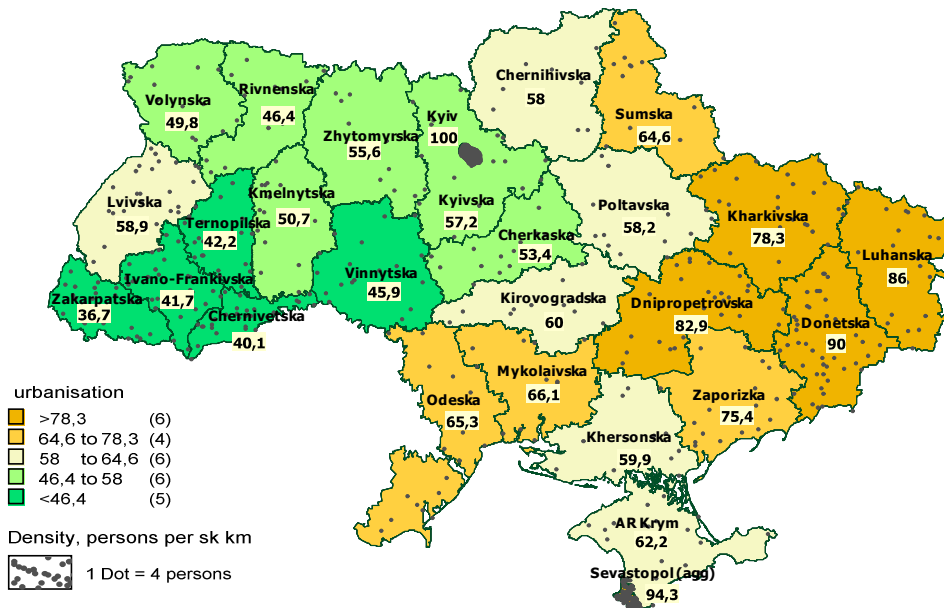
Region	% of region's area in total (603.6 thousand sq.km)	% of region's population in total (48.5 mln)	Density	Total number of administrative and territorial units	Districts	Cities with status of "state, republic, and oblast importance"	Urban aggregations	Cities
1	2	3	4	5 =6+7	6	7=8+9	8	9
Ukraine	100.0	100.0	80.3	664	490	174	91	83
Odeska (S)	5.5	5.1	74.1	33	26	7	2	5
Dnipropetrovska (E)	5.3	7.4	111.6	35	22	13	7	6
Chernihivska (N)	5.3	2.6	39.1	25	22	3	0	3
Kharkivska (E)	5.2	6.0	92.8	34	27	7	5	2
Zhytomyrska (N)	4.9	2.9	46.6	27	23	4	0	4
Poltavska (C)	4.8	3.4	56.7	30	25	5	1	4
Kyivska (N)	4.7	3.8	65.0	36	25	11	3	8
Khersonska (S)	4.7	2.4	41.3	21	18	3	2	1
Zaporizka (E)	4.5	4.0	71.0	25	20	5	2	3
Donetska (E)	4.4	10.0	182.6	46	18	28	22	6
Vinnitska (C)	4.4	3.7	66.9	33	27	6	3	3
Luhanska (E)	4.4	5.3	95.4	32	18	14	12	2
AR Krym (S)	4.3	4.2	78.0	25	14	11	7	4
Kirovogradska (C)	4.1	2.3	46.1	25	21	4	4	0
Mykolaiivska (S)	4.1	2.6	51.4	24	19	5	0	5
Sumska (N)	3.9	2.7	54.5	25	18	7	6	1
Lvivska (W)	3.6	5.4	120.3	27	20	7	4	3
Cherkaska (C)	3.5	2.9	67.1	26	20	6	4	2
Kmelnytska (W)	3.4	3.0	69.3	26	20	6	0	6
Rivnenska (W)	3.3	2.4	58.5	20	16	4	0	4
Volynska (W)	3.3	2.2	52.7	20	16	4	1	3
Ivano-Frankivska (W)	2.3	2.9	101.2	19	14	5	3	2
Ternopil'ska (W)	2.3	2.4	82.6	18	17	1	0	1
Zakarpatska (W)	2.1	2.6	98.5	17	13	4	2	2
Chernivetska (W)	1.3	1.9	114.0	13	11	2	0	2
Kyiv (N)	0.1	5.4	3112.4	1		1		1
Sevastopol(agg) (S)	0.1	0.8	439.2	1		1	1	
<i>Coef Variation, %</i>	<i>30.5</i>	<i>38.9</i>	<i>114.6</i>	<i>27.7</i>	<i>17.6</i>	<i>86.8</i>	<i>48.4</i>	<i>54</i>

\* sorted by column 2

\*\*W-West, E-East, N-North, S-South, C-Centre

Further evidence of disproportion is the level of urbanization (*Figure 3.2*). Intensification of production and massive movements of population to industrial agglomerates caused shifts in population distribution. According to the 2001 census, the ratio in population density reached 5, with the maximum in the East (183 per square kilometre in Donetsk oblast) and the minimum in the North (39 per square kilometre in Chernihiv oblast, which includes the zone of evacuation after the Chernobyl disaster).

Figure 3.2: Percent of urban population and population density by regions, 2001 census

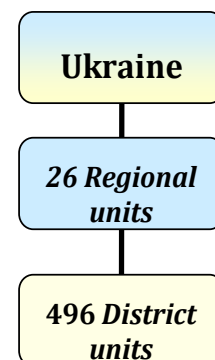


Source: data of the State Statistics Service of Ukraine.

The numbers of cities and agglomerations in regions are also different. There are four oblasts in the West that have no urban agglomeration at all, while only Donetsk and Luhanska oblasts alone account for 37% of all urban agglomerations in Ukraine. Together with Dnipropetrovska oblast, these account for 52% of all cities “of oblast significance”. And as was already said, economically important cities have their special territorial and administrative status and are treated equally to districts. This expulsion of some cities “ruralises” the term “district”, because some districts include both villages and cities while others include only villages. This does not permit making justified comparisons between these entities.

In order to solve this problem I decided to affiliate units with special status to the districts, in whose territories they are physically located. The subsequent summary of all districts in one region will produce a region total.

Figure 3.3: Simplified territorial division



So, out of 174 units with “special status” that were found in Ukraine at the moment of census, 167 units were affiliated to their corresponding districts. One city, Prypiat, which has no population, was eliminated. The city of Slavutych was kept in the Kyiv region, to which it officially belongs, and not in the Chernihiv region, where it is physically located. Though it was a rule to affiliate cities to districts, I could not affiliate cities to a region in the same way, as it would mess up the statistics for regions and the demographic data would not be comparable with socio-economic information given by regions. Only Sebastopol agglomeration was affiliated to AR Crimea, since in most statistical forms it appears separately only after 1995.

Lastly, 6 agglomerations (Alushta, Sudak, Feodosia, Yalta, Sebastopol and Dnyprodzerzhynks) still appear as separate entities, as there are no districts around to affiliate them to. The good news is that Alushta, Sudak, Feodosia, and Yalta are all neighbours and, moreover, shape the South Bank of Crimea, which is kind of an isolated area and therefore exceptional in many aspects when compared to the rest of Ukraine. Thus, instead of 490 rural districts and 174 agglomerations with special status, I received 496 territorial entities of the 3rd level (still named districts), each of which has a rural and urban population and include big cities as well (*Figure 3.3*). These 26 regions and 496 newly obtained districts will serve as study units in my analysis.

## **3.2 Data sources, availability and quality**

The organization responsible for the collection and primary processing of demographic statistics in Ukraine is the State Statistics Service (SSS). The SSS has 25 regional and 495 district subdivisions that collect census and micro-census data at the regional level and which conduct various statistical surveys as well.

### **3.2.1 Population number**

The most important source of information about population is census. The first All-Ukrainian census took place on 5th December 2001. It was the first national census since the proclamation of independence and since the last Soviet census took place in 1989.

The census of 2001, as well as that of 1989, counted population according to the actual place of living and hence produced figures that described the actual or “de-facto” population of Ukraine at that moment. Permanent or “de-jure” population was obtained by subtracting temporary present persons and adding temporary absent persons. As one may see from *Table 3.2*, census data is available by regions for both censuses, while for the 2001-census data is existing for



districts as well. The census form includes questions about sex, age, date and place of birth and also about family status, ethnic origin, language, citizenship, education, income sources, employment, and migration activity.

Table 3.2: Availability of information on population, Ukraine

Level	Forms	Type of data	Period	№ units	Age grouping	Comments
Region	Census data	Pop. count by age, sex & place of residence	1989, 2001	26/27	0, 1, 2...100+, unknown	
District	Census data	Pop. count by age, sex & place of residence	2001	490 +174	0, 1, 2...100+, unknown	
Region	RN-2	Pop. count by age, sex & place of residence at the beginning of the year	1988-2011	26/27	0, 1, 2...100+	intercensal 1990-2000 data recalculated
Cities	RN-2	Pop. count by age, sex & place of residence at the beginning of the year	2003-2011	45	0, 1, 2...100+	unknown are redistributed

For the remaining years, population is estimated using information about vital events and migration. As soon as a new census is organized, the population number in the intercensal period is recalculated.

The main statistical form on population is the “RN-2 Population count by sex and age at the beginning of the year”. Data in this form is obtainable by single age groups and sex for every region beginning from 1988. Until 1990 Sebastopol was not treated separately (it was included in the AR Crimea), and so the total number of administrative units was 26 rather than 27. Lastly, as is seen in the table, this statistical form is also available for the largest cities in Ukraine.

As said above, the State Statistics Service provides estimates of population in intercensal periods using the intercensal survival method. It provides an estimation of the size of each population cohort on January 1st of each intercensal year. The simplest procedure consists merely of subtracting death counts and adding births and net migration to the initial census figure to obtain cohort population estimates of each successive year. Unfortunately, the accumulated result produced by such a calculation at the end of an intercensal period differs from the count produced by census. By placing trust in the vital statistics, the entire fault is assigned to the migration component.

Information about migration processes includes official statistics and data of special sample surveys. Official statistics in their turn include national statistics (summarized by the State Statistics Service of Ukraine) and departmental data (data of Ministries and Departments on

special migration aspects). Among these are Ministry of Internal Affairs, Ministry of Foreign Affairs, State Border Guard Service, Ministry of Social Policy, Ministry of Education and Science, etc. (Maidannik and Pozniak, 2010). Unfortunately, there is no program coordinating functions of each governmental institution in respect to migration (Halkiv, 2010). As a consequence, the information produced does not properly reflect the reality.

The main source of information about migration is registration cards of departure or arrival. In the Soviet period and until 2003 these cards included a lot of information on the people migrating, such as: day and place of birth, sex, nationality, citizenship, purpose or cause of departure/arrival, place of destination (for departures) or previous place of living (for arrivals), and also marital status, educational level, and occupation (Pozniak, 2007). However beginning from 2004, according to the Decree of the Cabinet of Ministers of Ukraine (# 985), these registration cards were simplified and many questions, such as causes of migration and intended period of stay were canceled, as it was impossible to obtain feasible information. Questions on education level and occupation were cancelled as well (Pozniak, 2007).

These cards are collected by organs of the State Migration Service of Ukraine, which belongs to the Ministry of Internal Affairs. In accordance with the Law of Ukraine from 2012 (№ 5492-VI), later information about population movement (together with information on civil state acts received from the State Registration Service) is consolidated into the State Demographic Registers, which is a computerized information database on population.

Though these cards were designed to track any migration movement (as was in Soviet times), nowadays they only capture well those movements that require change of registration, i.e. internal migration. International migration is more difficult to fix.

Another additional source of data that captures migration exchanges with other countries is the State Border Guard Service, which provides pretty accurate information about entries and exits at check points. The difficulty is to distinguish a real migration event from numerous crossovers at the border. And despite the purpose of travel that a person declares, they may intend to stay illegally in the destination country. According to a survey, 85.7% of Ukrainians working in Italy arrived there with a tourist visa (Pozniak, 2007).

Another problem in fixing a migration event consists of the fact that a person migrating may not be aware himself whether a temporary stay for work will transform into a permanent residence. For this reason most labour migrants do not register themselves in state institutions. According to some estimates, this is true for 90% of departures from Ukraine (Halkiv, 2010).

The State Statistics Service collects and processes information collected by registers and other departments. It also organizes the census, which is one of important sources of information on migration. The questions of census permit learning about the number of people living in a given

place permanently since their birth (not counting military service, business trips and absence for less than 12 months), as well as the number of migrants. The problem of census data is that it fixes a migration event at the moment of census and not at the moment of movement. And since censuses are rarely organized, data becomes obsolete.

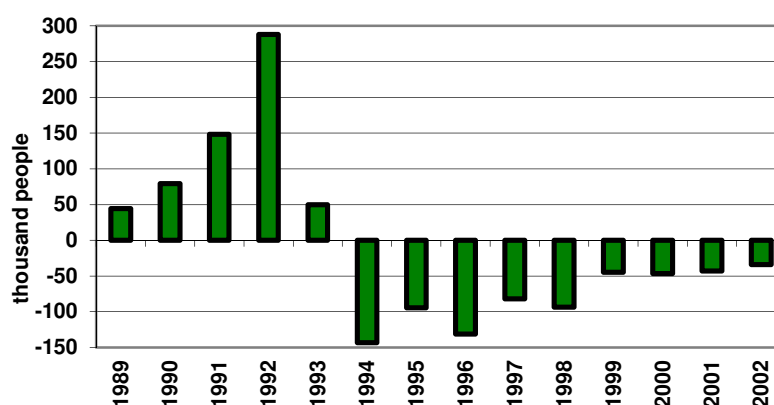
Taking into account difficulties in registering spatial movements, the deviation of registered figures from reality is no surprise. For example, as indicated in the study of O. Pozniak (2007, p.66), “according to current registers, population loss due to migration in 1994-2002 was 680 thousand persons, while real migration losses in this period were almost doubled – 1156 thousand persons”.

The low quality of migration statistics is confirmed also by the disagreement in data produced by different countries: for example by Russian and Ukrainian Statistics Offices. According to Ukrainian statistics, net migration between these two countries in 2006 was small and positive (+2 thousands); and according to Russian statistics, it was ten times bigger and negative (-20.8 thousand people) (Pozniak, 2007).

For this reason, annual estimations of population are usually adjusted on net migration calculated *a posteriori* after a census takes place. Namely, net migration is found as a difference between census and estimated populations. Subsequently, this difference is distributed evenly across years using the cohort method.

However, doubts regarding the quality of these estimations arise from the recognition of large fluctuations in migration streams in the intercensal period. The official method assumes that the total negative net migration was accumulated over time, year after year, while in reality the accumulation was positive in the first half of the 90s and it experienced a large drop only beginning from 1994 (Figure 3.4). Therefore, there is a chance that mortality rates in the first half of the 90s were overestimated as population at risk could be larger than was assumed.

Figure 3.4: Dynamics of net migration in 1989-2002 for the whole Ukraine (according to population registers)

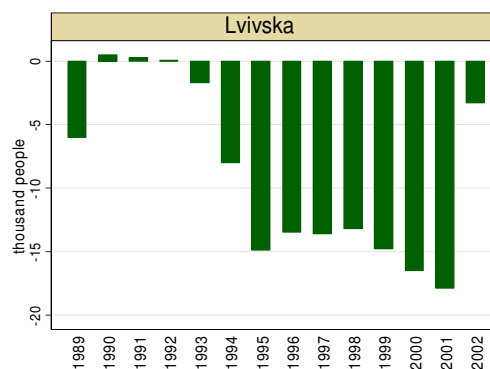


Source: Pozniak, 2007;

According to the pattern of net migration during the intercensal period, all regions can be classified into four groups.

a) One spectacular pattern is observed in Lvivska oblast, the most urbanized region in the west of Ukraine (*Figure 3.5*). This region borders Poland from the West. It started to experience population losses even before the dissolution of the Soviet Union, which were reinforced in 1994 and increased over time. This scenario is the closest to the assumptions made by the State Statistics Service when estimating the intercensal population; hence the population estimate for Lvivska oblast can be treated with confidence.

Figure 3.5: Net migration for Lviv region, 1989-2002



Source: data of the State Statistics Service of Ukraine

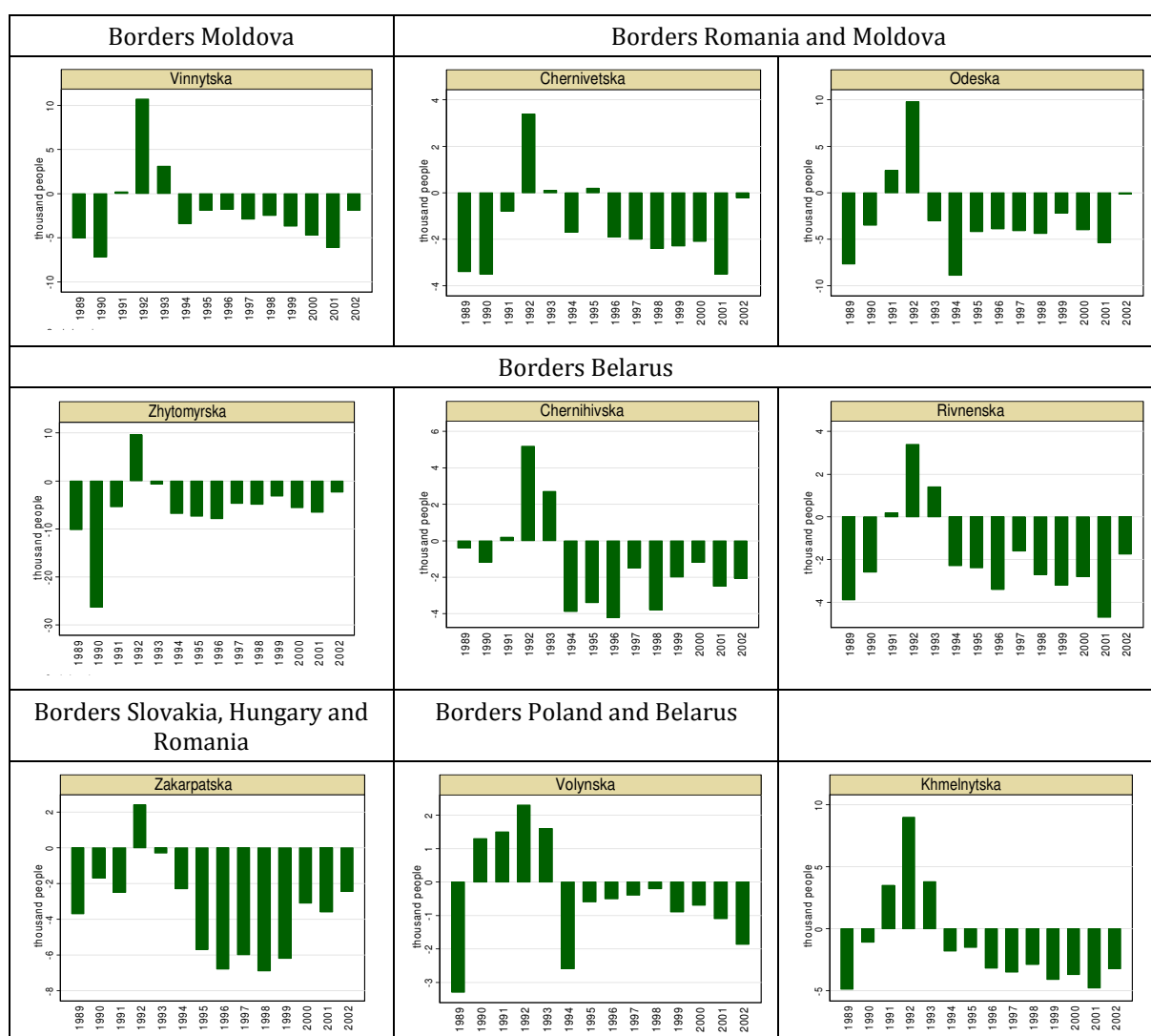
b) The next group of regions represents a rather mixed case, which is, however, still close to the first scenario where losses prevailed greatly over gains in population number. The wave of inflow that follows the dissolution of the Soviet Union was very short and was replaced by a large and long-lasting wave of out-flow. *Figure 3.6* groups regions with such patterns, which however have differences in magnitude of phenomenon (different scale on the graph).

Most selected regions (except Khmelnytska oblast) are located at the borders with other countries, migration processes are intense here and streams are associated with departures abroad. A different example is Odeska oblast, which lost most of its population to Israel. On the other hand, Zhytomyrska oblast, which is in the closest distance to Kyiv, participates a lot in supplying its active population to the capital.

A specific case is represented by Zakarpatska oblast, which is somewhat isolated from the rest of Ukraine by the Carpathian Mountains. It was annexed to Ukraine after the Second World War. Share of migrants in total population here is rather low (13.5% at the moment of census), while, on the other hand, those leaving the region are numerous (Pozniak, 2007).

The case of this group is still close to the one that was assumed in population assessments. Year of positive net migration was the same for every region: 1992 (and, in some cases, the years around); so if any population underestimation had taken place, it would have been for this short period.

Figure 3.6: Regions with rather negative net migration during the period of 1989-2002



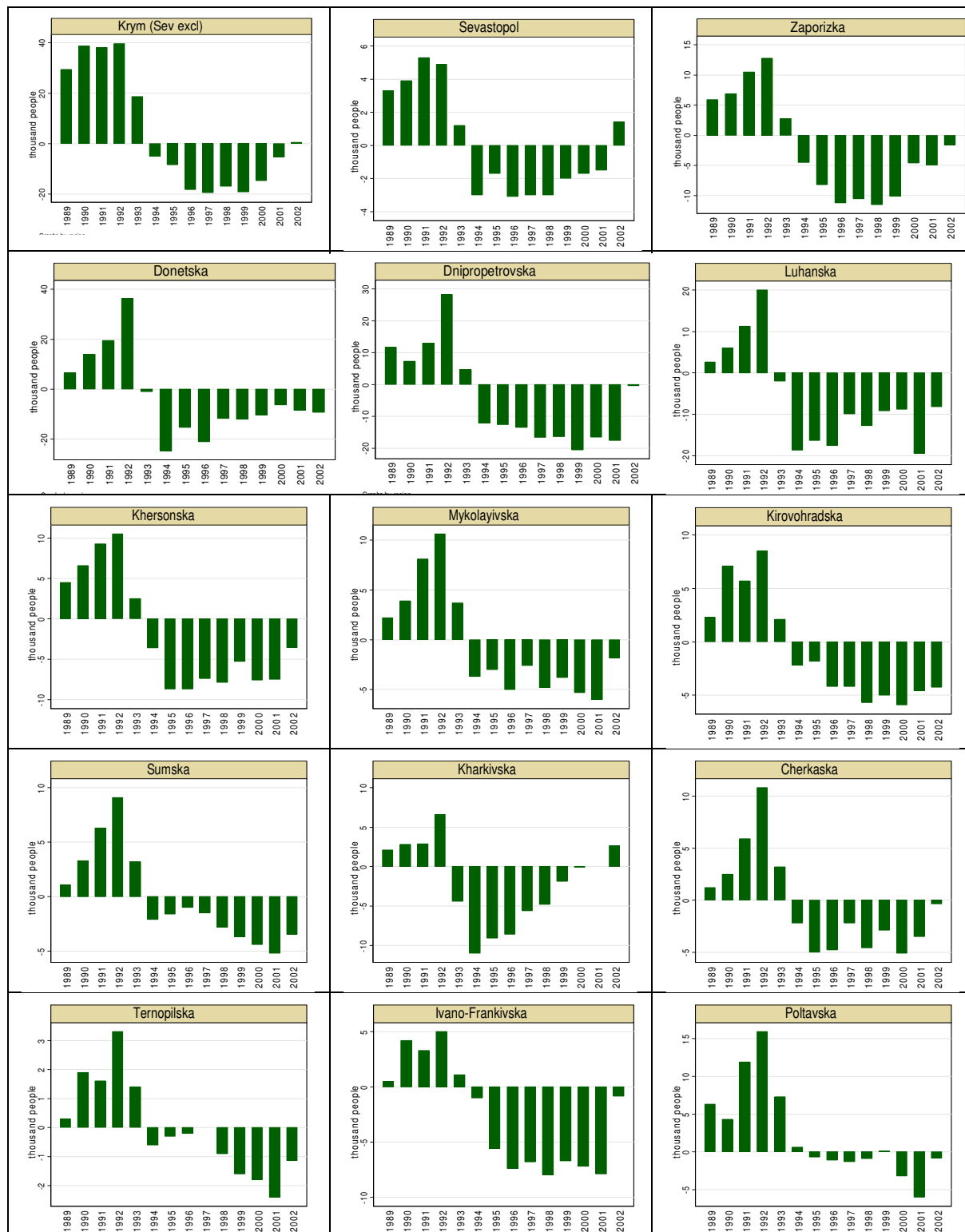
Source: according to the data of State Statistics Service of Ukraine

c) A huge group of regions in which the scenario of migration development very much resembles the all-Ukrainian pattern is presented below (*Figure 3.7*). After the dissolution of the Soviet Union, a great wave of arrivals was observed, followed by a wave of departures. The largest scale of migration movements was observed in AR Crimea and the industrial zone of Donbass (Donetska, Luhanska and Dnipropetrovska oblasts); they are followed by regions in the central and southern parts of Ukraine.

So, if there is one region that is the most suspected of having an unreliable population estimate in the intercensal period, it is the Autonomous republic of Crimea, which is characterized by the largest amplitude in net migration (from -20,000 to +40,000 persons). Many changes have happened to it during the transition period, and the most important one is the repatriation of original population, Crimean Tatars. It is also characterized by a high intensity of migration

exchange with the Russian Federation. In general, the share of migrants in the total population in Crimea is the highest in Ukraine: it was equal to 60.6% at the 2001 census (Pozniak, 2007).

Figure 3.7: Regions with sharp changes in net migration during the period of 1989-2002



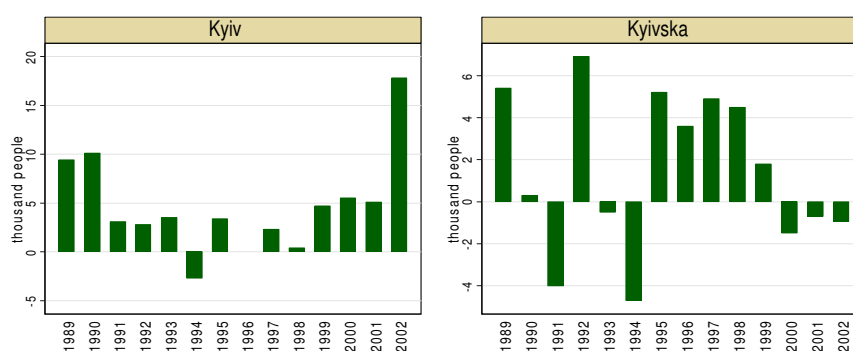
Source: according to the data of State Statistics Service of Ukraine

The quality of population estimates in the intercensal period is dubious in the south-eastern part of Ukraine as well. Migration activity here is higher than on average for Ukraine. It is also as high in rural area as in urban. This is explained by concentrations of numerous rural settlements within the boundaries of large urban agglomerations. On the other hand, even though this area has a large share of people born outside its borders, most of them come from other parts of Ukraine rather than from abroad (Pozniak, 2007). As for other nationalities, one can find here Russian citizens and persons originating from the Caucasus. There is also a group of Moldovans in the South of Ukraine (Mykolaivska oblast).

d) The last group is the city and region of Kyiv (*Figure 3.8*). The share of inhabitants born outside the capital is as high as in Crimea (around 50%), though most arrivals to Kyiv were born in the territory of Ukraine. Beginning from 1995, Kyiv was the only region in Ukraine that experienced positive net migration with a tendency for increasing.

Hence, due to its gradual rise, the population number assigned to Kyiv in estimations corresponds to the reality, and I can use these figures with a certain level of confidence.

Figure 3.8: Regions with rather positive net migration over the period of 1989-2002



Source: according to the data of the State Statistics Service of Ukraine

Lastly, even with information about annual net migration by regions received from population registers, it is still not enough to perform a better estimation of the intercensal population that was already done officially. First, because I don't have data by cohorts to spread deaths in Lexis triangles; and second, because even though population registers give some idea about net migration in each region, the quality of this information is still too low to make precise assessments and to fully rely on it. Hence, I will use official estimates of population made by the State Statistics Office, keeping in mind the qualitative assessment described above, which designates the degree of confidence that can be placed on demographic estimates.

### 3.2.2 Vital events

The information about individual life events (births, marriages, divorces and deaths) in Ukraine is collected by the bureaus of civil status registration (RAGS - Reestratsiia Activ Gromadskogo Stanu), in accordance with the Law of the Supreme Council of Ukraine (# 2398-VI, 2010). They belong to the structure of the State Registration Service operating under the Ministry of Justice of Ukraine. The civil status registration is confirmed by producing related certificates.

The registration of birth is made according to the actual place of birth or according to the parents' place of living. The registration of birth should be made within one day or, in the case of foetal death, within three days. The registration of birth is a document confirming the fact of birth issued by the health care institution; and when a birth happens outside of the health care institution, the document is issued by a medical advisory committee (Article 13, Law #2398-VI, 2010).

In cases where a baby is born dead, the registration of birth is made without issuing the certificate of birth. For confirmation of such an event, the bureau of civil state registration produces a document (Act) indicating the fact of stillbirth. The registration of death in such cases is not made. In cases where the baby's death occurred in the first weeks of life, the registration of birth is made with the issuance of the document (Act) stating that a baby died. The registration of the newborn's death is made in the prescribed manner with the issuance of the death certificate, in accordance with the Law of the Ministry of Justice (# 52/5, 2000).

Defining a Live birth is also an issue that requires attention. For a long time, Ukraine used the Soviet definition that had restrictions on weight and height in classifying a birth as a live one. Consequently, it excluded the most vulnerable infants from Ukraine's infant mortality measure. New rules on defining live birth and stillbirth (which correspond to the rules recommended by WHO) went into force in 2007 (Law of the Ministry of Health #179, 2006). A newborn does not have to meet any parameters other than showing signs of life to be counted as living.

In general, the share of newborns with low body weight in Ukraine is around 10-12% (Law #584, 2006). According to different assessments (see sub-chapter 3.3.2) the underestimation of infant mortality was around 15-20%. These deaths were registered as spontaneous abortions. After applying the new criterion and changes to the Civil Code of Ukraine to bring them in compliance with the WHO and EU requirements, an increase in new-born mortality is expected to begin in 2005.

There are also strict instructions from the Ministry of Health about the medical care of newborns. In particular, this is the Protocol on principles of neonatal care (Law of the Ministry of Health of Ukraine #152, 2005), issued in line with WHO recommendations. There also exists a Protocol on medical care of newborns with a low body weight (Law of the Ministry of Health



#584, 2006). During the first five minutes of an infant's life, a pediatric doctor or neonatologist evaluates the baby according to the Apgar scale. A low score on the one-minute test may show that the neonate requires medical attention, but it is not necessarily an indication that there will be long-term problems. If the Apgar score remains below 3 at later times - such as 10, 15, or 30 minutes - there is a risk that the child will suffer longer-term neurological damage. However, the purpose of the Apgar test is to determine quickly whether a newborn needs immediate medical care.

Death is another principal "vital event" for which vital statistics are collected and compiled by the vital statistics registration system. By law, the registration of death must be done no later than three days after the death or disclosure of a dead body. In cases where it is impossible to obtain the certificate from a medical institution or judicial-medical expert, the registration must be completed within five days. Death is confirmed by the medical certificate of death issued by the medical institution, a court decision about the fact of death, a notification from the state archives or from correctional institutions, etc. (Article 17, Law # 2398-VI, 2010).

The physician fills out the death certificate by describing the diseases, health conditions and damages found in the deceased. Then death is coded according to the International Classification of Diseases. Generally, it depends a lot on the skill of the certifying medical attendant in diagnosing the cause of death and in describing the cause of death on the death certificate. To a more limited extent, it also depends on the skill of the coder in classifying the cause based on the information on the certificate (Mcgehee, 2004; Kibele, 2012). The comparability of diagnosis might be affected also by such factors as religious or social constraints, or even by particular diseases being "fashionable" within the medical profession (Brouard and Lopez, 1985). All this yields different regional and temporary coding practices.

Individual mortality data registered in bureaus of the civil status registration are summed up in the regional statistical subdivisions as a complex of tables that reflect detail mortality structure by sex, age, type of residence (urban or rural area) and cause of death. The State Statistics Service compiles and analyzes these data and issues annual reports.

The primary important statistical forms about death counts are:

- Form C-6, "Distribution of deaths by sex and age". Beginning from 2001, a new version of this form went into usage and was named C-6p "Distribution of deaths by sex and age accounting for deaths with unknown age"
- Form A-1, "Summary of natural change of population".

The table below (*Table 3.3*) lists these forms in respect to period, administrative division, age grouping, etc. Vital statistics on natural change of population are also available for districts.

Table 3.3: Availability of information on death counts, Ukraine

Level	Forms	Type of data	Period	Nº units	Age grouping	Comments
Region	C-6	Deaths by age, sex and place of residence	1989-1994	26	0, 1, 2...,100, 100+, unknown	
			1995-2000	27	0, 1, 2..., 100, 100+, unknown	
Region	C-6p	Deaths by age, sex & place of residence	2001-2010	27	0, 1, 2...100+	unknown are redistributed
Region	A-1	Pop.; birth and deaths by sex & place of residence	2002-2010	27	0, total	
Districts	A-1	Pop.; birth and deaths by sex & place of residence	2002-2010	490+174	0, total	

*Source: data of the State Statistics Service of Ukraine summarized by the author*

However, some causes can produce errors in death registration. Mary Mcgehee (2004) classifies these deficiencies in three groups: (1) accuracy of the definition of death applied, (2) completeness of registration, (3) accuracy of allocation of deaths by place and time. To be more precise, the first type of error in Ukraine refers mostly to infant mortality. As for completeness, which reflects the coverage, it may be considered satisfactory. And, lastly, errors might be produced by the wrong allocation or late registration of death, which happens quite often.

According to Pirozhkov and his colleagues (2006), the death registration in Ukraine was reliable until 1990. Since 1990, because of the total liberalization in all spheres of life in Ukraine, the controls on gathering primary death information weakened and the quality of death statistics decreased. A serious problem that distorted mortality statistics involved difficulties in registration of deaths in rural areas at the correct time. Such unregistered deaths were not included in the official statistics at all (Pirozhkov et al., 2006).

In regard to territorial aspect, registration of death is performed according to the place of residence, place of death or place of burial. Confusion might occur in the situation where death happens in the city and relatives bury the deceased in a rural area. Having a medical certificate, they do not apply for the death certificate in the city. The lack of death certificate is revealed much later in matters involving inheritance or social help. In this case, registration according to the place of burial is normally made<sup>6</sup>. Alfred Sauvy (1992) explained that registering death according to the place of death and not to the place of residence drives mortality rates way up in places where medical or custodial institutions are located.

<sup>6</sup> <http://www.gazeta.rv.ua/articles/view/2009-11-12/15179.html>

### 3.2.3 Cause-of-death data

An important aspect in analyzing mortality relates to medical causes of death. The availability of such data gives a green light to investigate the medico-epidemiological situation in Ukraine. The main important statistical forms on death by causes are:

- Form C-8 “Distribution of deaths by sex, age and cause of death”
- Form C-14 “Distribution of death by causes of death and territories”.

As in the case of C-6, beginning from 2001, the State Statistics Service issued the new form C-8p, which presents numbers of deaths by age, sex and cause, which already accounts for those whose age at death is unknown (*Table 3.4*). The deaths with unknown cause and age are distributed proportionally to each cause of death and age group.

Table 3.4: Availability of information on death counts, Ukraine

Level	Forms	Type of data	Period	No units	Age grouping	Comments
Region	C-8	Deaths by age, sex, place of residence & cause of death	1988-1994	26	0, 1, 2, 3, 4, 1-4, 5-9, 10-14, 15-19... 80-84, 85+, unknown	Causes of death only for broad groups
			1995-2000	27	0, 1, 2, 3, 4...19, 20-24, 25-29... 95-99, 100+, unknown	Detailed info
Region	C-8p	Deaths by age, sex, place of residence & cause of death	2001-2010	27	0, 1, 2, 3, 4...19, 20-24, 25-29... 95-99, 100+	2005 – change from ICD 9 to ICD 10
District	C-14	Deaths by territory & cause of death	2005-2010	490+ 174	Total	19 classes according to ICD-10

Source: data of the State Statistics Service of Ukraine summarized by the author

Regarding mortality sheets for medical causes of deaths, they are incomplete for years 1989-1995. The information is given only for broad groups of diseases (subclasses), rather than for more precise causes of death. Beginning from 1996, detailed datasheets with deaths by causes became available for every region. Lastly, Ukraine switched to the 10th revision of International Classification of Diseases (ICD-10) in 2005. Until then, for the period 1988-2004, deaths were coded according to the Soviet version of ICD-9. This change makes data trends by cause of death inconsistent, since some groups became more detailed and some became aggregated.

Beginning from 2005, the year of switching to the 10th revision of ICD, it became possible to look also into the nosological profile by districts. Deaths are spread into 19 broad classes of

causes, with some subdivision into smaller groups for particular classes (i.e., for infectious diseases, psychic disorders, circulatory and digestive system diseases, and external causes of death).

Comparability of cause-of-death statistics has been affected by each revision of the Classification. Ukraine used the Soviet Classification of diseases, which was similar to an abridged list of the International Classification of Diseases. The work on creating transitions from one revision to another since 1965 up to 2004 was done by France Meslé and Jacques Vallin (2003, 2008, 2012). However, the last transition was not considered, as at the moment of their work there were not enough reference years to perform a transition. In this study I refer to both classifications: to the Soviet version of ICD9 for the period up to 2004; and to the Ukrainian version of ICD10 for the period after 2005. And where time series need to be presented, only broad groups of diseases are used to avoid the problem of inconsistency.

Table 3.5 classifies information available for regions in computerized form according to time periods when some changes occurred. The Class “External causes of morbidity and mortality” is, as a rule, doubled two times for each classification. In the first case, accidents are classified according to the type of external cause that provoked a death; and in the second, according to the nature of the injury.

Table 3.5: Availability of information by causes of death by regions

Years	1988-1994	1995-2004	2005-2007	2008-2010
Classification	Soviet classification of 1988	Ukrainian version of Soviet Classification	Ukrainian version of ICD10	Ukrainian version of ICD10
Number of causes	17 (18) classes + 8 subclasses	17 (18) classes + 8 subclasses + 177 causes +	19 (20) classes + 238 causes	19 (20) classes + 243 causes
Reference	Table 3.6	Annex F	Annex G	Annex G

### ***Period from 1988 to 1994***

The first period, 1988-1994, refers to the times when Soviet Classification was in use even though in 1991 Ukraine had already become independent. In fact, this classification remained in use for another 15 years (Meslé and Vallin, 2012).

For the year 1988, statistical sheets by regions were fully digitalized after obtaining archival data in the framework of this study. For the years 1990-1994, data was digitalized by the Statistics department of the Institute of Demography and Social Studies in Kyiv, and

unfortunately only broad classes of diseases were considered. Therefore, I have 25 groups of causes for each region, out of which 17 are Classes and 8 are additional categories (*Table 3.6*).

Table 3.6: List of causes available for regions for 1990-1994, Soviet Classification

Row	Code	Cause of death
<b>001</b>	<b>1 - 44, 206</b>	<b>Class I. Certain infectious and parasitic diseases</b>
002	9 - 13	Tuberculosis
<b>003</b>	<b>45 - 67</b>	<b>Class II. Neoplasms</b>
004	45 - 51	Malignant neoplasm of digestive organs
005	52 - 54	Malignant neoplasm of respiratory organs
006	58 - 60	Malignant neoplasm of female genital organs
007	45 - 66	Malignant neoplasms
<b>008</b>	<b>68 - 70</b>	<b>Class III. Endocrine, nutritional and metabolic diseases</b>
<b>009</b>	<b>71, 72</b>	<b>Class IV. Diseases of the blood and blood-forming organs</b>
<b>010</b>	<b>73 - 77</b>	<b>Class V. Mental and behavioural disorders</b>
<b>011</b>	<b>78 - 83</b>	<b>Class VI. Diseases of the nervous system</b>
<b>012</b>	<b>84 - 102</b>	<b>Class VII. Diseases of circulatory system</b>
013	90 - 95	Ischaemic heart diseases
014	86 - 90, 92, 94, 98	
<b>015</b>	<b>103 - 114</b>	<b>Class VIII. Diseases of respiratory system</b>
016	105 - 107	Pneumonia
<b>017</b>	<b>115 - 127</b>	<b>Class IX. Diseases of digestive system</b>
<b>018</b>	<b>128 - 134</b>	<b>Class X. Diseases of the genitourinary system</b>
<b>019</b>	<b>135 - 141</b>	<b>Class XI. Complications of pregnancy, childbirth and the puerperium</b>
<b>020</b>	<b>142</b>	<b>Class XII. Diseases of the skin</b>
<b>021</b>	<b>143, 144</b>	<b>Class XIII. Diseases of the musculoskeletal system</b>
<b>022</b>	<b>145 - 150</b>	<b>Class XIV. Congenital malformations, deformations and chromosomal abnormalities</b>
<b>023</b>	<b>151 - 157</b>	<b>Class XV. Certain conditions originating in the perinatal period</b>
<b>024</b>	<b>158, 159</b>	<b>Class XVI. Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified</b>
<b>025</b>	<b>160 - 176</b>	<b>Class XVII. External causes of morbidity and mortality (type of cause)</b>
<b>026</b>	<b>1-176, 206</b>	<b>TOTAL DEATHS</b>
027	на основі розтину	based on autopsy
028	за станом алкогольного сп'яніння	under alcohol intoxication
<b>029</b>	<b>186 - 195</b>	<b>Class XVII. External causes of morbidity and mortality (nature of cause)</b>

It is important to note that Class XII, “Diseases of the skin”, was ignored during digitalization and I calculated it by subtracting the sum of the remaining 16 classes from the total number of deaths.

The year 1989 posed a problem because, aside from diseases of the skin, the class of ill-defined causes of deaths was missing. In order to split this group, I needed to find coefficients which would give two quantities for two groups of causes after applying coefficients to the total amount. Therefore such a system of equations could be solved non-linearly by satisfying conditions that: 1) coefficients applied to the total amount for two groups sum to one, and 2) obtained amounts for all regions sum to the total of Ukraine. The optimization procedure gave pretty faire results<sup>7</sup>.

### ***Period from 1995 to 2005***

Starting from 1995, I provide a full list of 202 causes of the Ukrainian classification for each region. The innovation is that Sebastopol city is now excluded from the AR of Crimea as a separate region; though for consistency, I associated it back to the peninsula.

### ***Period from 2005 to 2010***

According to the Law of the Ministry of Health of Ukraine (#297, from 1998), a new classification of diseases had to be implemented in the health care system of Ukraine beginning from the 1<sup>st</sup> of January 1999. However, the State Statistics Service of Ukraine started to publish statistical forms on mortality by causes of death according to the new list only from 2005. This list has 19 classes and 238 more specific causes. Though it corresponds to the 10<sup>th</sup> version of the International Classification of Diseases, it still remains in its abridged version.

In 2008 a small change was applied when five additional causes related to alcohol were added (*Annex G*). For example, accidental poisoning was split into “poisoning by and exposure to alcohol” and the remaining poisonings.

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<sup>7</sup> It consisted of looking for coefficient  $a$  and  $b$  that needed to be applied to the known total ( $t$ ) number of ill-defined (i) and skin diseases (s):

$$D_{x,r}^t \cdot a_{x,r} + D_{x,r}^s \cdot b_{x,r} = D_{x,r}^t \quad (3.1),$$

where  $x$  is an age group,  $r$  is a region, and  $a + b = 1$ .

Summing numbers across regions (separately for each age group) should produce the known total for Ukraine:

$$\sum_{r=1}^{26} D_{x,r}^t \cdot a_{x,r} = D_x^i \quad \text{where } x = 0, 1-4, 5-9 \dots 85+ \quad (3.2)$$

$$\sum_{r=1}^{26} D_{x,r}^s \cdot b_{x,r} = D_x^s \quad \text{where } x = 0, 1-4, 5-9 \dots 85+ \quad (3.3).$$

In addition, Annex H presents a list of causes available by districts (although only total number of deaths). It is restricted to only classes of causes (19 classes), with some few specifications of a cause (16 causes).

There are some points of view (Polischuk et al., 2010) regarding quality of coding that claim diseases of the circulatory system may be overestimated. This question was on the agenda of epidemiological studies in the Soviet period. Ella Libanova (1991) suggested that a negligent registration of medical cause of death might also take place. Such trends (when cardiovascular mortality tended to be overreported and cancer mortality was underreported) were observed also in the German Democratic Republic (Kiebel, 2012). The question about under-estimating mortality from cancer in the countries of the former USSR, and perhaps particularly in Ukraine, is considered by France Meslé and Jaques Vallin (2012).

Polischuk and his colleagues supposed that, in recent years, diseases of the circulatory system are stated in the death certificate more and more often, especially for old people without proper ascertainment of the real cause of death. France Meslé and Jacques Vallin (2012, p.129) note that unfavourable trends in mortality from circulatory diseases reflect true deterioration much more than any increased over-estimation.

### **3.2.4 Socio-economic information**

Health information is collected by health facilities and by the medical statistical services of the Ministry of Health. It is then sent through the territorial statistical offices to the State Statistics Service. Based on compiled health data, the Ministry of Health issues annual thematic reports and a bi-annual report entitled, "Health indicators of the population and usage of health care resources in Ukraine." The national data are available at the WHO website, Health for All Database, and the regional data at the Centre of Medical Statistics' website.

Indicators that can be obtained from this database are listed in *Table 3.7*. Several sources for socio-economic indicators are presented as well. Besides macro-data, some indicators can be used from micro-data obtained through surveys. Particularly, the Demographic and Health Survey collected retrospective data, which is representative at the national level as well as the urban/rural and domain level. Domain means that the geographical area comprises several regions. Five domains were distinguished – West, North, East, Central and South.

Table 3.7: Availability of socio-economic information

Macro data		Micro data	
“Health for All” database (Centre of medical statistics)	State Statistics Service of Ukraine	Demographic Health Survey (2007)	Household Survey
Health care system recourses and performance. Mothers and child health (IMR, abortions, breastfeeding). Prevalence of alcoholic psychosis, drug abusing Professional health.	Gross Regional Product. Agricultural production. Industrial production. Consumer Price Index. Average income. Labour market indicators	High blood pressure prevalence. Tobacco smoking. Alcohol consumption. Illicit drug use. Sexual behaviour. HIV-related behaviour. Working abroad/ human trafficking.	Self-rated health Lifestyles Education Occupation Income source

Summarizing, one can confirm that existing statistical information provides rich material for mortality analysis in a geographical context. However, a careful researcher has to pay attention to numerous flaws and shortcomings regarding its quality. This relates to such aspects as: conscientiousness in registering events; the way of collecting information and organizing it into useable tables; classifications and groupings used; changes that occur over time; and the possible biases peculiar to different geographical areas. Some of these aspects are discussed below.

### 3.3 New estimates and correction

#### 3.3.1 Population estimation in the intercensal period for districts

Since population age structure of districts is known only for one census year, I needed to estimate it for the remaining consequent years. Since the census was organised in December 2001, I roughly assumed that the obtained population was the same as that at the beginning of 2002. Therefore, I needed to find the population for the years 2003 to 2011. To do this, I used a known total population of districts, number of births and population structure of regions.

The estimated population of a district by age groups was found as follows:

$$\text{for age } x = 0 : , \text{ where } L_0^{n+1} = \text{livebirth}^n - \text{death}_0^n \quad (3.4)$$

$L_0^{n+1}$  - population at age 0 at the beginning of the year  $n+1$ ;



$livebirth^n$  - babies born live during the year  $n$ ;

$death_0^n$  - babies dead below age one during the year  $n$ .

For the remaining age groups I assumed that population structure of a district in respect to population structure of a region remained unchanged during the considered period.

$$\text{for } 1 \leq x \leq 100+ : \frac{prop_x^{j,n}}{prop_x^{r,n}} = \frac{prop_x^{j,census}}{prop_x^{r,census}}, \text{ where} \quad (3.5)$$

$prop_x^{j,n}$  - share of population of age  $x$  in the total population of district  $j$  in the year  $n$ ;

$prop_x^{r,n}$  - share of population of age  $x$  in the total population of region  $r$  in the year  $n$ ;

$prop_x^{j,census}$  - share of population of age  $x$  in the total population of district  $j$  in the census year;

$prop_x^{r,census}$  - share of population of age  $x$  in the total population of region  $r$  in the census year.

### 3.3.2 Correction of infant mortality

Infant mortality is considered to be the most sensitive indicator of social transformations, and it requires particular attention. Changes in infant mortality reflect changes in the population's living standards, general well-being, quality and accessibility of medical services. For this reason, it was highly desirable that the rates being compared were computed according to similar standards providing maximum accuracy and precision.

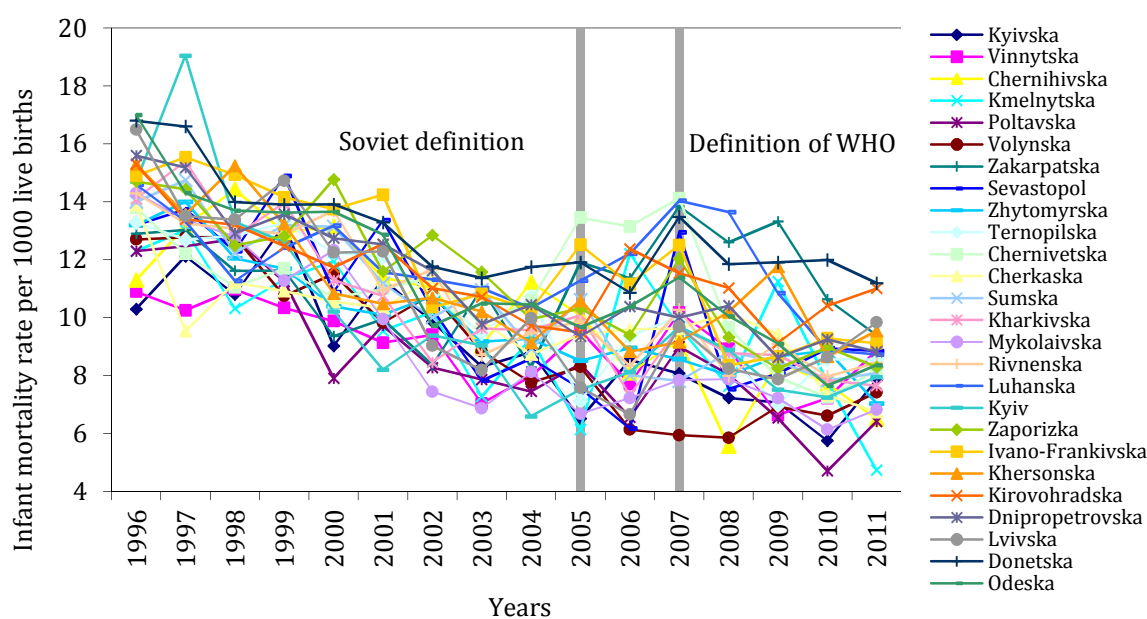
As said before, the definition of a live birth used in Ukraine until very recently was very different from that recommended by the World Health Organization. According to the WHO definition, an infant is considered live-born (regardless of gestational stage) if, after exiting its mother's body, it "breathes or shows any other evidence of life such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles". In Ukraine, however, an infant had to be at least 35 centimetres long, to weigh at least 1000 grams at birth and to be born after 28 weeks of gestation in order to be counted as living, according to the definition that remained unchanged since the Soviet era. If such an infant died during the course of the first week of life, it was counted as a stillbirth. This excluded many of the most vulnerable infants from Ukraine's infant mortality measure, and gave rise to the under-estimation of neonatal mortality.

In Ukraine, it was only in 2007 that the WHO definition was officially adopted (Law of the Ministry of Health #179, from 2006). However regional trends reveal a jump in infant mortality in 2005 (*Figure 3.9*), which might be explained in general by the transition to the 10th revision of the International Classification of Diseases and the more careful coding of death and in particular by the causes of death of infants.

It is logical to expect an increase in new-born mortality after applying the new criterion and changes in the Civil Code of Ukraine to bring them in compliance with the WHO and EU requirements. As said above, these changes started in 2005, and the maximum figure was observed in 2007, 11 deaths per 1000 live births (compared with 9.5 in 2004) for all of Ukraine.

Referring to the experiences of other countries that had the same definition as Ukraine but performed a transition earlier, one may find that the increase was about similar: in the Baltic States, for example, neonatal mortality increased by 50% (Meslé and Vallin, 2012).

Figure 3.9: Dynamics of IMR in Ukraine's regions before and after the definition change



Source: data of the State Statistics Service of Ukraine

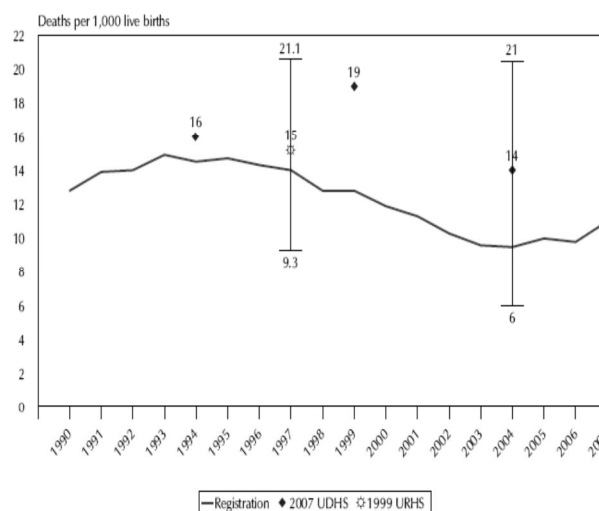
As for Ukraine, Anderson and Silver (1986) projected an underestimation of infant mortality because of the restricted definition of live birth at around 22-25%. Kingkade and Sawyer (2001) estimated adjustment factors at the level of 50-60%. Meslé and Vallin (2008) found the total underestimation to be nearly 20%. According to Levchuk (Pirozhkov, 2006), the level of unregistered deaths of newborn babies is about 23%. These deaths were registered as spontaneous abortions.

To correct rates registered before the change of definition of live birth, one can use the following adjustments: 1) comparing official statistics with survey estimations (Aleshina and Redmond, 2003); 2) measuring the ratio of neonatal death to stillbirth (Velkoff and Miller 1995); 3) estimating trends in neonatal mortality and overall infant mortality before and after the definition change (Meslé and Vallin, 2008); 4) using mortality at ages 4-9 months in order to predict mortality in the earlier months of infancy (Kingkade and Sawyer, 2001); 5) looking at the distribution of infants by weight in Ukraine and some reference country (Levchuk, 2002), etc.

Following the first approach (comparing official figures with survey estimates), we use the findings of the Demographic and Health Survey implemented in Ukraine in 2007. Similar estimates can be found in the Reproductive and Health Survey (1999) and the World Health Survey (2002), though DHS is valued for collecting the past reproductive history.

Figure 3.10 presents infant mortality estimates from civil registration data as well as the 1999 Ukraine Reproductive Health Survey (URHS) and the 2007 UDHS for the period 1990-2007 (UDHS, 2007). The estimates from the two surveys shown in the figure are higher than the official estimates from the State Statistical Service of Ukraine, which was derived from registration data during the period; however, the confidence intervals for the survey-based estimates overlap with the registration-based statistics. In general, an examination of these estimates suggests that, overall, child mortality levels declined gradually during the period, although the trend cannot be considered statistically significant.

Figure 3.10: Infant mortality rate estimates from registration system, 2007 UDHS, and 1999 URHS (with confidence intervals)



Source: Demographic and Health Survey, 2007

Given the data by region available to me, the only suitable approach was the one proposed by Meslé and Vallin (2008). The method envisages the correction of infant mortality for underregistration by focusing on neonatal deaths (0-28 days), as these are the most vulnerable babies that were referred to as stillbirth. I added some features to it to make it more flexible in automatic calculations by region.

Therefore, the method is based on two assumptions that give a system of two equations with two unknowns: first is the true infant mortality rate; second is the number of babies that were not accounted for in mortality statistics. The latter is expressed in absolute terms as it was important to keep it in numerator as well as in denominator, which would not be possible when dealing only with rates. In other words, I keep in mind that this kind of under-registration of infant deaths happened concurrently with an under-registration of births.

*1st assumption: change of definition influence only neonatal deaths (0-28 days):*

$IMR = \text{neonatal mortality rate (NMR)} + \text{postneonatal mortality rate (PNMR)}$

$$IMR^{corr} = \frac{death^{neonatal} + X}{livebirth + X} + \frac{death^{postneonatal}}{livebirth + X}, \quad (3.6)$$

where  $X$  - unregistered as live birth infants who were likely to die;

$IMR^r$  - the true (corrected) infant mortality;

$death^{neonatal}$  - deaths of infants during first 28 days of their life;

$death^{postneonatal}$  - deaths of infants below one year but older than 28 days.

2nd assumption: proportion of neonatal mortality in total infant mortality is constant in the short-term:

$$\frac{NMR_{after}}{IMR_{after}} = \frac{NMR_{before}}{IMR_{before}} \Rightarrow \frac{death_{after}^{neonatal}}{death_{after}^{infant}} = \frac{death_{before}^{neonatal} + X}{death_{before}^{infant} + X}, \quad (3.7)$$

where  $NMR_{before / after}$  - neonatal mortality rates observed before and after the change of definition;

$IMR_{before / after}$  - infant mortality rates observed before and after the change of definition;

$death_{before / after}^{neonatal}$  - number of infant deaths during first 28 days of their life observed before

and after the change in definition;

$death_{before / after}^{infant}$  - number of infant deaths during first year of their life observed before and

after the change in definition;

To be more precise, the periods used before and after the definition change were reviewed as described in *Table 3.8*. Therefore, only the recent years before the definition change were chosen to assess under-registration, i.e., years from 2001 to 2004 and the period of partial implementation, from 2005 to 2006. This short retrospective was chosen in order to insure that roughly the same set of factors affected infant mortality and that only the change of definition made a difference. The reference “control” period was from 2007 to 2011. For all three periods, I calculated averages so as to level off annual fluctuations.

Table 3.8: Time intervals according to which correction of infant mortality was made

Before		After	
1988-2000	2001-2004	2005-2006	2007-2011
Period of actual decline in infant mortality; not used in calculation of correction coefficients.	Period used to measure part of neonatal mortality in total infant mortality to perform corrections.	Period compared with reference period independently, as some regions have already performed a transition.	Reference period.
<b>Corrected rates</b>			

Finally, every year in the study period (from 1989 to 2006) was adjusted. The years before 2001 were corrected based on the assumption that the proportion of unregistered infants in neonatal deaths was the same every year as they were on average in 2001-2004.

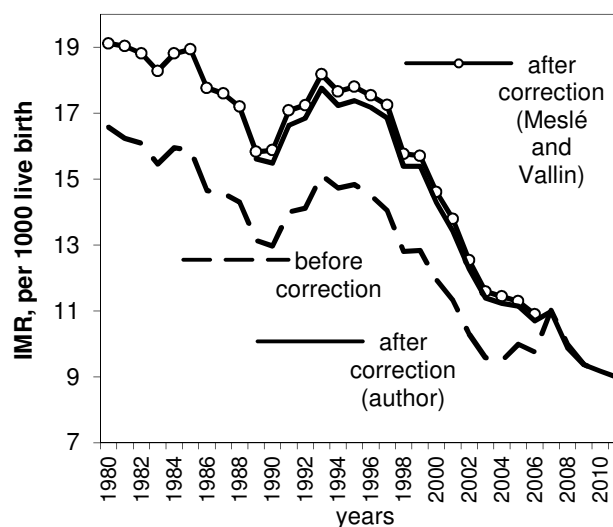
Having found the extent to which IMR should be corrected, infant mortality rate was recalculated for each year beginning from 1988 and up to 2007, the year of the official switch to a new definition.

In order to inspect the results, I first compare the rates obtained with a similar calculation of Meslé and Vallin (2012). In *Figure 3.11*, one can see that IMR estimated by Meslé and Vallin is a bit higher than if using our technique. However, their assumptions were based on the experience of switching to the new definition of the Baltic states while I benefit from the original Ukrainian data of recent years.

Some examples of resulting IMR are presented in *Figures 3.12* and *3.13*. First is the case when the transition to a new definition was made rather at one time in 2007 (Odeska oblast), the second when the definition was reviewed several times in 2005 and 2007 (Kharkivska oblast).

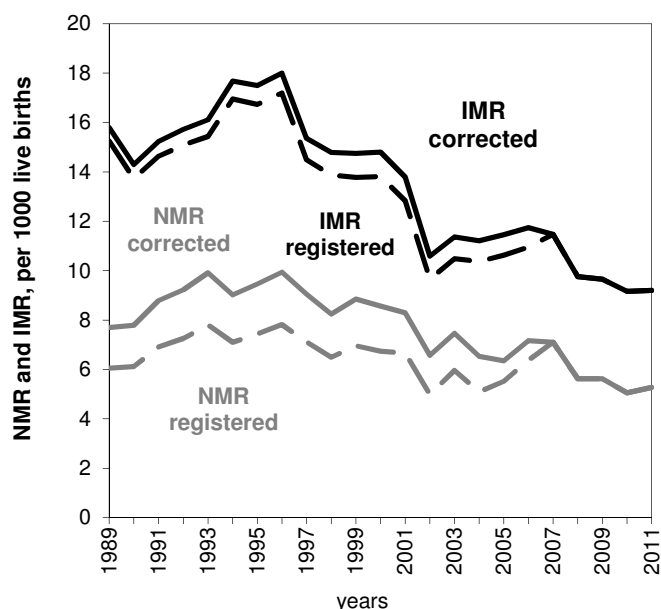
In both cases, even though rates are augmented for every year before 2007, the overall tendency of decreasing is preserved while at the same time differences in the “pre-” and “post-definition” periods are smoothed. One can conclude that the

Figure 3.11: Infant mortality rate registered and corrected for Ukraine, 1980-2011



Source: before correction - data of the State Statistics Service of Ukraine; after correction 1980 - 2006 - Meslé and Vallin, 2012; after correction 1988 - 2011 - author calculation

Figure 3.12: Infant mortality rate registered and corrected, Odeska oblast, 1989-2011



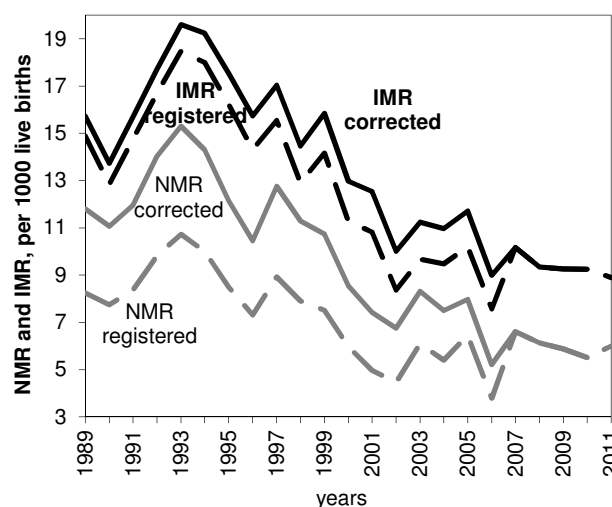
Source: author calculation according to the data of the State Statistics Service of Ukraine

method chosen provides quite realistic corrections.

The result of correction for every region is given in *Annex I*. Some average and maximum correction coefficients are presented in *Table 3.9*. This average means a simple arithmetical average across all years and all regions. In comparison, figures for Ukraine as a total are given as well, which are the weighted average.

In general one can see that the correction increased total IMR for Ukraine by 17%, which is around the estimation of other authors, though a bit lower. In rural area, the increase was larger than in urban, which also supports the hypothesis that registration of vital events in rural zones is weaker than in urban

Figure 3.13: Infant mortality rate registered and corrected for Kharkivska oblast, 1989-2010



Source: author calculation according to the data of the State Statistics Service of Ukraine

Table 3.9: Minimum and maximum correction coefficients for correcting infant mortality among regions in Ukraine, 1989-2006

	Total population	Urban population	Rural population
Ukraine total	1.171	1.150	1.208
Average correction coefficient	1.155	1.139	1.219
Max correction coefficient	1.489	1.441	2.503

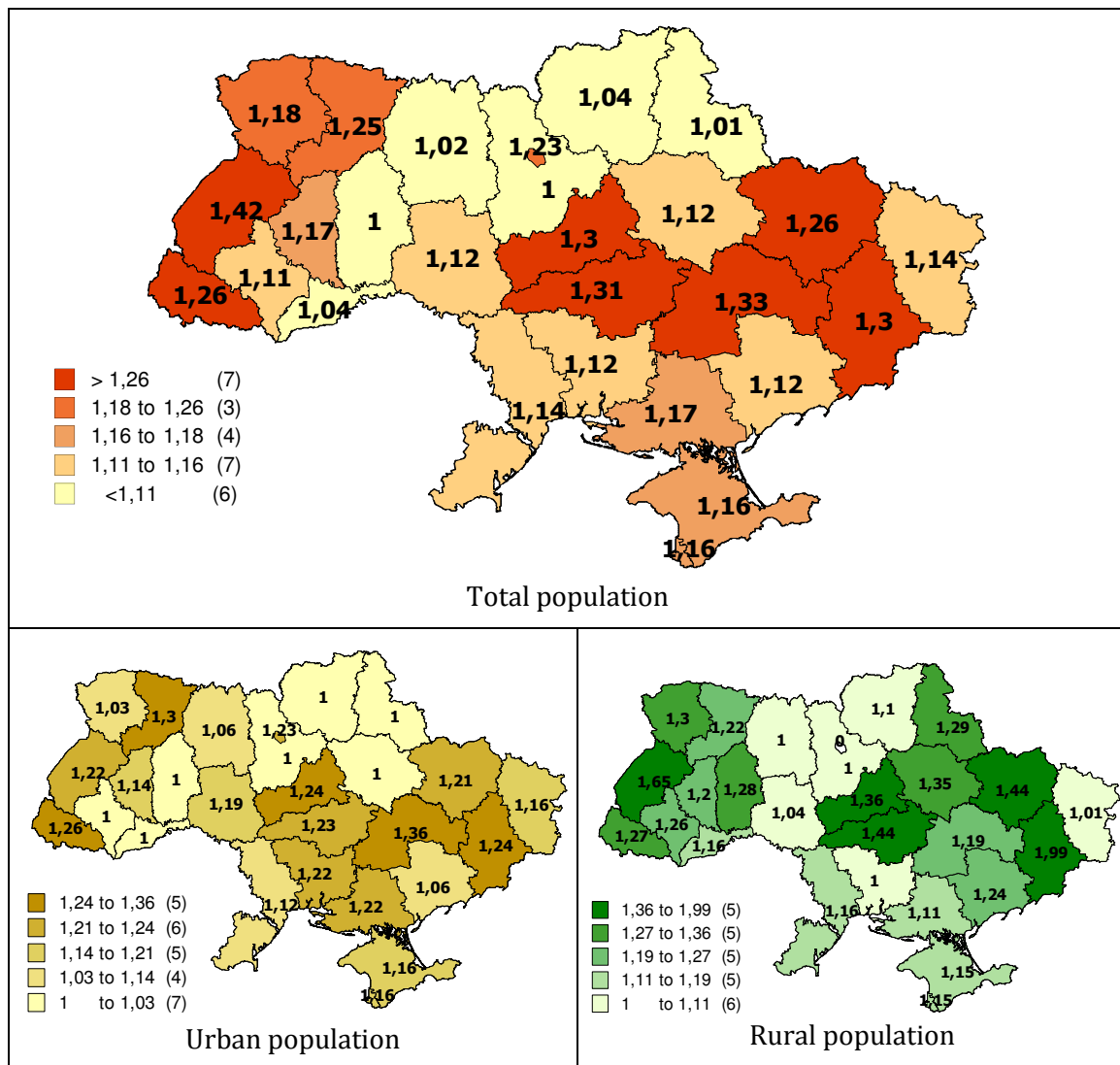
Lastly, I can observe how the correction coefficient varies across regions using a map (*Figure 3.14*). The first thing one can see from the maps is that the highest correction coefficient (more than 30%) is observed in a highly populated region, Dnipropetrovska oblast. A quite significant correction (more than 20%) is peculiar again for the industrial eastern zone, the most industrialized regions of the west (Lvivska oblast) and some regions in the centre that traditionally used to have a high IMR already. This is difficult to explain, as urbanized regions are normally characterized by high rates of hospitals and doctors per 100,000 people and IMR is usually low here. The other thing to note is that the change in definition has not affected the dynamics of IMR at all in some parts (namely Khmelnytska and Kyivska oblasts), and it

continues to decline there. Therefore, no corrections for these regions were made. On the other hand, it is possible that underestimation of infant mortality still takes place in those regions with no or very little increase, while a sharp rise of indicators is evidence of a more conscientious attitude.

The majority of regions remain at the average, which is about 9 to 13 percent. Some very minor corrections of infant mortality were employed for the northern belt of regions, testifying some common habit in registration procedures.

Corrections were not the same for urban and rural areas though some common patterns are visible. In urban agglomerations adjustment was larger in the east and south, which are themselves more urbanized, and such a significant increase can be explained by a more conscientious attitude toward the definition change. As for rural areas, the increase was more significant in the west, centre and some eastern regions.

Figure 3.14: Correction coefficients by regions of Ukraine, 2001-2004



Source: author calculation according to the data of the State Statistics Service of Ukraine

### 3.3.3 Correction of cause of death data

It is not always easy for a physician to ensure that medical information is accurately recorded. Diagnostic and coding errors often occur and the complexity of multiple disease processes can mask the true underlying cause of death. The unclassified deaths are stored in Class XVI, the grouped named “symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified” or otherwise known simply as ill-defined causes. Its share reduces this class of causes to the fifth position in the structure of mortality, even before digestive system and infectious diseases. This is clearly evidence of statistical flaws; however, there might be some reason behind this. For example, it may include some causes that previously were either hidden (like suicide and homicides) or not considered (like malnutrition).

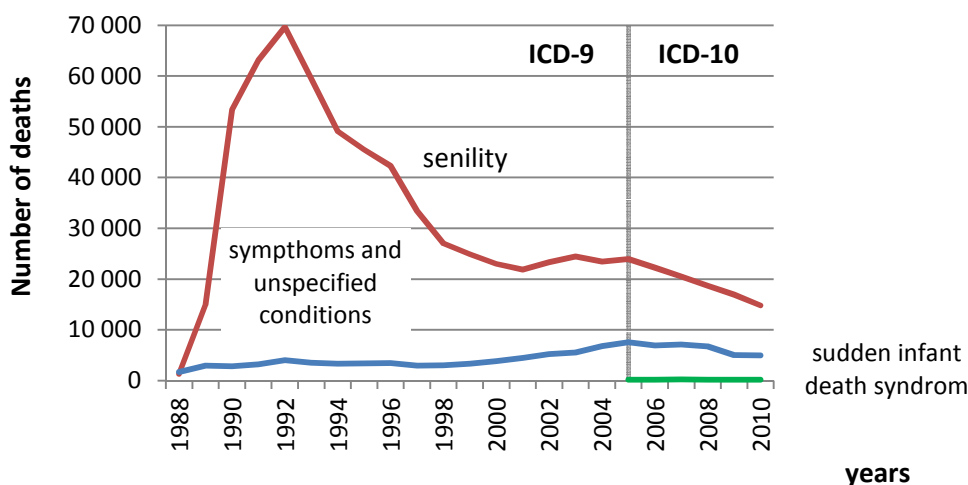
By making some excursion into the past, one may refer to the attentive study of this class of deaths made by France Meslé and Jacques Vallin (2012), who observe a big change in the trend of death rates from this cause due to the definition change, particularly in defining cause 158, which is death from senility. In 1989, the Soviet Health Minister issued a new directive, according to which “any death occurring at age of 80 had to be registered as due to senility, unless the person’s medical history or an autopsy report made it possible to diagnose a precise cause of death or mentioned death from injury, poisoning or another external cause” (Meslé and Vallin, 2012; p.150).

As soon as the directive was issued, the number of deaths classified under “senility” rose dramatically, as shown in *Figure 3.15*. The maximum was observed in 1992 when the total absolute number of deaths from this cause reached 73.7 thousand deaths. It is notable that around half of this amount (35.2 thousand) was associated to females from rural areas alone (*Figure 3.16*). After 1992, the general rush in classifying deaths due to senility fell off, and it levelled off only at the end of the 1990s.

With the switch to a new classification of diseases, this class of deaths was spread into three categories, adding deaths from sudden infant death syndrome to the total amount of undefined deaths also (*Figure 3.15*). In any case, this does not have any impact on the number of deaths from senility, which started to shrink again in 2005. This could be explained perhaps by a more attentive attitude in defining the cause of death after the new law and new instructions went into force.

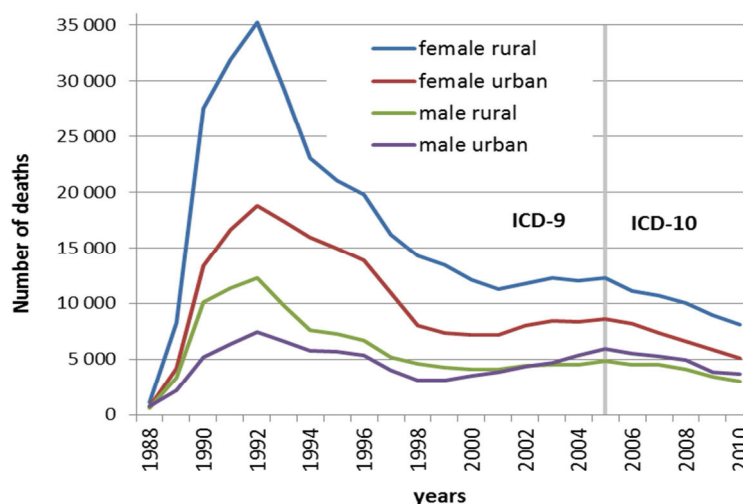


Figure 3.15: Annual number of deaths classified under “senility”, “symptoms and other unspecified conditions”, and “sudden infant death syndrome”, Ukraine



Source: data of the State Statistics Service of Ukraine

Figure 3.16: Annual number of deaths classified as “ill-defined”, Ukraine

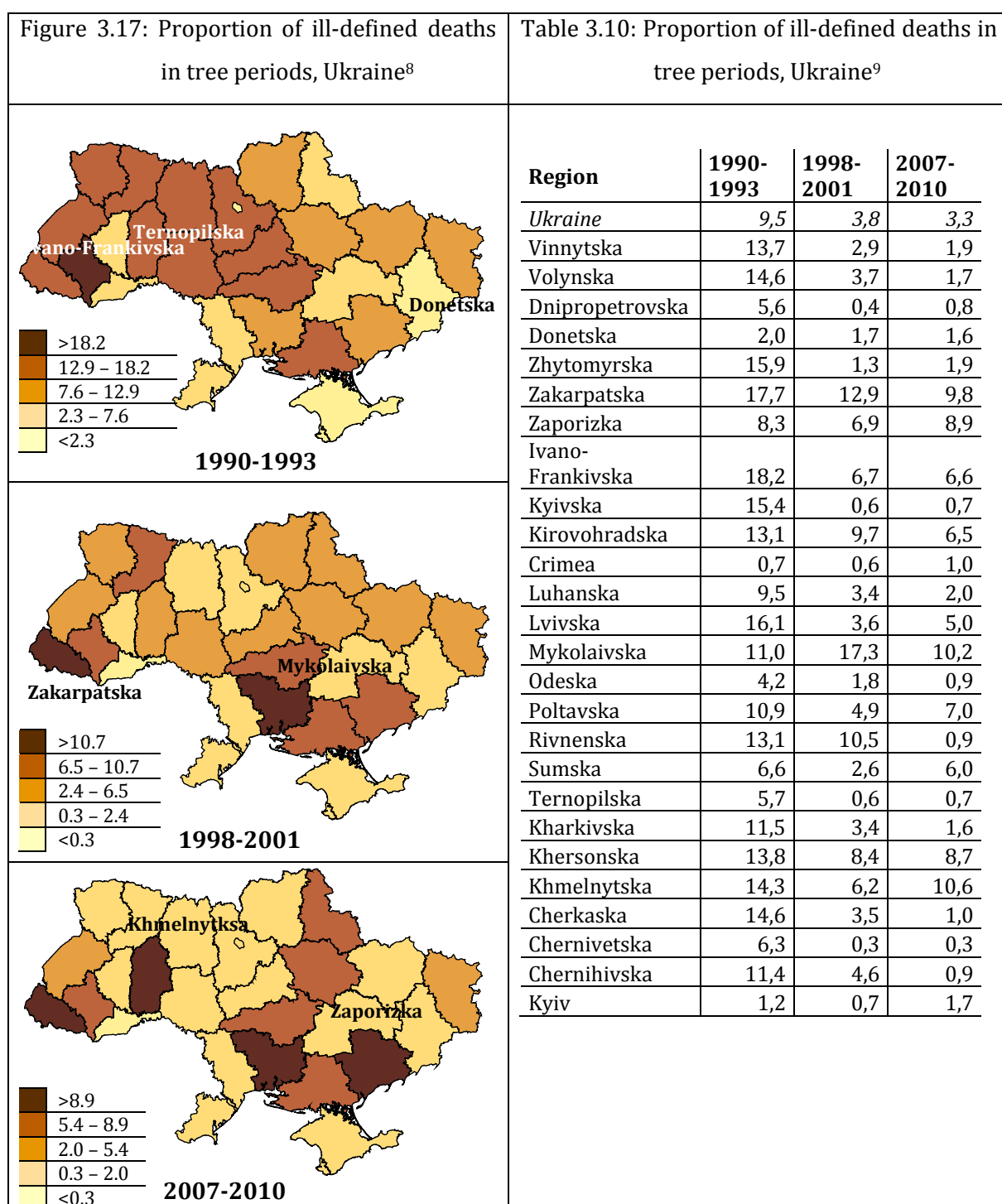


Source: data of the State Statistics Service of Ukraine

This trend was not the same for all regions. In some regions this splash lasted only one year, in other regions it happened later, and in some it did not happen at all. I aggregated data for the three most noticeable periods: the period of burst (1990-1993), the period of levelling off (1998-2001), and the new times (2007-2010). I then depicted proportion of ill-defined in total number of deaths on the map (Figure 3.17, Table 3.10).

One can see that this increase in the number of deaths classified as *ill-defined* in the beginning of the 90s concerns mostly western regions. When the proportion of ill-defined on average for the entire Ukraine was already pretty high, 9.5%, it rose to more than 15% for some regions. It should be said that in other years this average proportion of “undefined” deaths for Ukraine was around 4%; and with a switch to ICD10, it decreased to 3%.

The maximum numbers in all tree respective periods were observed in Ivano-Frankivska oblast (18.2%) as well as in Zakarpatska (17.7%). In contrast, their neighbour, Ternopilska oblast, demonstrates the same stable dynamics of low proportion of ill-defined deaths.



Note: made with PhilCarto <http://philcarto.free.fr>

<sup>8</sup> Intervals were chosen based on standard deviation:

<sup>9</sup> 1) [mean+1.5SD ; max); 2) [mean+0.5SD ; mean+1.5SD); 3) [mean-0.5SD ; mean+0.5SD); 4) [mean-1.5SD ; mean-0.5SD); 5) [min ; mean-1.5 SD)

At the same time, while the number of deaths in the West attributed to senility increased abruptly, there was no such trend in the South-East. Donetsk oblast had only 2% of unclassified deaths in 1990-1993, which is not very different from what it had in other periods (1.7 and 1.6%). Similar low proportions in 1990-1993 were observed for the oblasts of Sumska (6.6%), Dnipropetrovska (5.6%), and Odeska (4.2%), as well as for the city of Kyiv (1.2%) and the Republic of Crimea (0.7%).

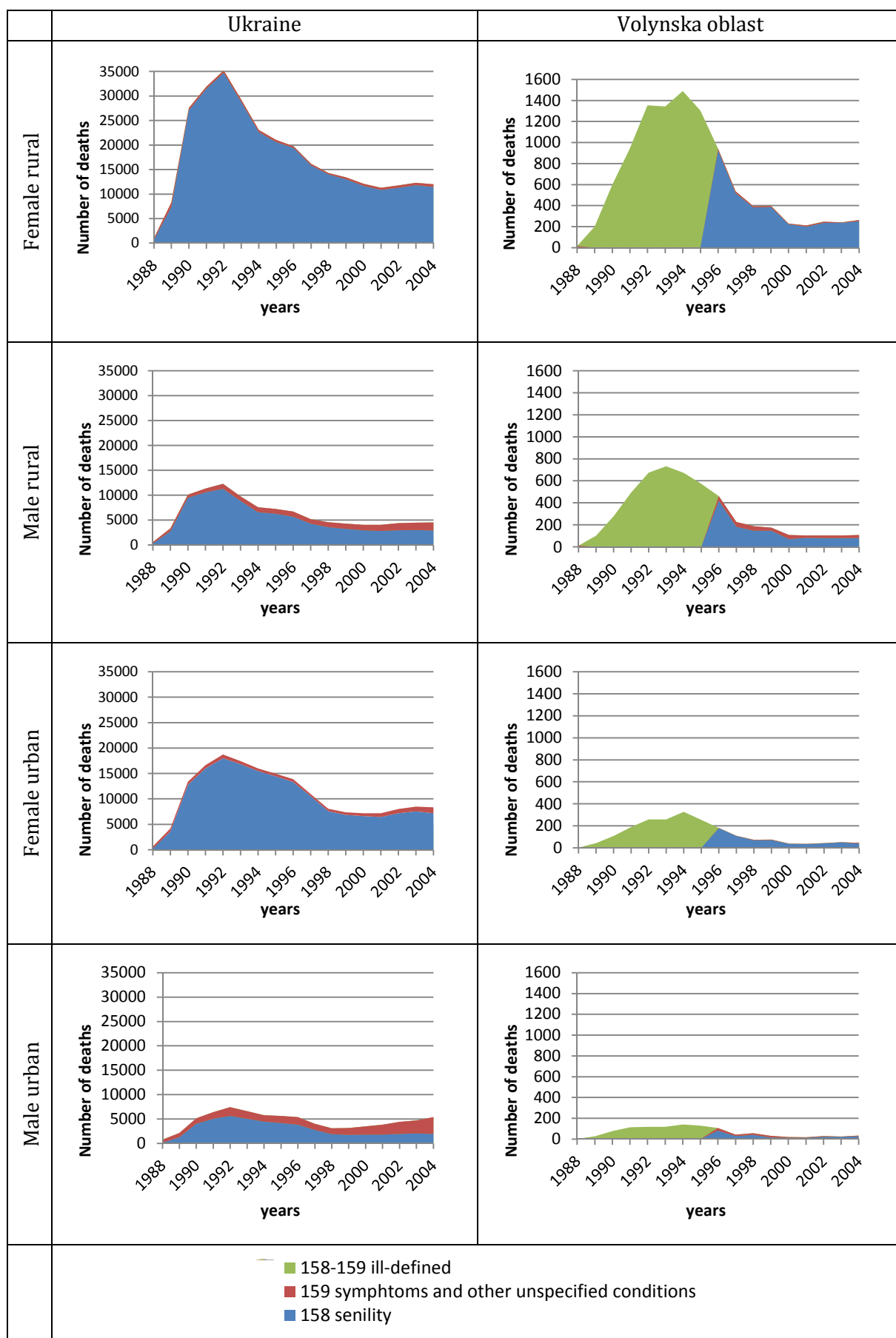
The last conclusion is that, even though it looks like western regions were as a rule more responsive than eastern regions to regulations issued by the Soviet government, there is no longer a geographical pattern or regularity in classifying ill-defined death nowadays. Since there is great variability in the proportion of such undefined deaths from one region to another in Ukraine, one may assume that it depends also on belonging to a certain administrative region. This is bad news as it may signify that the approach to classifying other causes of death also varies from one region to another.

It should be noted that, before this reform, there were not many deaths classified under senility. For example, in 1988, the total number of Ukraine deaths in this category was half that of “other ill-defined” (1331 vs. 2632); and for nine regions it was equal to zero. And Meslé and Vallin (2012) reasoned that a lot of ill-defined deaths were classified under “sudden cardiac death” or “health failure”, which led to overestimation of mortality from circulatory system diseases.

To solve the problem of consistency, I needed to redistribute ill-defined deaths among other causes of death. Unfortunately, as was proven by France Meslé and Jacques Vallin (2012), a proportional distribution is not applicable because it overestimates deaths from certain causes and it underestimates those from others. They advise a different redistribution of two articles that belong to the class of ill-defined causes (“senility” and “other ill-defined”). “Other ill-defined” can be redistributed proportionally among other causes while deaths from senility should be assigned back to the class of circulatory system diseases.

Before doing that, I also faced a problem of missing detailed data for the period 1989-1995. For these years, I have only total deaths for two items, 158 and 159: so I needed to split them. *Figure 3.18* presents the random sample of dynamics in the number of deaths from ill-defined causes for Volynska oblast and also for total Ukraine. One may see that senility accounts for the lion’s share in all ill-defined deaths (which happened since the reform); and in some cases it goes up to 99.9%. As the graphs present absolute numbers (the scale is preserved for better comparison), one may see that the distribution of undefined causes between males and females as well as rural and urban areas follows a general pattern of death distribution according to age structure: there are more females who die at age 80+ than males, and in rural area more than in urban.

Figure 3.18: Deaths from ill-defined causes in Volynska oblast and Ukraine, 1988-2004



Therefore to split total ill-defined deaths into two groups, I used again the optimization procedure<sup>10</sup>.

Such a procedure permits determining coefficients individually for males and females in rural and urban areas, but also individually for each age group. Even though regulations say that the age limit is 80 years, the data testifies that classifying deaths under senility starts as a rule earlier, at age 60. However, while one may refer to more than 90% of all ill-defined to senility after age 80, these deaths are mixed to a great extent with other ill-defined deaths in the age interval from 60 to 80 years, and the proportions of deaths for both categories vary significantly.

Hence, the numbers finally obtained for items 158 and 159 were redistributed as described above (senility referred to circulatory system diseases). This greatly enables avoidance of distorting trends in other causes of death. For comparison, I calculated the standardized death rates using data before redistribution, using data where ill-defined deaths are redistributed proportionally among other causes, and finally using data where senility is treated separately (the method that was finally applied). For visual representation, I chose examples of some regions, which are presented in the *Figure 3.19*.

The graphs clearly illustrate that a proportional distribution (solid black line) gives completely unacceptable results: mortality rates from cancer go up sharply for no reason, while in reality overall trends in mortality from neoplasms in all of Ukraine as well as by region went downward. At the same time, SDR from circulatory system diseases are underestimated.

In the case of circulatory system diseases, it is impressive how the redistribution of ill-defined may restore damaged dynamics: large gaps in the period of reforms are mended and trends regain their normal course.

There is also an example of the city of Kyiv, where the proportion of ill-defined deaths is one of the lowest. One may see that adjustments did not produce any significant effect.

<sup>10</sup> It consisted of looking for coefficient  $a$  and  $b$ , which needed to be applied to the known total number of ill-defined deaths in respect to the same regional dimension and totals for Ukraine:

$$D_{x,r}^{158-159} \cdot a_{x,r} + D_{x,r}^{158-159} \cdot b_{x,r} = D_{x,r}^{158-159} \quad (3.8),$$

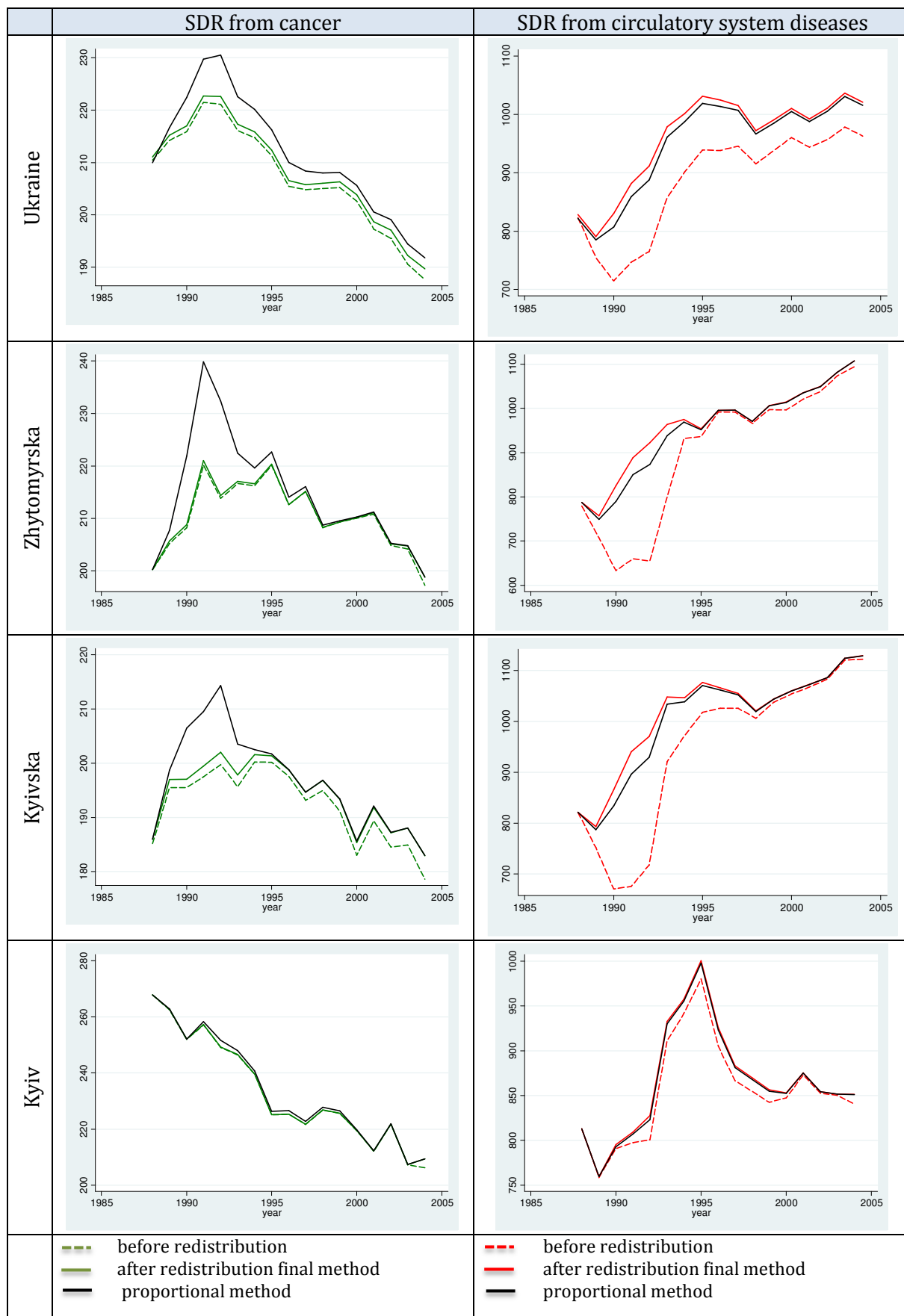
where  $x$  is an age group,  $r$  is a region, and  $a + b = 1$ .

Summing numbers across regions (separately for each age group) should produce known total for Ukraine:

$$\sum_{r=1}^{26} D_{x,r}^{158-159} \cdot a_{x,r} = D_x^{158}, \quad \text{where } x = 0, 1-4, 5-9 \dots 85+ \quad (3.9)$$

$$\sum_{r=1}^{26} D_{x,r}^{158-159} \cdot b_{x,r} = D_x^{159}, \quad \text{where } x = 0, 1-4, 5-9 \dots 85+ \quad (3.10).$$

Figure 3.19: Trends in standardized death rate from neoplasms and diseases of circulatory system before and after redistributing deaths from ill-defined causes, 1988-2004



## **Conclusions**

This chapter opens a view on data available for studying mortality in Ukraine by regions. Summarizing one may say that existing sources are generally sufficient and give opportunity to study mortality profiles at different levels of specification. There are, however, some concerns about data completeness in certain years, and about its quality. As was reviewed in Chapter 3.1, possible biases peculiar for Ukraine can arise from particularity of administrative division, the approach to civil data registration, or the method of population estimation in the intercensal period. While some tasks are possible to deal with (to correct the infant mortality rate, estimate the population by districts etc.), some others were impossible to accomplish (reestimating the population in the intercensal period).

Nevertheless, I believe that using population data provided by the State Statistic Service will not bias results too much. This is because the possible inaccuracies related to migration concern mostly ages (young and working-age), where mortality is rather low.

In general, data completeness (availability by causes, districts etc.) increases with time. In 2005, Ukraine switched to the 10th revision of ICD, and new changes and practices went into force. Many new statistical forms became published, new attitude in classifying causes of death appeared (which can be traced in classification of infant deaths), etc. All this new information and corrected or estimated data for earlier periods permits moving on and analyzing the health situation and its diversity in Ukraine's regions by using demographic methods as well as some means of geography.

## Chapter 4

# Methodology and techniques

### 4.1 Rates and ratios

#### 4.1.1 Age-specific death rates

In nearly every population, the rate of occurrence of demographic events varies very sharply with age. This variation mainly reflects age differences in physiological capacity (Preston et al., 2001). Moreover, age may be considered the most important demographic variable in the analysis of mortality, argues M. Mcgehee (2004), in view of the close relation between age and the risk of death. Therefore, this process is measured by age-specific death rates (ASDR), which is a relation of deaths at age  $x$  to population of the same age at risk.

Once the focus of analysis is on data from small areas, small populations, or for a narrow range of time, the confidence in accuracy of death rates becomes reduced. This happens because small areas or small numbers of years can be viewed like a sample, and potential fluctuations in an ASDR series may be termed a sampling error in addition to random error (Rosenberg 1998).

Answering the question about what is the minimum population size to insure a good-quality of ASDR for constructing a life table, different researchers propose different criteria. Eayres and Williams (2004), after having evaluated the methodologies for small area life expectancy construction found that life expectancy tends to be overestimated with a small population size. They recommend a population size of 5,000 person-years at risk, above which life expectancy can be calculated with a reasonable confidence. Ediev and Scherbov (2011) have added that not



only the size of population counts, but also its age composition. They also found that estimating life expectancy at age 60 may be recommended for areas with at least 46,000 people.

The US National Centre for Health Statistics (Young Cai, 2006) requires a total of 700 deaths (for each sex, in 3 years), implying a population size of 70,000 if I assume a death rate of 1 percent. Although there is no standard sample size requirement for life table construction, a population of 50,000-100,000 is desirable (Young Cai, 2006).

Marc Luy (2003), studying mortality at cloistered populations in religious orders in Bavaria solves the problem of an “insufficient” number of deaths widening the observation period. Subsequently, the minimally sufficient observation period to obtain statistically significant results in his study was equal to thirty years.

As for Ukraine, the average population size of 27 Ukrainian oblasts enumerated in the 2001 census is about 1.8 million, with the maximum population reaching almost 5 million in Donetsk region, and with a minimum of around 380 thousand people residing in Sebastopol agglomeration. This is quite a sufficient population size for calculating complete life tables. If I switch to more detailed profiles by gender or by place of residence, the population base remains satisfactory with a minimum of 143,000 inhabitants. However, some fluctuations are still present, especially at old age.

Considering the problems described above, some correction on crude data had to be made. The target was to have mortality indices such that would adequately describe the mortality regime in every region, employing as much available information as possible while accounting at the same time for the data quality. In other words, the goal was to construct a death-rate series by single year of age for every region and every year. These death rates will be further used for construction of life tables and analyzing interregional differences.

At first glance, an easy way to escape the data quality problem would be to abridge data to five-year age groups. However, a closer look tells us that random fluctuations are not always completely eliminated, even in five-year age groups, especially moving to sex or place-of-residence dimension. Ediev and Scherbov (2010) argue that estimates of abridged life tables tend to be systematically biased when the age composition deviates from that of a stationary population, irrespective of the population size. And, lastly, the population of the average Ukraine region is not that small, around 1.8 million, which is quite a sufficient size for dealing with information aggregated by single-year age. Under conditions of accurate statistical “polishing” of such series, single-year age groups can provide us with enviable precision.

To improve the interpretability of the data, to increase the stability of rates and hence diminish their jagged appearance one may use different smoothing procedures. Various forms of

averaging - including use of multiple year rates, moving averages, and regression procedures - can accomplish the desired smoothing (Rosenberg 1998).

Therefore, at first I intend to produce some reference curves for every region that would serve as a standard in case the remaining ASDRs need to be adjusted. For this purpose, population and death figures are compounded for years around the census year, from 2000 to 2003, as they are the least susceptible to fluctuations.

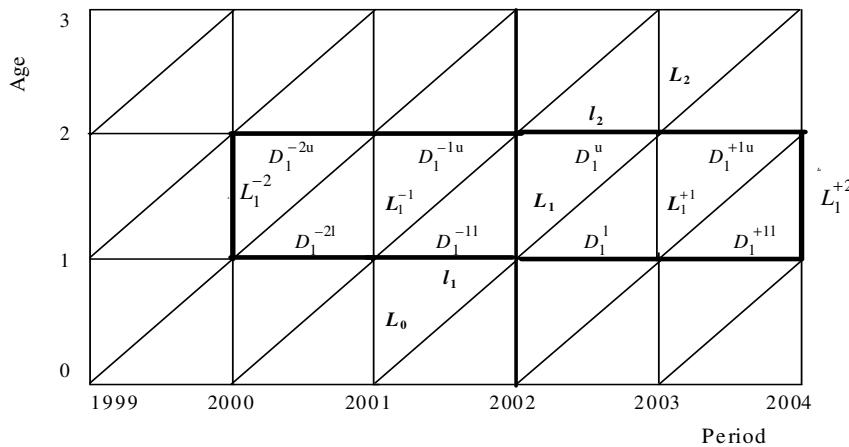
The raw series of  ${}_n m_x$  were calculated using A-sets (classification by age and period □) of the Lexis diagram shown in bold lines in *Figure 4.1*.

According to the method,  $m_x = \frac{D_x}{L_x}$ , where: (4.1)

$D_x = D_x^u + D_x^l$  - is the total number of deaths in age group x, and is the sum of the upper (u) and lower (l) triangles

$L_x$  - is the number of person living between age x and x+1.

Figure 4.1: Fragment of Lexis diagram portraying A-sets of deaths



In case of "reference curve":  $D_x = D_x^{2000} + D_x^{2001} + D_x^{2002} + D_x^{2003}$  (4.2)

$L_x = 0.5 \cdot L_x^{2000} + L_x^{2001} + L_x^{2002} + L_x^{2003} + 0.5 \cdot L_x^{2004}$ . (4.3)

The second stage is to refill gaps or zero values that can be found, in order to proceed with smoothing. Replacing missing values was done by using standard relationships:

$m_x = m_{x-1} \cdot \frac{m_x^{st}}{m_{x-1}^{st}}$  (4.4)

where  $m_x$  - is a death rate that I want to estimate;

$m_{x-1}$  - is a known value of a death rate for the age group  $x-1$ ;

$m_x^{st}$  - is a known "standard" value (value for 2000-2003) of a death rate for age group  $x$ ;

$m_{x-1}^{st}$  - is a known "standard" value (value for 2000-2003) of a death rate for age group  $x-1$ .

As there are still some "holes" even in this time period, the values for total population serve as a standard for smaller groups.

Lastly, we smooth the observed death rates. Smoothing is applied in two phases: first, for ages above 80 years old; second, for ages below 80. This is done because different parts of the mortality curve are shaped by different factors: at early ages, it is only random fluctuations that need to be smoothed, while at old ages large up and down jumps are connected to the low quality of the data.

#### For ages greater than 80 years:

Smoothing at old ages was done according to the technique described in the Max Planck Methods Protocol for the Human Mortality Database (Wilmoth et. al., 2007). This method envisages smoothing  $m_x$  by fitting the Kannisto model of old-age mortality with an asymptote

$$\text{equal to one, to estimate the underlying hazards function: } \mu_x(a, b) = \frac{ae^{b(x-80)}}{1 + ae^{b(x-80)}} \quad (4.5).$$

Assuming a Poisson distribution, they derive parameter estimates  $\hat{a}$  and  $\hat{b}$  by maximizing the following log-likelihood function:

$$\log L(a, b) = \sum_{80}^{100} [D_x \log \mu_{x+0.5}(a, b) - L_x \mu_{x+0.5}(a, b)] + \text{const} \quad (4.6).$$

Substituting  $\hat{a}$  and  $\hat{b}$  into equation 4.5 yields smoothed death rates  $\hat{m}_x$  for age groups above 80 years, where  $\hat{m}_x = \mu_{x+0.5} = \mu_{x+0.5}(\hat{a}, \hat{b})$  (Wilmoth et. al., 2007).

#### For ages below 80 years:

1) One way to do smoothing was to use moving average (Rosenberg 1998; Richards, Kirkby, and Currie 2005). This can be done with the help of a STATA-software function "smoother". The

smoothing mode which was applied is “4253H, twice”. The numbers specified in the smoother represent the span of a running median smoother. Smoothing by even numbers of the running median at the beginning prevents producing flat-topped hills and valleys, as when using odd-smoothers. The letter H indicates a Hanning linear smoother. Finally, the “twice” operator specifies that after smoothing, the smoother is reapplied to the result and that any recovered signal is added back to the original smooth (StataCorp. 2009, p 1758).

2) Another way of smoothing death rates is utilization of the P-splines approach (Richards, Kirkby, and Currie, 2005; Camarda, 2010). This technique is described as penalization of B-splines. A relatively large number of B-splines provide enough flexibility to capture trends while smoothing the data. The assumption made is that, over a small age interval, deaths are distributed following the Poisson model.

3) Lastly, the P-splines approach in two dimensions was introduced recently by Carlo-Giovani Camarda (2010) as a tool to escape the problem of overparametrization, as it belongs to parsimonious models. Two-dimensional smoothing means accounting simultaneously for the age and the period while considering at the same time information from neighbouring areas in the mortality surface.

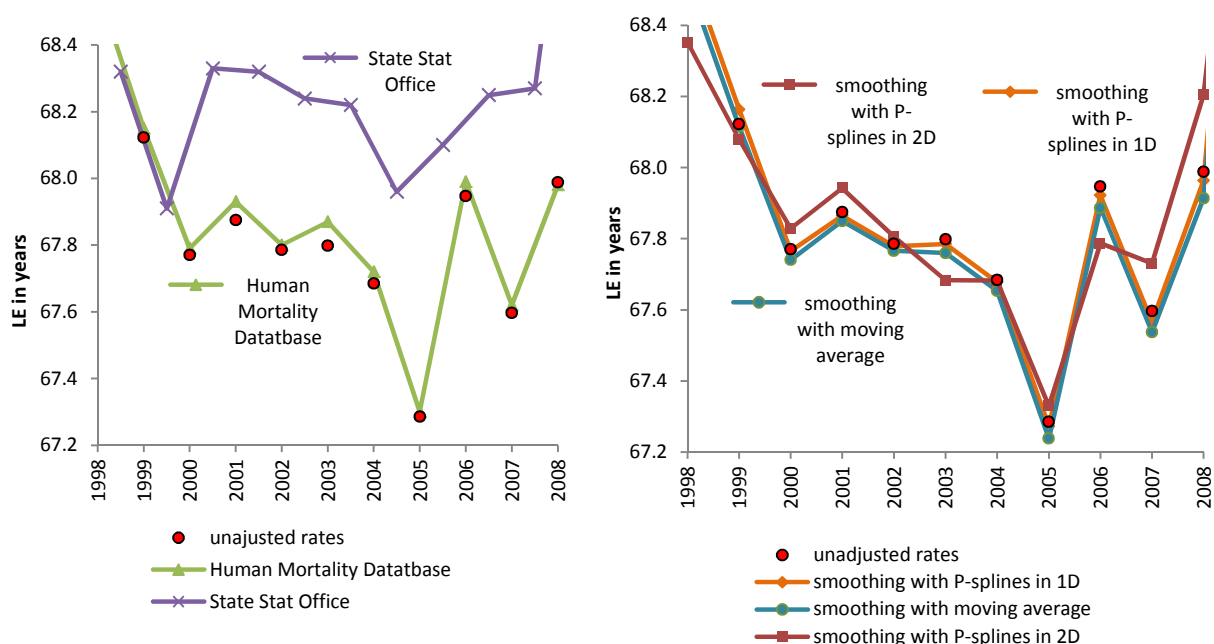
The technique of using P-splines in one- and two-dimensions was coded by Camarda using R-language into the package specifically tailored for demographers called MortalitySmooth.

Using different techniques of smoothing I obtained series of death rates based on which different life tables were constructed. One can compare produced life expectancy by using *Figure 4.2*.

As one can see, the official method (purple line) for calculating life expectancy differs very much from the remaining techniques. The reason is that, for this calculation, data from two adjacent years is used, implying some mixture of cohort and period approaches, so it is not comparable with other methods.

The other reference is the calculation of the Max Planck Institute presented in the Human Mortality Database (green line). This calculation is very similar to our techniques, thus insuring their accuracy. On the other hand, while smoothing using average (dark green line) and P-splines in one dimension (orange line) provides quite similar results, smoothing using P-splines in two dimensions (red line) differs from the rest, especially at the points of extremes. The reason for this is large fluctuations in mortality dynamics in Ukraine over the course of time. As this technique involves data by age and by years at the same time, the result produced is equally smoothed by age groups as by years. Therefore, this method is inappropriate for Ukrainian data.

Figure 4.2: Life expectancy at birth in Ukraine calculated by different methods, 1998-2008

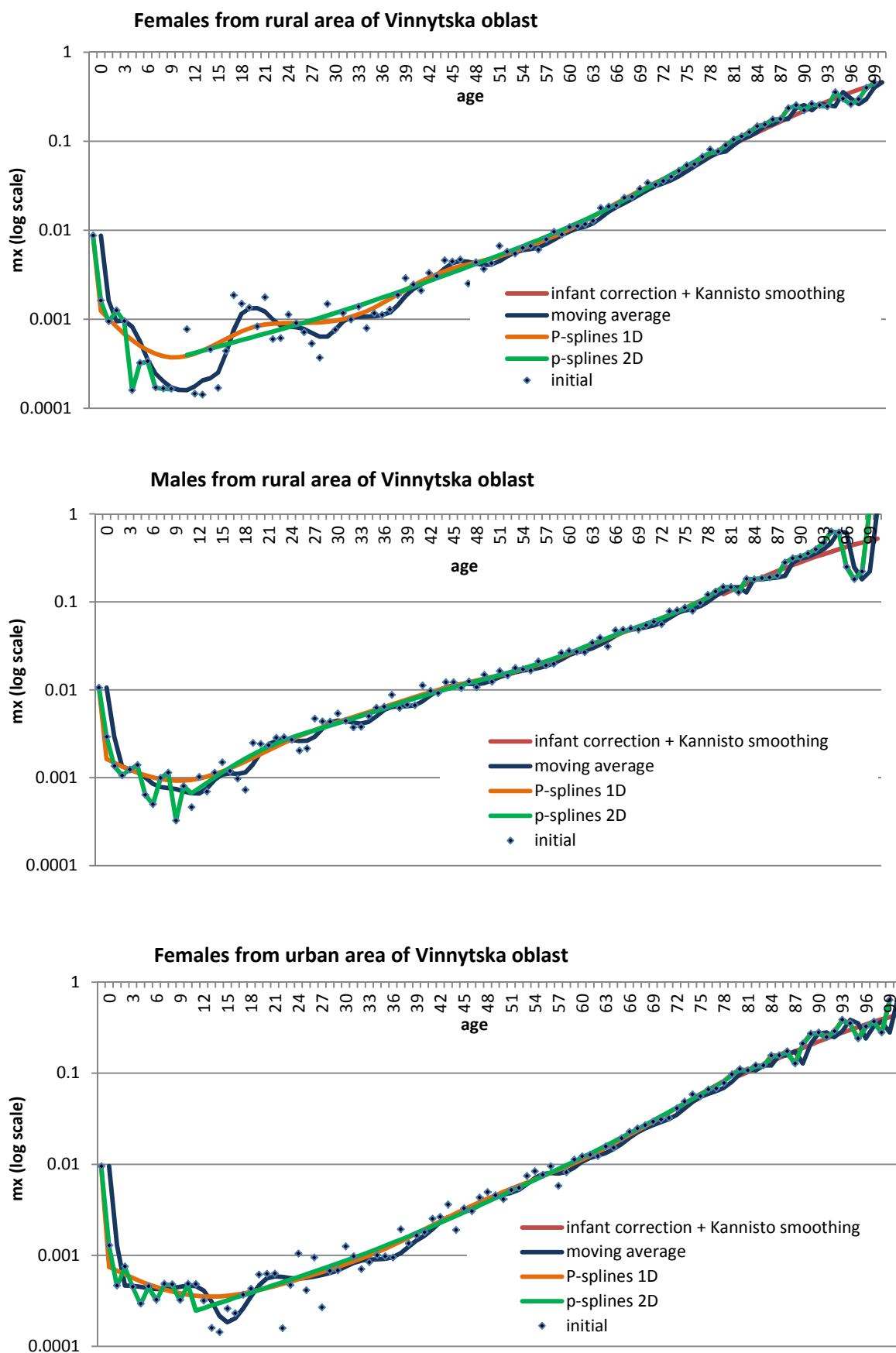


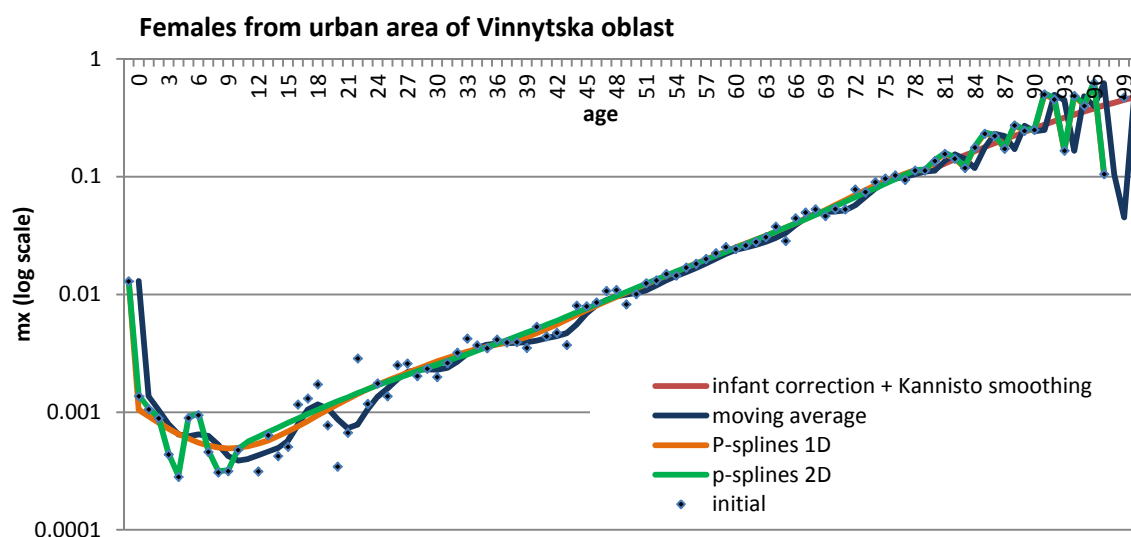
Source: Human Mortality Database, data of SCS of Ukraine and author calculation

The last thing to portray is patterns of age-specific death rates and how the smoothing procedure changes them (*Figure 4.3*). In order to demonstrate the results I randomly chose Vinnytska oblast and present initial and smoothed ASDR curves for urban and rural populations.

One may see that no method is perfect, and each presents some problems. First, smoothing with a moving average does not provide a fit, but rather deformed or shifted fluctuations. The Kannisto model provides a good fit at old age, but one should be careful in applying it at the same time with other methods, as two different techniques at the age of change might produce an abruptness. Smoothing using P-splines in 1 dimension does not always work automatically. The smoothing parameter can be out of reasonable values. Finally, smoothing using P-splines in 2 dimensions (over ages and years) is not appropriate because of different dynamics over years and because it performs poorly at young ages.

Figure 4.3: Age-specific death rates: initial and smoothed by different methods, 1989





Source: calculated using data of the State Statistics Service

The effect of applying different techniques to life expectancy is described in the table below (Table 4.1). There, we have an average across twenty-three years (from 1988 to 2010) of differences between life expectancy, calculated by using completely raw data in combination with that calculated by applying some corrections to the data.

Almost every method produced life expectancy lower than if no method were applied. Logically, that correction of infant mortality after a definition change decreased life expectancy, and the average decrease was 0.12 years. Kannisto smoothing for old age also somewhat decreased the result, which is expected as well, given that unadjusted death rates decrease at very old ages because of very small numbers and because of data flaws.

As for smoothing with moving averages, most regions experience a little increase in LE but these effects are minor. Applying smoothing using P-splines in one dimension is somewhat similar to using a moving average. However, smoothing using P-splines in 2 dimensions somewhat increases life expectancy on average because it eliminates elevated mortality at working age and softens the effect of crisis. This is a very important feature of Ukrainian mortality, so this method is not applicable at all. In the end the hierarchy of regions according to life expectancy at birth does not change. The results of smoothing using different methods at years of census 1989 and 2001 are given also in Annex K and Annex L.

Therefore, the final choice of technique was to use smoothing with moving average and with the Kannisto model for old ages. The obtained age-specific death rates were used in the calculation of life tables for every region and every sex and residence profile.

Table 4.1: Effects from applying different techniques to life expectancy, average difference for 1988-2010, in years

Regions	Effect of correction of infant mortality (age 0)	Effect of Kannisto smoothing (age 80+)	Effect of smoothing with moving average (age 1-80)	Effect of smoothing with P-splines in 1 dimension (age 1 - 80)	Effect of smoothing with P-splines in 2 dimensions (age 12 - 80)
Vinnyska	-0,06	-0,05	-0,03	-0,02	0,01
Volynska	-0,10	-0,12	-0,08	-0,04	0,00
Dnipropetrovska	-0,23	-0,02	-0,02	-0,02	-0,01
Donetska	-0,22	-0,02	-0,01	-0,01	0,00
Zhytomyrska	-0,01	-0,09	-0,04	-0,01	0,00
Zakarpatska	-0,13	-0,06	-0,03	-0,03	0,01
Zaporizka	-0,08	-0,04	-0,02	-0,03	0,00
Ivano-Frankivska	-0,07	-0,08	-0,05	-0,04	0,00
Kyivska	0,00	-0,05	-0,03	-0,02	0,00
Kirovohradska	-0,18	-0,11	-0,06	-0,03	0,00
Crimea	-0,10	-0,03	0,00	-0,02	0,00
Luhanska	-0,10	-0,05	-0,03	-0,02	0,00
Lvivska	-0,27	-0,02	0,00	-0,01	0,00
Mykolayivska	-0,09	-0,07	-0,04	-0,02	0,01
Odeska	-0,09	-0,02	0,00	-0,02	0,01
Poltavska	-0,07	-0,09	-0,05	-0,02	0,00
Rivnenska	-0,16	-0,10	-0,05	-0,06	0,00
Sumska	-0,01	-0,12	-0,09	-0,03	0,00
Ternopil'ska	-0,10	-0,18	-0,11	-0,07	0,01
Kharkivska	-0,19	-0,03	-0,02	-0,01	0,00
Khersonska	-0,13	-0,07	-0,04	-0,04	0,01
Khmelnyska	0,00	-0,09	-0,05	-0,04	0,01
Cherkaska	-0,18	-0,08	-0,07	-0,03	0,00
Chernivetska	-0,02	-0,15	-0,09	-0,07	0,00
Chernihivska	-0,03	-0,12	-0,07	-0,03	-0,01
Kyiv	-0,18	-0,01	0,00	-0,01	0,00
Ukraine	-0,12	-0,06	-0,03	-0,01	0,00

Source: calculated using data of the State Statistics Service

#### 4.1.2 Standardized Death Rate

A major goal of standardization, besides combining a set of age-specific rates into a synoptic figure is to provide a quantitative measure of the difference in rates between the study population of each region and a standard population.

Direct standardization appears to have been motivated by the idea of determining the crude death rate that would be observed in population if its age distribution were the same as that of the standard population. Standardized Death Rate (SDR) is obtained by applying the age-specific death rates to the standard age distribution:  $SDR_j = \sum_x m_{x,j} \times p_x^{st}$ , where (4.7)

$m_{x,j}$  - death rate at age  $x$  for a region  $j$ ;



$p_x^{st}$  - proportion of the population at age  $x$  in a standard population.

### 4.1.3 Standardized Mortality Ratio

When detailed mortality data by age is missing, we refer to indirect standardization. Standardized Mortality Ratio (SMR) has been in service since at least 1786. It was used by W.H. Farr in the 1855 annual report of the Registrar General of Great Britain to compare mortality in different occupational groups (Breslow and Day, 1987). SMR is a ratio of the observed number of deaths to the expected number obtained by applying the standard rate to the given age structure. In symbols,

$$SMR_j = \frac{D_j}{\sum P_{x,j} \cdot m_x^{st}}, \quad (4.8)$$

where  $D_j$  denotes the total observed number of deaths in the district  $j$ ;  $P_{x,j}$  - age structure of the population in the region  $j$ ;  $m_x^{st}$  - standard death rate at age  $x$ .

The Standardized Mortality Ratio by cause of death will be:  $SMR_j = \frac{D_{j,c}}{\sum P_{x,j} \cdot m_{x,c}^{st}} \quad (4.9)$

where  $D_{j,c}$  - total deaths in district  $j$  from cause  $c$ ;

$m_{x,c}^{st}$  - standard death rate at age  $x$  for cause  $c$ .

In my case, mortality rates that were chosen for a standard in total and by causes are those ones observed for Ukraine as a whole. Hence, SMR above 1 means higher mortality than for total Ukraine, and below 1 means lower.

The advantage of this is that it suffices to know only the total  $D$ . Since details on number of deaths by cause and age for districts are omitted from official statistical forms, the subtotals by cause are given. This indicator permits comparing mortality indirectly by district.

Another advantage of the SMR, when viewed as a weighted average of the ratios of age-specific rates for cohort and standard population, is that the weights  $m_x^{st}$  minimize the variance of the weighted average. In practical terms, it means that it tends to be less sensitive to numerical instabilities in age-specific rates (Breslow and Day, 1987). SMR is thus appropriate when the sample is small and questions of statistical significance are at issue.

### Confidence interval for SMRs

The confidence interval (CI) provides the range of values within which I expect to find the real value of the indicator under study, with a given probability. In the case of the SMR, the calculation of the confidence interval is carried out using a method described by Goldblatt (1990). The confidence intervals are derived from an assumption that the Poisson distribution of the observed number of deaths has a mean, which is equal to the expected number. Therefore,

$$\text{limits of confidence intervals are found from the formula: } \frac{s_e^{L,U}}{\widehat{D}_j^n} \cdot 100 \quad (4.10),$$

where  $\widehat{D}_j^n$  - expected number of deaths for the district j in the year n;

$s_e^{L,U}$  - Standard error for lower and upper limits, correspondingly.

Standard errors for lower and upper limits are found in three different ways, depending on the number of observed deaths. Where the number of deaths is less than 100 the values of standard error for the upper and lower limits are taken from a table of exact confidence intervals, which is included in Annex J. For larger numbers of deaths, little accuracy is lost by using a method, which approximates the calculation of the exact limits. This method of calculation differs slightly if the observed number of deaths is greater than 900.

Table 4.2: Formulas for calculating standard error for confidence intervals depending on the number of observed deaths

Observed deaths	Standard error for lower limit	Standard error for upper limit
< 100	from exact CI – annex 1	from exact CI – annex 1
100-900	$0.96 + D_j^n - 1.96 \cdot \sqrt{D_j^n + 0.11}$	$1.94 + D_j^n - 1.96 \cdot \sqrt{D_j^n + 0.96}$
900 >	$0.962 + D_j^n - 1.9602 \cdot \sqrt{D_j^n}$	$1.94 + D_j^n - 1.96 \cdot \sqrt{D_j^n + 0.96}$

Source : Goldblatt (1990)

#### 4.1.4 Proportionate Mortality Ratio

The basic idea of proportional mortality analysis is to compare the fraction of deaths due to a specified cause with the corresponding fraction for the general population (Breslow and Day, 1987) as illustrated in *Figure 4.4*.

Proportionate Mortality Ratio can also be expressed as the ratio of the observed number of cause-specific deaths to the number of expected deaths by applying

the standard proportion to the total death. It allows one to determine whether the proportion of deaths from a certain cause of death for a certain district is higher (PMR greater than one) or lower (PMR less than one) than the corresponding proportion for all districts combined (McGehee 2004, p.282).

A PMR greater than one is an indicator of higher relative risk of mortality than overall Ukraine's overall risk. An advantage of the PMR is that it does not require population data that is needed for population-based measures such as SMR.

$$\text{Proportionate Mortality Ratio: } PMR = \frac{D_{cj}}{E_{cj}} \times 100, \quad (4.11)$$

where  $D_{cj}$  - actual number of deaths from a specific cause  $c$  for a specific district  $j$ ;  $E_{cj}$  - expected number of deaths from a specific cause  $c$  for a specific district  $j$ .

$$\text{Expected number of deaths is found as a relationship } E_{cj} = \frac{\sum_1^c D_{c1} \cdot \sum_1^j D_{c1}}{\sum_1^c \sum_1^j D_{c1}} \quad (4.12),$$

which can be more easily understood from *Table 4.3*.

Here, for example,  $D_{11}$  is the actual number of deaths from the first cause in the first district. Expected number of deaths is found as the cross-relation of corresponding columns and rows of totals. In our case, I would need as totals: 1) number of deaths for the entire Ukraine for a cause 1 ( $\sum_1^j D_{1j}$ ); 2) total for all causes number of deaths for the district 1 ( $\sum_1^c D_{c1}$ ); 3) total by districts

and by causes ( $\sum_1^c \sum_1^j D_{cj}$ ).

Figure 4.4: Illustration of the Proportionate Mortality Ratio

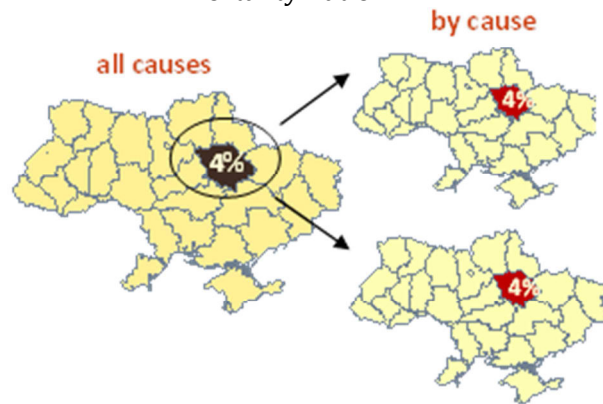


Table 4.3: A scheme of tabulated numbers of deaths by causes and by district

	Cause 1	Cause 2	...	Cause c	Total
District 1	$D_{11}$	$D_{21}$	...	$D_{c1}$	$\sum_1^c D_{c1}$
District 2	$D_{12}$	$D_{22}$	...	$D_{c2}$	$\sum_1^c D_{c2}$
...	...	...	...	...	...
District j	$D_{1j}$	$D_{2j}$	...	$D_{cj}$	$\sum_1^c D_{cj}$
Total	$\sum_1^j D_{1j}$	$\sum_1^j D_{2j}$	...	$\sum_1^j D_{cj}$	$\sum_1^c \sum_1^j D_{cj}$

Since the death rates, and thus the proportion of deaths for different causes, depend on age in different ways, the age distribution of the comparison group can influence the overall proportion. The conventional approach to adjusting for such age differences is to calculate the expected number on an age-specific basis and then sum them up (Breslow and Day, 1987), which would yield a refined indicator from the impact of age structure.

#### 4.1.5 Trade-off between PMR and SMR

Since I don't have deaths by age for districts I could not standardize PMR on age, so I calculated a kind of crude one. Plotting PMR and SMR on the same graph allowed judging about the difference between these two indicators. One can see that in some cases like respiratory and digestive system diseases, they are pretty close (*Annex M*); and in other cases they are pretty different (like circulatory system diseases, infectious diseases, external causes of death).

To find out from where the difference comes from, I performed the same manipulation, but with data by regions for which I have age-specific data. PMR was calculated in two ways: with and without standardizing for age. The example of results is given in *Figure 4.5* and *Figure 4.6*.

The figures present SMR and PMR calculated for districts (without age standardization) and for regions (with and without age standardization). Both indicators were calculated with confidence intervals. Geographical units were ranged from the smallest to the highest values. In the case of regions, the hierarchy of regions after standardization is preserved as before in order to observe changes that standardization produces. *Figure 4.5* gives an example (respiratory system diseases) where almost no changes happened, while *Figure 4.6* gives an example (external causes) where changes were substantial.

Figure 4.5: SMR vs. PMR for respiratory system diseases in Ukraine, 2005-2010

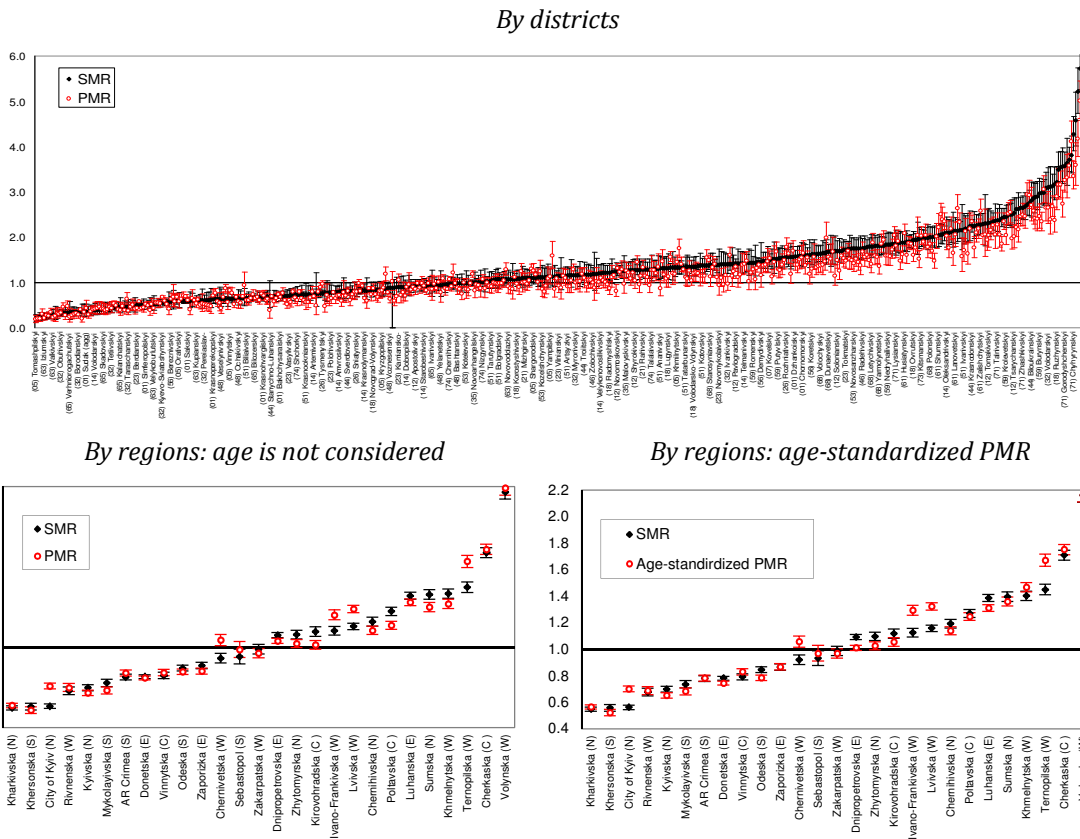
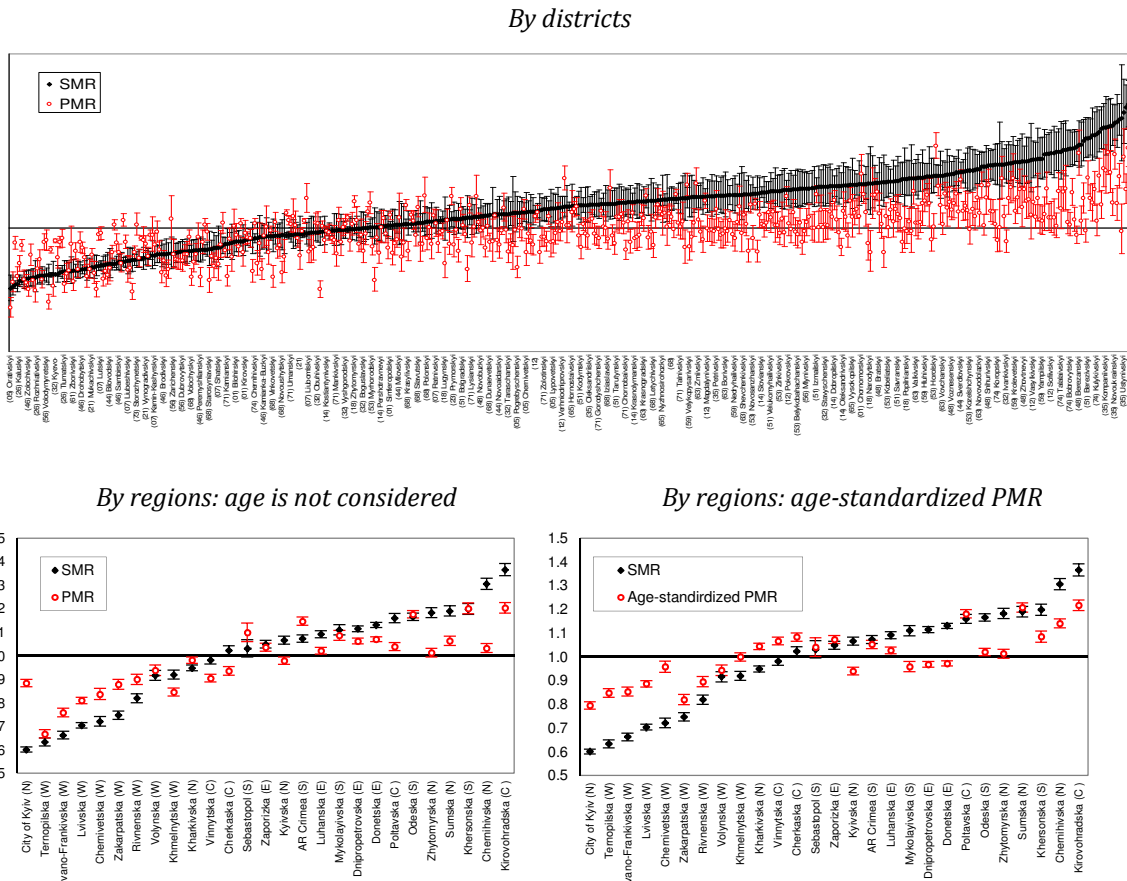


Figure 4.6: SMR vs. PMR for external causes in Ukraine, 2005-2010



Source: calculated using data of the State Statistics Service

Empirical comparisons of results show that two indicators are not alternative to each other. Even after age standardization (which was supposed to remove dissimilarities), even greater differences occurred. The cause of these differences is in the approach to the data employed: age-standardized PMR accounts for the age structure of mortality, while SMR accounts for the age structure of the population. Therefore, these two differ for those causes where the death distribution does not adequately follow the population distribution by age.

The important assumption in calculating PMR is that the specific-cause-mortality-age profile follows the all-cause-mortality-age profile, which is not the case for every cause of death. For example, total number of deaths from all causes increases exponentially with age, while mortality from external causes is high at young ages and falls sharply when approaching ages 40-50 years. That's why I decided to choose from among these two and to operate only with SMR.

## 4.2 Estimating indicators from the life table

### 4.2.1 Life expectancy

Life expectancy at birth has been used as a measure of the health status of the population of Ukraine since the 1920s. Studies of Ukraine's mortality have been limited to major divisions such as male/female and urban/rural place of residence, and less often by regions. As I do not have complete cohort data for Ukraine, I calculate period life tables by converting death rates to probabilities of death. A period life table represents mortality conditions at a specific moment in time. The technique described below needs to be applied separately for females and males. The life table for the total population is calculated by averaging figures for males and females.

#### 1. Setting the observed number equal to the estimated number of deaths

Having calculated smoothed death rates for all age groups, I adjust them once more to insure that the estimated total number of deaths is equal to the actual total number of deaths.

The first step is to apply smoothed death rates to the given population:

$$\text{a) } D_x^{estim} = m_x^{sm} \cdot L_x \quad (4.13)$$

b) to calculate the difference in the actual and estimated total number of deaths:

$$diff = \sum_1^{100} D_x - \sum_1^{100} D_x^{estim} \quad (4.14)$$

b) to calculate proportions : 
$$prop_x = \frac{D_x^{estim}}{\sum_{x=1}^{100} D_x^{estim}} \quad (4.15)$$

c) to obtain the finally corrected number of deaths: 
$$D_x^{corr} = D_x^{estim} + prop_x \cdot diff \quad (4.16)$$

d) to recalculate death rates, which will serve as input for the life table: 
$$m_x^{corr} = \frac{D_x^{corr}}{L_x} \quad (4.17).$$

## 2. Separation factor $a_x$

The separation factor is the average duration of life within the age interval (from  $x$  to  $x+n$ ) of people who died in this interval. Traditionally,  $a_x$  is equal to the middle of the interval, and a rule of thumb (Young Cai, 2006) is used for its calculation:  $a_x = n/2$ . For age 0 and age 1, I followed the technique applied in the Human Mortality Database (Wilmoth J. et. al., 2007), which uses formulas suggested by Preston (Preston S., 2001) that are adopted from the Coale-Demeny model life tables (Coale and Demeny, 1983). Thus:

Table 4.4: Calculation of separation factor  $a_x$  for males and females for age 0 and 1 years

		Males	Females
a0	If $m_0 \geq 0.107$	0.330	0.350
	If $m_0 < 0.107$	$0.045 + 2.684 \cdot m_0$	$0.053 + 2.800 \cdot m_0$
a1	If $m_0 \geq 0.107$	$1.352/4$	$1.361/4$
	If $m_0 < 0.107$	$1.653 - 3.013 \cdot q_0$	$1.524 - 1.627 \cdot q_0$

For a life table with sexes combined, I compute  $a_0$  and  $a_1$  as follows:

$$a_x^T = \frac{a_x^F \cdot D_x^F + a_x^M \cdot D_x^M}{D_x^F + D_x^M} \quad (4.18)$$

For age  $x = 100+$ : 
$$a_x = 1 / m_x \quad (4.19)$$

The following life table functions are calculated the same way for males and females.

## 3. Probability to die ${}_n q_x$ :

for  $0 \leq x \leq 99$ : 
$${}_n q_x = \frac{n \cdot m_x}{1 + (n - a_x) \cdot m_x} \quad (4.20)$$

where  $n$  - is a length of interval in years;

$$\text{for } x = 100+: \quad q_{100+} = 1 \quad (4.21)$$

4. Probability to survive from age  $x$  to  $x + n$ :

$$p_x = 1 - {}_n q_{x-n} \quad (4.22)$$

5. Number of survivors (survival function)  $l_x$

The radix of life table is  $l_0$  and is set at 100,000. The populations at other ages are sequentially

$$\text{calculated as:} \quad l_x = l_{x-n} \cdot p_{x-n} \quad (4.23)$$

6. Number of deaths from age  $x$  to  $x + n$ :

$$\text{для: } 0 \leq x < 100+ \quad {}_n d_x = l_x \cdot {}_n q_x \quad (4.24)$$

$$\text{for } x = 100+: \quad d_{100+} = l_{100+} \quad (4.25)$$

7. Number of person years lived in the interval from age  $x$  to  $x + n$ :

$$\text{for } 0 \leq x < 100+: \quad {}_n L_x = l_x - (n - a_x) \cdot d_x \quad (4.26)$$

$$\text{для } x = 100+: \quad L_{100+} = l_{100+} \cdot a_{100+} \quad (4.27)$$

$$8. \text{ Total number of person years lived beyond age } x: \quad T_x = \sum_x^{100+} {}_n L_x \quad (4.28)$$

$$9. \text{ Life expectancy at age } x: \quad e_x = \frac{T_x}{l_x} \quad (4.29)$$

10. Calculation of Standard Errors

The stochastic variation of life table functions can be substantial for units with a small sample size. To gauge the effect of stochastic variation, I calculated the sample variance and standard errors of life expectancies following Chiang and described by Young Cai (2006).

$$S_{nq_x}^2 = \frac{n \cdot {}_n m_x (1 - {}_n a_x \cdot {}_n m_x)}{{}_n P_x^m [1 + (n - {}_n a_x) \cdot {}_n m_x]^3} \quad (4.30)$$

$$S_{e_x}^2 = \frac{\sum_{x=y}^{99} l_x^2 [e_{x+n} + (n - {}_n a_x)]^2 S_{nq_x}^2}{l_x^2}, \quad y=0, 1, 2, \dots, 99 \quad (4.31).$$



### 4.2.2 Lifespan disparity

Patterns of diversity in age at death can be examined using  $e^\dagger$  (e dagger), a dispersion measure that tells how many years of life are – on average - lost due to death (Shkolnikov et al., 2011; Kibebe, 2013). It weights the average remaining life expectancy at age  $x$  by the number of life table deaths at age  $x$ :

$$e^\dagger = \frac{1}{2l_x} \sum_{y=x}^{\omega-1} d_y (e_y + e_{y+1}) \quad (4.32),$$

where  $\omega$  is the highest age group;  $d_y$  is number of life table deaths at age  $y$ ;  $(e_y + e_{y+1})/2$  is an approximation for the average remaining life expectancy.

Differences in the measure  $e^\dagger$  can be decomposed by age groups and causes of death, just like the differences in a decomposition of life expectancy differences (Shkolnikov et al., 2011; Vaupel and Canudas Romo, 2003).

## 4.3 Decomposition

### Age-cause decomposition

The method of decomposition proposed by Evgeny Andreev (1982) allowed splitting the difference between life expectancies in different reference periods (or between two populations) into contributions of elementary differences in age-specific mortality rates and by causes as follows:

$$e_x^2 - e_x^1 = \sum_{y=x}^W {}_n\mathcal{E}_y \quad (4.33),$$

where  ${}_n\mathcal{E}_y = \sum_c {}_n\mathcal{E}_{y,c}$ ;  ${}_n\mathcal{E}_y$  is a contribution produced by the difference in mortality in the age group  $y, y+n$ .

Decomposition of life expectancy by age groups between population 2 and population 1 can be done as follows:

$${}_n\mathcal{E}_y^{2-1} = \left[ l_y^2 (e_y^2 - e_y^1) - l_{y+n}^2 (e_{y+n}^2 - e_{y+n}^1) \right] \quad (4.34)$$

Decomposition of life expectancy by age groups and cause of death:

$${}_n\mathcal{E}_{y,c} = \frac{{}_n m_{y,c}^1 - {}_n m_{y,c}^2}{{}_n m_y^1 - {}_n m_y^2} \times {}_n\mathcal{E}_y \quad , \text{ where} \quad (4.35),$$

${}_n\mathcal{E}_{y,c}$  - contribution produced by the difference in mortality in the age group  $y, y+n$  by cause  $c$ ;

${}_n m_{y,c}$  - central death rate for age group  $y, y+n$  and cause of death  $c$ ;

${}_n m_y$  - central death rate for age group  $y, y+n$  and all causes.

## 4.4 Some measures of variation

The scheme of studying inequalities between groups consists of two steps: the first step is to describe the differences between the groups, and the second step is to summarize the variation in a single figure (Kibele, 2012). A great variety of inequality measures exist. In order to describe distributions, one may apply measures of the centre or measure of dispersions.

**Measures of centre** are commonly known. These are average, mode and median. Life expectancy is also a measure of the centre as it is defined as the expected value in terms of probability theory.

As for **measures of dispersion**, their choice is much larger, from simple ones like the difference between maximum and minimum values, to the interquartile range, to some standardized indicators that help to avoid the problem of different units of measurements, such as standard deviation, the coefficient of variation, the Gini coefficient, the Lorenz curve, the slope index of inequality, the concentration index, etc.

The **Dispersion Measure of Mortality (DMM)** is more elaborated and applicable in regional studies. This is based on the mortality differences between all pairs of geographical units and is weighted by population size (Kibele, 2012; Moser et al., 2005). It summarizes interregional differences by taking into account population numbers. It is calculated as:

$$DMM = \frac{1}{(2W_z)^2} \sum_i \sum_j (|e_i - e_j| \cdot W_i \cdot W_j) \quad (4.36),$$

where  $i, j$  denote different regions,  $z$  denotes Ukraine, and  $W$  is a weighting on population  $\sum_i W_i = \sum_j W_j = W_z = 1$ . A greater value of DMM reflects higher degrees of inequality in length of life among the regions. Relative DMM values are obtained by dividing the absolute DMM value by the overall value of life expectancy in Ukraine (Kibele, 2012).

## 4.5 Spatial analysis

Demographers often use maps and regional tabulations to demonstrate the spatial dimension of population characteristics in given settings. To have an idea of how variable is distributed over area, I refer to cartographic illustrations such as thematic maps. On the other hand, while using thematic maps to study a phenomenon illustrates where particular values tend to be concentrated, they remain rather intuitive and fail to demonstrate how close areas may affect each other (Oliveau S. and Guilmoto CZ).

The strength of “geographic correlation” is measured by spatial analysis tools, which include quantitative and visual methods and together represent Exploratory Spatial Data Analysis (ESDA).

Central to ESDA is the concept of spatial autocorrelation, i.e., the correlation of a single variable between pairs of neighbouring observations. Once the concept of “neighbouring observations” is defined (using the contiguity of distance matrix), the correlation between neighbours may be compared to the general variance of the sample in the same way as in ordinary correlation analysis. This correlation may be non-existent, low or strong, according to the variables used.

In my case, spatial autocorrelation measures the extent to which the occurrence of death from a particular cause in one district constrains, or makes more probable, the occurrence of such deaths in a neighbouring district.

One of the oldest indicators of spatial autocorrelation is Moran’s Index, which is a measure of global autocorrelation. It compares the spatial distribution of life expectancy in space to a complete random distribution of this variable (Kibele 2012). Arthur Lembo proposes a use of the alternative Geary’s C index, which is more sensitive to very small neighbourhoods. The application of spatial analysis in health studies is found in Congdon (1995, 1997), Joins (2003), Miranda (2003), O’Neill (2003) etc. The difficulties arise from deciding which domain to choose as a spatial unit and which method of spatial data analysis to apply.

In my study, I use Moran’s index as a global measure to estimate the strength of the correlation:

$$I = \frac{\sum_{i,j} W_{ij} (SMR_i - \overline{SMR}) \cdot (SMR_j - \overline{SMR})}{\sigma^2 (SMR)}, \quad (4.37)$$

$$\text{where } \sigma^2 = \frac{\sum_{i,j} W_{ij} \sum_i (SMR_i - \overline{SMR})^2}{N} \text{ is the sample variance,} \quad (4.38)$$

$N$  – the number of districts;  $SMR_{i,j}$ - values in the district  $i/j$ .

$W_{ij}$  – represents the spatial proximity between district  $i$  and district  $j$ , which is given by the matrix of weights applied to the comparison.

Moran’s Index usually ranges between -1 and 1 but not bound to this range.

To measure local autocorrelation, I use the LISA index (Local indicator of spatial association). The sum of all local indices is proportional to the (global) value of Moran’s statistic.

$$I_i = \frac{\sum_{i,j} W_{ij} (SMR_i - \overline{SMR}) \cdot (SMR_j - \overline{SMR})}{\sum_i (SMR_i - \overline{SMR})^2} \quad (4.39)$$

LISA indexes are possible to map, so one can capture areas of elevated risk of mortality. These are so called “hot spots”, districts with high values with similar neighbours. Contrary “cold spots” are districts with low values with similar neighbours. Potential “spatial outliers” are those districts that negatively correlate with their surroundings.

As I saw both Moran’s and Liza’s Indexes require the definition of neighborhood structures, given by the spatial weight matrix. In my case a spatial weight matrix was build based on criteria of spatial contiguity, that is, districts are defined as neighbors if they share a common border. Depending on the definition of spatial weight matrix, Moran’s Indexes differ in the level, but the qualitative trend is the same (Kibele 2012).

## 4.6 Principal component and correspondence analysis

Correspondence analysis (CA) is a multivariate statistical technique proposed by Hirschfeld and later developed by Jean-Paul Benzécri (1975) in the early 1960’s and 1970’s. However, it has only more recently gained increasing popularity. It is conceptually similar to principal component analysis, but applies to categorical rather than continuous data. In a similar manner to principal component analysis, it provides a means of displaying or summarizing a set of data in two-dimensional graphical form. One way to state the goal of a typical analysis is to represent the entries in the table in terms of the distances between individual rows and/or columns in a low-dimensional space. In mathematical terms, it decomposes the overall Chi-square statistic by identifying a small number of dimensions in which the deviations from the expected values can be represented.

Correspondence analysis is a statistical visualization method for picturing the rows (regions) and columns (causes) of a two-way contingency table, such that the positions of the row and column points are consistent with their associations in the table. The distance between the points summarizes information about the similarities between the rows in the table. The name of a specific cause is placed near the region for which that specific cause is overrepresented (Brouard, 1985). The goal is to have a global view of the data that is useful for interpretation (Bee-Leng Lee, 2010).



## Chapter 5

# Geographical patterns of mortality at the turn of the XXI century

### 5.1 Level of mortality and age-sex patterns

#### 5.1.1 Life expectancy

I start the analysis by reviewing the situation around 2001, as this was the year of the first census in Ukraine since it received independence. Because there were no other censuses organized in subsequent years, data are the most fruitful and reliable for the period around 2001. This year came after a phase of deep health and mortality crisis when life expectancy fell significantly and then recovered shortly before a new stagnation. In order to have a sufficient number of deaths by regions I accumulated the four years around 2001 (from 2000 to 2003 - because the census was taken at the end of the year). In the end I came up with 3 million deaths (3 024 353) for the total Ukraine, fluctuating from 49 to 328 thousand deaths in different regions.

The general death rate for Ukraine at the time of the 2001 census was 15.7 per 1000 population, which is a very high death rate. For comparison, it was 9.3 in Slovenia in 2001, 9.5 in Poland, and the average for the European Union was 9.9.

To compare this rate among regions, I needed to standardize it. The standardized death rate<sup>11</sup> ranged from 13 to 17 deaths per 1000 population (both sexes) in different regions. For males, the maximum was observed in Khersonska oblast in the South (25 per 1000), and the minimum was in the capital Kyiv (18 per 1000). As for women, the variation was much lower: SDR ranged from 10 to 13 per 1000 of standard population, with the minimum in the West (Ternopil'ska oblast) and the maximum in the South (Odeska oblast).

A more precise indicator that allows totally getting rid of the impact of age structure is life expectancy (LE) at birth. *Figure 5.1* presents regional patterns of life expectancy using maps. Annex N (*Table 1*) presents the corresponding numerical values of life expectancy for males and females for rural and urban area together with confidence intervals. Since confidence intervals are very narrow and almost coincide with single values, (thanks to a large population size) I will further operate only with single values.

First of all, one may see some visible geographical opposition: in the case of males it is between the west and east of Ukraine; while in the case of females, the contrast is rather between the west and south-east. The regions with the worst situation form a belt that starts from Odeska oblast, passes the southern areas, and ends up in Donbas. The regions with the lowest mortality are found in the west, in the zone around the Carpathian Mountains.

For every region, life expectancy at birth for men is always lower than for women. For males, average for Ukraine LE is equal to 62 years, and for females – it is 73.5 years.

For males, the highest value (as in the case of SDR) is observed in the city of Kyiv (66 years) and the lowest is in Khersonska oblast (59.6). The difference between these extremes is 6.4 years. In addition to Kyiv, Ternopil'ska and Chernivetska are oblasts with relatively high values of male life expectancy (more than 65 years). The southern and eastern regions perform poorly and have the lowest values. In the south, it is AR of Crimea that performs the best, having a life expectancy close to the Ukraine average.

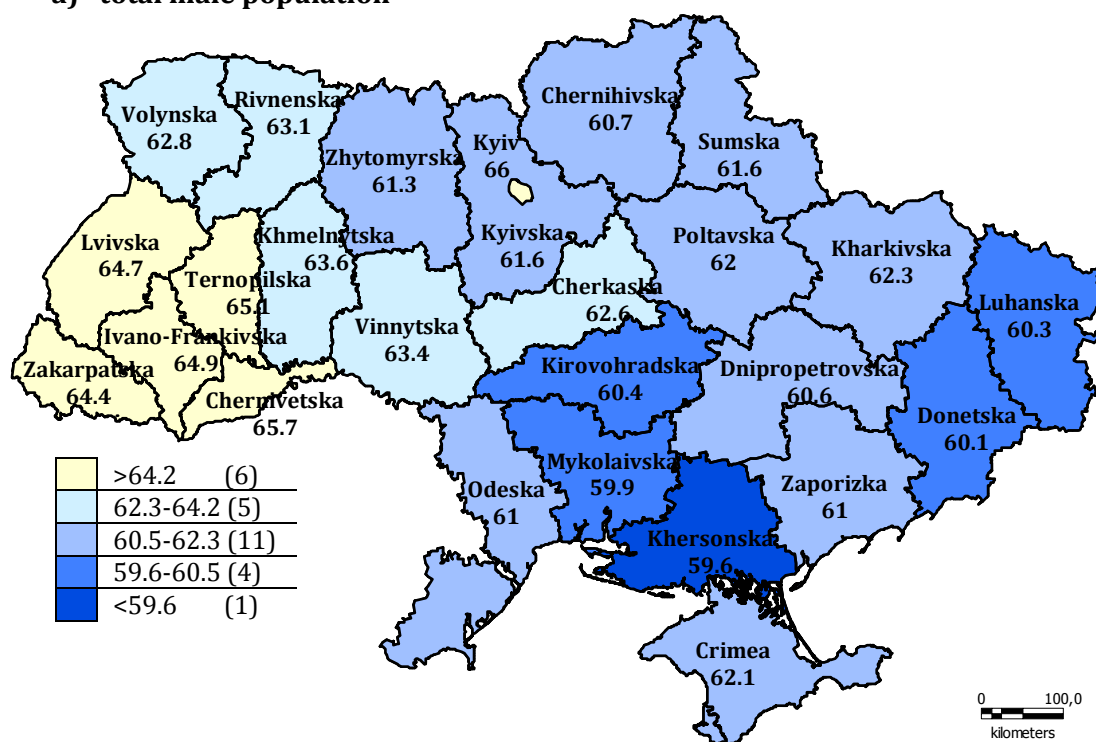
For women, the regional pattern is similar to that of men with some exceptions. The highest values of the life expectancy distribution among regions (more than 75 years) are observed in the city of Kyiv, Ternopil'ska and not Chernivetska as for males but Lviv'ska oblast. The lowest value is observed in the south as well, but in Odeska oblast (71.5 years). The difference in female life expectancy between these two extremes reaches 4.1 years. Another difference with males is that the bad situation on the north is not so much pronounced; and on the western side, female mortality in Zakarpatska oblast is higher than on average.

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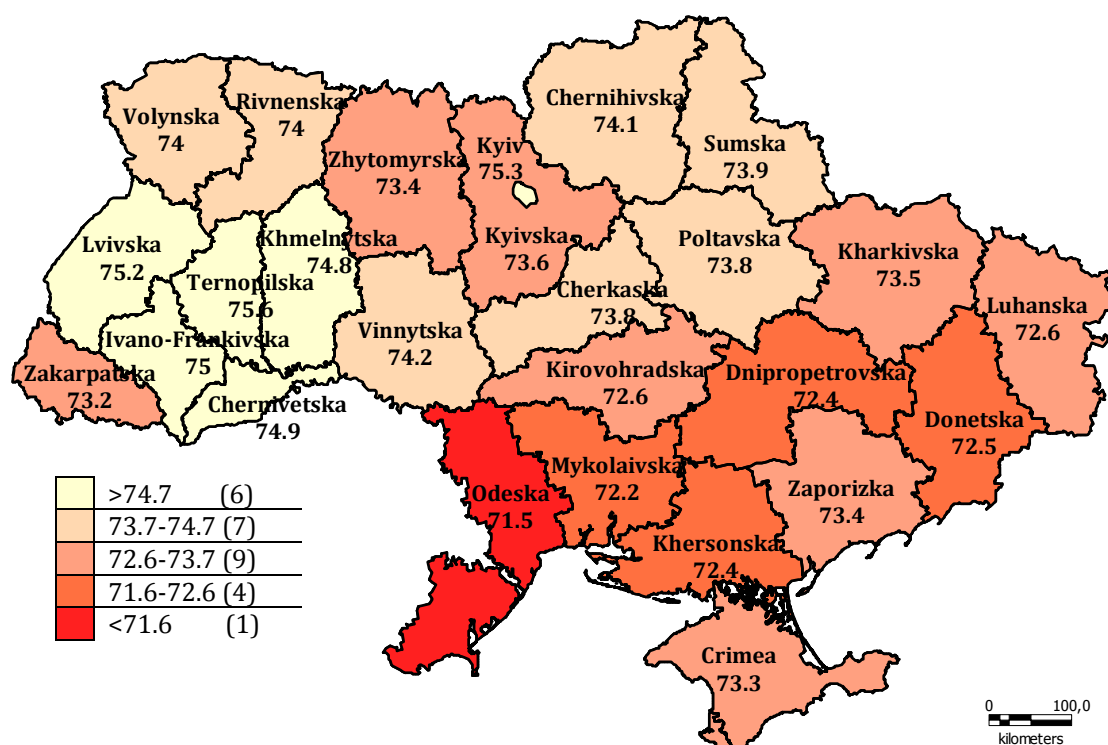
<sup>11</sup> Using the direct standardization described in chapter 4 "Methodology and techniques". All-Ukraine's population was chosen as a standard.

Figure 5.1: Life expectancy at birth for males and females, Ukraine, average for 2000-2003

## a) total male population



## b) total female population

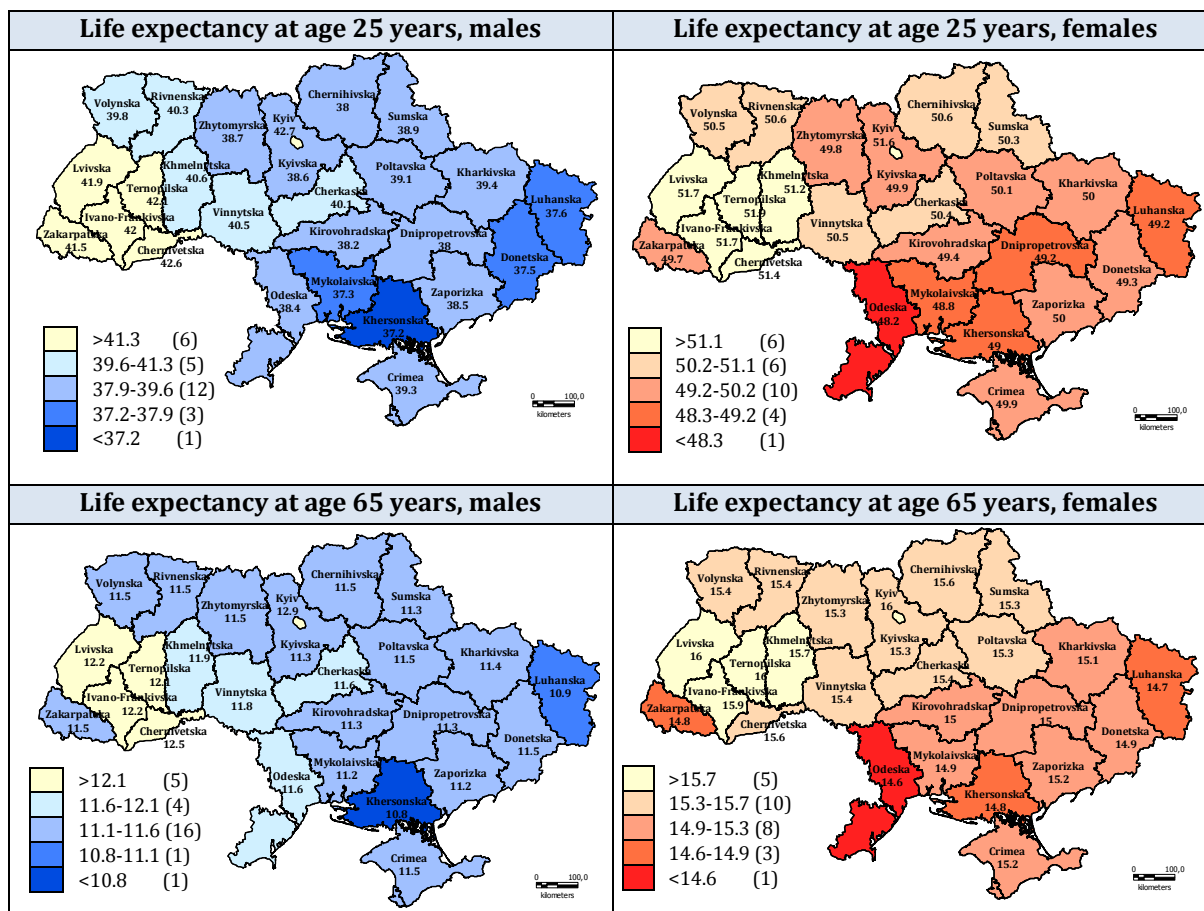


Source: Author calculation using data of the State Statistics Service of Ukraine with correction for infant mortality



The spatial patterns of life expectancy at age 25 and 65 (Figure 5.2) generally follow the pattern of life expectancy at birth. The most important characteristic is that disparities shrink with age. The coefficient of interregional variations goes down from 3% at birth to 1.7% at age 25, and to 0.5% at age 65 years in the case of males. In the case of females, it corresponds to 1.4, 1.0, and 0.4%.

Figure 5.2: Life expectancy at birth, at age 25 and 65 years for males and females, Ukraine, average for 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine with correction for infant mortality

Table 5.1: Some measures of variation of life expectancy at different ages, Ukraine, 2000-2003

	Life expectancy at birth		Life expectancy at age 25 years		Life expectancy at age 65 years	
	males	females	males	females	males	females
Ukraine's average	62.0	73.5	39.3	50	11.6	15.2
Coefficient of variation, %	3.0	1.4	1.7	1.0	0.5	0.4

Source: Author calculation using data of the State Statistics Service of Ukraine with correction for infant mortality

The difference between male and female life expectancies decreases with age as well, which is logical. While at birth it is equal to 11.5 years, at age 25 it becomes 10.7 years, and 3.6 years at age 65. However, in relative terms (in respect to male LE) it is the reverse: this difference becomes bigger. It constitutes around 19% of the average male span at birth, 27% at age 25, and 31% at age 65 years. Hence, with age, interregional disparities decrease though the intergender gap increases.

Therefore, geographic variation in mortality is not the same at different ages and it would be good to determine its main features. However, it is not convenient to operate with 19 age groups (which I have in the initial abridged data) in order to perform comparisons by regions and causes. So I decided to regroup the ages into larger groups, which will be, however, homogenous enough from a geographical point of view.

### 5.1.2 Age regrouping

The age-specific mortality profiles differ from one region to another. To decide which regrouping of ages will be useful, I had to consider these differences. The analysis of coefficients of correlation allows estimating distances between geographic distributions of mortality levels of different age groups. *Table 5.2* presents the matrix of Pearson correlations for males and females. Values in bold are different from 0, with a significance level (alpha) of 0.05.

I observe that geography of mortality begins to become stable at very young age groups: around age 5 for males and age 15 for females. This is certified by high correlation coefficients, which considerably increase further with age, reaching around 90% already in working ages. This is an impressive result that depicts very strong correlations among age groups, no matter which region.

To better visualize age specific mortality profiles, I used a principal component analysis. The projection of points representing mortality coefficients on the plane helped to define the main features of these relations. A strong correlation between two successive ages is portrayed by the proximity of points on the plane (*Figure 5.3*). A visual examination of the biplots allowed distinguishing large age groups as homogeneously as possible. For men, they are: 0, 1-19, 20-59, 60-74 and 75+ years. For women: 0, 1-19, 20-44, 45-74, and 75+. I circled these groups together on the graph. Hence, one may see that a principal age grouping differs for males and for females. The categories are more pronounced for females in particular, while male groups correlate strongly, beginning from a very young age and up to 74 years. To harmonize groups for males and females, I split some of them. In the end I had 6 categories: infants (<1 year), children (1-19 years), adults (20-44 years), late working age (45-59), retired (60-74 years), and old people (75+). Names are chosen arbitrarily and only to facilitate descriptions.

Table 5.2: Matrix of Pearson correlation coefficients by age, 2000-2003, Ukraine

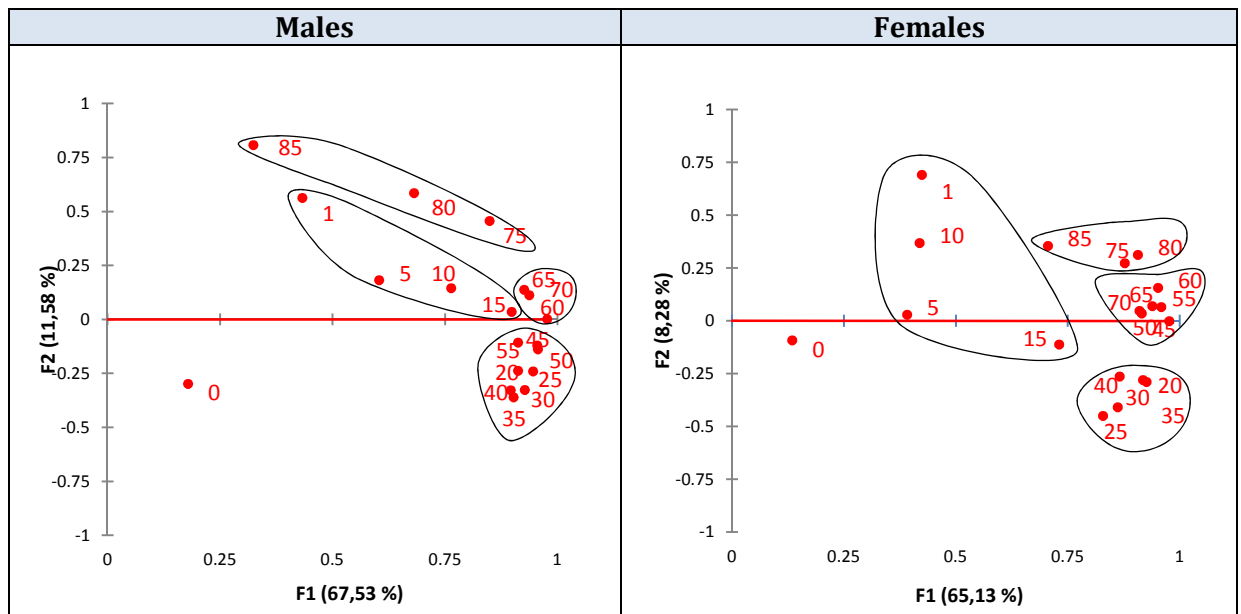
Male	0	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
0	1																		
1-4	-0.08	1																	
5-9	0.24	0.56	1																
10-14	-0.08	0.52	0.47	1															
15-19	0.22	0.53	0.67	0.65	1														
20-24	0.03	0.35	0.57	0.77	0.85	1													
25-29	0.07	0.30	0.54	0.70	0.81	0.94	1												
30-34	0.15	0.27	0.49	0.65	0.79	0.89	0.97	1											
35-39	0.20	0.20	0.40	0.63	0.76	0.86	0.94	0.98	1										
40-44	0.23	0.19	0.43	0.63	0.81	0.85	0.90	0.92	0.96	1									
45-49	0.24	0.24	0.46	0.68	0.81	0.86	0.88	0.90	0.94	0.98	1								
50-54	0.28	0.27	0.52	0.69	0.82	0.85	0.85	0.84	0.87	0.94	0.97	1							
55-59	0.26	0.22	0.49	0.69	0.80	0.88	0.87	0.87	0.90	0.94	0.96	0.97	1						
60-64	0.17	0.35	0.55	0.66	0.85	0.85	0.87	0.86	0.89	0.93	0.94	0.95	0.95	1					
65-69	0.20	0.43	0.48	0.69	0.77	0.74	0.76	0.76	0.80	0.84	0.87	0.89	0.88	0.94	1				
70-74	0.20	0.40	0.54	0.66	0.85	0.77	0.78	0.75	0.78	0.85	0.87	0.91	0.90	0.94	0.94	1			
75-79	0.09	0.57	0.53	0.68	0.77	0.67	0.61	0.58	0.59	0.66	0.71	0.79	0.77	0.84	0.88	0.88	1		
80-84	-0.13	0.48	0.39	0.49	0.60	0.56	0.51	0.47	0.45	0.45	0.51	0.55	0.59	0.70	0.69	0.71	0.84	1	
85+	-0.03	0.34	0.21	0.29	0.23	0.20	0.07	-0.02	0.01	0.04	0.14	0.28	0.28	0.35	0.46	0.40	0.66	0.73	1

Female	0	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+
0	1																		
1-4	0.02	1																	
5-9	0.11	0.13	1																
10-14	0.12	0.41	0.13	1															
15-19	-0.05	0.28	0.37	0.26	1														
20-24	0.02	0.22	0.33	0.43	0.71	1													
25-29	0.13	0.13	0.34	0.33	0.68	0.90	1												
30-34	0.18	0.19	0.28	0.25	0.64	0.87	0.95	1											
35-39	0.20	0.25	0.28	0.33	0.66	0.84	0.91	0.94	1										
40-44	0.16	0.20	0.33	0.27	0.70	0.84	0.87	0.90	0.95	1									
45-49	0.13	0.46	0.34	0.38	0.68	0.85	0.80	0.85	0.90	0.91	1								
50-54	0.10	0.40	0.20	0.34	0.58	0.82	0.70	0.75	0.81	0.85	0.93	1							
55-59	0.01	0.37	0.32	0.34	0.59	0.81	0.71	0.77	0.82	0.83	0.92	0.90	1						
60-64	0.06	0.42	0.36	0.38	0.67	0.74	0.68	0.72	0.81	0.83	0.91	0.88	0.94	1					
65-69	0.14	0.40	0.32	0.33	0.65	0.73	0.72	0.78	0.86	0.89	0.93	0.89	0.91	0.97	1				
70-74	0.18	0.37	0.37	0.26	0.59	0.67	0.67	0.72	0.82	0.86	0.89	0.83	0.86	0.93	0.94	1			
75-79	0.20	0.50	0.37	0.36	0.47	0.61	0.54	0.62	0.75	0.74	0.87	0.81	0.86	0.92	0.92	0.90	1		
80-84	0.12	0.54	0.34	0.47	0.63	0.68	0.59	0.66	0.75	0.74	0.87	0.81	0.88	0.92	0.90	0.86	0.90	1	
85+	0.01	0.41	0.37	0.36	0.61	0.55	0.44	0.43	0.49	0.52	0.64	0.65	0.72	0.72	0.67	0.56	0.60	0.76	1

Source: Author calculation using data of the State Statistics Service of Ukraine

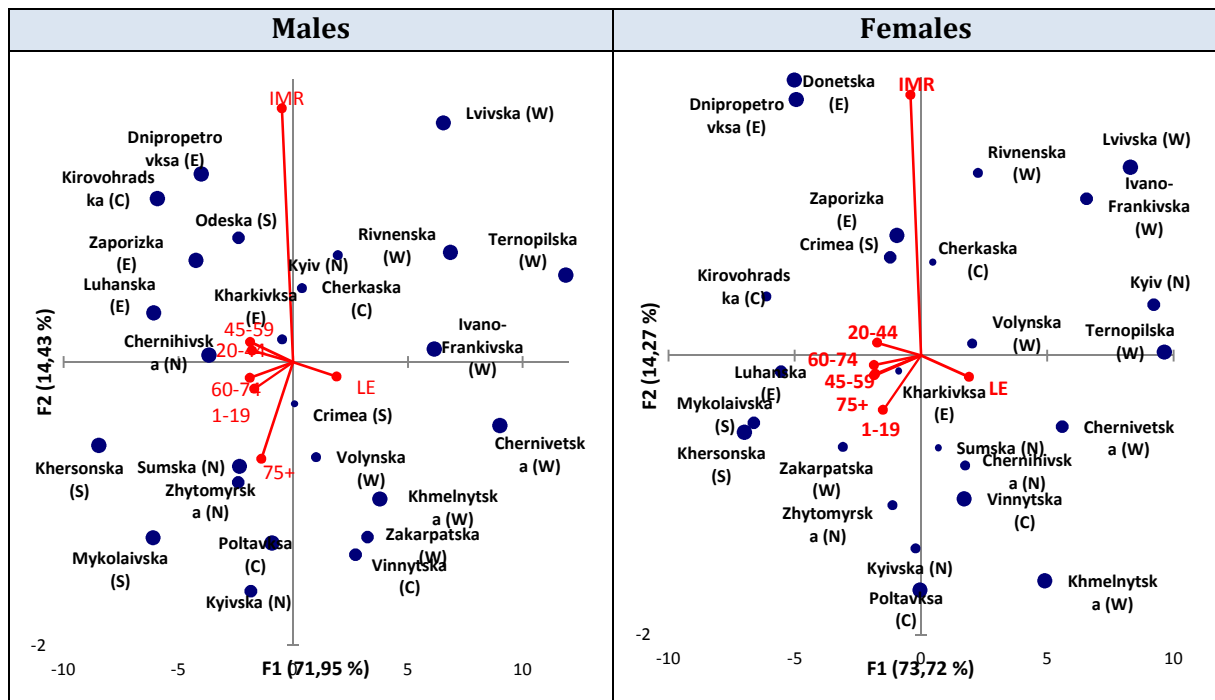
Figure 5.3: Biplot of principal component analysis of mortality by age, 2000-2003



In order to see the role of regions, I added a geographical variable to the analysis; and to avoid too many components, I used the large groups obtained above. Death rates were standardized within each large group. The first component in this analysis (represented by life expectancy) specifies the overall level of mortality, while other components give the age pattern.

According to the results of the analysis, the first component (life expectancy) explains 72-74% of interregional variation, and together with a second component (infant mortality rate) they explain 86-88% of variation for males and females (*Figure 5.4*). The six axes  ${}_1M_0$ ,  ${}_{19}M_1$ ,  ${}_{25}M_{20}$ ,  ${}_{15}M_{45}$ ,  ${}_{15}M_{60}$ , and  ${}_nM_{75}$  corresponding to age-specific mortality rates rotate round the centre and highlight “balances” between ages. The farther a region is from the centre, the larger the age deviation from the mean. The distance between the points is a measure of similarity between the regions. The size of a point tells how well a region is represented in space.

Figure 5.4: Biplot of principal component analysis of mortality by age and region, 2000-2003



In *Figure 5.4* one may see that on the right there are regions with lower mortality and on the left with higher mortality; in the top part there are regions with higher IMR, and in the bottom part with lower IMR. Logically that lower mortality corresponds to higher life expectancy (right side of the biplot). More interesting is that all five vectors of age-specific death rates (not considering IMR) have the same direction and sometimes overlap each other, confirming the previous conclusion that if a certain region is characterized by high mortality, all age groups are affected. The situation for males and females is similar in general.

Using *Figure 5.4*, one may classify regions into 4 categories. The best situation, low IMR and high life expectancy (bottom square on the right) is observed in some particular regions without any pronounced geographical regularity. It includes oblasts from different parts of Ukraine, though not from the south or east. The top square on the right includes regions with high life expectancy as well, though with elevated IMR. These are the five western regions, joined by Cherkaska oblast in the centre, and the city of Kyiv.

On the other side of the spectrum, there are regions with high mortality in all age groups, including newborns. As one may see, these are all the eastern and southern regions, and also Kirovohradska oblast in the centre. In the case of males, the group of worst performers is supplemented by Chernihivska oblast in the north, and in the case of females by the AR of Crimea.

And the last group, low infant mortality but high mortality in other ages is rather mixed.

This biplot justifies the statement about the importance of geographical belonging - diagonal situations on different sides of the spectrum demonstrate geographical homogeneity. It is also proven by analysis that age groups strongly correlate positively with each other (correlation coefficients of Pearson are very high); meaning that if mortality in a certain region is elevated in some age group, it is likely to be elevated over the entire age span.

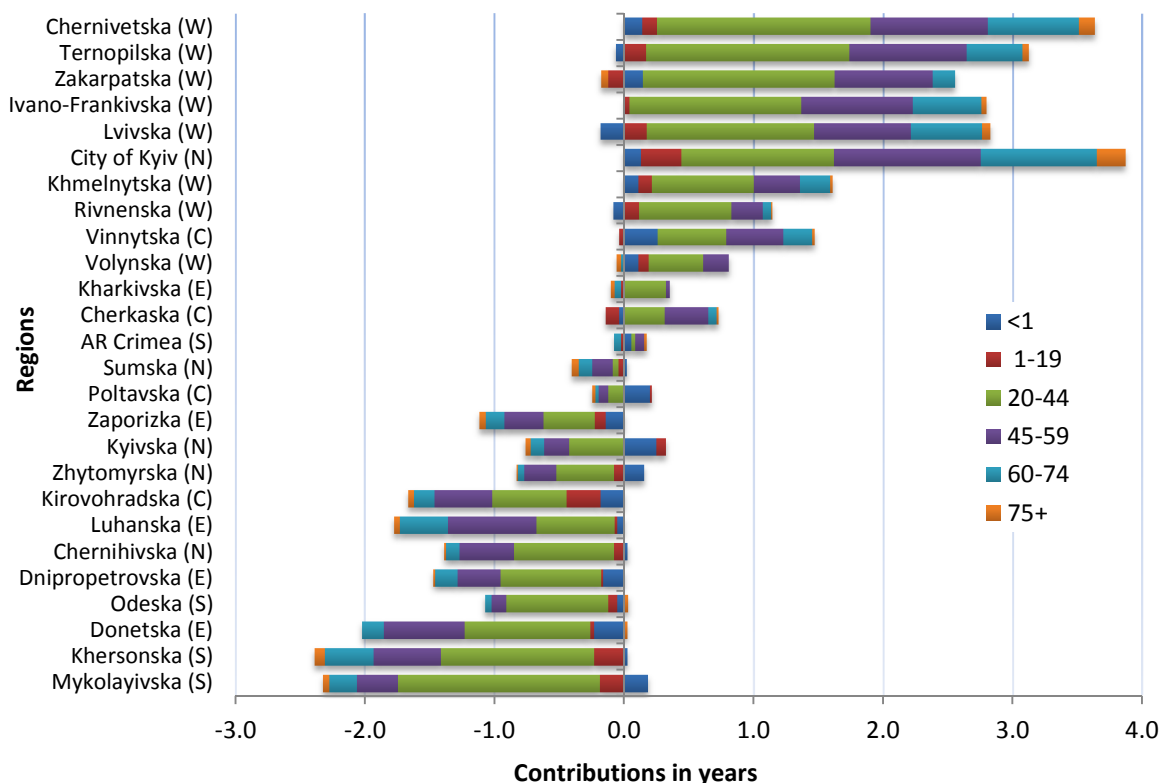
### **5.1.3 Age decomposition**

Before describing causes of death, one may examine the contributions of different age groups to the deviation from the Ukrainian average life expectancy in certain regions. I have chosen Andreev's method (1982) to decompose the difference observed between each region and the Ukraine as a whole. *Figure 5.5* presents these contributions for males and females. Age groups are chosen as described above (six broad groups). In the end, regions were sorted according to the largest contributions, those of males at age 20-44 years.

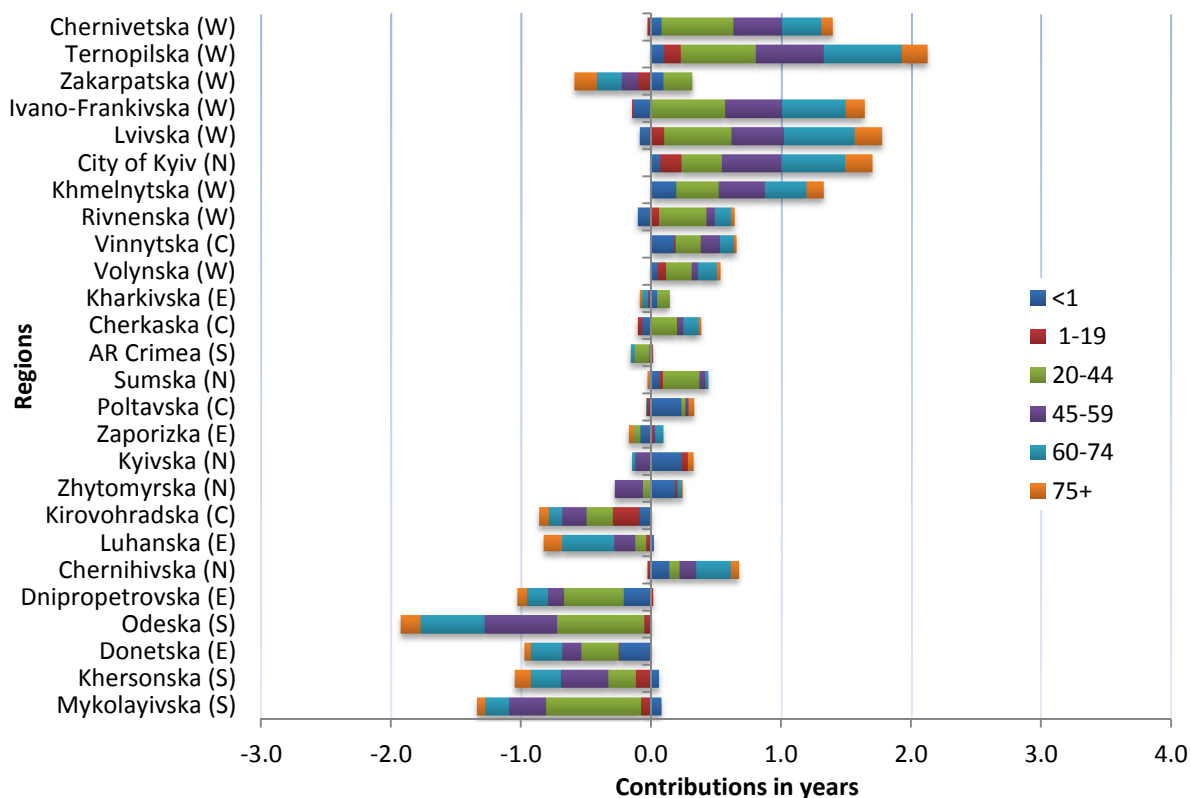
Therefore, from the graphs below (particularly for males), one may see one important feature: if some region is characterized by a positive age-specific contribution to the deviation of life expectancy from the average, every age group is involved positively, and *vice versa*. This roughly divides regions into two groups. AR Crimea is found in the middle (at the level of average), as often happens in regard to other indicators. Above Crimea are regions where every age group contributes positively, and below they contribute negatively (with some exceptions for infants).

Figure 5.5: Contributions of age-groups to the differences in life expectancy between each region and average for Ukraine, 2000-2003

**Males**



**Females**



Source: Author calculation using data of the State Statistics Service of Ukraine

One may see that the majority in the first group is represented by western regions and also by the city of Kyiv. Vinnytska oblast, which is found in the intermediate area between the western and central regions, demographically resembles its western more than eastern neighbours, though it is not traditionally referred to as the west.

Below AR Crimea one may find the remaining regions: 1) central-northern regions with moderate negative contributions at adult ages and positive contributions of infant mortality; and 2) eastern and southern regions, with negative tendencies in all age groups.

One may see that there are also some exceptions. The most noticeable are Zakarpatska and Chernihivska oblasts. Zakarpatska oblast is found in the west but is separated from its well-performing neighbours by the Carpathian Mountains. It has a rather low life expectancy, and thanks to this type of analysis I may determine that it is because of females aged 45 years and older. There is no such trend observed for males. However, there is an alarming tendency regarding young people below age 20 years of both sexes in this region, for whom mortality is above Ukraine's average level.

A different case is Chernihivska oblast, which belongs to the north. It used to be among the leaders in terms of life expectancy in the past, but has now joined the lowest ranks. As I see it, those negative indicators are typical only for men but not for women. Moreover, in the case of women, every single age group contributes to a positive deviation from the average level, while in the case of men every single age group contributes to a negative deviation.

Somewhat less obvious is the case of Odeska oblast, where both male and female mortality profiles are bad; but females contribute to negative tendencies much more actively.

Another distinct feature of these two groups is that the magnitude of positive contributions is larger (reaching almost four years) than that of negative (reaching 2.4 years). The determinant role of working ages is evident. The age group 20-44 years is the one that contributes the most to the differences, either positively or negatively. In Donetska oblast it reduces life expectancy by almost one year compared to the average, and it gives an advantage of 1.7 years to life expectancy in Chernivetska oblast, hence creating a gap of almost three years between these two extreme regions.

A bit lesser but still significant importance is attached to older ages. Their role is more vital as well in the first (rise in LE) than in the second (decrease in LE) cluster of regions. Therefore, the conclusion is that regions that were the most successful in increasing life expectancy are those characterized by decreased mortality at older ages.

## 5.2 Mortality by causes of death

Before starting to review the cause-of-death situation by region, it is convenient to outline the situation at the national level. Until 2005 Ukraine used the Soviet classification of diseases, which corresponded to the ICD9, and which included 17 broad classes of diseases that led to death. However, only some of them were usually stated as a main cause of death. These are cardiovascular diseases, cancers, digestive diseases, respiratory diseases and infectious diseases. In rare cases the main cause of death claimed was related to metabolic diseases, blood-forming organs, mental disorders, nervous, genitourinary, musculoskeletal system and skin diseases. One should also not lose sight of the fact that in analyzing cause of death data, we are dealing merely with the medical or “stated” cause of death. These data does not give an indication of the behavioural, environmental and/or biological circumstances which lead to death (Brouard and Lopez, 1985).

*Table 5.3* presents the nosological structure of mortality in Ukraine according to categories of disease classification. Two columns distinguish the shares of groups of causes, before and after the redistribution of ill-defined causes (method described in Chapter 3.3.3). After redistribution, the main features of such a structure sharpened. In a few words, one may characterize it as a mixed type in which both endogenous and exogenous diseases play their roles. One may see that mortality due to chronic diseases greatly prevails while at the same time mortality from infectious diseases still remains. In general, the first three places in the hierarchy of causes of death are occupied by 1) diseases of the circulatory system (65%), 2) neoplasms (12.7%), and 3) external causes of mortality (10%).

The distribution of regions according to mortality from the primary three killers is given in *Figure 5.6*.

Diseases of the circulatory system are the single biggest killer in Ukraine. Whereas Central European countries have achieved certain success in reducing mortality from this cause, and therefore have increased life expectancy, in Ukraine this was not the case. Circulatory diseases are an evil for Ukraine people’s health. This problem is the most acute for males in the north (Kyivska oblast) and along the coast of the Black Sea in the south (Odeska, Mykolaivska, and Khersonska oblasts).

While mortality caused by circulatory system is abnormally high, mortality from cancer is strangely low. There are many explanations for this phenomenon. As cancer is considered an old-age disease, Ukrainians might simply die earlier from other causes prior to reaching the age of dying from cancer. Also factors such as a low prevalence of smoking, a high prevalence of breastfeeding, and good nutritional habits may also provide leverage toward reducing the



probability of acquiring neoplasms. It is also true that there is difficulty in accurately diagnosing a cause, given the lack of modern screening equipment in hospitals. The high negative coefficient of correlation between neoplasm and diseases of the circulatory system testifies to the fact that deaths are often wrongly referred to as cardiac arrest (Libanova, 1991).

Interregional patterns of cancer mortality are not wordy. The only regularity is elevated mortality in the South. Specific behaviour is demonstrated by Khmelnytska oblast, which has high SDR from cancer but low SDR from diseases of the circulatory system when compared to its neighbours. At the same time, it has high mortality from “other causes”. Moreover, remembering the discussion in previous chapters, it has a higher than average share of “ill-defined” deaths, and this share is growing over time. Hence, without redistribution of “ill-defined” deaths, mortality from circulatory system diseases would be even lower there. It is difficult to believe that there is some special medical equipment in Khmelnytska oblast that is not common to the remaining regions, or that people follow some special type of behaviour. Most likely there is a different attitude in determining a main cause of death.

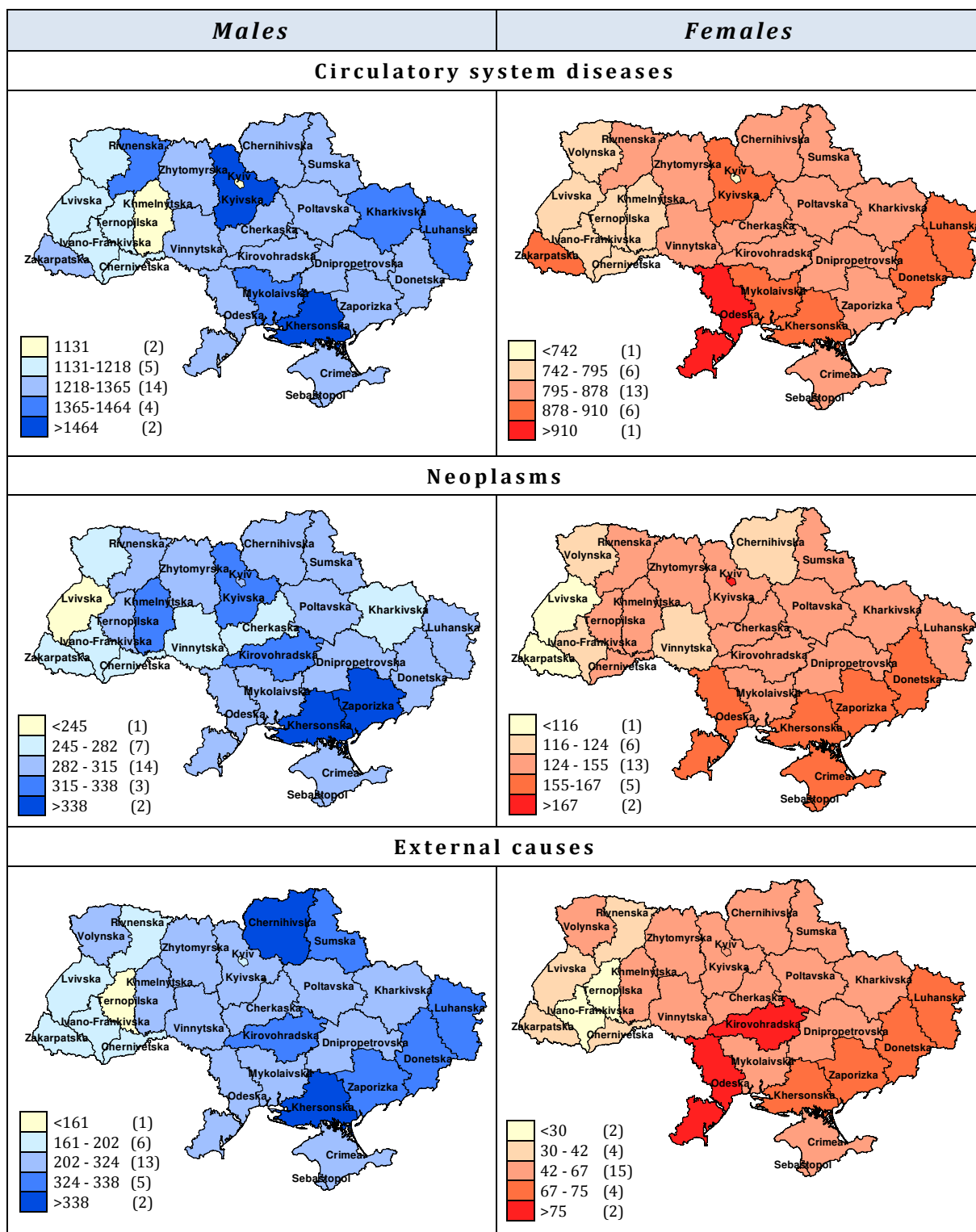
Together, the first two causes form a group of non-communicable diseases, which are characterized by a long time-lag between exposure and manifestation, and usually require life-long observation and treatment.

Table 5.3: Mortality structure by causes of death for total Ukraine, average for 2000-2003

	Group of diseases	% in total ( <i>before redistributing ill-defined</i> )	% in total ( <i>after redistributing ill-defined</i> )
1	Certain infectious and parasitic diseases	1.77	1.81
2	Neoplasms	12.63	12.72
3	Endocrine, nutritional and metabolic diseases	0.48	0.49
4	Diseases of the blood and blood-forming organs	0.06	0.05
5	Mental and behavioural disorders	0.36	0.36
6	Diseases of the nervous system	0.72	0.73
7	Diseases of the circulatory system	61.68	64.99
8	Diseases of the respiratory system	4.41	4.44
9	Diseases of the digestive system	3.07	3.11
10	Diseases of the genitourinary system	0.58	0.58
11	Pregnancy, childbirth and puerperium	0.01	0.01
12	Diseases of the skin	0.09	0.09
13	Diseases of the musculoskeletal system	0.11	0.11
14	Congenital malformations, deformations and chromosomal abnormalities	0.29	0.30
15	Certain conditions originating in the perinatal period	0.22	0.23
16	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	3.69	
17	External causes of morbidity and mortality	9.84	9.99
	Total	100.00	100.00

Source: Author calculation using data of the State Statistics Service of Ukraine

Figure 5.6: SDR for main causes of death in Ukraine regions, average for 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

The third place belongs to external causes of death. It includes all violent and accidental deaths, such as accidental poisoning, falls, drowning, transport and industrial accidents, suicides, homicides, etc. Alcohol plays a particular role in this group and is directly responsible for transport accidents induced by the state of intoxication, alcohol poisoning etc.

Maps for regions testify to one particular characteristic only for this group of causes – the maps are almost identical for men and women. The border of the low mortality zone separates the most western regions from the rest of Ukraine. Historically, the western edge of Zhytomyrska and Khmelnytska oblasts was a border of the Soviet Ukraine.

Especially high mortality is observed in one of the poorest regions: Kirovohradska oblast in the centre; and in the southern regions that border each other: Khersonska, Zaporizka, Donetsk, Luhanska (and in the case of females also Odeska) oblasts.

In the case of males, this is Chernihivska oblast in the north, which has the highest SDR from external causes. This region used to be a leader in male life expectancy in the past, and now it is in the worst situation. As I discussed above, it is working age males (20-60 years) that provoke this backlog. The map helped to ascertain that it is violent mortality that pulls a region down.

When one looks at the map of overall mortality, he/she sees a zone made up of Kyivska, Chernihivska, and Zhytomyrska oblast (*Figure 1.13a*); and it is often argued that these are the Ukraine regions that suffered the most from the Chernobyl catastrophe. However, the causes behind the deaths appear to be significantly different. In Kyivska and Zhytomyrska oblasts, it is mortality from circulatory system diseases that prevails; while in Chernihivska oblast, it is mortality from external causes.

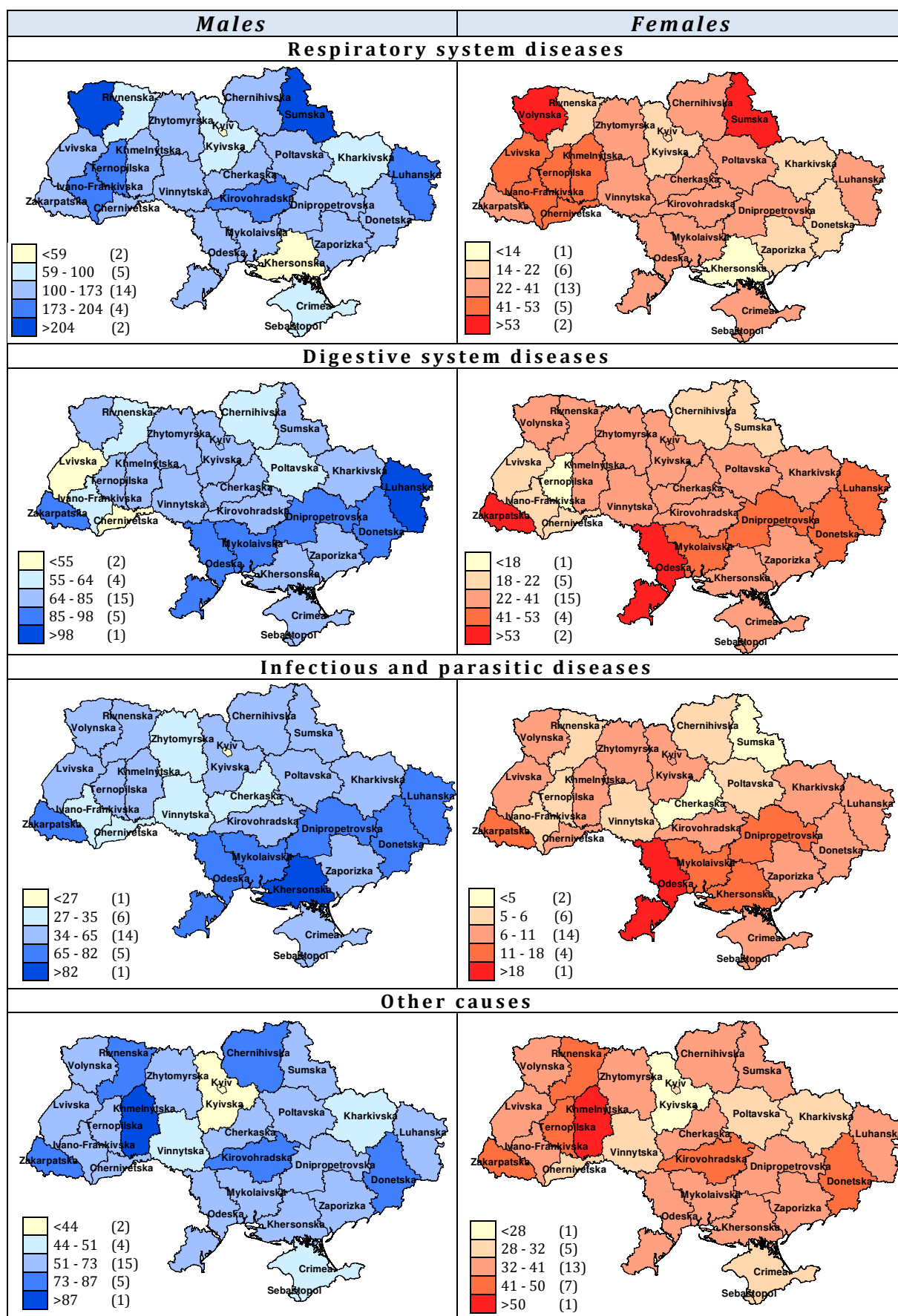
There are also some other classes of diseases that play their roles (*Figure 5.7*).

First, there are respiratory system diseases. This is the only important class of diseases, whose mortality is higher in the north than in the south. Male and female patterns don't differ very much. There are some particular regions with abnormally high SDR (Volynska and Sumyska oblasts), which are found in opposite parts of Ukraine. At the same time, their neighbours (Rivnenska and Kharkivska oblasts) demonstrate low SDR. Therefore, it is difficult to conclude about any regularity.

Next, the spatial profiles of mortality from digestive system diseases and infectious and parasitic diseases are pretty similar in depicting the high risk zone of the south-eastern belt. High SDR are typical also for Zakarpatska oblast in the west.

The remaining diseases (endocrine and metabolic diseases, mental and behavioural disorders, diseases of the nervous system, genitourinary system, musculoskeletal system, skin diseases, congenital malformations, pregnancy and perinatal period complications) were grouped into a category of "other causes" because they have very small shares in total. One may see that there is no pattern in the geography of their spread. As stated, the highest SDR are observed in Khmelnytska oblast, and also in Kirovohradska, Rivnenska, Donetsk oblasts, etc.

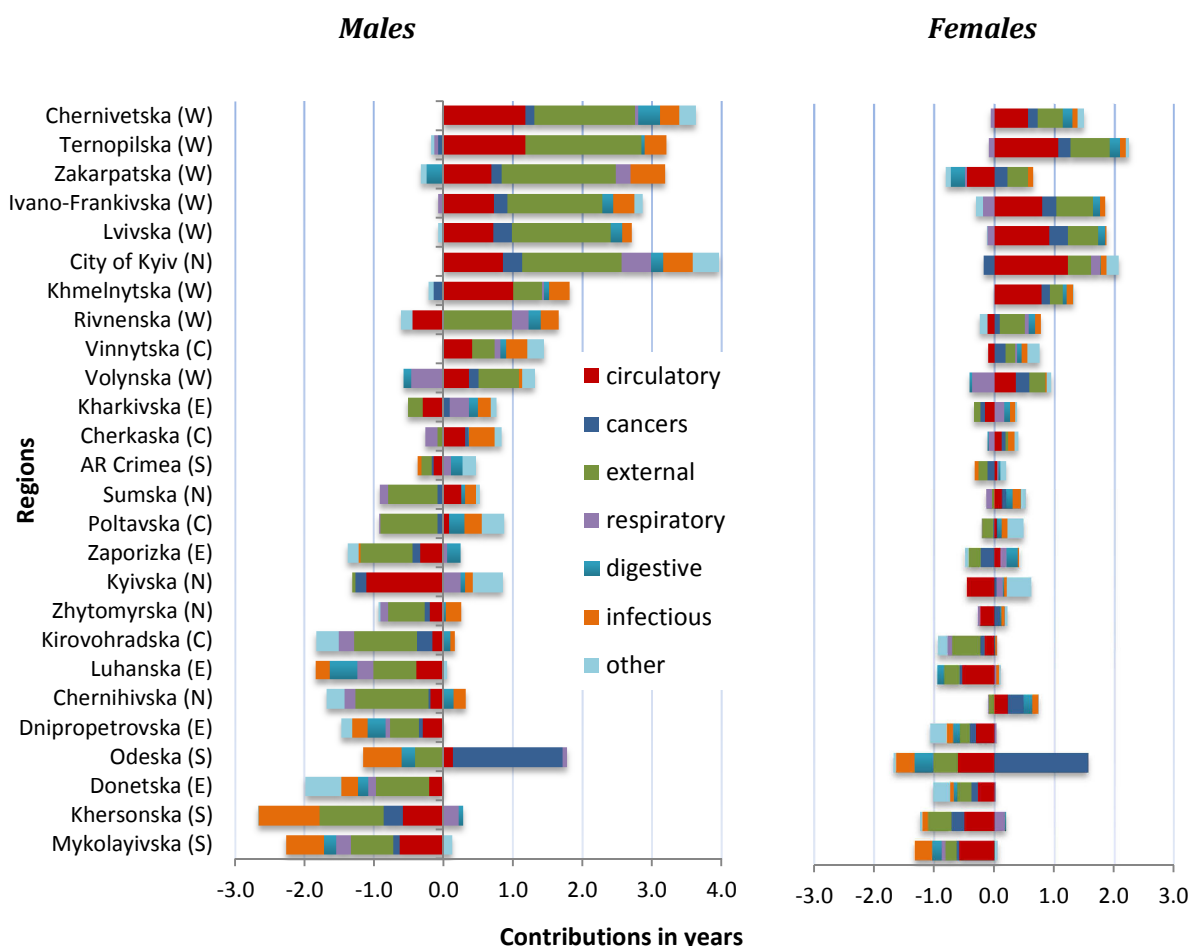
Figure 5.7: SDR for selected groups of causes in Ukraine regions, average for 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

The result of decomposition by causes of death is given in *Figure 5.8*. Contributions of males and females are put on the same scale for the sake of comparison.

Figure 5.8: Contributions of different causes of death to the difference in life expectancy between each region and average for Ukraine, average for 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

In general, two classes of causes that contributed the most to the difference of LE from the average are circulatory system diseases (mostly for females) and external causes (mostly for males). The impact of circulatory system diseases is around one year. The impact of external causes in the case of males may go up to 1.7 years.

As for age groups, the magnitude of positive contributions is larger than that of negative. Cancer did not play a decisive role; it decreased life expectancy by a maximum of 0.27 years, and increased it by 0.26. However, Odeska oblast appeared to be very exceptional and lower than average mortality from cancers here gave an advantage of 1.6 years, both for males and females.

In the case of males, the increase in life expectancy due to reduced cancer mortality was important in some urbanized regions in the west: Lvivska, Ivano-Frankivska oblasts and the city of Kyiv. Negative contributions were not so notable.

Contrary to cancer, the contribution of infectious diseases to the increase in LE was small; however, its contribution to a decrease it was pretty large. The three most affected regions were: Odeska, Khersonska, and Mykolaivska oblasts. Some negative contributions of other causes were apparent in Donetska, Dnipropetrovska, Kirovohradska and Chernihivska oblasts.

In the case of females, the situation was more or less similar. Infectious diseases as well as diseases of the digestive system are visible only for their negative impact. The impact of respiratory system diseases is almost negligible. The only exception is Volynska oblast, where they contribute to a decrease in life expectancy by half of a year (0.58 for males, and 0.37 – for females).

### **5.3 Mortality by age and causes of death**

Mortality at different age groups does not involve the same causes. One may distinguish the main periods of life when the nosological structure of mortality changes. *Figure 5.9* pictures age-specific death rates for the seven main classes of causes. According to patterns, it is possible to distinguish between diseases from which mortality increases exponentially with age, and diseases from which mortality decreases after reaching some peak. The first group is composed of circulatory and respiratory system diseases. Cancer may also be referred to this category, though the increase in mortality slows down at a very old age.

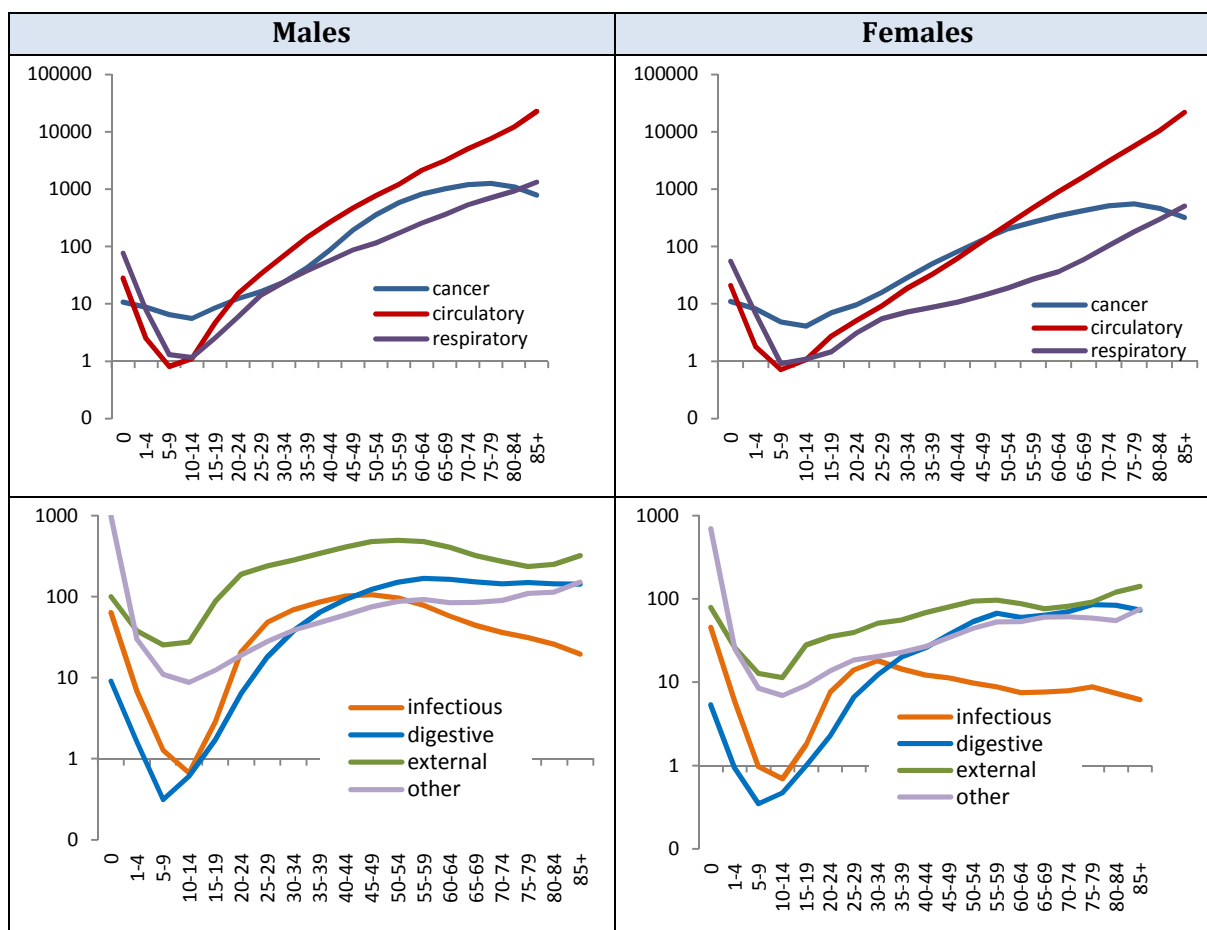
The second group includes patterns when mortality rates reach their maximum at working age. For different causes, this peak may happen earlier (infectious and parasitic diseases) or later (diseases of digestive system, external causes). Patterns are also different for males and females. Because of this, there are several points of intersection of cause-specific mortality curves along the age span when certain pathologies start to prevail and mortality structure changes.

Changes in the nosological profile across the age span are more or less similar for regions, although, with some small differences (*see Annex P*). First, regions may be classified into two groups: those that have low and that have high mortality from external causes. Those with low mortality from external causes have low SDR along the entire age span. However, those with high SDR have their curves double peaked: the first peak is observed at around 20-25 years of age; and a second peak occurs somewhere around age 50-55 years.

The second difference is that infectious diseases are more important for some regions than for others. This is usually the case of males and of working age. However, for some southern regions (Odeska and Mykolaivska oblasts), the maximum SDR from infectious diseases are observed even younger, at age 25-30 years, with a consequent sharp decline.

Lastly, regions may be distinguished by the patterns of cancers and of respiratory system diseases. In some cases, respiratory system diseases prevail largely over cancers at old age (80-84 years), and in others they never surpass. The last group is less numerous (AR Crimea, Donetsk, Zaporizka, Kyivska, Mykolaivska, Khersonska oblasts and the city of Kyiv). Such dynamics occurred here because respiratory mortality is low, while cancer mortality is still high in these regions.

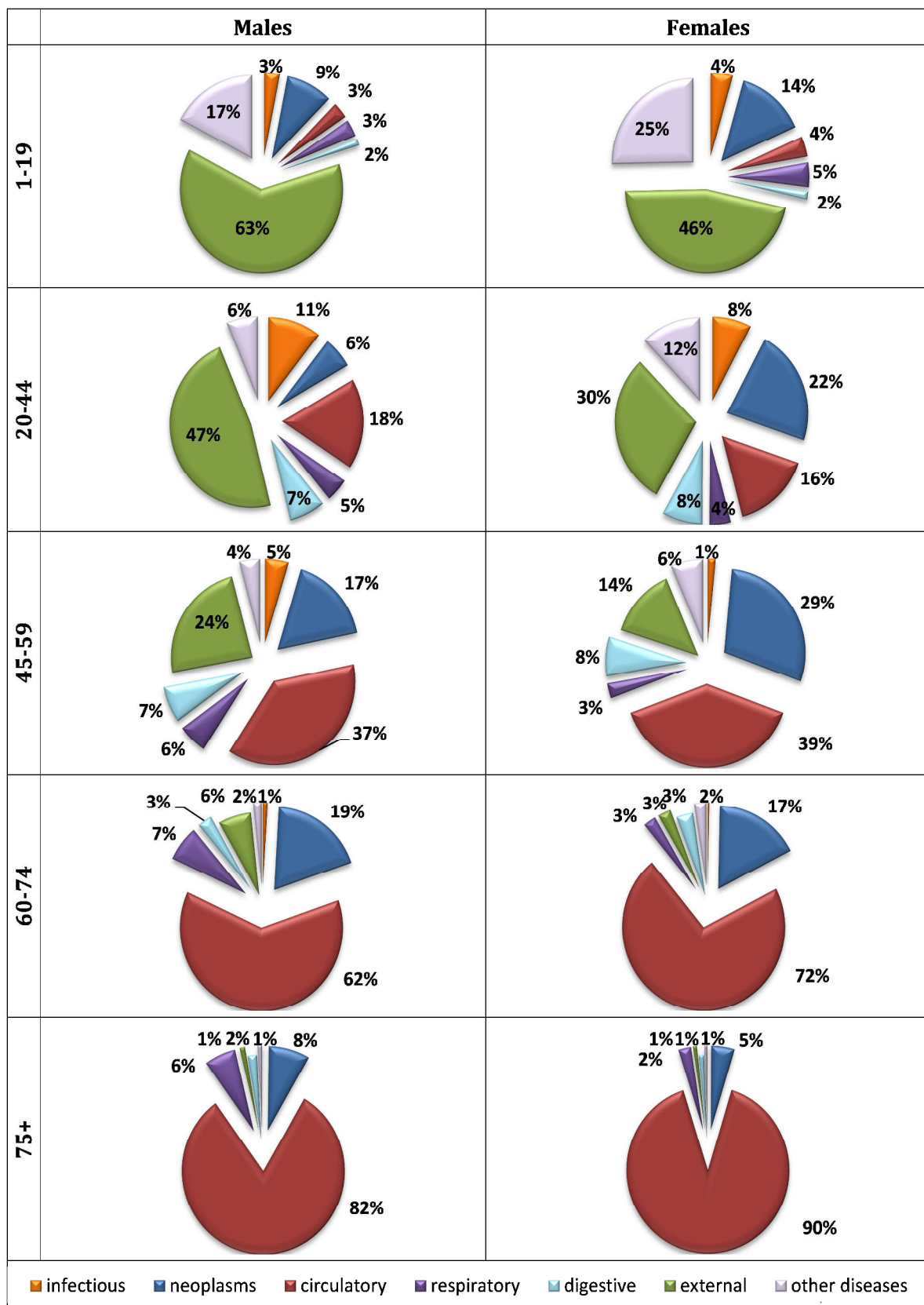
Figure 5.9: Age-specific death rates from main causes of death, for total Ukraine, average for 2000-2003 (circulatory system diseases – second axis)



Source: Author calculation using data of the State Statistics Service of Ukraine

The diagram in the *Figure 5.10* proposes a distribution of causes according to SDR for different age intervals, determined by the principal component analysis in the previous sub-chapter. It represents five age groups, but not infants, as certain conditions originating in the perinatal period are separated into a separate class, which in my regrouping belongs to “other causes”.

Figure 5.10: Mortality structure according to SDR from different causes of death for selected age groups, for males and females, total Ukraine, average for 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

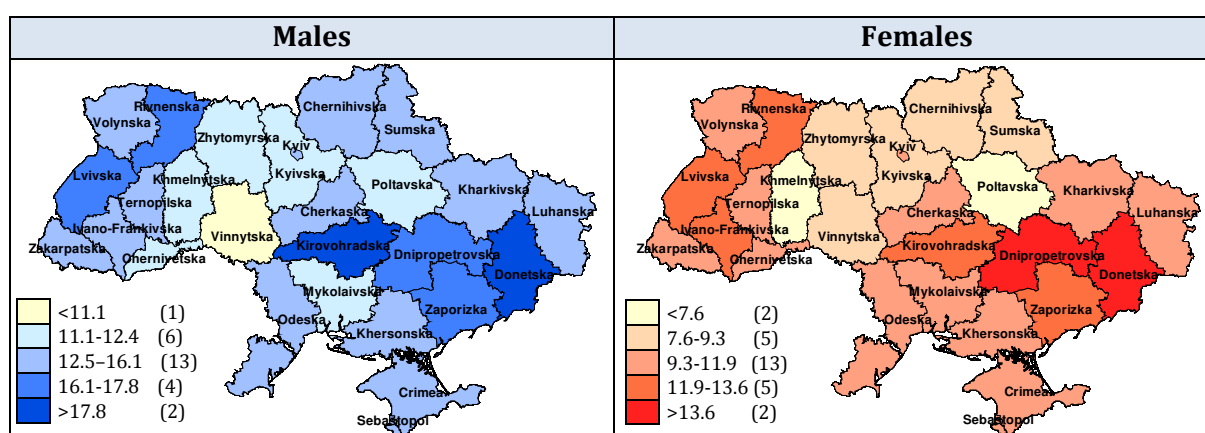


Below I will review the characteristics of these main age groups while referring to the geography of causes of death.

### 5.3.1 Infant mortality

Figure 5.11 presents the infant mortality rate in 2000-2003 for males and females, already corrected for underregistration. The corresponding figures at the national level for males and females were 15 and 11 deaths per 1000 live births, with a coefficient of interregional variation for both sexes of around 16% - 17%. The spatial pattern of IMR for males and females was almost the same: high death rates in particular regions in the east as well as in the west. Namely, these are Kirovohradska (centre), Dnipropetrovska, Donetsk, Zaporizka (east), Rivnenska, Lvivska, Ternopilska and Ivano-Frankivska (west) oblasts.

Figure 5.11: Infant mortality rate for males and females, Ukraine, 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine with correction for underregistration

In each region, IMR was higher for males than for females. However, when comparing them altogether, the highest rates for females were higher than the lowest for males. The highest rates were observed in Donetsk oblast (18.6 per 1000 live births for males and 14.0 per 1000 for females). The lowest rates were 11.0 per 1000 in Vinnytska oblast for males, and 7.4 per 1000 in Khmelnytska oblast for females. One may see that in the case of females the most disadvantageous region has an IMR that is almost double of the most advantageous. All this is a sign that there is room for improving infant survival in regions.

In general, these maps are different from those observed for life expectancy at birth, indicating that the mortality of newborns does not play a crucial role in defining the level of life expectancy in Ukraine.

Referring to causes of death and in particular to the most important etiologies, we should clarify these territorial differences. To select causes which play the most important role in infant

mortality, I simply sorted them according to the absolute number of deaths in descending order and chose those that appear on the top. Roughly, these were nine different causes that account for more than 500 infant deaths in all of Ukraine for the aggregated period. They ranked from 602 deaths from “other acute pneumonias” to almost 2800 deaths from “other conditions originating in perinatal period”. Among these eight, there was also a group of “symptoms and other unspecified conditions” that accounted for 913 deaths. As it was still the old revision of Classification of diseases, sudden infant death syndrome was included in this group together with other unclassified deaths; therefore, I distributed this group proportionally among other causes.

Most of the causes selected belong to classes XIV and XV, which join causes originating in the perinatal period and different congenital malformations. However, there is also an important number of accidental deaths at the infant age that belong to the class of external causes. Some of the causes selected were close in describing the origin of cause, so I put them together to insure a larger number of deaths: in this way, I united congenital heart anomalies (147) with other congenital anomalies (150) and also combined diseases of the respiratory system, codes 153, 154 and 107 (*Table 5.4* and also *Annex O: Table 2, Figure 2 – by regions*).

Table 5.4: Mortality rate at age 0, per 100 000 of standard population, Ukraine, 2000-2003

Categories and code in classification	Class of causes	Mortality rate at age 0 per 100 000 of standard population		Coefficient of variation (%)	
		males	females	males	females
Congenital heart anomalies and other congenital anomalies (147+150)	Congenital malformations	327	255	21.0	18.6
Congenital pneumonia + pneumonia due to respiration and other respiratory conditions + other acute pneumonias (153+154+107)	Certain conditions originating in the perinatal period / Diseases of the respiratory system	305	210	33.3	35.7
Other conditions originating in the perinatal period (157)	Certain conditions originating in perinatal period	225	150	49.9	49.3
Intrauterine hypoxia and birth asphyxia (152)		70	44	68.2	88.7
Accidental inhalation and ingestion causing obstruction of respiratory tract, foreign body entering other orifices (169)	External causes of morbidity and mortality	69	49	45.6	62.8

Source: Author calculation using data of the State Statistics Service of Ukraine with correction for underregistration

Congenital heart anomalies and other congenital anomalies were the most important group, followed by diseases of the respiratory system. The maximum IMR from these causes was observed for males in Luhanska oblast, and for females in Donetska oblast. Zaporizka,

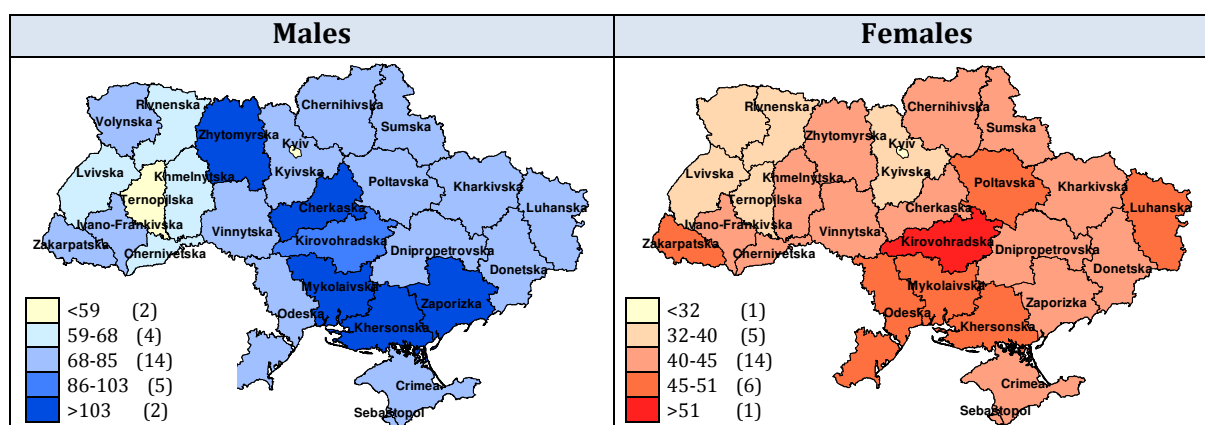
Dnipropetrovska, and Kharkivska oblasts had IMRs that were not significantly lower than their more eastern neighbours, who altogether formed a zone of high infant mortality that contrasts with the western part, where there were no visible differences from the average. However, western regions are noticeable when we deal with accidental inhalation, particularly in Lvivska and Ternopil'ska oblasts.

### 5.3.2 Mortality at age 1-19 years

The next group includes those deaths that happened before reaching age 20 years. At this point death rates are at their minimum (if not to consider infant mortality). In 2000-2003, SDR for males from all causes was 78 per 100 000 of the standard population and 42 for females. The indicator for interregional variation was almost the same as for infant mortality: 17% for males and 13% for females.

As for causes of death, recently grown up boys and girls were dying mainly from external risks (63 and 46% correspondingly), cancers (9 and 14%), and other causes (17 and 25%) that include the remaining 11 classes not used in the analysis (*Figure 5.10*). Such a significant role of various diseases regrouped into "other causes" is particular only for very young ages. As a person grows older, other etiologies take the lead. The most important category in "other causes" was "other diseases of the nervous system and sense organs". This is a "residual" category, which includes all the remaining illnesses of the class of nervous system diseases, but not meningitis, sclerosis, epilepsy and inflammatory diseases, which are treated separately.

Figure 5.12: SDR for age group 1-19 years from all causes, Ukraine, average for 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

To choose the leading causes of deaths at age 1-19, I again sorted diseases according to the number of deaths and selected the top ten whose number of deaths is more (or around) than 1000 for Ukraine as a whole. They are listed in *Table 5.5*. External causes play the leading role in

mortality structure at young ages. The SDR for males is higher than for females at this age as well as at other ages.

Among external causes, the most important category is transport accidents, which may be the result of an increased number of cars in the population. This category includes three types of transport accidents: “motor vehicle traffic accident”, “motor vehicle traffic accident involving collision with pedestrians”, and “other transport accidents”. This young age is different from very old ages (when up to 60% of transport accident deaths happen to pedestrians), in that both categories (involving and not involving pedestrians) are balanced. The territorial distribution of death rates from transport accidents is rather even; the variation is relatively low (around 20%). Regions with the highest SDR from transport accidents are found mostly in the south of Ukraine: the maximum for men is observed in Khersonska oblast (15.8) and for women in Zaporizka oblast (5.8). Another feature is that the rate for men (11.1) is double that for women (5.4).

Table 5.5: SDR for 1-19 years, per 100 000 of standard population, Ukraine, 2000-2003<sup>12</sup>

Categories and code in classification	Class of causes	SDR at age 1-19 per 100 000 of standard population		Coefficient of variation (%)	
		males	females	Males	Females
Transport accidents (160-162)	External causes	11.1	5.4	21.2	23.1
Accidental drowning (168)		8.1	2.6	25.3	32.5
Suicide (173)		7.1	1.6	44.4	55.5
Injury undetermined (175)		4.6	1.9	81.9	91.9
Other diseases of the nervous system (83)	Nervous system	4.2	2.6	43.5	55.1
Accidents caused by electrical current (171)	External causes	3.7	0.5	43.8	54.8
Other accidents (172)		3.7	1.3	38.0	50.3
Accidental poisoning (173-174)		3.1	2.3	47.4	48.2
Homicide (174)		3.0	2.1	45.8	54.0
Leukemia (65)	Neoplasms	2.0	1.6	27.6	34.7

Source: Author calculation using data of the State Statistics Service of Ukraine

The second highest SDR from external causes was from drowning (8.1 for males and 2.6 for females). Extreme values among oblasts (around 10-12 for males) were observed in regions situated on the shore of the Black sea (Mykolaivska, Khersonska oblasts and AR Crimea), hence identifying insufficient safety measures undertaken at the coastline. Similarly high values from accidental drowning for males as for females were observed in Chernihivska oblast in the north,

<sup>12</sup> to see the same indicator but for all regions refer to Annex 0, Table 3 and Figure 3

where the river Desna flows. The river is popular for kayak-paddling, which could be a cause of high accidental mortality.

And the third important killer of children and teenagers was suicides. The suicide rate of young boys and girls was the highest in Kirovohradska oblast (11.9 and 3.3 for males and females), one of the poorest regions in the centre of Ukraine, and was also high in Sumska oblast (11.7 and 3.0 for males and females). The lowest rates were observed in Kyiv (0.9 and 0.1 for males and females). No female suicides at this age were registered in Rivnenska oblast in the west of Ukraine.

There are also other external factors that are no less important than the above-mentioned ones. These are: accidents that happen with electrical current, accidental poisonings, undetermined injuries, homicides, etc.

Already at this age, children are dying from cancers; girls more than boys. The main type of child cancer is leukemia, which takes approximately 2 young lives from every 100 000 of the standard population.

### **5.3.3 Mortality at age 20-44 years**

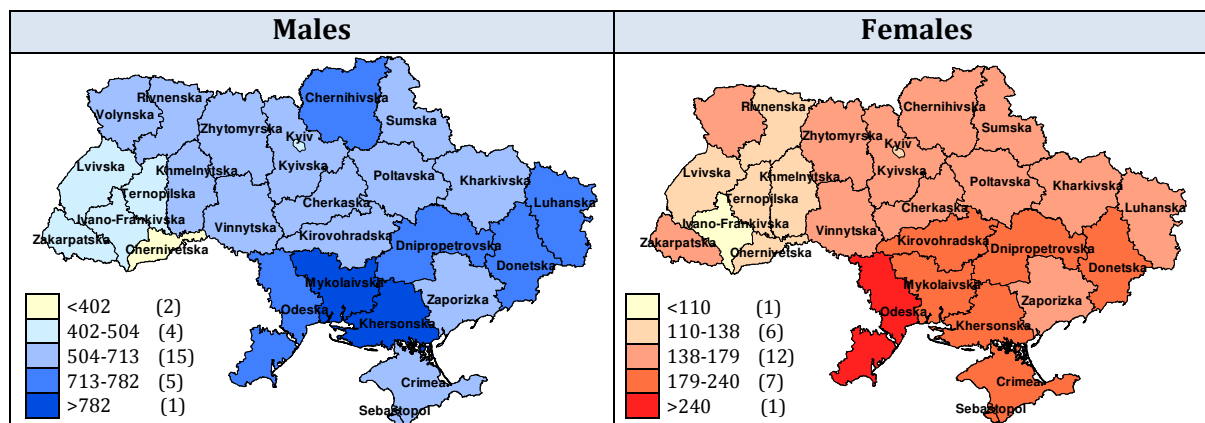
At the turn of twenty years, a person passes through the period of life during which he or she has to assume important modification of his/her behaviour and of his/her habits. It is also the age when a person easily takes more different risks (Casselli and Egidi, 1988). The general SDR for this age group in Ukraine sharply increases when comparing to the previous age group: from 79 to 609 deaths per 100 000 of the standard population for males, and from 43 to 179 for females. The coefficient of variation of SDR increases as well, reaching its maximum at this age when comparing to other ages, and it equals around 22% for males and for females.

At the same time, geography acquires its clear patterns (*Figure 5.13*). It is no longer separate regions that suffer some surplus of mortality compared to the general level, but geographic zones with certain regularities are visible now. One may see an evident zone of high risk in the south-east, and a zone of favourable zone in the west. At this point Chernihivska oblast starts to give alarming signs concerning male mortality. For female mortality, the same is true in Odeska oblast.

In regard to causes of death, it is still external causes that take the first place (47% and 30% for males and females, respectively) at this age (*Figure 5.10*), followed by circulatory system diseases (18% and 16%). Another feature is that cancer loses its relative importance for males (from 9% to 6%) but gains it for females (from 14% to 22%) when comparing to the previous

age group. And finally, this period of life is the most amenable to infectious diseases (11% and 8% for males and females).

Figure 5.13: SDR for age group 20-44 years for males and females, Ukraine, 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

The category of people aged 20-44 years constitutes a crucially important social class. It is the most economically active cohort represented by young people who have just graduated from the universities or professional colleges; it is a working population of taxpayers, employees and employers, managers, etc. These people are parents who raise their children and who at the same time support the generation of grand-parents.

Again, as for previous age groups I selected the most important etiologies: categories that have more than 10 000 deaths for total Ukraine. In *Table 5.6* one may find the SDR for leading causes of Ukrainian deaths for ages 20-44 years, sorted in descending order. The sorting is done according to male mortality.

The obtained result is striking. The first important cause responsible for most adult male deaths in Ukraine was suicides. More men have been departing life voluntarily (55.0 per 100 000) than those dying from ischaemic heart disease (55.4 per 100 000). And looking at the interregional profile, it appears that the maximum was observed not in the eastern regions but in Chernihivska oblast in the north (89.9 per 100 000), the one that started to suffer abnormally high mortality only recently. Similarly high suicides rates for adults as well as for younger ages are typical also for Sumska and Kirovohradska oblasts (88 and 82 per 100 000). The lowest SDR from suicides is observed in the city of Kyiv: 5.3 deaths per 100 000, which is 17 times lower than in Chernihivska oblast. Besides the city of Kyiv, all of the western regions (particularly Lvivska, Chernivetska, Ternopilska oblasts, etc.) are found on the other side of the spectrum, with very low suicide death rates.

In the case of females, suicides occupy the fifth position in the mortality hierarchy. The highest rate is observed in Kirovohradska oblast as well (12.8 deaths per 100 000), but also in three

southern regions on the Black see: Khersonska (12.2), Odeska (10.2) and Mykolaivska (10.0) oblasts.

Table 5.6: SDR for 20-44 years, per 100 000 of standard population, Ukraine, 2000-2003<sup>13</sup>

Categories and code in classification	Class of causes	SDR at age 20-44 per 100 000 of standard population		Coefficient of variation (%)	
		males	females	males	Females
Suicide (173)	External causes	55.0	7.2	38.9	44.8
Ischaemic heart disease (90-95)	Circulatory system diseases	54.4	9.6	41.8	53.3
Tuberculosis (9-13)	Infectious diseases	52.4	7.6	53.3	55.4
Injury undetermined whether accidentally or purposely inflicted (175)	External causes	41.8	8.0	72.9	75.6
Accidental poisoning by alcohol (163)		36.2	6.0	48.6	55.5
Other heart diseases (97)	Circulatory system diseases	30.4	7.2	53.0	59.4
Cirrhosis of liver (122+123)	Digestive system diseases	27.7	9.2	36.0	46.1
Homicides (174)	External causes	26.2	7.4	46.1	43.8
Other accidents (172)		25.1	3.9	37.9	53.9
Pneumonia (105-107)	Respiratory diseases	19.6	4.6	45.2	64.9

Source: Author calculation using data of the State Statistics Service of Ukraine

The most important cause of female mortality is ischaemic heart disease. For men it comes in the second place. However, the geography of mortality from this cause is identical for males and females in three zones of localization: 1) Kyivska oblast (123 and 22) and Kyiv (101 and 24 for males and females); 2) Donetska (67 and 13) and Dnipropetrovska (64 and 12) oblasts in the east; and 3) Rivnenska (78 and 11) oblast in the north-west.

As mentioned above (*Figure 5.9*), at this age the curve of death rates from infectious and parasitic diseases passes through its maximum. In particular, the most common infectious disease that leads to death is tuberculosis. Its alarming importance concerns more males than females, and especially those in prisons where it is spread (Levchuk, 2011). The problem is acute in the south of Ukraine: SDR for males in Khersonska oblast (142) is almost seven times higher than SDR in Kyiv (21). Female tuberculosis mortality also has its particular localization in Odeska oblast. The SDR here (15) is way above the minimum in Cherkaska oblast (2), and it is this cause of death that makes Odeska oblast so visible on the map.

<sup>13</sup> For SDR for all regions refer to *Annex 0, Table 4, Figure 4*

Hence, the three main important killers at this age are: suicide, ischaemic heart disease and tuberculosis, all of which belong to different classes and have a different genesis. However, most causes that come next in the hierarchy and that kill the lion's share of working age men belong to the class of violent causes. Namely they are: accidental poisoning by alcohol, homicides, and injuries undetermined (whether they be accidentally or purposely inflicted) and other accidents. Together 130 men per 100 000 of population die on average in Ukraine from this group of causes.

These causes are not the same in their spatial predominance. Alcohol poisoning prevails in the north (Poltavska, Sumska and Chernihivska oblasts); the leader in homicides is Donetska oblast; while injuries undetermined (whether accidentally or purposely inflicted) are at their maximum for some reason in Kyiv and its region. For the last cause, the coefficient of variation is very high, at 67%, and the values rank from 2 in Zakarpatska oblast to 106 deaths per 100 000 of population in the city of Kyiv. The same regularity for Kyiv is observed in the remaining age groups, which will be shown next.

Among respiratory system diseases, the most common was pneumonia: the average SDR was 20 and 5 cases per 100 000 (for males and females respectively), with the maximum in the most industrial regions of Donetska (36 and 9), Mykolaivska (34 and 13), and Dnipropetrovska (29 and 8) oblasts.

Among digestive system diseases, the most common was cirrhosis of the liver, which includes "alcoholic cirrhosis of the liver" and "other cirrhosis of the liver". Alcoholic cirrhosis of the liver on average comprises 25% of all liver cirrhosis at this age, ranging from 8-10% in Volynska and Ternopil'ska oblasts to 50% in Luhanska. However, there is a tentative issue of registering liver cirrhosis as alcoholic. Very often patients prefer to avoid the word "alcoholic" in diagnosis (Skrypnyk, 2007) to prevent problems with their employers. This could probably affect also mortality statistics as well. The average SDR from all cirrhosis was 28 and 9 cases per 100 000 (for males and females respectively), with the maximum in the south-east – oblast of Dnipropetrovska (47 and 15 per 100 000 for males and females), Luhanska (47 and 13 per 100 000 for males and females) and Odeska (43 and 20 per 100 000 for males and females).

The last among the most important killers and that will be reviewed more in detail in the next age group is cancer. At this point, age-specific death rates begin a path that will turn into an exponential curve. For males the biggest concern is lung cancer, while for females it is cancers of the genital organs and of the breast. Breast cancer occupies second place after ischaemic heart disease in the female hierarchy of causes. Average SDR for Ukraine was 8.3 deaths per 100 000, and there were no spatial patterns in the distribution of rates over the territory observed.

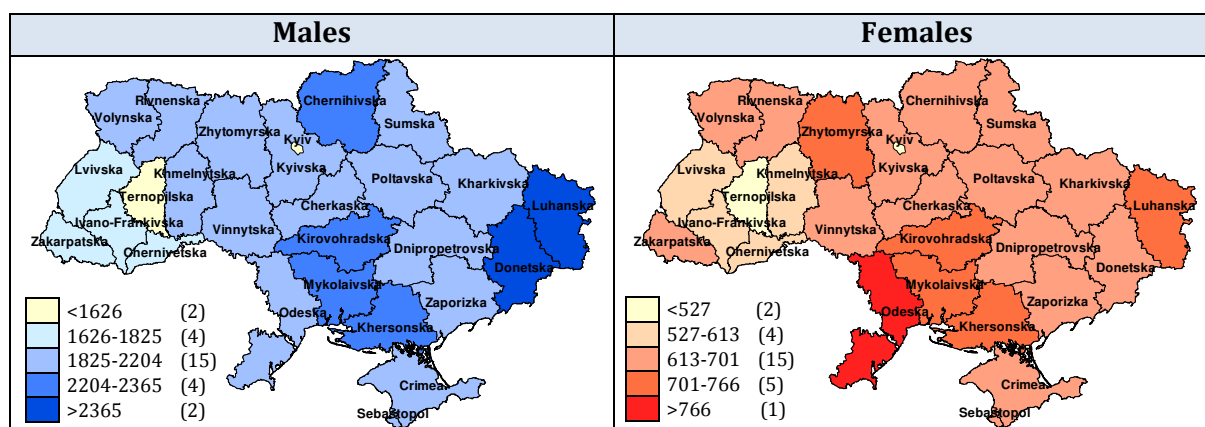


Finally the problem that should not be ignored is drug abuse. The situation was particularly alarming in Chernihivska oblast, where SDR for males reached 20 deaths per 100 000, which was at the level of Ukraine's pneumonia mortality (21). Chernihivska oblast demonstrated extreme values for males as well as for females. The lethality of young women there was 4.3 deaths per 100 000. Narcomania in Chernihivska oblast may explain a high suicide rate.

### 5.3.4 Mortality at age 45-59 years

The given age group includes individuals of pre-retirement age and those already retired (the retirement age in Ukraine in 2001 was 55 years for females and 60 years for males). General SDRs for this age group increase considerably in comparison to the previous age group: in particular for females it increases 4 times (from 179 to 654 deaths per 100 000), though it is still much lower than the level of males (increased from 609 to 2005 per 100 000). The territorial variation of SDR from all causes at the same time decreased from 22 to 12%. The geographical relief remains practically unchanged: regions in the south along the coastline together with Donetska and Luhanska oblasts continue to form a zone characterized by overmortality in comparison to the remaining regions (*Figure 5.14*). At this point some other oblasts with death rates exceeding the average level emerge (for instance, Luhanska oblast in the case of males).

Figure 5.14: SDR for age group 45-59 years for males and females, Ukraine, 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

As for nosological structure, it has also changed a bit. Violent deaths lose their primary role and become responsible for 24% of male and 14% of female deaths (*Figure 5.10*). Cancers go into force and take 17% of male and 29% - of female deaths. Another killer that raises its head is circulatory system diseases, which account for 37% of male and 39% of females deaths.

The selected top killers that account for more than 10 000 deaths in the Ukraine total are in the *Table 5.7*. At this point mortality from circulatory system diseases is dominant and is evenly

important in the cause-of-death hierarchy for males and females: ischaemic heart disease comes in first place and cerebrovascular diseases come next. The remaining heart diseases appear in fifth place, after cancers.

The coefficient of territorial variation of SDR from circulatory system diseases is similar for two sexes and is around 20%. The only difference is that the levels of male are much higher than for females: almost four times higher for ischaemic heart disease, and two times higher for cerebrovascular diseases. The geography of these two largest groups of circulatory system diseases is different: while maximum SDRs from ischaemic heart disease are observed in and around the capital Kyiv (722 and 203 deaths per 100 000 for males and females), the zone of high SDR from cerebrovascular diseases stretches along the eastern border with Russia, and is also in the south. The highest SDR for males was in Luhanska oblast (212) and for females in Khersonska (121) and Odeska (115) oblasts.

Table 5.7: SDR for 45-59 years, per 100 000 of standard population, Ukraine, 2000-2003<sup>14</sup>

Categories and code in classification	Class of causes	SDR at age 45-59 per 100 000 of standard population		Coefficient of variation (%)	
		males	females	males	Females
Ischaemic heart disease (90-95)	Circulatory system diseases	462.5	126.2	23.9	20.9
Cerebrovascular diseases (86-89, 98, 99)	Circulatory system diseases	165.4	85.3	17.7	22.7
Malignant neoplasm of digestive organs (45-51)	Neoplasms	146.4	50.1	11.5	11.1
Malignant neoplasm of respiratory organs (52-54)	Neoplasms	119.6	10.9	13.7	20.8
Other heart diseases (84-85, 96-97)	Circulatory system diseases	110.0	35.9	48.4	41.1
Cirrhosis of the liver (122+123)	Digestive system diseases	98.9	36.7	29.7	36.1
Accidental poisoning by alcohol (163)	External causes	91.7	20.1	52.5	54.6
Tuberculosis (9-13)	Infectious diseases	88.4	7.8	37.4	49.4
Suicides (173)	External causes	80.6	11.2	35.5	36.6
Undetermined injury (175)		75.4	13.4	69.6	70.7
Pneumonia (105-107)	Respiratory diseases	53.4	7.7	43.3	44.1
Transport accidents (160-162)	External causes	37.5	8.7	17.8	21.6
Homicides (174)		28.4	8.8	49.0	37.4

Source: Author calculation using data of the State Statistics Service of Ukraine

<sup>14</sup> For SDR for all regions refer to the Annex 0, Table 5, Figure 5

Another cause that weights a lot in mortality at this age is neoplasms. The type of cancer that was mentioned in the previous sub-chapter and continues to have significance is cancer of the digestive organs. The particular disease hitting digestive organs at this age is stomach cancer. Cancer patterns of digestive system organs for males and females are completely different. The male cancer mortality reveals a clear opposition between the west and east, with the highest death rates in the north-west, which is not typical for other causes. The maximum SDRs from neoplasms of digestive system organs were observed for males in Vinnytska (179) and Chernihivska (176) oblasts. For females there was no continuous pattern observed: the maximum is seen in Odeska oblast (165) and the minimum in Ternopil'ska oblast (40).

Not less important is cancer of the respiratory system organs, among which lung cancer is foremost. The excess mortality was detected in two regions in the centre – Kirovohrad'ska oblast (153 and 12), and Poltav'ska oblast (122 and 14 deaths per 100 000 population for males and females).

After diseases of the circulatory system and cancers, the most lethal at this age is cirrhosis of the liver, which belongs to diseases of digestive system. The most male liver cirrhosis were observed in Luhanska oblast (195 per 100 000); this indicator is higher than the average male SDR for circulatory system diseases (165 per 100 000). The problem is acute and particular in this region because it is the only region where the share of alcohol-induced cirrhosis in all cirrhosis of the liver reaches 50% for males and 40% for females (the average proportion is around 20%). The same observation was noted for the previous age group.

An even higher share (surpassing 50% for both sexes) of alcohol-induced cirrhosis was observed in Zakarpatska oblast, which otherwise has moderate SDRs (83 and 67 deaths per 100 000 for males and females). In the case of this region, there is suspiciously high female mortality from this cause (67 in comparison to 37 on average). It is interesting that while Luhanska oblast is the most eastern region in Ukraine, having 75% of its borders common with the Russian Federation, Zakarpatska oblast – is the most western region and isolated from the rest of Ukraine by the Carpathian mountains; the two regions are found at the opposite edges of the country and yet both have the highest share of alcoholic cirrhosis of the liver. Such a disparity is also confirmed by the abnormally high coefficient of variation for this cause of death: 96% for males and 107% for females. Such an important coefficient of variation is a sign that there is a high concentration of a declared problem in certain circumscribed zones of a country (Caselli and Egidi, 1988).

SDRs for “accidental poisoning by alcohol” were around the same level as SDRs for “cirrhosis of the liver”, though they were different in their spatial distribution. It was difficult to detect any pattern, however. What is clear is that the contrast is produced between western regions (where

SDRs are below the mark of 65 and 15 deaths, respectively, per 100 000 males and females) and some particular regions with extreme values. The latter is represented by Chernihivska (182 and 28) and Poltavaska (165 and 38) oblasts. The figures demonstrate that Poltavaska oblast is performing badly in the case of both males and females, while in Chernihivska oblast the problem is acute only for males. The indicator in Chernihivska oblast for males is five times that of those men dying in traffic accidents on average, though traffic accidents are more difficult to avoid than accidental poisoning.

It was also interesting to figure out how “alcohol” mortality intersects with other causes of death, whether there is any link with transport accidents that could be induced by alcohol consumption or something else. Therefore, I calculated the matrix of Pearson coefficients. Though in the end I did not come up with any commonsensical conclusions for transport accidents (that do not correlate with any cause), there were some few observations made. The strongest correlation coefficient of “accidental poisoning by alcohol” was observed with “suicides” (77% for males and 68% for females, and they are both significant). I did the same calculation for the previous age group, 20-44 years, and received similar results - unintentional self-harm such as poisoning by alcohol and intentional self-harm such as suicide are strongly related (68% for males and 74% for females). A given coefficient is higher only for the pair “alcohol poisoning” and “homicides”; and this type of relationship is typical only for women (72% and 78% for two age groups) but not for men. It means that women often become victims of homicides in the same places where they may die also from the bad quality or overdose of alcohol. When correlating female homicides with male alcohol poisoning, the coefficient of correlation is still high, at 60%, which is significant. It means that there is domestic violence in Ukraine, especially in places where men are used to excessive alcohol consumption.

For males, “homicides” correlate the most with tuberculosis, pneumonia, heart attack and other accidents, which could be probably due to the fact that they happen in prisons or places of social deprivation.

Concerning infectious diseases the figures clearly show that mortality from tuberculosis largely shapes patterns on the map. The highest SDR for males was observed in Khersonska (203), Luhanska (125), and Donetsk (118) oblasts; and the highest SDR for females was observed in Khersonska (20) and Odeska (16) oblasts. The epidemic of pneumonia, though, is not at its maximum in the very same oblasts, but is still spread throughout the east, bringing the south-eastern regions into the continuous belt of high-risk zone.

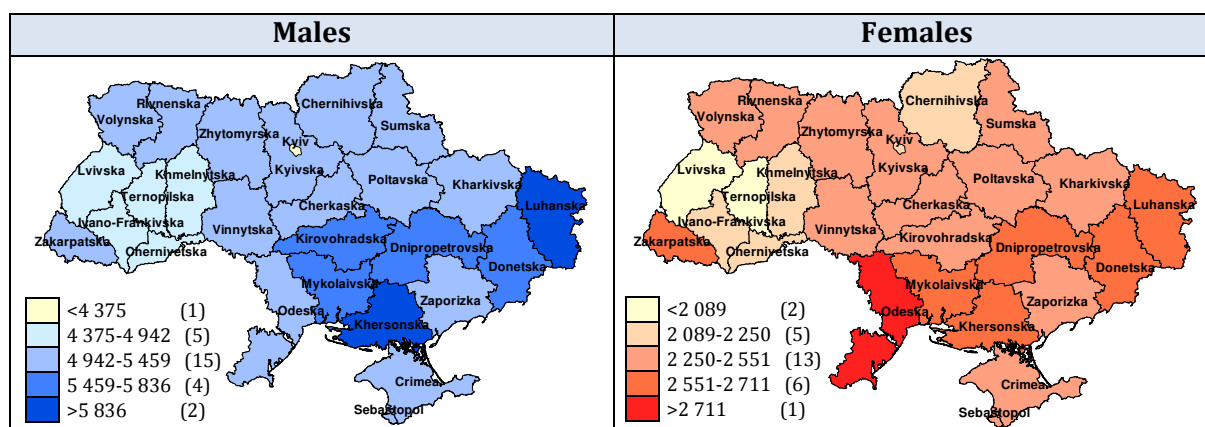
Therefore the predominant mortality at this age is from circulatory system diseases. The SDRs are high in general, and they are evenly high in every region (with the exception of Kyiv region). The second important killer in this age group is cancer. However, it does not shape the map

because there is no regularity in the spread of SDR from cancer. The causes that have some pronounced geography are infectious diseases (spread in south-east) and external causes (spread in the north-east). Mortality patterns from different causes overlap with each other to produce a map on which the well-performing west opposes the rest of Ukraine.

### 5.3.5 Mortality at age 60-74 years

Mortality at age 60-74 approaches patterns that are typical for old age: this is where death rates from neoplasms reach their maximum. The share of cancer accounts for 19% for males and 17% for females (Figure 5.9). Nevertheless, diseases of the circulatory system are the most important ones (shares are 62% for males and 72% for females). Together, these two classes account for 80-90% of all deaths at this age, leaving some room for respiratory diseases, external causes and the rest. The SDRs from all causes increase considerably for this age group in comparison to the previous one increase, even more so for women (3.8 times) than for men (2.7 times). To be more precise, SDR for males increases from 2005 to 5325, and SDR for females increases from 654 to 2464 deaths per 100 000.

Figure 5.15: SDR for age group 60-74 years for males and females, Ukraine, 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

From the geographic point of view, even though diseases of the circulatory system are the most important, they do not shape the pattern. As one may see from Table 5.8, the most important etiologies (that account for more than 10 000 deaths for Ukraine as a whole) of this class of diseases are: ischaemic heart disease, cerebrovascular diseases, and cancers of the digestive and respiratory organs. It should be noted that, while SDRs from ischaemic heart diseases are the highest, the coefficients of variation from this cause are rather low (around 15%), indicating that there are no geographic disparities in regard to this cause of death. On the other hand, cerebrovascular diseases are responsible for around 40%, and diseases of the arteries for

around 100% of variation. It is interesting to see which regions provoke these variations and whether they coincide for both etiologies.

The first thing to note is that the regions of maximum and minimum SDR are usually the same for males and females, though sometimes not in the same order. The second observation is that there is some negative correlation between ischaemic heart disease and cerebrovascular diseases. The coefficient of correlation of Pearson is -0.45 for males and -0.60 for females. To be exact, the regions with high mortality from ischaemic heart disease are those with the lowest mortality from cerebrovascular diseases (particularly Vinnytska and Zhytomyrska oblasts). However, it is not entirely true in the opposite direction.

Table 5.8: SDR for 60-74 years, per 100 000 of standard population, Ukraine, 2000-2003<sup>15</sup>

Categories and code in classification	Class of causes	SDR at age 60-74 per 100 000 of standard population		Coefficient of variation (%)	
		males	females	males	Females
Ischaemic heart disease (90-95)	Circulatory system diseases	2287	1153	14.5	15.7
Cerebrovascular diseases (86-89, 98, 99)		730	473	42.2	40.7
Malignant neoplasm of digestive organs (45-51)	Neoplasms	401	162	11.3	15.5
Malignant neoplasm of respiratory organs (52-54)		343	32	15.4	19.8
Chronic bronchitis (108)	Respiratory system diseases	284	48	51.2	61.6
Diseases of arteries, arterioles and capillaries (100)	Circulatory system diseases	154	73	91.8	110.3
Other heart diseases (84-85, 96-97)		81	40	52.6	41.3
Cirrhosis of the liver (122+123)	Digestive system diseases	81	102	68.2	53.9
Malignant neoplasm of urinary organs (63)	Neoplasms	73	14	12.5	18.4
Malignant neoplasm of breast (57)		2	72	39.1	18.3

Source: Author calculation using data of the State Statistics Service of Ukraine

On the other hand, low-mortality regions for cerebrovascular diseases and diseases of the arteries overlap; but the regions of high mortality for these two etiologies are all different and are found in removed parts of Ukraine. In the end, when maps for all circulatory system causes are put on top of each other, the final image is rather smoothed (of the same level of death

<sup>15</sup> For SDR for all regions refer to the *Annex 0, Table 6, Figure 6*

rates). Among regions with high SDR, one may highlight ischaemic heart disease in Vinnytska (with SDRs of 2848 and 1545 per 100 000, respectively for males and females); cerebrovascular diseases in Khersonska (1273 and 773) and Sumska (1177 and 775) oblasts; and diseases of the arteries in Zakarpatska oblast (664 and 372). As for Zakarpatska oblast, it is exceptional in regard to SDR for males, which is abnormally high. The region that comes next, Mykolaivska oblast, has an SDR that is two times smaller (348).

In regard to cancer, there were also four most common types: cancer of the respiratory and digestive organs, cancer of the urinary organs (for males) and breast cancer (for females). The SDR for cancer of the digestive organs is the third highest after the SDRs for ischaemic heart disease and cerebrovascular diseases, and the rates for males are 2.5 times that for females. The male SDR from cancer of the urinary organs is five times that for females, while the male SDR from cancer of the respiratory organs is 10 times that for females.

High rates of cancer of the digestive organs are typical for males, and the geography in this case is clear and similar for both sexes, highlighting the southern regions (Khersonska, Zaporizka oblast and AR Crimea). In the case of males, Kyivska oblast is pronounced as well. The highest rates of cancer of organs of the respiratory organs and of the urinary system are found again in Zaporizka, Khersonska and Kyivska oblasts. As one may see, Zaporizka oblast often appears on the map as the one with the highest cancer mortality. As it is one of the most urbanized and richest regions, it makes one think that the reason for this high rate is simply the presence of better diagnostic capabilities and the existence of specialized hospitals. The same conclusion can be applied to the Kyiv region.

The highest death rates from bronchitis (689 and 148 per 100 000 for males and females) were observed in Volynska oblast in the north-west, the finding that always comes out. Among the external influences, the one that continues to be notable is suicides, which spread the most throughout the north in Sumska and Chernihivska oblasts, as was the case at younger ages. Cirrhosis of the liver at this age is at the level of suicides; however, its most noteworthy feature is that it is the only one among all the above-mentioned causes where SDRs for females are higher than for males (102 against 81 per 100 000). The zone of high risk is the same as for the previous age group: Luhanska and Odeska oblasts.

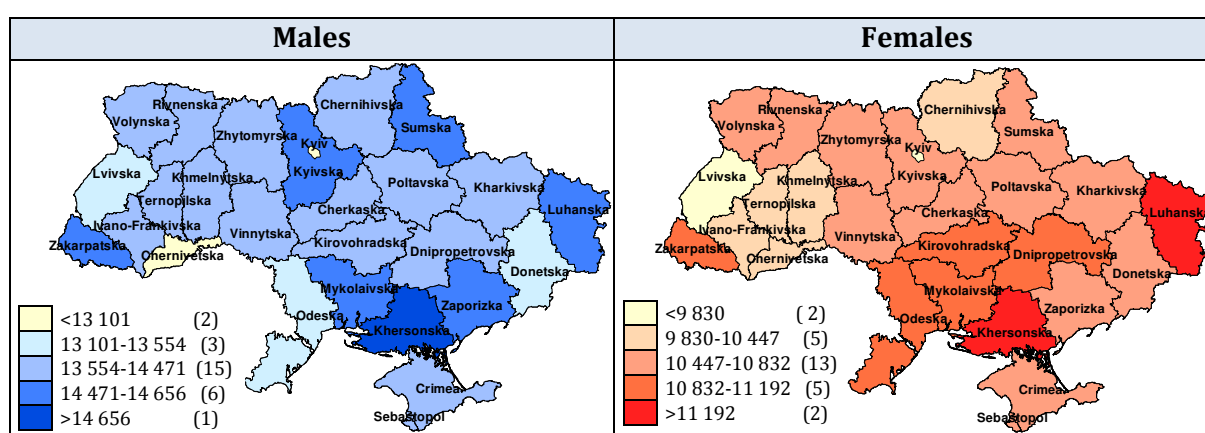
### **5.3.6 Mortality at age 75 years and more**

And finally, in the very last age group, SDR for males increases from 5325 to 13 554 (or 2.5 times), and for females from 2464 to 10 510 (or 4.3 times). At the age of 75 years and older, diseases of the circulatory system become almost the only important cause of death (82% for

males and 90% for females), while other causes lose their relative significance (*Table 5.10*). Cancers acquire the same importance for males and females (around 5-8%). In the case of males 6% belongs to respiratory system diseases, among which the most important is chronic bronchitis.

As for geography, the overall patterns show that high risk zones prevail in the south and in the east. At the same time, more refined patterns for separate groups of causes differ significantly among themselves. At the given age, the top killers were selected as causes that account for around 30 000 deaths or more for Ukraine as a whole. They are listed in *Table 5.9* below.

Figure 5.16: SDR for age group 75 and over for males and females, Ukraine, 2000-2003



Source: Author calculation using data of the State Statistics Service of Ukraine

Table 5.9: SDR for 75 years and more, per 100 000 of standard population, Ukraine, 2000-2003<sup>16</sup>

Categories and code in classification	Class of causes	SDR at age 74+ per 100 000 of standard population		Coefficient of variation (%)	
		males	females	males	Females
Ischaemic heart disease (90-95)	Circulatory system diseases	7627	6086	21.0	24.9
Cerebrovascular diseases (86-89, 98, 99)		2468	2319	62.1	65.0
Diseases of arteries, arterioles and capillaries (100)		981	903	102.1	105.9
Chronic bronchitis (108)	Respiratory system diseases	764	232	62.3	77.1
Malignant neoplasm of digestive organs (45-51)	Neoplasms	485	220	23.1	31.8
Malignant neoplasm of respiratory organs (52-54)		287	41	26.4	29.2

Source: Author calculation using data of the State Statistics Service of Ukraine

<sup>16</sup> For SDR for all regions refer to the *Annex O, Table 7, Figure 7*



Expectedly, the highest death rates are observed for pathologies of circulatory system diseases: ischaemic heart disease, cerebrovascular diseases, and diseases of the arteries, arterioles and capillaries. Ischaemic heart disease is the most common cause of death responsible for around 54-57% of all deaths at this age (cerebrovascular diseases for 18-22%, and diseases of the arteries for 7-8%). These three groups of causes have completely different patterns of spatial distribution (although they are identical for males and females within each group). The variation of IHD is moderate, while the variation of cerebrovascular diseases is high (62 and 77% for males and females), and it is very high for diseases of the arteries (102 and 106% for males and females). The latter varies from 39 in Chernivetska to 3039 deaths per 100 000 in Cherkaska oblast (in the case of males) and from 21 in Volynska to 2972 deaths per 100 000 in Cherkaska oblast (in the case of females). Such high coefficients (around 3000) are higher than the average level of SDR from IHD for the whole of Ukraine (2468). Hence, one may imagine that regional maps for these three causes would overlap – and this is what is observed. Vinnytska oblast has the highest SDR from IHD, though the lowest for cerebrovascular diseases and diseases of the arteries. In its turn, Khmelnytska oblast has the lowest SDR from IHD, but it is very high for the other two causes. Sumska oblast has one of the lowest SDRs from IHD, but the highest from cerebrovascular diseases. These are extreme cases, though other regions follow the same such regularity as well.

The important thing to note is that regions that demonstrate extreme SDRs have neighbours with SDRs found on the other side of spectrum, which makes the dissonance even more pronounced. Such a situation could be the consequence of statistical problems with registration. At this age, determining the cause of death may be less thorough, and doctors in a certain region might be inclined to assign a certain cause. Therefore, I believe the prevalence of certain pathology of the circulatory system could be wrongfully concluded in a region at this age, and that it is better to study them all together, although the group will be quite large.

Hence, when putting together these three groups of circulatory system diseases, the highest SDR will be observed in Khersonska oblast (12 017) for males and in Odesa oblast (9 977) for females; while the lowest SDR is in the city of Kyiv (9 102 for males and 8 018 for females). Such a distribution corresponds to the map presented for all causes.

And lastly, there are also cancers that play their role as well; these are cancers of the digestive and respiratory organs. Among respiratory organs, around 40% of cancers belong to lung cancer, while among digestive organs around 90% of cancers belong to stomach cancer. As a separate class, mortality from cancer of the digestive system organs resembles to a great extent mortality from diseases of the digestive system, i.e., they spread mostly throughout the south and east. However, the difference is that neoplasms are also concentrated in the regions which have good means for diagnosing cancer: Kyiv and Zaporizzia. As for mortality from cancer of the

respiratory organs, it does not coincide as a separate class with patterns of mortality from diseases of the respiratory system. The highest death rates are observed in the centre (Kirovohradska oblast) and in the south as well.

Therefore, after reviewing interregional mortality profiles in each age category, it was seen that at each stage there are specific causes that take the lead and remove one region from the rest in respect to the values of SDR. At each stage of life, these categories are different, in terms of their geographic distribution over the territory, and it was almost impossible to highlight some continuous zones of risk. To try to group regions according to prevailing patterns, I applied a principal component analysis, as described in the next sub-chapter.

## 5.4 Mortality from particular causes

The problem in visualizing mortality by cause of death is that thematic maps don't allow seeing the distributions of regions according to death rates from different causes at the same time. However, it is possible to do so through of correspondence analysis. This helps to plot the column points in a small-dimensional space, which satisfactorily reproduces the similarity (distances) between the relative frequencies for the columns across the rows.

The chosen causes of death are all those that were highlighted in the previous sub-chapter and they are listed in the table below (*Table 5.10*). These are causes that detail the main important classes of death in Ukraine: 1) circulatory system diseases, 2) neoplasm 3) external causes of death 4) respiratory system disease 5) digestive system diseases, and 6) infectious and parasitic diseases. The reasons for them receiving extra attention are different: a high share in total (circulatory system diseases), social importance (tuberculosis), suspicion of high variation (external causes of death, respiratory system disease), etc.

As the graphical display in *Figure 5.17* shows, the first axis constitutes 55.3% of variation, and together with the second axis it becomes 78%. Adding a third axis may improve representation up to 84.6%. Axes are chosen automatically and they represent the coordinates of each point. The coordinates are computed so as to maximize the difference between the points.

The fourth dimension of display is expressed by the size of points, telling how well causes and regions are represented in space. The fifth dimension was added artificially as a cardinal direction in brackets next to the name of each region, signifying in which part of Ukraine it is found<sup>17</sup>.

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<sup>17</sup> W stands for West, N for North, E for East, S for South and C for Center

After performing an analysis using the data listed in the table below, it was discovered that the distribution of regions according to their cause-specific mortality profile had the shape of a triangle, with three vertices representing pathologies of the circulatory system: ischaemic heart disease; cerebrovascular disorders, and diseases of the arteries, arterioles and capillaries. These categories appeared to be best represented in two-dimensional space and are responsible for disparities. On the other hand, they could be viewed also as outliers, as they have high contributions in determining axes. Considering the conclusion made in the previous paragraph, I finally decided not to detail circulatory system diseases and treat them altogether in order to avoid biases.

Table 5.10: Selected causes of death in the mortality structure, Ukraine, 2000-2003

Nº	Code in ICD9	Cause	Class	SDR, per 100 000	% in total
1	9-13	Tuberculosis	Infectious diseases	22.3	1.4
2	1-8, 14-44, 206	Other infectious diseases		6.1	0.4
3	45-51	Cancer of the digestive organs	Neoplasms	76.8	4.9
4	52-54	Cancer of the respiratory organs		42.7	2.7
5	55-67	Other cancers		79.8	5.1
6	90-95	Ischaemic heart diseases	Diseases of the circulatory system	660.8	42.1
7	84, 85, 96, 97	Other heart diseases		243.2	15.5
8	86-89, 98, 99	Cerebrovascular diseases		36.1	2.3
9	100-102	Diseases of arteries, arterioles and capillaries and other diseases of circulatory system		78.3	5.0
10	105-107	Pneumonia	Diseases of the respiratory system	13.6	0.9
11	108	Chronic bronchitis		46.8	3.0
12	103,104,109-114	Other respiratory diseases		9.4	0.6
13	115-127	Diseases of digestive system	Diseases of the digestive system	48.7	3.1
14	160-162	Transport accidents	External causes of death	18.3	1.2
15	173	Suicide		27.7	1.8
16	174	Homicide		12.4	0.8
17	163-172, 175, 176	Other external causes		98.3	6.3
18	68-83, 128-157	Other causes		47.6	3.0

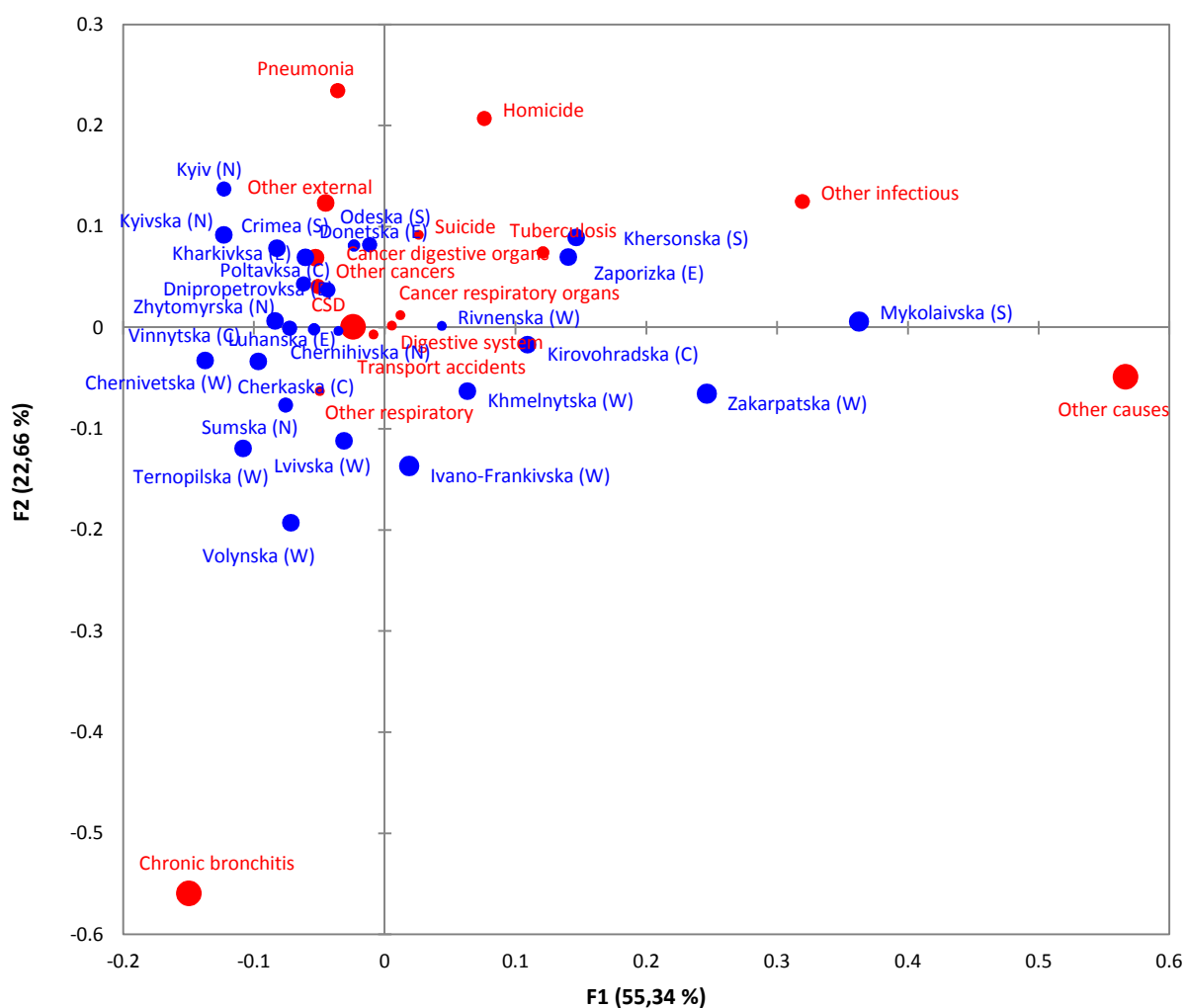
Source: Author calculation using data of the State Statistics Service of Ukraine

Ignoring diseases of the circulatory system, I received a distribution such as the one presented in Figure 5.17. The first axis captures a pretty high percentage of variation (55.3%). Two of the most important groups of causes that have the biggest weights (expressed by the size of circles) and which explain the lion's share of regional mortality variation are circulatory system diseases (CSD) and the others that are not used in analysis diseases: "other causes". While CSD appear on

the same side where most regions are found, “other diseases” explain mortality in a few regions that could be characterized as isolated (Zakarpatska oblast) or removed (like Mykolaivska oblast).

As for the second axis, one may observe some kind of regularity in the spread of column (cause) points: mortality of an exogenous nature is in the upper part of the graph and is then replaced by endogenous pathologies in the lower part. Diseases of the respiratory system absorb most of the responsibility for variation. Pneumonia and chronic bronchitis appear at the edges of this scale.

Figure 5.17: Correspondence analysis of cause-specific death rates in Ukraine’s regions, both sexes combined, 2000-2003



Source: Calculated using data of the State Statistics Service of Ukraine

The distribution of row points (regions) follows a similar vertical pattern, with the southern and eastern regions in the upper part indicating high mortality, while the northern and western regions are at the bottom. Correspondingly, one may roughly distinguish two main groups.

The first group can be found at the bottom part of the graph and it displays the best performing regions in terms of life expectancy. They are characterized by prevailing bronchitis, CSD, other diseases of the respiratory organs not selected in the analysis, and “other causes” in the nosological structure. These are all western regions (the oblast of Volynska, Ternopilska, Ivano-Frankivska, Lvivska, Chernivetska, oblasts, Khmelnytska, Rivnenska) and also Cherkaska oblast in the center.

The second group includes regions found in the upper part of the graph and that have a rather unfavourable mortality profile meaning prevailing mortality from pneumonia, different types of cancer, and also homicides, suicides, tuberculosis, other violent causes and infectious diseases. These are the southern regions (Odeska, Khersonska oblast, and AR Crimea) and eastern regions (Donetska, Zaporizka, Kharkivska, Luhanska oblasts).

Adding a third axis helps to explain only 6% percent of variation. I removed the first axis and added a third axis to the projection so as to see what other causes define the pattern. In this case it was infectious diseases and violent causes of mortality that came to the front. However, there is no clear indication that adding a third axis could be useful. Therefore, more than 80% of the differences among regions are determined by circulatory system diseases, external causes, respiratory system diseases and infectious diseases.

There are also some outliers that have weight in causing the variation and that are well represented in space. Volynska oblast is responsible for high mortality from chronic bronchitis, Sumska oblast for cerebrovascular diseases, and Kyiv for pneumonia.

Such an analysis helps to verify that “all-causes” rates mask very different cause-specific structures and that mortality patterns should be studied in their integrity.

## Conclusions

In this chapter I reviewed the situation observed around the census of 2001, the year of the first census in Ukraine.

First of all, in regard to life expectancy at birth, one may see some visible geographical opposition: in the case of males it is between the west and east of Ukraine, while in the case of females the contrast is rather between the west and south-east. Regions in the worst situation form a belt that starts from Odeska oblast, passes through the southern areas, and ends up in Donbas. Regions with the lowest mortality are found in the west, in the zone around Carpathian Mountains.

For every region, life expectancy at birth for men is always lower than for women. For males, the average for Ukraine LE is equal to 62 years, and for females it is 73.5 years. Exploring life expectancy at age 25 and 65, it was found that interregional disparities decrease for age while the intergender gap increases.

In analyzing age patterns, there are very strong correlations among age groups no matter which region. Principal component analysis added to this finding that, if mortality in a certain region is elevated in some age group, it is likely to expect that it is elevated over the entire age span.

From the analysis of age-sex patterns one could receive first evidence about the arrangement of Ukraine's region into contradictory categories: regions with favourable mortality in all age groups versus regions with unfavourable mortality in all age groups, plus an intermediate group with favourable infant mortality but a disadvantageous situation in the remaining age groups. It is notable that these categories could be associated to geographical location. The first group is found uniquely in the west, the second in the south-east, and the last includes regions in the centre and north. Detailing by gender, the gradient would be from the west to east for males and from the west to the south-east for females.

By decomposing the contribution of different age groups to the deviation of life expectancy in a region from the average, one can see that regions could be roughly alienated into two groups by the criteria: if some region is characterized by positive age-specific contribution, then every age group is involved positively, and *vice versa*. The advantage of better-performing regions was larger than the disadvantage of others. This is true for all age groups, but especially so for the elderly. Another observation is that regions that succeeded the most in increasing life expectancy are those characterized by decreased mortality at older ages.

Regarding causes of death, the three most important killers shape the patterns: diseases of the circulatory system, cancers, and external causes of death. Each of them has its own particularity.

Diseases of the circulatory system are an acute problem in every region of Ukraine; cancers don't show any regularity; and external causes of death do provoke a sharp contrast between the west and the rest of Ukraine.

Mortality profiles do change with age. External causes play an important role at a young and middle age, after which circulatory system diseases take their toll. It is this group of causes of death that decrease life expectancy in the eastern regions by around one year, and they give an advantage to the western regions of around one and a half years in comparison to the average for all of Ukraine.

Circulatory system diseases prevail largely at old age. It is also notable that this largest group of causes includes some important subcategories, which have their own patterns and which suspiciously overlap. It forces us to conclusions about a prejudiced registration of cause of death from the circulatory system diseases and necessitates treating them together in order to avoid biased conclusions.

Summarizing, one may say that the eastern regions are at a lower stage of development than the western regions, which have lower mortality from circulatory system diseases and violent causes, and higher life expectancy. This is due to improvements at old age and a more favourable epidemiological profile in the western regions.

## Chapter 6

# From Soviet times to independence

## 6.1 General mortality

### 6.1.1 Trends and recent upturns in life expectancy

In this section I investigate the evolution of mortality in regions from the last Soviet census to recent times. Looking at *Figure 6.1* one may distinguish three periods: a period of degradation that started at the end of the 1980s and lasted until 1995; a period of crisis and stagnation that continued until the end of the 2000s; and the latest period of recovery, which started in 2008. I highlighted three points of reference to which I want to refer in a comparison analysis and which were described in Chapter 1.6 (data for years around reference points were aggregated).

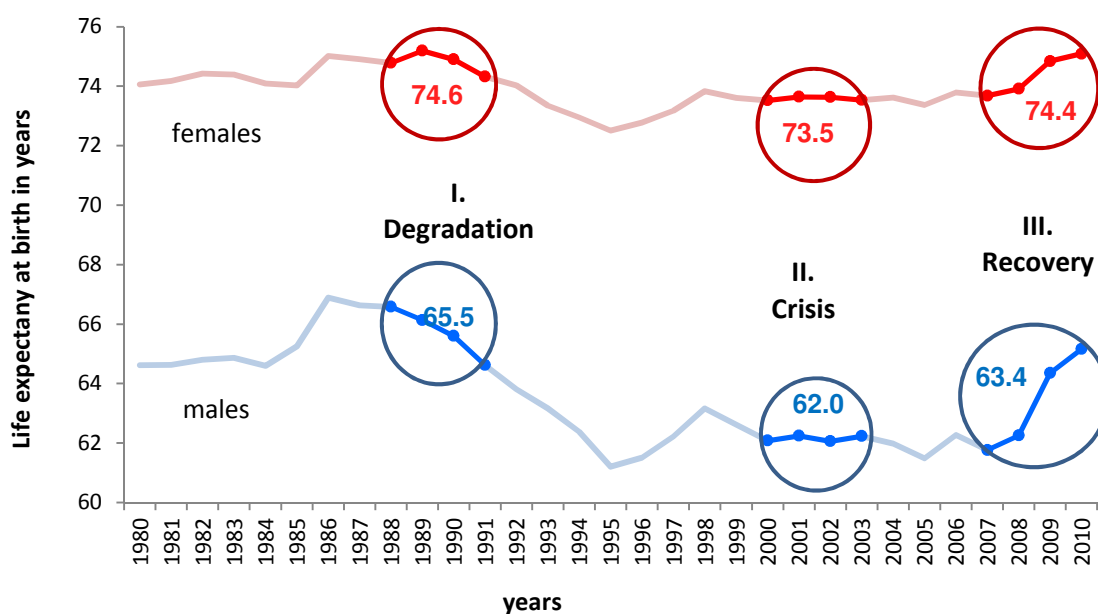
The values of average life expectancy for four years are presented in *Figure 6.1*. The first period (1988-1991) captures the years before the collapse of the Soviet Union. The situation then looked the most optimistic. The country had not yet experienced bad economic and psychological stress. On the other hand, this period is too close in time to the anti-alcohol campaign that finished in 1987, and it is very likely that the positive effect of this campaign was still present at that moment, which may be reflected by the data.

The 2001-2003 reference describes the period that arrived after the years of crisis that followed the collapse of the Soviet Union and which had a negative impact on mortality. A large drop in 1990 was replaced by moderate improvements and by a decade of stagnation.



Finally, the period 2007-2010 refers to recent times marked by a notable increase in LE.

Figure 6.1: Life expectancy at birth for males and females, Ukraine 1988-2010



Source: 1988-2010 - author calculation using data of the State Statistics Service of Ukraine (infant mortality corrected)  
1980-1987- Human Mortality Database

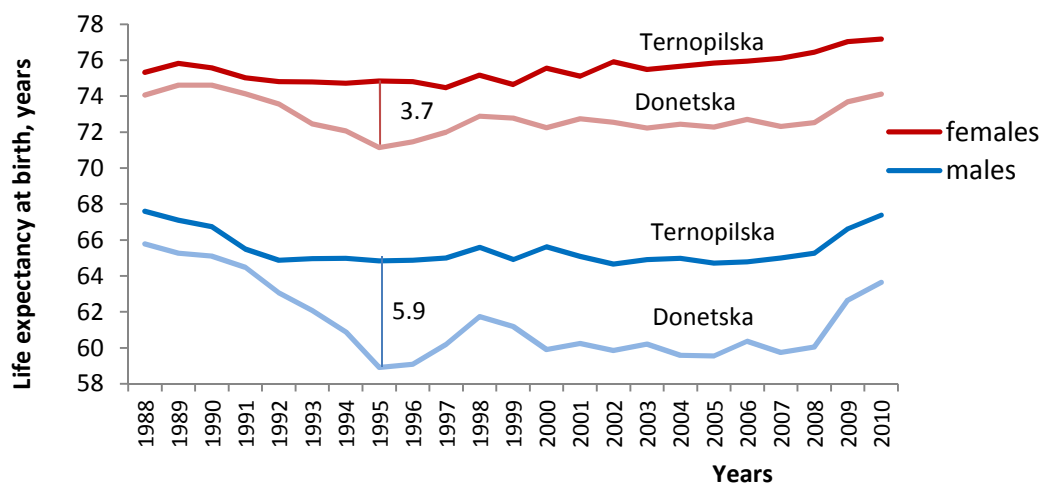
One may see that these changes were significant in the case of males and less pronounced for females. As the long-term trends were everywhere more unfavourable to men than to women, the upturn is more spectacular for the male life expectancy than for the female one. However, after two decades, LE in both cases has almost returned to the initial values observed at the end of the Soviet epoch.

Similar patterns are observed in regions, although not on the same magnitude. *Figure 6.2* displays trends for two regions: the best and the worst performers for life expectancy, among which the former (Ternopil'ska oblast) is found in the west, and the latter, (Donetska oblast) – in the east. In fact, the highest life expectancy was observed not in Ternopil'ska oblast but rather in the city of Kyiv. However, its example is not typical for Ukraine, so I preferred to choose regions which are good representatives of their geographical counterparts.

One may see that divergence restarted again (after some convergence was observed during the anti-alcohol campaign) in the beginning of the 1990s with the proclamation of independence. The maximum difference between the life expectancies of these two regions was observed in 1995: for females it was equal to 3.7 years, and for males – to 5.9 years. And it is only recently that the gap started to narrow. The eastern region is also characterized by great amplitude of fluctuations, while the western one does not demonstrate any abrupt changes. For a

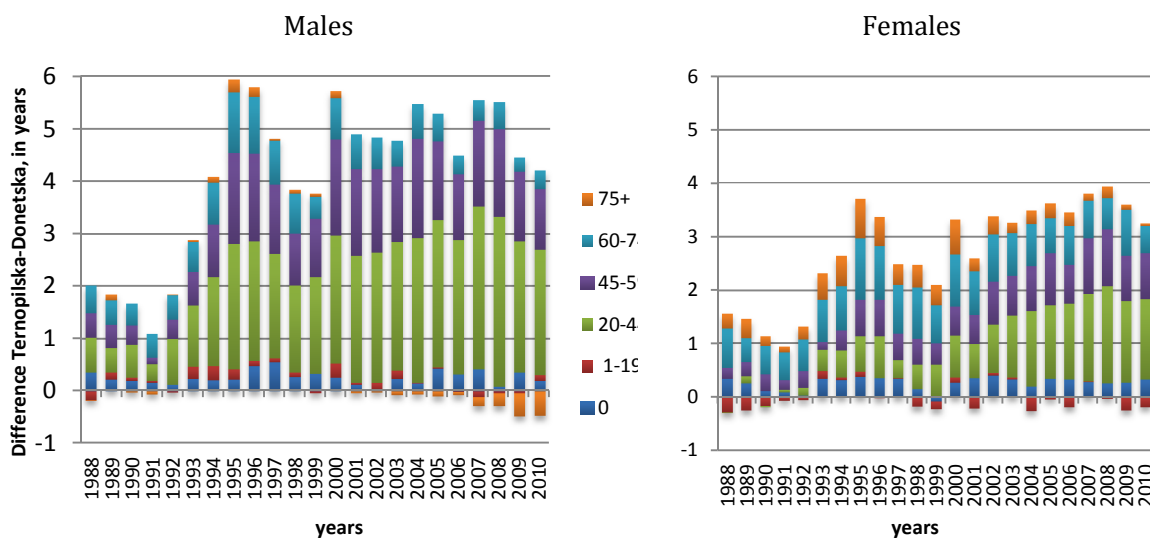
comprehensive understanding of how these changes happened, the difference in life expectancy was decomposed into age groups (Figure 6.3).

Figure 6.2: Life expectancy at birth for males and females observed in Donetska and Ternopilska oblast, 1988-2010



Source: Calculated using data of the State Statistics Service of Ukraine with correction for infant mortality

Figure 6.3: Contribution of age-specific mortality to differences in life expectancy between Ternopilska and Donetska oblasts, 1988-2010



Source: Calculated using data of the State Statistics Service of Ukraine with corrections for infant mortality

As seen in Figure 6.3, almost all age groups in Ternopilska oblast contributed to positive deviations of this region from Donetska oblast. The most remarkable contribution was made by the most active working-age group, from 20 to 45 years, and also of preretirement age, from 45 to 60 years. In the case of females, older age groups of 60 years and more also made important contributions to this gap. The only exception (while talking about females) is very young ages,

from 1 to 19 years, which contributed to a negative deviation of the western region from the eastern one. And in the case of males, recently very old age groups in the eastern region started to gain an advantage.

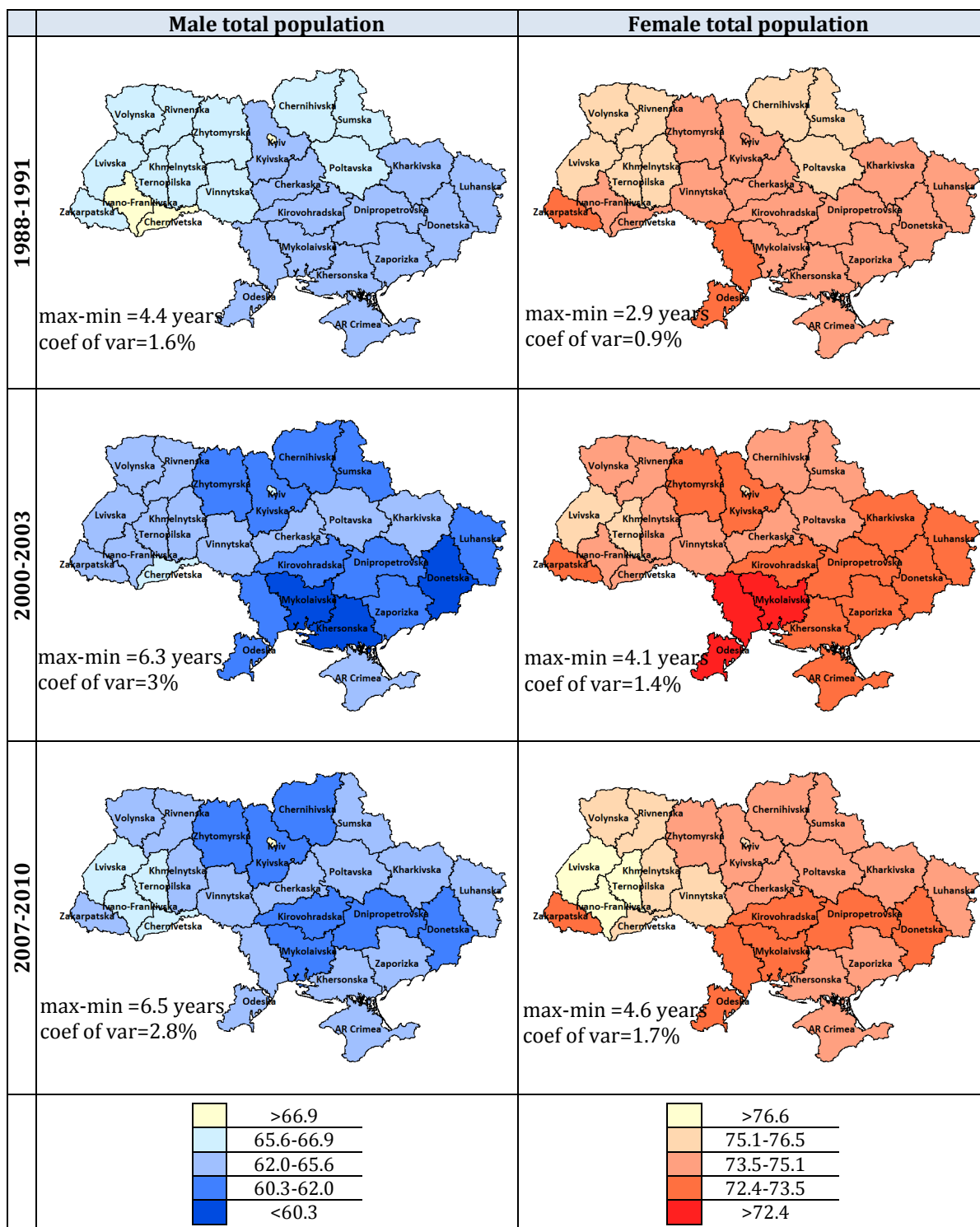
Above, I compared two extreme examples of the best and the worst performing regions; and, in order to see the whole picture of regional variability, one may refer to *Figure 6.4*, which presents maps for life expectancy at birth in three reference periods. For the sake of comparability, I put the values of all three periods on the same scale but distinguished males and females. To facilitate comparisons, I also created *Figure 6.5*, which displays the relation of life expectancy in the earlier period (on the abscissa) to the one in later periods (on the ordinate) for every region, comparing three reference periods with each other. The lower the values of life expectancy changes over time, the closer the region is found to the bisecting line.

In the case of **males**, the situation was the most favourable in 1988-1991. The average for Ukraine life expectancy at birth was 65.5 years. In 2000-2003, after years of transitional crisis, LE for males fell by more than 3 years and consisted of 62 years. Disparities increased as well: from 4.4 years in 1988-1991 to 6.3 year in 2000-2003.

One may observe this by looking at the first row of *Figure 6.5*: every region is found below the bisecting line. The vector of scatter distribution reflects a direct correlation: regions that had higher values in the earlier period also have higher values in later periods, and those that had lower values are found again at the bottom. However, the degradation was deeper in already vulnerable areas. Maps help to indicate that these were southern and northern regions. Two regions, Mykolaiivska and Khersonska oblasts, which are situated at the shore of the Black sea, were marked by life expectancy falling below the level of sixty years.

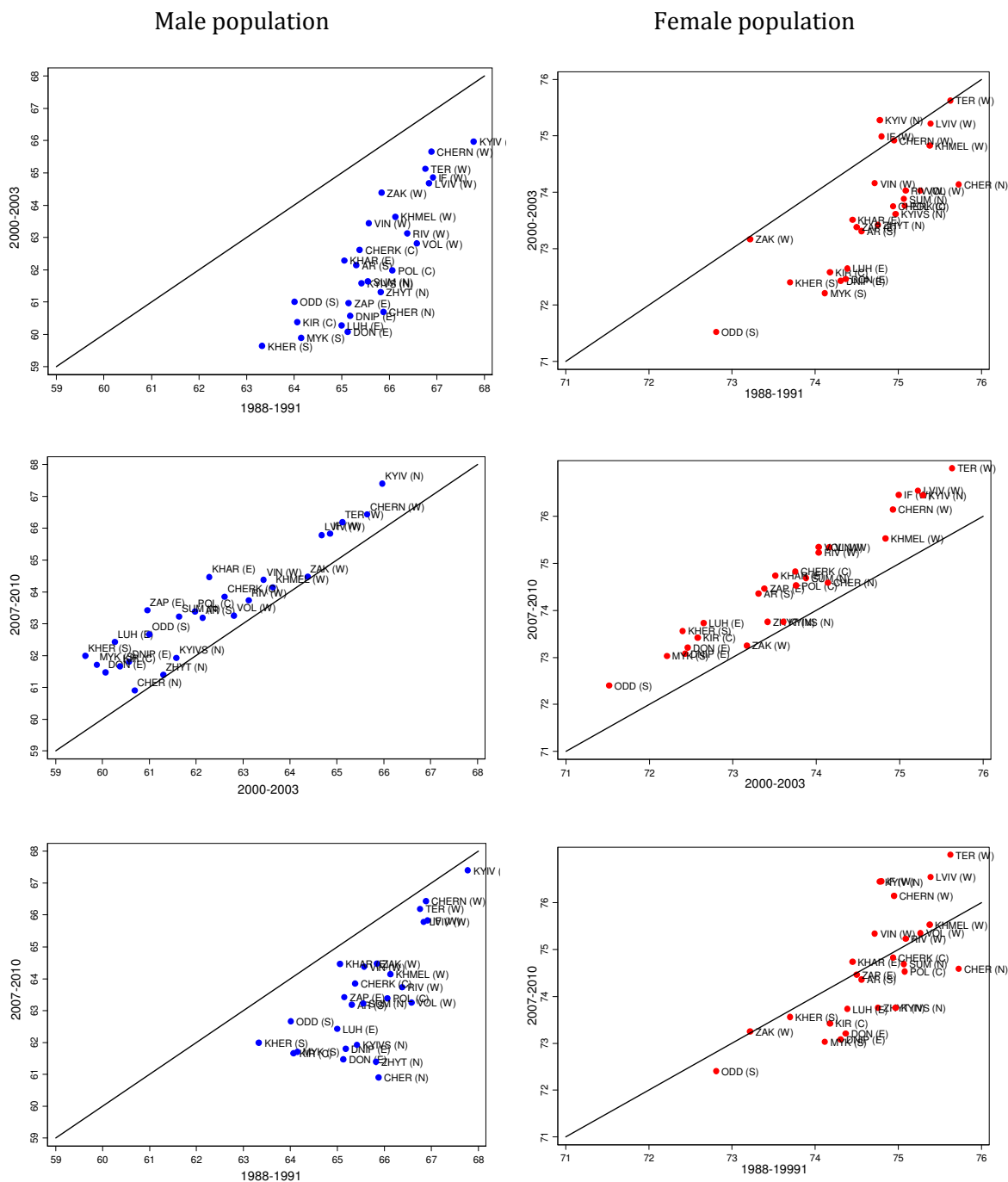
Since the beginning of the 2000s, the situation has improved. Life expectancy for total Ukraine has increased to 63.4 year, which is still, however, less than it was in 1888-1991. Amelioration happened thanks to the southern and western regions, as is seen on the map. Comparing the 2007-2010 period to 2000-2003 with the aid of the scatter plot, one may see that LE has improved in every region, though not significantly. In some regions (Chernihivska, Zhytomyrska oblasts), changes are almost invisible: their points tend to approach the bisector closely, which means that the values in both periods are almost the same.

Figure 6.4: Life expectancy at birth for males and females, by regions of Ukraine, comparison of three periods



Source: Calculated using data of the State Statistics Service of Ukraine with corrections for infant mortality

Figure 6.5: Life expectancy at birth for males and females, by regions of Ukraine, correlation between situations in 1988-1991, 2000-2003, and 2007-2010



Source: Calculated using data of the State Statistics Service of Ukraine with corrections for infant mortality

These positive dynamics at first appear to give a reason for optimism, though not truly. Even with a small increase in the general level, the difference between maximum and minimum values increased as well up to 6.5 years. And when comparing the situation finally obtained in 2007-2010 to the one observed at the beginning of the study period (1988-1991), it is clear

that LE for males has not fully recovered to its pretransition level in any region. Every region is found below the bisector (third row), meaning higher values in the earlier period.

Another feature is that the relative importance of regions has somewhat changed. The most notable change is negative: the northern oblasts have deteriorated in the hierarchy of regions and slipped from the top to the very bottom. The particular region in the north is Chernihivska oblast. In 1989 it was among the top three regions in total life expectancy and the absolute leader in female life expectancy. Since then, life expectancy for females in the region fell slightly by more than one year, and this region is no longer among the leaders. However, male life expectancy decreased by five years and now Chernihivska oblast is the worst performer in terms of male life expectancy. One explanation for this is its close proximity to the Chernobyl Nuclear Power Plant, though this is not the region where most of the radiation fallout landed.

To summarize, the best performing regions in terms of male life expectancy in different times were Ternopilska, Lvivska, Ivano-Frankivska, and Chernivetska oblasts, all of which are found in the west of Ukraine, and also the city of Kyiv. As for the poorly performing regions, during the years of crisis these were almost all south-eastern regions from the industrial basin. However, the bad situation in the north was taking over and reduced the northern regions to becoming the worst performers.

The case of females is a bit different than of males in terms of the level of life expectancy, as well as in terms of territorial variation. Life expectancy at birth for females is approximately ten years higher than for males, and the coefficient of variation for female LE is usually half that of males. In 1988-1991, life expectancy at birth for females was equal to 74.6 years for Ukraine as a whole. After losing about one year, it has almost regained its value in recent times, and was 74.4 years in 2007-2010. On the other hand, similarly to males, the disparities have not shrunk but, on the contrary, have increased from 2.9 years at the beginning of the retrospective span to 4.2 years at the end of the period. However, contrary to males, the degradation happened in different areas to a very different degree. Moreover, certain improvement was observed in some regions.

The regions doing better in 2001-2003 than in 1989 were Ivano-Frankivska oblast and the city of Kyiv, joined by Ternopilska, Lvivska, Chernivetska, Vinnytska, and Kharkivska oblasts in 2007-2010. With the exception of Kharkivska oblast, these are all western oblasts. At the same time, the degradation happened because of the south-eastern belt of regions that pulls LE down. These are: Odeska and Mykolaiivska oblasts, sometimes joined by their neighbouring Khersonska oblast. In different years, Zakarpatska oblast took the lead as well. This region, isolated by the Carpathian Mountains, constantly demonstrated a bad situation that was independent of what was happening in other regions.

Also, one may observe on maps that, in the beginning of the study period, a hierarchy of regions was almost the same for both sexes. However, over the course of time divergence appeared and the situation developed differently for males and females. The gap in male and female LE increased as well, from nine years in 1988-1991 to eleven years in 2007-2010. The gap is larger in those regions where mortality is higher. An abnormally large difference, of almost 14 years is observed in the above-mentioned Chernihivska oblast in the north. This aspect can be better explained by a cause-of-death analysis, as different sexes are subject to different risks.

Hence, the conclusions that can be made from *Figure 6.4* and *Figure 6.5* are, first, that variation of mortality for males and for females was the smallest in 1989 among the three periods. The coefficient of variation almost doubled in consequent years in comparison to the beginning of the study period.

Second, different regions experienced changes at a different pace. In some regions, the decline in life expectancy occurred faster than in others and, as a result, the difference between maximum and minimum values increased.

Third, the opposition between the north-west and the south-east was visible even in Soviet times. At the moment of the first all-Ukrainian census, it was a bit blurred by the overall critical situation. Since then, the situation ameliorated for a number of western regions, though it has not reached the level of 1989. On the other hand, the eastern regions still bear the scars of crisis.

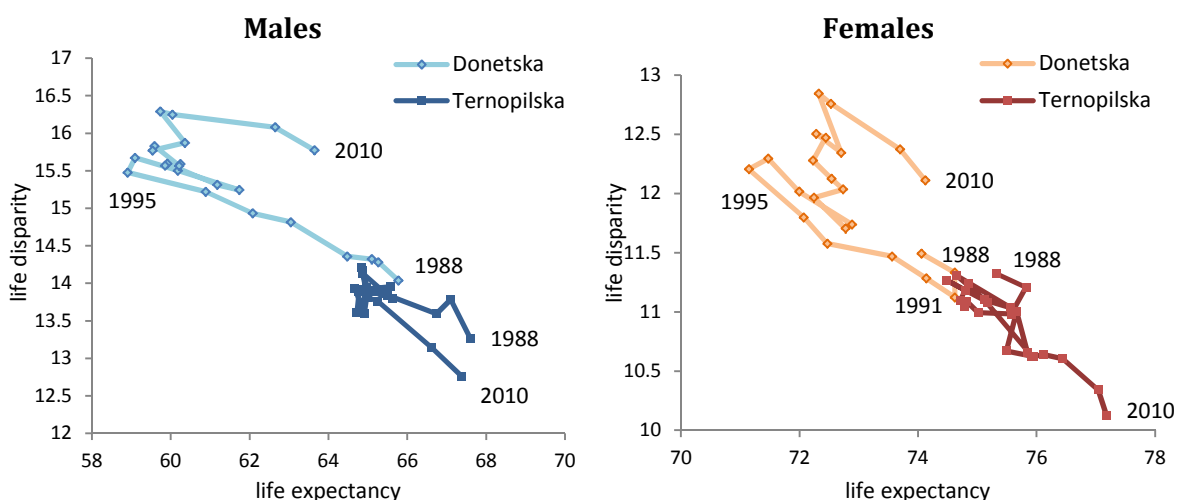
### **6.1.2 Lifespan disparity**

In addition to the average lifespan, population health can also be examined from the perspective of lifespan inequality. The health equality agenda seeks to achieve both high life expectancy and low lifespan disparity. In general, mortality reductions in any age group lead to increasing life expectancy; the reduction of death at early ages reduces lifespan disparity while a reduction in late death leads to a rise in lifespan disparity (Kibele, 2012). Given different patterns of life expectancy in Ukraine across regions, one may expect that the pathways along the lifespan among regions diverge as well.

*Figure 6.6* presents two earlier chosen example regions, which portray two extreme cases: Donetska and Ternopil'ska oblasts. The graph in the figure is presented by a scatter plot with values of life expectancy plotted on the X axis versus values of lifespan disparity on the Y axis. Each point represents a year, and points are connected for the sake of chronological order.

For example, life expectancy for males in Donetska oblast in 1988 was equal to 65.6 years while lifespan disparity was 14 years. When mortality degraded and life expectancy decreased, lifespan disparity in its turn increased, which is presented by a light blue line moving to the upper right corner. In theory, this is what should be observed - a negative correlation between life expectancy and lifespan disparity, because a reduction in mortality leads to mortality compression, which is a synonym for the rectangularization of the survival curve (Kibele, 2012), and therefore lifespan disparity as a measure of years of life should decrease.

Figure 6.6: Lifespan disparity versus life expectancy in two oblasts, 1988-2010<sup>18</sup>



Source: Calculated using data of the State Statistics Service of Ukraine

In practice, different situations are observed. For example, female life expectancy at birth in Donetska oblast reached a level of 74 years three times: in 1988, 1991 and 2010. And each time lifespan disparity was different. When comparing 1991 with 2010, it increased from 11 to 12 years. Therefore, the first impression that LE has regained its pretransitional values is partly wrong, because lifespan disparities at the same time increased.

Comparing the best and the worst performing regions with each other, one may observe the basic difference. In both cases, the curves do some kind of a turn-over, starting at certain levels of life expectancy and returning almost to the same values but at different levels of lifespan disparity. However, curves go clockwise in the case of a poorly performing eastern region, while anticlockwise in the case of a well-performing western region. The curve ends up at the point of higher lifespan disparity in the first case and lower in the second case. The general conclusion is that, even though regions managed to achieve some improvements, they are not always completely positive, as may be seen from the first glance. Some negative processes may be still going within.

<sup>18</sup> The graphs for the remaining regions of Ukraine are regions of Ukraine can be found in *Annex P*.



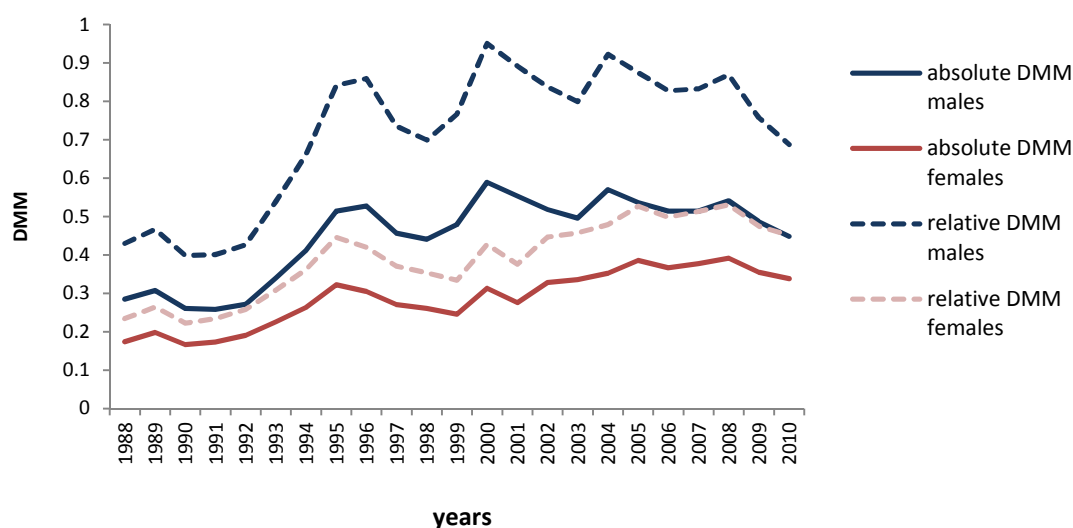
### 6.1.3 Dispersion measure of mortality

In order to summarize the variation in a single figure, I calculated the Dispersion Measure of Mortality (DMM). Its advantage is that it accounts for the difference between all pairs of units rather than only between extreme values. The DMM of one year in absolute terms means that the average population-weighted difference across all pairs of regions equals one year. In relative terms, DMM is expressed in relation to life expectancy at birth.

In previous paragraphs I showed that life expectancy at birth has recently recovered from a long crisis. However, looking at the maps presented for reference periods, one may see that its divergence among regions has not decreased. The DMM provides a quantitative answer to the question of whether convergence or divergence really happened during these years.

In *Figure 6.7* one may see that the lowest dispersion levels were observed in 1990 and 1991. At this point, divergence started and increased significantly up to 1995. The directions of male and female trends were similar, but males experienced higher levels of regional life expectancy dispersion than females. From 1995 and until 2000 regional dispersion decreased slightly, but a new wave of divergence arrived immediately afterwards, which corresponds to the increase in mortality in this period. During the 2000s, DMM was stagnating and only at the end of the decade did it start to decrease. For now, the absolute average population-weighted difference across all pairs of regions in LE is around 0.35 years for females 0.45 years for males, which is a bit less than in previous years but still above the numbers that were observed in 1990. Therefore, a large divergence happened and recovery of life expectancy to pre-transition levels was not accompanied by the same convergence.

Figure 6.7: DMM across regions of Ukraine for life expectancy at birth, 1988-2010



Source: Calculated using data of the State Statistics Service of Ukraine

## 6.2 Hierarchy of causes of death in three periods

A study of recent cause-specific mortality trends in Ukraine is hampered by discontinuities that distort statistical series. This distinct problem starts in the year 2005, when Ukraine adopted the tenth Revision of the International Classification of Diseases.

Periodical revisions were produced in the past as well, causing ruptures in the time series. This problem was resolved by France Meslé and Jacques Vallin (2003, 2008, and 2012), who reconstructed the retrospective data. More precisely, this data refers to the years 1965 to 2004. During this time span, there were four versions of the Soviet classification in use, which was revised in: 1965 (223 items), 1970 (185 items), 1981 (185 items), and in 1988 (176 items). After the proclamation of independence in 1991, Ukraine continued using the Soviet classification of 1988, through it was called Ukrainian Classification. Only a very minor modification was introduced in 1994, when AIDS was added as an extra 177th item to the list of causes. Finally, Ukraine performed a switch to the 10th revision of the ICD quite late, in 2005. However, it was not the final version and another review of the 2005 Ukrainian Classification was done in 2008, when 5 new alcohol-related causes were added to the list.

Lists of causes in different periods were different. To be precise, classification until 2005 consisted of 17 broad classes that included 177 causes, while after 2005 it became 19 classes with 238 causes (see *Table 3.5* and *Annexes F* and *G*). Two new classes were added: “Diseases of the eye” and “Diseases of the ear and mastoid process”, which previously belonged to “Nervous system diseases”.

In order to avoid disruptions that could be induced by the change of classification, I chose to work at a fairly rough level of detailing, i.e. by classes, which remain almost unchanged through time. It should be noted that, by working at such a level, some classes are of very little importance in Ukraine. Furthermore, when specifying by regions, sex, etc., their use becomes impractical due to very small numbers. So I decided to choose for analysis only those classes of causes that account for more than 1% in the mortality structure. These are six groups listed in *Table 6.1*.

Deaths that were not classified elsewhere and were assigned to the class of “ill-defined” deaths were redistributed following the same approach described in Chapter 3.3.3 (deaths from “senility” were assigned to circulatory system diseases, and deaths from “other ill-defined and unspecified causes” were redistributed proportionally among the remaining causes). The difference from the previous classification is that ill-defined causes now also include Infant Death Syndrome, which I added to the class of “Conditions originating in the perinatal period”.

Table 6.1: Hierarchy of causes of death in three periods, for total Ukraine

	SDR			Proportion		
	1989	2001	2009	1989	2001	2009
<b>Males</b>						
Circulatory system	1017	1301	1258	56.0	59.2	61.6
Cancers	329	296	274	18.1	13.5	13.4
External causes	186	275	207	10.2	12.5	10.2
Respiratory system	152	137	89	8.4	6.2	4.4
Digestive system	52	75	100	2.9	3.4	4.9
Infectious diseases	22	51	56	1.2	2.3	2.8
Other	56	62	58	3.1	2.8	2.8
Total	1814	2197	2042	100.0	100.0	100.0
<b>Females</b>						
Circulatory system	728	844	771	69.8	73.4	72.8
Cancers	155	142	137	14.8	12.4	12.9
External causes	45	59	43	4.3	5.1	4.1
Respiratory system	50	31	19	4.8	2.7	1.8
Digestive system	24	29	41	2.3	2.5	3.8
Infectious diseases	5	9	15	0.5	0.8	1.4
Other	38	37	33	3.6	3.2	3.1
Total	1043	1150	1059	100.0	100.0	100.0

Source: Calculated using data of the State Statistics Service of Ukraine

As seen in the table, none of the above-mentioned classes that produce disruption were selected for analysis, due to their very low relative importance. There were, however, other changes that had to be considered. In the new classification of 2005, certain types of respiratory tuberculosis were moved from the class of infectious diseases and added to the class of respiratory system diseases. Because in the previous Chapter 5 I was referring to old revisions of classification, in order to be consistent and follow the same revision of classification, I moved part of respiratory tuberculosis (17.6% according to calculations) back to infectious diseases for the years after 2005.

As said before, the share of chronic conditions is prevailing in the nosological structure of mortality while infectious diseases still remain. This was the case in 1989 and it still is now, though some changes have occurred. By comparing the situation in three reference time points, one may examine also *Figure 6.7*, which visualizes information from *Table 6.1*.

Therefore, the main important characteristics in developing the nosological structure during the last twenty years are the following: circulatory system diseases preserved their role as a major killer; no advances in prevention and treatment happened; mortality from neoplasms constantly decreased; mortality from external causes returned to its initial level after boosting (and they are, however, menacingly high); respiratory system mortality continuously declined; and digestive system and infectious mortality constantly grew. A detailed analysis of cause-of-

death trends by age and cause is presented in a book by France Meslé and Jacques Vallin, "Mortality and Causes of Death in 20<sup>th</sup> Century Ukraine" (2012), where cause-specific trends are studied within each age category.

The hierarchy of causes is the same for males and females, though their importance is a bit different (*Figure 6.8*). The first position is traditionally occupied by circulatory system diseases. While in the male mortality structure they are responsible for 56-62% of deaths, in female mortality structure this figure grows to 73%. The second important killer is neoplasms or cancers, which are responsible for around 12 to 18% of deaths for males as well as for females. And the third killer is external causes or violent deaths, which are more considerable in the case of males (around 10-13%) and much less for females (around 4-5%). Together, these three classes account for around 85% of all deaths for males and 90% for females.

The hierarchy of main killers was somewhat different before the study period. Earlier, in Soviet times, the third position was occupied by diseases of the respiratory system while external causes were in the fourth place (Libanova, 1991). Such an order was reasonable, since harmful working conditions in industries did increase the risk of lung diseases and also because infectious diseases were still high among respiratory conditions. Sharply increased mortality from external causes in the later period was striking evidence of both the ignorance of the problem in the past and its aggravation during the crisis. Particularly during the 1990s, external causes provoked more deaths than cancers.

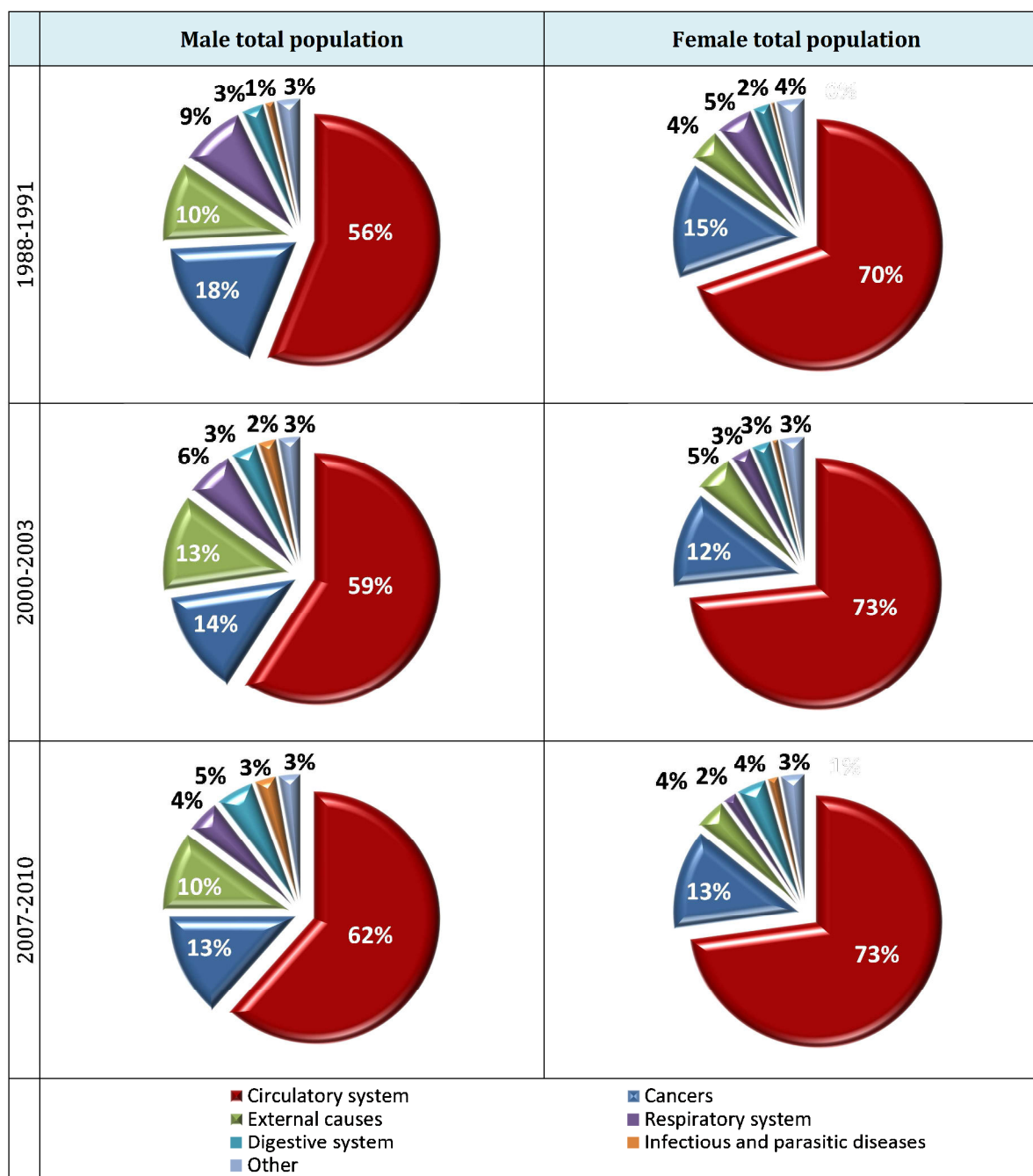
The remaining 15% (10% for females) are distributed among infectious, respiratory and digestive systems diseases, leaving around 3% for other causes.

One more comparison to finalize in portraying the mortality structure is the international comparison. For better comprehension, I've chosen only countries of Eastern Europe that are geographically or politically closest to Ukraine and also to France, and I've also included the average for the EU's pre-2004 borders. SDR are taken from the database of WHO, which uses the European standard population for the procedure of age standardizing.

As I said above, the contradictory nature of the mortality profile is characterized by a high share of communicable and chronic diseases. One may see in *Table 6.2* that Ukraine had the highest (or one of the highest) SDR for infectious and parasitic diseases in all three periods. This SDR was almost tripled (from 12 to 33 per 100 000) when comparing 2009 levels with those observed in 1989. Similarly high levels as in Ukraine were observed only in Russia, where they also grew in the last two decades, though not as sharply as in Ukraine (from 13 to 23 per 100 000). The proportion of infectious diseases in the mortality structure increased as well, from 1.1 to 2.6% during the study period. Among the selected countries, the share of

France (1.9%) was the closest to Ukraine's; however, SDRs from infectious mortality in France are much lower. In the remaining countries, this share does not reach even one percent.

Figure 6.8: Nosological structure of mortality in Ukraine according to standardized<sup>19</sup> death rates, comparison among three periods



Source: Calculated using data of the State Statistics Service of Ukraine

<sup>19</sup> Using Ukraine's census population as a standard

Table 6.2: Hierarchy of causes of death in three periods in Ukraine and selected countries

Infectious and parasitic diseases	SDR, per 100 000			Proportions		
	1989	2001	2009	1989	2001	2009
Hungary	9	5	4	0.7	0.5	0.4
Slovenia	7	5	4	0.7	0.6	0.6
Czech Republic	4	3	7	0.3	0.3	0.9
France	9	12	8	1.2	2.0	1.9
Belarus	8	12	9	0.7	0.9	1.0
EU members before May 2004	6	9	9	0.7	1.4	1.7
Romania	12	15	10	1.0	1.3	1.1
Russian Federation	13	25	23	1.1	1.7	1.8
<b>Ukraine</b>	<b>12</b>	<b>25</b>	<b>33</b>	<b>1.1</b>	<b>1.9</b>	<b>2.6</b>
Neoplasms	1989	2001	2009	1989	2001	2009
Belarus	176	178	123	16.5	13.4	14.0
France	208	191	130	29.9	31.3	33.6
<b>Ukraine</b>	<b>185</b>	<b>170</b>	<b>159</b>	<b>16.2</b>	<b>12.6</b>	<b>12.7</b>
EU members before May 2004	205	184	168	26.2	28.6	30.8
Russian Federation	203	190	180	17.1	12.6	14.2
Romania	151	177	181	12.6	15.8	18.8
Slovenia	214	208	201	22.1	26.3	31.9
Czech Republic	259	236	202	22.5	26.6	27.1
Hungary	266	269	246	21.6	25.6	26.6
Diseases of the circulatory system	1989	2001	1989	2001	1989	2001
France	212	163	93	30.4	26.7	24.0
EU members before May 2004	330	238	176	42.0	36.8	32.1
Slovenia	449	300	236	46.4	38.0	37.3
Czech Republic	634	460	357	55.1	51.8	47.9
Hungary	631	509	430	51.2	48.6	46.4
Belarus	564	689	445	53.1	51.9	50.7
Romania	725	680	556	60.5	60.9	57.8
Russian Federation	671	828	705	56.8	54.7	55.4
<b>Ukraine</b>	<b>627</b>	<b>797</b>	<b>761</b>	<b>54.9</b>	<b>58.9</b>	<b>60.7</b>
Diseases of the respiratory system	1989	2001	2009	1989	2001	2009
France	42	34	21	6.0	5.6	5.3
Belarus	77	56	28	7.3	4.3	3.2
Slovenia	58	59	35	6.0	7.4	5.6
<b>Ukraine</b>	<b>70</b>	<b>59</b>	<b>39</b>	<b>6.1</b>	<b>4.4</b>	<b>3.1</b>
Czech Republic	51	40	42	4.4	4.5	5.6
EU members before May 2004	57	51	44	7.2	7.9	8.0
Hungary	55	38	45	4.5	3.6	4.8
Russian Federation	63	66	49	5.3	4.4	3.8
Romania	113	66	50	9.4	5.9	5.2
Diseases of the digestive system	1989	2001	1989	2001	1989	2001
France	39	29	18	5.6	4.8	4.7
EU members before May 2004	37	31	27	4.7	4.8	4.9
Belarus	23	33	33	2.1	2.5	3.8
Czech Republic	45	37	36	3.9	4.2	4.8
Slovenia	62	54	42	6.4	6.8	6.7
Russian Federation	30	48	57	2.5	3.2	4.5
<b>Ukraine</b>	<b>30</b>	<b>44</b>	<b>61</b>	<b>2.6</b>	<b>3.3</b>	<b>4.9</b>
Romania	55	66	64	4.6	5.9	6.6
Hungary	78	82	67	6.4	7.8	7.2
External causes	1989	2001	1989	2001	1989	2001
EU members before May 2004	50	38	32	6.4	5.9	5.8
France	72	55	33	10.3	9.0	8.6
Czech Republic	81	62	50	7.0	7.0	6.6
Romania	58	64	55	4.9	5.7	5.7
Hungary	116	81	60	9.4	7.7	6.5
Slovenia	93	69	61	9.6	8.8	9.6
Belarus	100	164	103	9.4	12.4	11.7
<b>Ukraine</b>	<b>105</b>	<b>149</b>	<b>111</b>	<b>9.1</b>	<b>11.0</b>	<b>8.8</b>
Russian Federation	131	224	155	11.1	14.8	12.2

Source: Health for All Database of the WHO

\*Data sorted according to SDR for 2009

Ukraine takes a leading position in terms of levels and shares for mortality from circulatory system diseases. The SDR for 2007-2010 was equal to 761 deaths per 100 000 standard population, which is a bit higher than in Russia (705), almost five times higher than on average for the EU (176), and eight times higher than in France (93). More than 60% of deaths in Ukraine are caused by such pathologies. Other Eastern European countries that managed to navigate through cardiovascular revolution succeeded in decreasing this share to 50%, and such a developed country as France even reduced it to 24%. The impact of trends in mortality from circulatory diseases on the evolution of life expectancy at birth is incontestable in Central European countries. After numerous years of steep increase, mortality from circulatory diseases has started to decline everywhere exactly at the same moment as life expectancy was beginning to increase (Meslé, 2002).

Expectedly high SDRs in Ukraine are observed from violent mortality. Only Russian mortality (155 in 2007-2010) is higher than Ukraine (111), and Belarus is somewhat close to Ukraine's level, which points one more time to the social origin of this type of mortality. This group of causes of death was the most sensitive to the large fluctuations of the last fifteen years. With Gorbachev's anti-alcoholic campaign, mortality declined for the four main components of violent deaths, but especially for accidental poisoning (which includes alcohol poisoning) and suicide. As for the share in mortality structure, 8.8% of all deaths in Ukraine are due to external causes, which are a bit higher than in European Union countries (5.8%) but lower than in Russia, where 12.2% of people die from something other than diseases.

SDRs from diseases of the digestive system in Ukraine do not deviate significantly from Europe, neither by levels, nor in relative proportions.

At the same time, we see that Ukraine is among countries with the lowest mortality from neoplasms and respiratory system diseases. For both classes, Ukraine is on the same side with Belarus and France, where mortality from these causes is decreasing as well. Cancer mortality is declining in most industrial countries, thanks to early screening (which is not, however, the case of Ukraine). While levels of mortality from neoplasms are approximately the same, their share in mortality structure in given countries is different. Ukraine's share of cancers is one third that of France and of the average for EU-2004 countries. A similar situation occurs with respiratory system diseases, where Ukraine's proportion of respiratory mortality is half that of developed countries. A low share of people dying from cancer is evidence that they don't survive till very old age and die earlier from other causes.

In the next sub-chapter I review the interregional variation of death rates for each cause of death separately. The maps presented next are similar to those in Chapter 5, though the legends are different because they were calculated based on the data of three reference

periods, in order to put values on the same scale. For this reason, in better periods it appears that death rates fall only into lower interval groups, while for the worst period they fall only into higher interval groups. This makes the maps rather of the same colour and does not exhaustively reflect the variation. On the other hand, such maps depict the contrasts and extreme situations well, and such an approach is acceptable for performing the comparisons.

### **6.2.1 Circulatory system diseases**

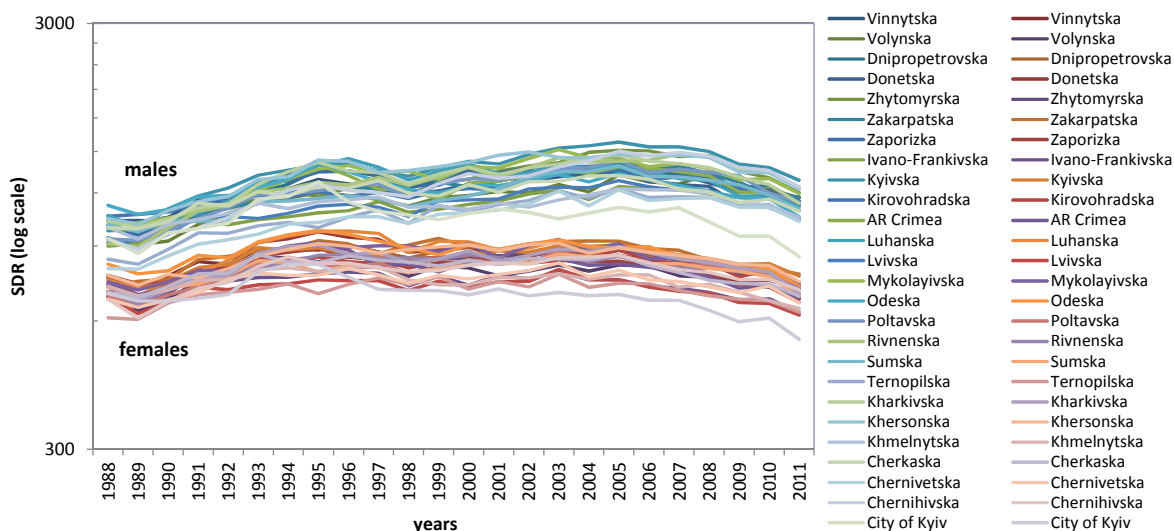
Circulatory system diseases are the biggest killer in Ukraine. They are responsible for around 65% of all deaths, and it is this group of causes that governs the general mortality trend and determines the overall mortality pattern across regions. France Meslé and Jacques Vallin (2012) note that this expansion in diseases of the circulatory system is a phenomenon very largely shared by other European republics of the former USSR, namely Russia and the Baltic States.

The years 1988-1989 were marked by a concomitant reduction in mortality from diseases of the circulatory system, thanks to the anti-alcohol campaign. However, at the same time, the link is not very clear, since this low level resulted from the drop that had been under way since the very early 1980s (Meslé and Vallin, 2012). During the 1990s, mortality from this group of causes of death started to rise and was increasing constantly and simultaneously in all regions, culminating around 1995 (*Figure 6.9*). From 1995 to 2007, mortality from CSD was stagnating at a pretty high level. Levels of male mortality have been always higher than those of females. SDR increased strongly again, as 1999 gave way to 2000 for males whereas it stayed at fixed levels for females. This created an even larger intergender gap. Only beginning from 2008, death rates from CSD started to decrease, though it is still two to three times higher than in other Eastern European countries.

In *Figure 6.9*, one may also see one exception, an area that has lower mortality than in any region of Ukraine for males as well as for females. This is the capital of Kyiv. The trends observed for Kyiv are less pronounced than for other regions; mortality did not experience an abrupt increase and started declining earlier than in other parts of Ukraine.

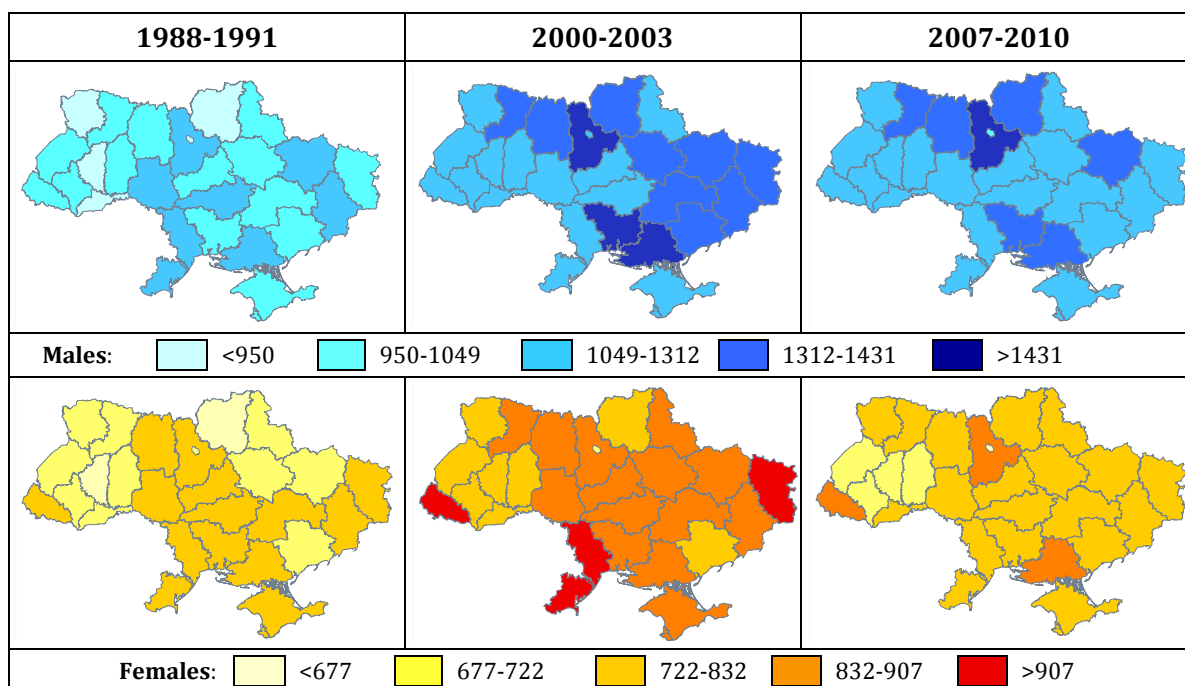


Figure 6.9: Trends of SDR from circulatory system diseases by regions, 1988-2011 Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

Figure 6.10: Geographical patterns of SDR from circulatory system diseases, Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

The interregional pattern of mortality from this group of causes reveals that, at the beginning of the study period there were no patterns observed. Western regions were in a somewhat better position though, in general, the situation was rather smoothed across the country (Figure 6.10). During the years of crisis, the situation has worsened in almost all regions. The crisis badly hit the entire Ukraine with about the same force.

Since then the situation has ameliorated though, some scars remained. This is a dark area of high male death rates in the north, which includes the zone of radioactive contamination created by the explosion in the reactor of the Chernobyl Nuclear Power Plant. Surprisingly this is not mortality from neoplasms that is abnormally high there, but mortality from circulatory system diseases. Such degradation of the situation in the north is a main feature of recent mortality changes in Ukraine and is a main characteristic of interregional variation, since circulatory system diseases are responsible for most of the deaths in Ukraine.

On the other hand, while northern regions did not manage to recover, western regions returned to almost their pre-crisis level of mortality from circulatory system diseases.

### **6.2.2 Neoplasms**

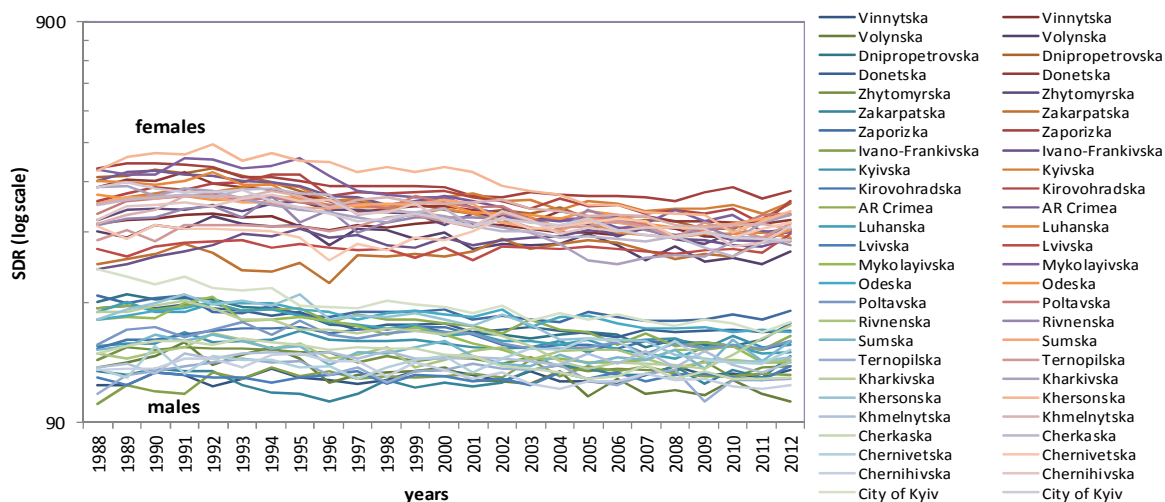
The level of cancer in Ukraine is not that high compared to other countries, as was shown in *Table 6.2*. On the other hand, neoplasms in Ukraine occupy the second place in mortality structure. They were slightly outstripped by violent deaths at the end of the 1990s (in the case of males), but later retook their second position again. Nevertheless, mortality curves for all regions show a clear downward trend (*Figure 6.11*) and, as Meslé and Vallin note (2012), one may observe that recent trends in mortality from cancer are totally absent of any links to political, economic and social circumstances in the country.

Such a low cancer mortality rate in comparison with Europe may be because premature mortality from circulatory system diseases and external causes somewhat reduces the number of elderly persons exposed to the risk of cancer. The same opinion is shared by Vladimir Shkolnikov (1999), who says that the decline in mortality from malignant neoplasms can be explained in part by the explosion in mortality from other causes resulting from the 1992-1995 economic crisis. This carried off a growing number of people suffering from cancer before they had time to die from the disease.

The other characteristic of cancer mortality in Ukraine is its high lethality, especially at young old ages (Menon et al, 2009). The explanation for this is the difficulty in accurately and timely diagnosing a cause, given the lack of modern screening equipment.

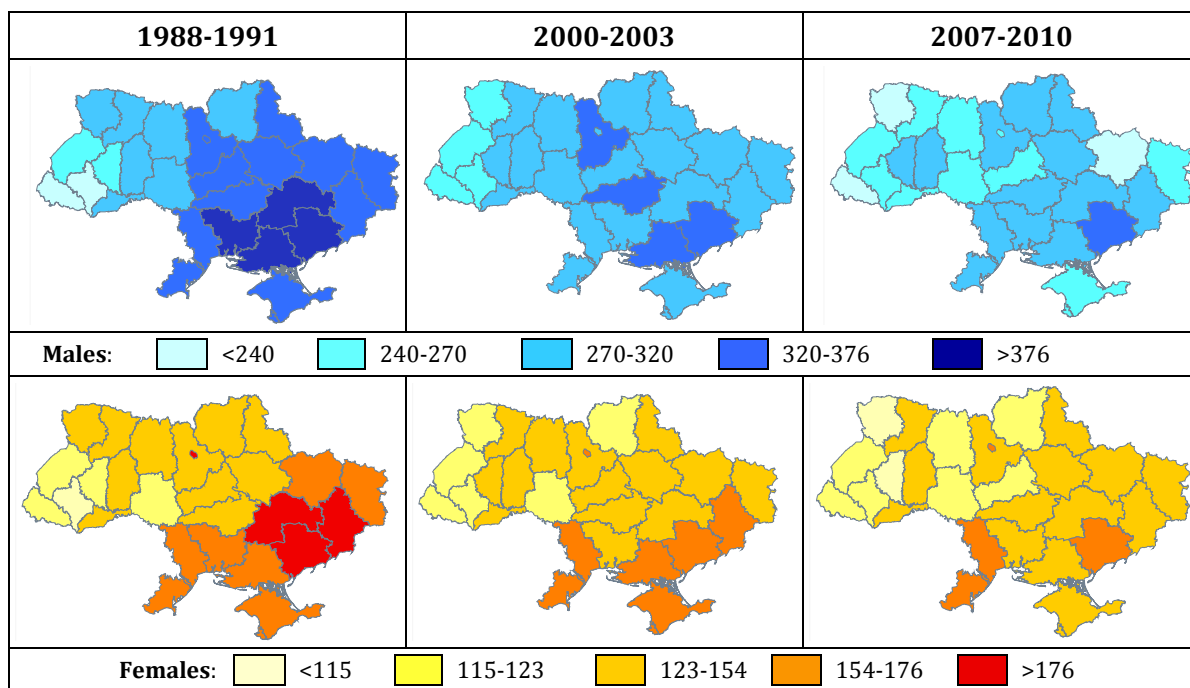
Women in Ukraine die from cancer at twice the rate of men. Among cancers, the most frequent localization is the breast and the uterus for females, and the stomach and the lung for males. Also remarkable is the convergence of male and female regional trends at a fairly high death rate level in the 2000s.

Figure 6.11: Trends of SDR from neoplasms by regions, 1988-2011 Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

Figure 6.12: Geographical patterns of SDR from neoplasms, Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

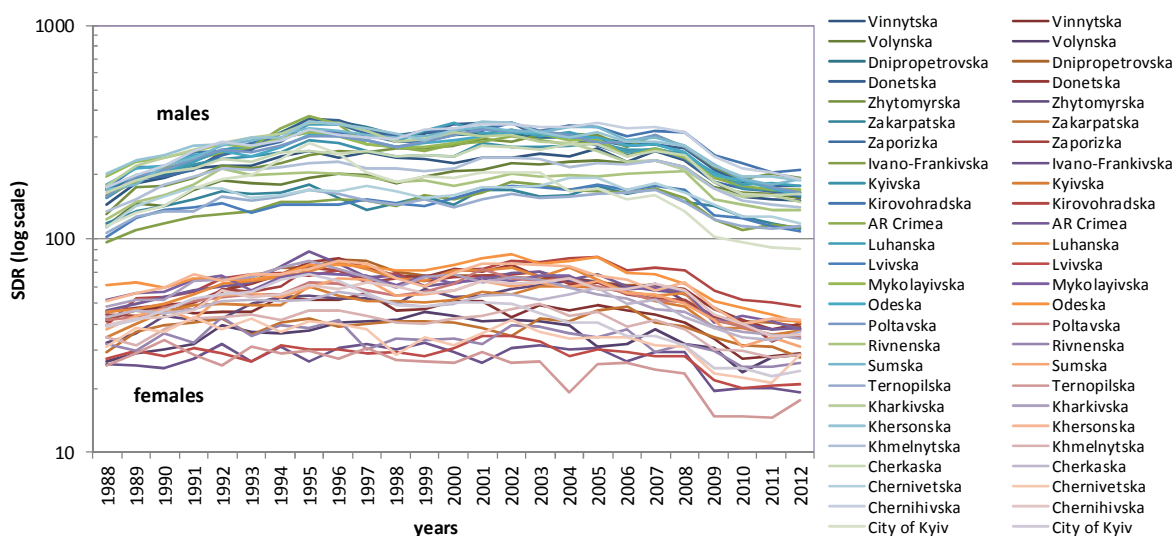
Interregional patterns indicate a constant amelioration of the situation over time for both males and females (Figure 6.12). A fairly clear contrast existed between west and east for males, and west and south for females in the beginning of the period, and then almost disappeared in the 2010s. It should be noted that Zaporizka oblast (in the South) stands out against the background of other regions in all three periods and evenly for males and females. This may be rather a positive phenomenon arising from good screening and coding practices.

### 6.2.3 External Causes

The third most important group of causes of death is the group of external or violent causes. Throughout the study period, external causes (together with circulatory system diseases) have been influencing the direction of mortality trends in Ukraine. In all regions, the launch of the Gorbachev anti-alcohol campaign brought a pronounced fall in mortality from injury and poisoning, which is still reflected in the years at the beginning of a study retrospective (Figure 6.13). Since then, as with diseases of the circulatory system, there was a substantial rise in the following years until 1995, which happened simultaneously with transformation processes in the society. Contrary to neoplasms, which are not sensitive to immediate circumstances, mortality from injuries and poisonings is the most responsive to the fluctuations. A short downward trend that occurred between 1996 and 1998 was followed by an immediate increase in 1999. The main causes for the rise in deaths from external causes in Ukraine were a deterioration of the economic situation, growing psychological stress, relaxation of previous occupational safety and a return to drinking patterns seen before the 1985–1986 anti-alcohol campaign.

In 2008 a sharp decrease in violent mortality was observed and the tendency continues declining. The peculiarity of this decline is that it occurred simultaneously for males and females as well as for all regions. However, in the case of males, some convergence of SDR series was observed for regions; while in the case of females, SDR from external causes in some regions was decreased much faster than in others where divergence appeared.

Figure 6.13: Trends of SDR from external causes by regions, 1988-2011 Ukraine

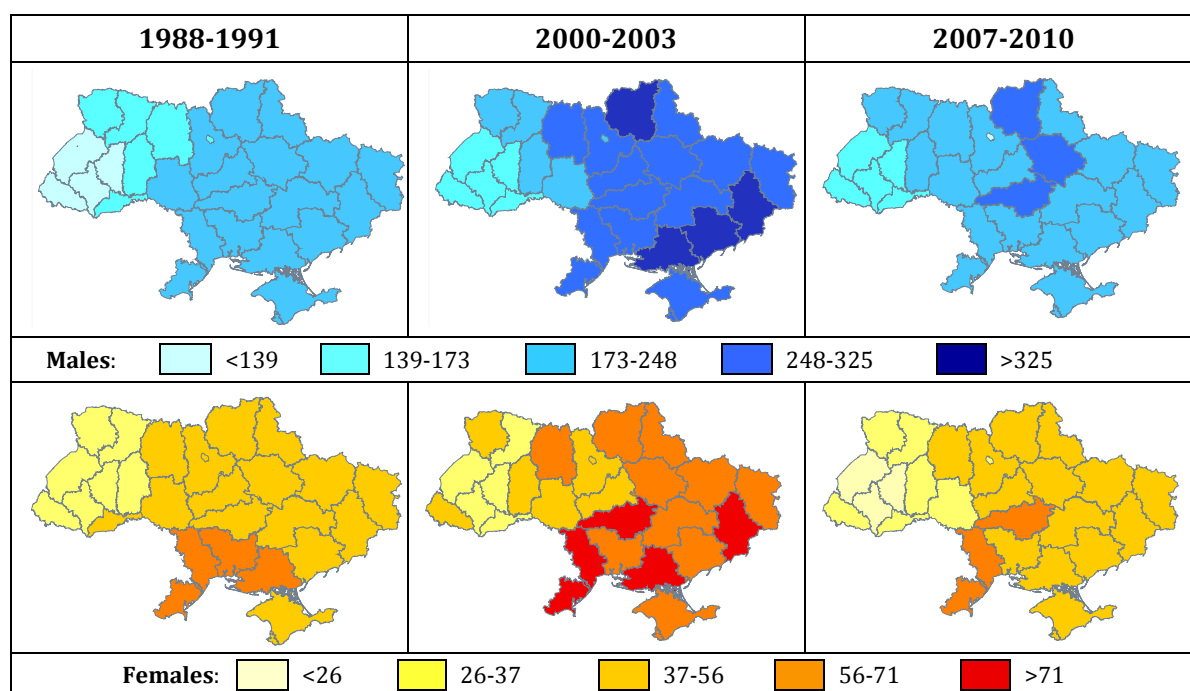


Source: Calculated using data of the State Statistics Service of Ukraine

To be precise, external causes include: unintentional injuries, poisoning, drowning, falls or fires, transport accidents, suicides, and homicides, etc. The most important external cause of death in Ukraine for both males and females (especially at working age) is unintentional poisoning. An important sub-category of unintentional poisonings is death by alcohol abuse, which may lead to death directly and indirectly. The latest may involve a number of transport accidents. In addition a large proportion of crimes are committed by men and women while intoxicated, and in a majority of cases the victims of homicide are also intoxicated at the time of the crime (Marquez, 2005).

Looking at the graph and maps (*Figure 6.14*), one may note that this group of causes contributed a lot to the fluctuations in mortality trends as well as to the geographical divergence between regions. The situation has worsened extremely during the years of crisis. In the period around 2001 Ukraine was sharply divided into two parts: only western regions managed to keep low death rates, while the rest of Ukraine plummeted into violent mortality. The southern regions and Chernihivska oblast were the most badly affected. Being responsive to social processes, death rates from violent mortality recovered as soon as the crisis was over. The problem remains acute for males in Chernihivska oblast, for females in Odeska oblast, and for both sexes in Kirovohradska oblast.

Figure 6.14: Geographical patterns of SDR from external causes, Ukraine



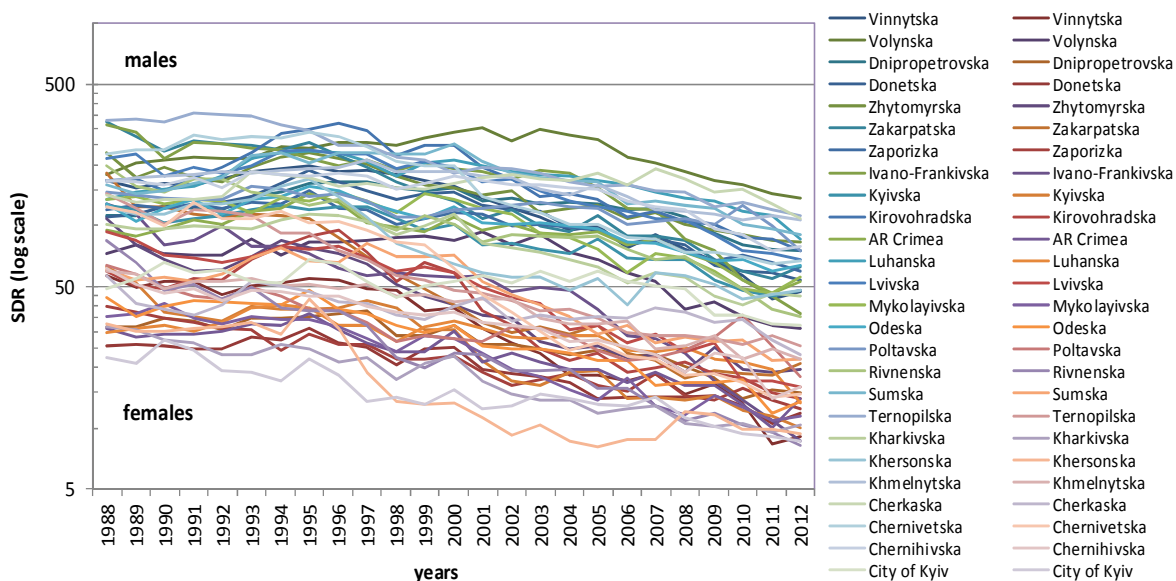
Source: Calculated using data of the State Statistics Service of Ukraine

### 6.2.4 Respiratory system diseases

Mortality from respiratory diseases, still very substantial in the late 1960s, has declined markedly since then, despite a significant upsurge particularly among males in the mid-1990s (*Figure 6.15*). Since 1995, mortality from diseases of the respiratory system organs showed a clear downward trend. The economic crisis triggered by the transition to a market economy reduced industrial pollution emissions and altered tobacco consumption habits through price increases and the wider availability of less harmful imported tobacco products (Meslé and Vallin, 2012). Nowadays, it occupies fourth place and is almost equal to SDR from diseases of the digestive system, which themselves have greatly increased.

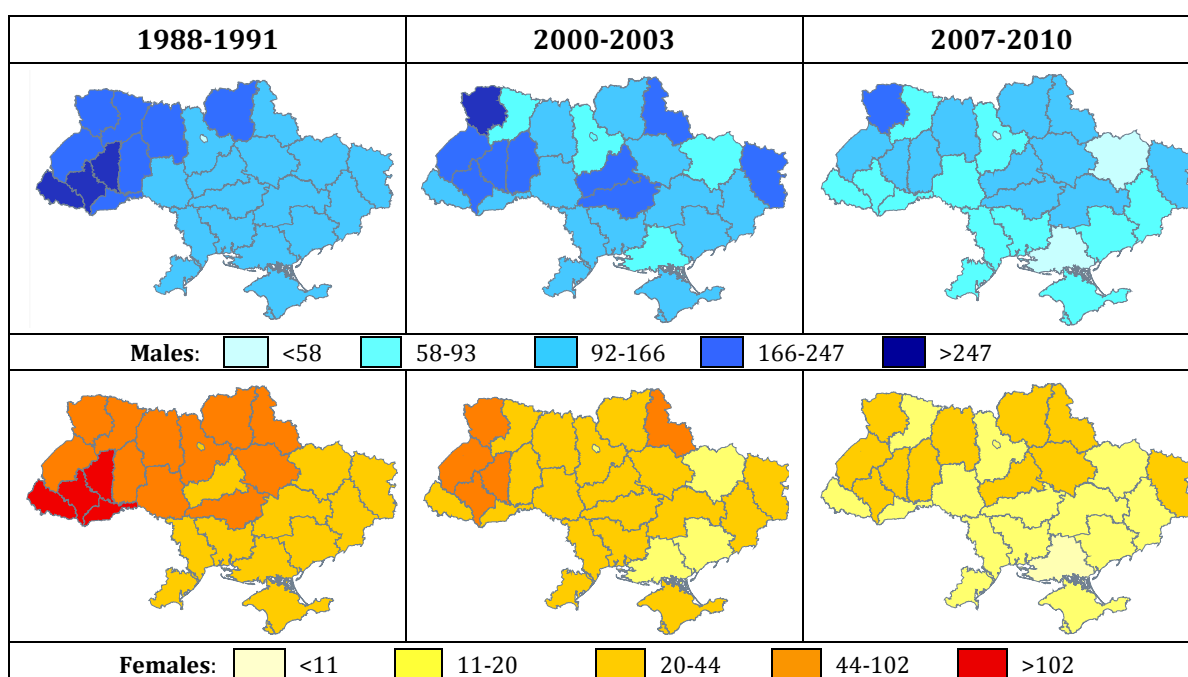
The geographic patterns of mortality from respiratory system diseases are unique (*Figure 6.16*). It is the only group of diseases provoking mortality in the west that is higher than in the east. The contrast was very sharp in the beginning of the study period; and even though levels of death rates have decreased substantially everywhere, it still can be tracked nowadays.

Figure 6.15: Trends of SDR from respiratory system diseases by regions, 1988-2011 Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

Figure 6.16: Geographical patterns of SDR from respiratory system diseases, Ukraine



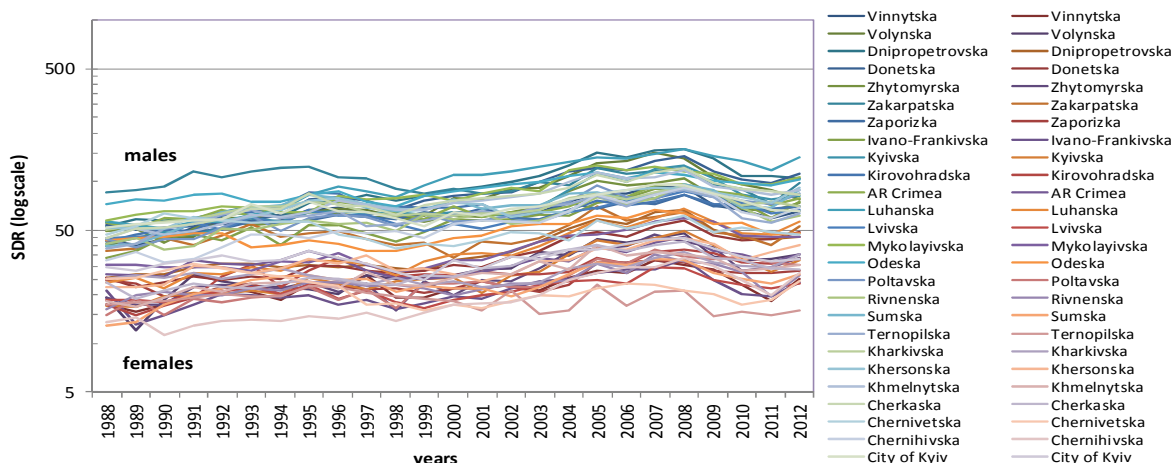
Source: Calculated using data of the State Statistics Service of Ukraine

### 6.2.5 Digestive system diseases

Mortality from digestive diseases increased regularly throughout the whole period to the point where it reached the same level as mortality from respiratory diseases. The deterioration that started at the end of the anti-alcohol campaign was also just as substantial for digestive system diseases as for deaths from injury and poisoning. In the case of digestive system diseases, it continued increasing until 2008. In 2008, it reached its climax, after which it began to decline. However, recently this trend has been replaced by an upward tendency.

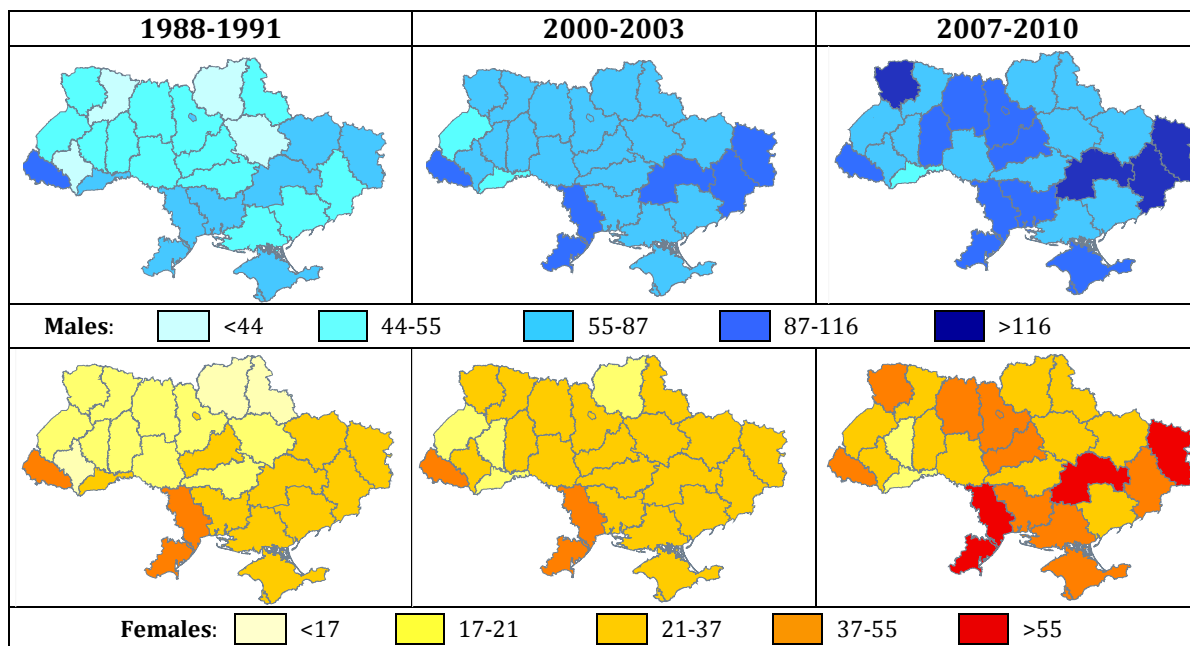
When looking at interregional variation, the contrast between the south-east and north-west has remained visible since the beginning. The marked zone of risk is in the south: an alarming situation remains constant for males in Khersonska, Zaporizka and Donetsk oblasts; and for females in Odeska, and Kirovohradska oblasts. Suspiciously high death rates from digestive system diseases are in Zakarpatska oblast in the west, whose mortality profiles are closer regarding to the east of Ukraine than to its neighbours, which is also the case for circulatory system and infectious diseases.

Figure 6.17: Trends of SDR from digestive system diseases by regions, 1988-2011 Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

Figure 6.18: Geographical patterns of SDR from diseases of the digestive system, Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

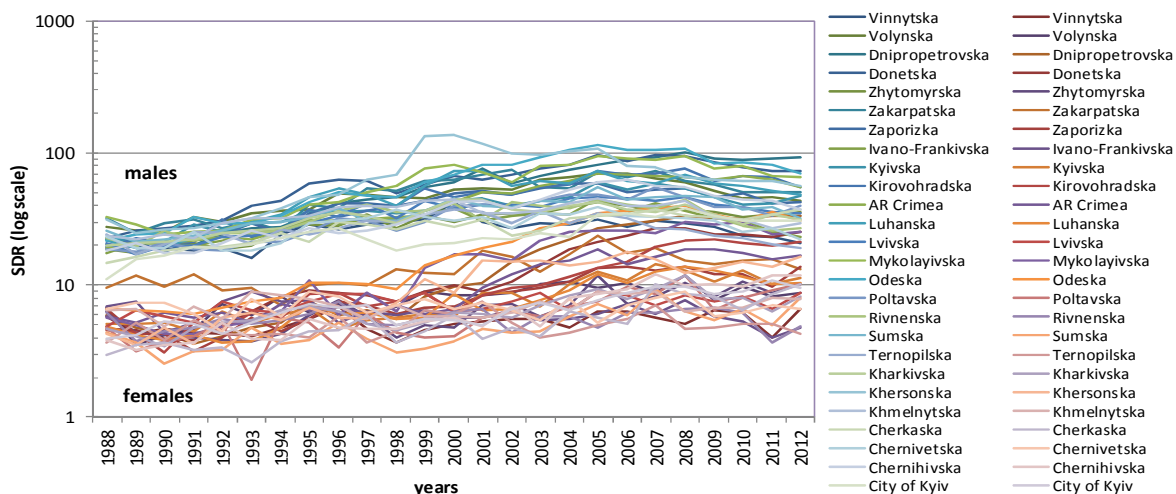
### 6.2.6 Infectious and parasitic diseases

Another emerging health problem in Ukraine is related to the growing importance of the increase of mortality by infectious diseases. Infectious mortality is completely ruled by tuberculosis. *Figure 6.19* shows the increase and interregional divergence in the mortality from infectious diseases over the course of time. The increase was paradoxically as substantial as the decrease in mortality from infectious diseases during the 1960s-80s (not captured by the graph), which was one of the main achievements of the Soviet health care system. The increase



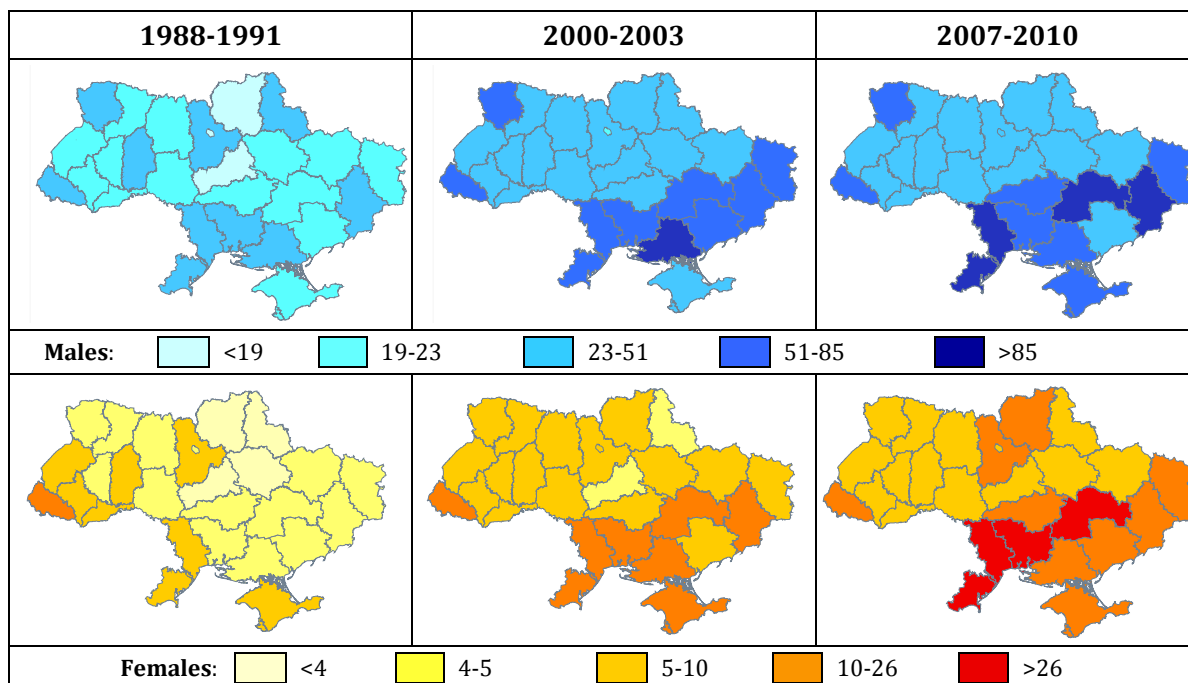
started in the 1990s and turned into a large surge in death rates, which was accompanied by a divergence of time series among regions and between sexes. A tendency for improvement began in 2009, though the situation nowadays is incomparably worse than at the end of the Soviet epoch.

Figure 6.19: Trends of SDR from infectious and parasitic diseases by regions, 1988-2011  
Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

Figure 6.20: Geographical patterns of SDR from infectious and parasitic diseases, Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

The geographical localization has reversed as well (*Figure 6.20*). As at the end of the 1980s, there were certain western regions suffering more than other regions from infectious and parasitic killers (especially in the case of females). Beginning in the 2000s, a large southern Odesa-Luhansk belt appeared in opposition to the rest of Ukraine. The Odesa-Luhansk vector is also observed for digestive system diseases, which somewhat corresponds to the geography of mortality from infectious diseases.

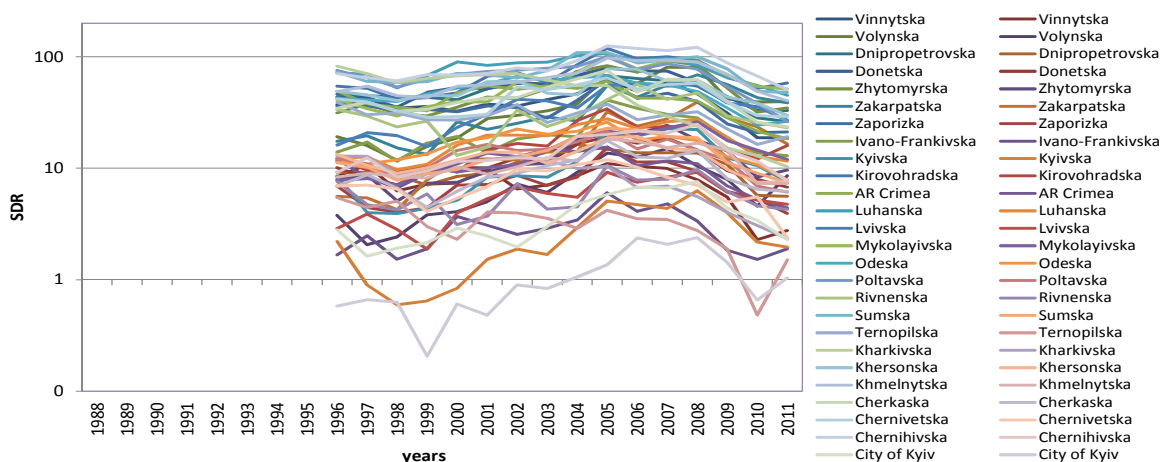
### **6.2.7 Alcohol-related causes**

This last subsection is different from the previous because a given group of causes is not an independent class from ICD10, but just a regrouping of different diseases in order to track alcohol-related mortality. This group includes three specific categories: alcohol psychosis, alcoholic cirrhosis of the liver and accidental poisoning by alcohol.

Because cause-specific detailing of data is not available by regions until 1996, we cannot observe trends at that time. We know from the literature that mortality was low in the beginning of the 1990s, when the anti-alcohol campaign of Gorbachev resulted in a significant reduction in mortality. After the end of the campaign, a fresh upsurge in male mortality manifested itself from 1990 onwards, and rose until 1995 without a break (Meslé and Vallin, 2012). A small decrease in 1997 - 1999, was replaced by an increase, which lasted until 2008.

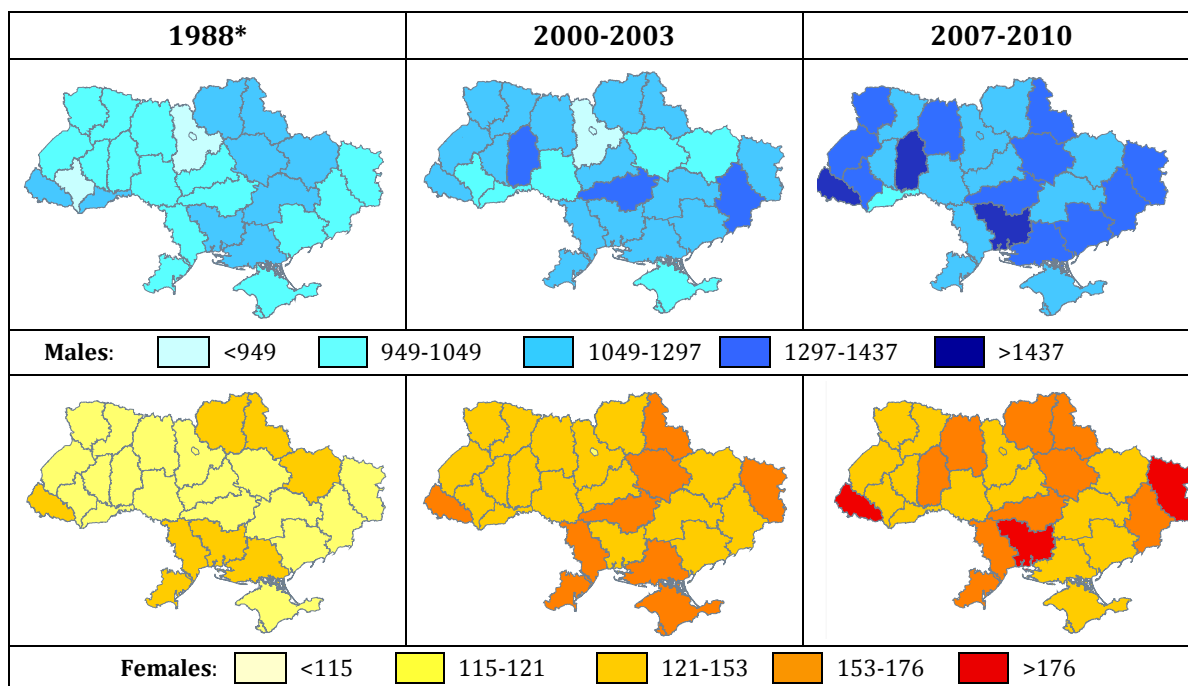
Maps in *Figure 6.22* indicate the opposition between the western and eastern parts of Ukraine according to alcohol-related mortality. This contrast corresponds to mortality from external causes. Since alcohol-induced causes include also some diseases of the digestive system (alcohol liver disease), which geographically prevail in the south, it corresponds to observed patterns in the current period. Another noticeable phenomenon on the map is that alcohol-related mortality is high in regions that have high mortality from infectious diseases and digestive system diseases. Namely, this is Luhanska and Zakarpatska oblast, which are found on two opposite sides of Ukraine.

Figure 6.21: Trends of SDR from alcohol-related causes by regions, 1988-2011 Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

Figure 6.22: Geographical patterns of SDR from alcohol-related causes, Ukraine



Source: Calculated using data of the State Statistics Service of Ukraine

\* Data only for 1988, because this year was digitalized manually while data for the years 1989-1995 was provided by SSS only for broad classes, which is insufficient for analyzing separate alcohol-induced causes of death.

## Conclusions

During two decades, life expectancy in Ukraine experienced a sharp decrease, then stagnation followed by recovery. The recovery was not a mirror image of the initial situation. While at first glance it seemed that Ukraine had recovered what it had lost during the years of crisis and stagnation, a closer look one may convince us that this is not completely true.

The variation in mortality for males and for females was the lowest in 1989 throughout the three periods. The coefficient of variation almost doubled in consequent years when compared to the beginning of the study period.

Different regions experienced changes at a different pace: in some regions, the decline in life expectancy occurred faster than in others and, as a result, the difference between maximum and minimum values increased. Lifespan disparity also increased for most regions (except western).

The opposition between the north-west and south-east was visible even in Soviet times. At the moment of the first all-Ukrainian census, it was a bit blurred by the overall critical situation. Since then, the situation ameliorated for a number of western regions, though it has never reached the 1989 level. On the other hand, eastern regions still bear the scar of crisis.

The nosological profiles were not the same in the three periods. The trends of mortality from most causes (except the biggest killers) continue their course, which is the one that started at the beginning of the study period. To be more precise, first, circulatory system diseases preserved their role as major killer and no advances were made in their prevention and treatment. This class of diseases is responsible for 60 to 70 percent of all deaths, and the trend increased throughout the whole period. However, a small improvement was recently observed, though it is yet not clear how long it will last.

Second, the SDRs for neoplasms are constantly decreasing. Mortality curves for all regions show a clear downward trend, which is completely unlinked to political, economic or social circumstances in the country.

Third, after boosting, mortality from external causes returned to its initial level, which is, however, menacingly high.

The remaining trends for other classes follow the same direction: respiratory system mortality constantly declined; digestive system and infectious mortality constantly grow.

As for the spatial dimension, mortality improved the most in the regions that suffered the most during transformations, i.e., those in the east. At the same time, western regions appeared to be less vulnerable and less reactive.

Diseases of the circulatory system, which shape the main patterns of regional mortality, have affected the most northern and southern parts of Ukraine. The main characteristic of the interregional variation of SDR from circulatory system diseases is a total degradation of the situation in the north, since this class is responsible for the most of the deaths in Ukraine. The appearance of the most nearly poorly performing Chernihiv oblast on the map after 2001 is a phenomenon of recent times; no such feature was ever observed before. It may also be associated with the Chernobyl disaster.

Mortality from cancer has notably decreased and has spread rather homogenously. Regions with the highest death rates could actually be the best organized ones in diagnostic and financing of special treatment centers.

Finally, the sharpest contrast between eastern and western Ukraine is observed for external or violent causes of death. The situation had greatly worsened during the 1990s, reflecting the consequences of the economic crisis. External causes proved to be very sensitive to changes in society, and mortality levels after have returned to their pre-crisis position after a big jump.

Diseases of the respiratory system are the only group of causes that prevails in western Ukraine more than elsewhere. However, as the situation improves, this contrast is smoothed over.

Patterns of mortality from infectious and digestive system diseases somewhat overlap. To be precise, diseases of these classes prevail in the south and east of Ukraine, and also in Zakarpatska oblast.

## Chapter 7

# Analysis of mortality across districts

### 7.1 Description of districts

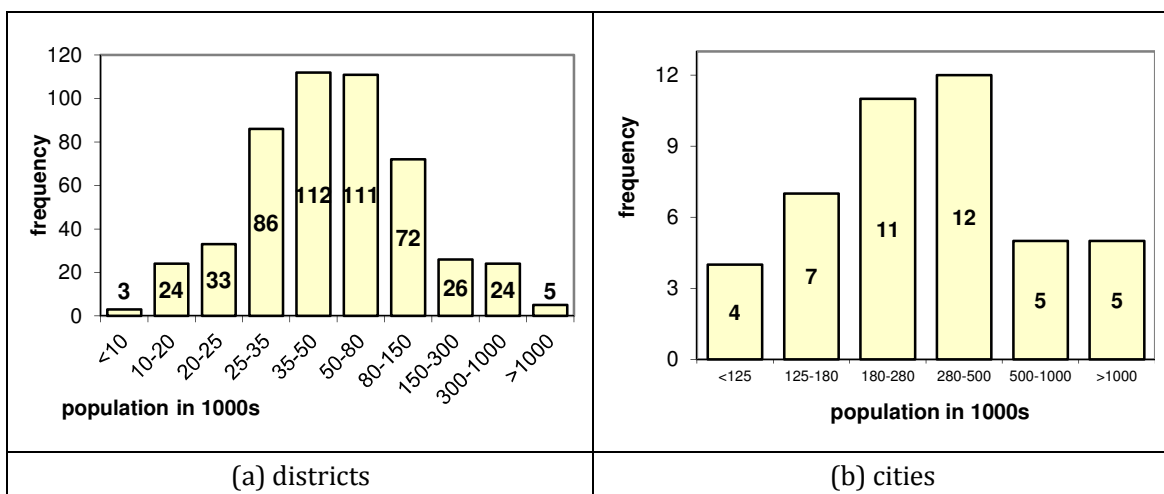
This chapter presents a similar analysis to the one presented in previous chapters but at the more profound level of districts. When studying interregional variation, one should realize that regional figures are averages for large geographical entities, and that important internal patterns may be smoothed. To answer the question as to whether regions are homogenous or heterogeneous inside themselves, one needs more detailed information. For example, comparisons could be made for urban and rural zones separately, though this does not give a comprehensive answer about the role of big cities. For this purpose, I use data detailed by districts.

Luckily the last census (2001) provided the population structure for districts and for the biggest cities in each region. On the other hand, mortality data at the same level of division is available only from 2005. Therefore, mortality patterns at the district level can only be investigated for recent years (starting from 2005). Because at this level annual fluctuations are significant, data were aggregated for the years 2005 to 2010.

As said in the first chapter, there are 27 regions in Ukraine, which include 24 regions themselves, the Autonomous Republic of Crimea (AR Crimea), and two cities of state importance: Kyiv and Sebastopol. The 25 regions are further subdivided into 490 districts and 174 cities of regional or republic (for AR of Crimea) importance. For the sake of simplicity, I affiliated cities of regional importance to the area where they are physically located and received 496 districts that act as observation units in the analysis. Those six agglomerations that could not be affiliated are kept separately, as was described in Chapter 3.1. These are 4 agglomerations that shape the South Bank of Crimea (Alushta, Sudak, Feodosia and Yalta), as well as the Sebastopol and Dnyprodzerzhynks agglomerations.

Figure 7.1a presents the distribution of districts according to population size. Districts with a population of 25 to 150 thousand people represent 80% of all districts. Districts that have a population of more than 150 thousand but less than 1 mln people account for 10%. And 5% corresponds to districts with very large (over 1 mln) and very small (less than 25 thousand) populations in each group. For the analysis, this means that districts may not be treated equally, as some are huge and densely populated and others are tiny. Because of this, whenever I construct a model I use weights represented by the number of live births.

Figure 7.1: Frequency distribution according to the population size, census data (2001)



It is worth mentioning that, according to Eurostat guidelines, NUTS-3 regions should have a population of between 150 000 and 800 000 people (Kibele, 2012). Therefore, only the largest Ukraine's district would have corresponded to NUTS-3 if this system had been in place in Ukraine.

Asides from regions and districts, I am also particularly interested in situations in big cities, for which I luckily also have some data. For the analysis, I selected 44 big cities that have

population of more than 100 thousand people (*Figure 7.1b*). There are five cities with more than one million people in Ukraine: Kyiv, Kharkiv, Dnipropetrovsk, Donetsk, and Odesa. There are also five cities that range from half to one million inhabitants; two of them belong again to the Donetsk and Dnipropetrovsk regions (listed above). Only one among all of the above-mentioned cities is situated in the west; this is the city of Lviv. The rest, except Kyiv and Odesa, are found in the east of Ukraine. Aside from these metropolises, 23 out of 44 cities (or 50%) have populations from 180 to 500 thousand people. The rest are rather smaller towns which, however, were selected because they act as regional centres and are probably better positioned to fight mortality when compared to other towns in a region.

## 7.2 Infant mortality

This sub-chapter pays particular attention to infant mortality using detailed district data. It is different from previous chapters (where only general maps of infant mortality were presented) in that it includes some statistical analysis to investigate internal relations.

The infant mortality rate defined as a risk for a live-born child that dies before its first birthday is known to be one of the most sensitive and commonly used indicators of the social and economic development of a population (Masuy-Stroobant, 2001).

In recent times Ukraine has achieved certain success in saving the lives of newborns. However, the mechanism, which worked well in the 1980s, has exhausted its potential, and new means are needed to reinforce the fight for the lives of newborns and to catch up with European countries. These new mechanisms are shaped by the current realities in Ukraine, and one may try to identify them by referring to the fact that infant mortality is lower in certain regions and higher in others.

The level of infant mortality in Ukraine is not very high (9.1 infant deaths per 1000 live births in 2010) compared to the one observed in 1980 (19.1 per 1000<sup>20</sup>) and this is no longer the driving factor of high mortality in Ukraine.

The current figure is a result of two contrary developments. The first development is associated with successes in decreasing infant mortality in the last few decades. This happened thanks to improvements in medicine, living conditions, immunization policy, etc. For children less than one year of age in Ukraine at that time, immunization coverage was

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<sup>20</sup> Including correction for the change of definition

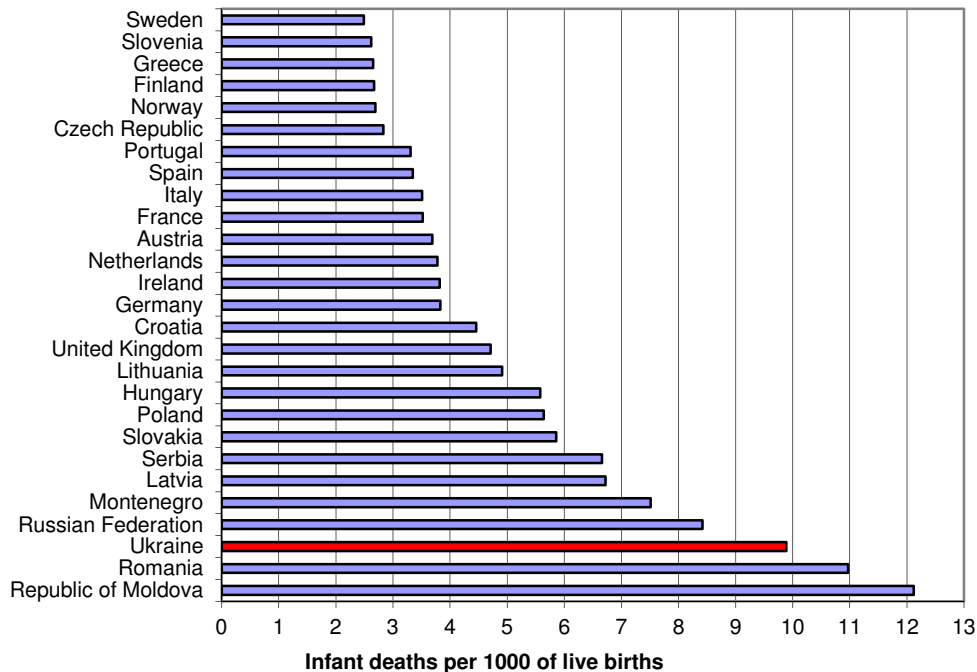


above 95% against tuberculosis, diphtheria, poliomyelitis, tetanus, pertussis, measles, rubella, hepatitis B. High priority was given to maternal health and a large network of clinics named “Maternal and child consultation” was created. Thanks to these efforts, infant mortality from diseases of the respiratory system started to decrease in 1975. Almost at the same time, mortality from infections began to diminish at almost the same rate as mortality from diseases of the respiratory system (Meslé and Vallin, 2012). These successes allowed for gains in life expectancy.

On the other hand, reduction is observed on the scale of live births, whose restricted definition excluded the most vulnerable babies from infant mortality measures. Therefore, the actual magnitude of the indicator was probably higher. The extent to which such a definition could have had an impact has been discussed by many researchers (Anderson and Silver, 1986; Velkoff and Miller 1995; Kingkade and Sawyer, 2001; Levchuk, 2002; Aleshina and Redmond, 2003; Meslé et Vallin, 2003, etc.) until the real switch happened in 2007. This finally enabled a precise correction, which increased the attained level of IMR by around 17% and partly exacerbated the achievements of recent years in preventing the death of infants (see Chapter 3.3.2).

Therefore, there is still a room for improvement. One may be convinced by comparing Ukraine with other European countries (*Figure 7.2*). The closest western neighbour, Poland, whose situation was even worse than Ukraine’s at the beginning of the 1990s, succeeded in reducing IMR by a factor of 3 and by 2009 its IMR was equal to 5.6, compared to 16 deaths per 1000 live births in 1993. Now Poland can be fairly placed next to the United Kingdom, where IMR equaled 4.7 in 2009.

Figure 7.2: Infant mortality rate in Ukraine and some European countries, 2008



Source: WHO "Health for all" database

On the other hand, the literature identifies some determinants of the high mortality of infants that are possible to deal with and do not require large investments. Professor Maidannyk, the chair in paediatrics at the National Medical University points to several problems in this field. The first one is related to the preparation of midwives and paediatricians. Instead of investing in quality improvement for children's doctors, the reform of medical education planned to suppress this medical specialty. As a result, between 2000 and 2006, Ukraine did not have any paediatrician graduates. A third of those practicing were already retired<sup>21</sup> of age 70 and older (Maidannyk, 2006). Even children's-clinics in the city of Kyiv were staffed at only 20-30%. As for Ukraine as a whole the number of children's doctors was almost halved during last few decades; and as a result there was a number of districts that were supplied by only one specialist for the entire district. Moreover, disregarding already a great deficit of paediatricians, it was this branch of medicine that was chosen for re-qualifying doctors into generalists in the framework of reforming the health care system and creating family medicine.

The underestimation of the wrong role of doctor-paediatrician comes from the abuse of high specialization in Ukraine's health care system, disregarding the first link of medical care.

<sup>21</sup> In Ukraine the Law permits to be retired and to work receiving both pension and salary at the same time.

Very often mothers avoid contacting a child's doctor and refer directly to the specialist. In their turn, local paediatricians often restrict themselves to only giving references. Such a role of a dispatcher who redirects patients may work well for adults, but is not acceptable for children, as the peculiarities of their growth require the intervention of a competent professional who is specially trained in this field (Maidannyk, 2006).

Another point of focus is the so called "modern perinatal technologies" (Barsukova, 2006 (interview with Kaminskyi V.)). They include the availability of individual maternity rooms, which create a positive experience in delivering a baby, so that woman does not face a fear of hospitals and thus delivery. Individual maternity rooms can be situated in a separate hospital ward, where the woman can give birth to her child in already familiar conditions. This is to insure the least stress and to prevent the spread of hospital infections.

However, Professor Kaminskyi identifies the other side of this situation, a phenomenon called "obstetrician aggression" (Barsukova, 2006). This happens when doctors tend to accelerate the delivery for some reason. As there is no mandatory health insurance in Ukraine, there is no such agent as an insurance company who can control the real necessity of surgical intervention. Such practice of speeding up the physiological course of pregnancy results in an increased number of caesarean sections, as well as delivery and post-delivery complications.

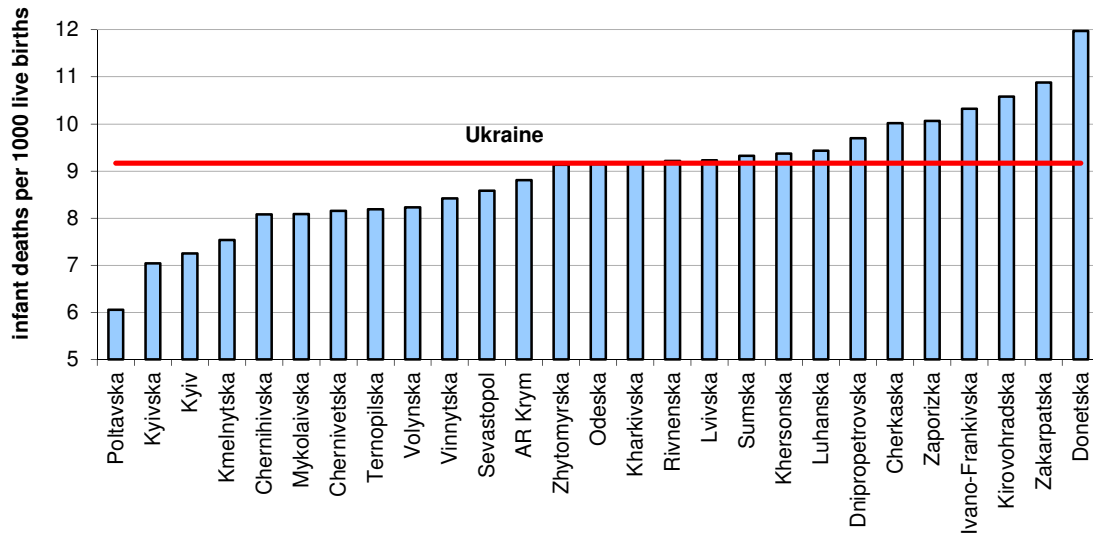
The extent of these problems is not the same in every region. When looking at the geographical distribution of infant mortality rate by regions in Ukraine, some well and poorly performing regions are contrasted (*Figure 7.3*). Such links between individual-level social inequalities and regional (aggregate level) differences are partly explained by the relatively high spatial concentration of the deprived and of lower social class populations (Masuy-Stroobant, 2001).

The coefficient of variation of the infant mortality rate across regions is around 17%. The highest level of IMR (12 deaths per 1000 live births) is twice that of the lowest level (6 death per 1000 live births). These disparities indicate that there are some means for improving the situation, that there might be some positive experience that should be considered in deprived regions.

High infant mortality rates discovered in certain regions uncover insufficient efforts to save children. The early deaths are related mostly to the possibilities of obstetric, perinatal and neonatal medical services. In general, there is still a problem for rural dwellers regarding the

accessibility to prenatal and postneonatal diagnostics that reveal pathologies (Levchuk N. *et al.*, 2007). This drives up the differences between mostly urban and mostly rural regions.

Figure 7.3: Regional variation of infant mortality in Ukraine, 2010



Source: Data of the State Statistics Service of Ukraine

The documented differences between rural and urban areas go as far back as to the beginning of XX century. Infant mortality at that time was usually higher in rural districts than in the cities. This was apparently associated with the widespread illiteracy and the low economic level of the Russian peasantry (Lorimer, 1946). A drop in infant mortality, observed in the second half of the 1990-s, resulted in convergence rural and urban IMRs (Levchuk N. *et al.*, 2007). It should be noted that when a new definition went in force, the increase in IMR became more pronounced in rural than in urban area, which widened again an existing gap.

In order to test which variables are important in shaping patterns of infant mortality, one may run a regression model. According to the concept of Masuy-Stroobant (2001), the framework of analyzing child survival includes dependent variables, proximate determinants, and socio-economic determinants. The latter are grouped into three broad categories of factors: individual-, household- and community-level factors. In my case neither individual nor household data is available, and all determinants belong to the community level. The smallest unit of observation in analysis is a district or alternatively a city.

Vital statistics (births and deaths) is provided by the State Statistics Service of Ukraine, grouped by regions and districts. Information about health resources is found on the web-

page of the Center of Medical Statistics at the Ministry of Health of Ukraine, and information about climatic conditions is extracted from Wikipedia and climatic maps<sup>22</sup>.

According to the available data, the following hypothesis will be tested:

H1: IMR is higher in the south-east and lower in the north-west.

H2: IMR is higher in rural area than in urban.

H3: IMR is higher where the number of specialists is lower.

The dependent variable in the analysis is infant mortality rate. As at the district level, situation is not always definite, levels of infant mortality change from year to year, and it is difficult to highlight some leaders and outliers. To solve the problem of annual fluctuations, I aggregate data for the years 2005 to 2010. Averaged infant mortality is calculated as:

$$IMR = \frac{D_0^{2005} + D_0^{2006} + D_0^{2007} + D_0^{2008} + D_0^{2009} + D_0^{2010}}{B^{2005} + B^{2006} + B^{2007} + B^{2008} + B^{2009} + B^{2010}},$$

where  $D_0$  – is death below age one year and  $B$ - is births.

Accounting for existing problems and available data, the following groups of explicative variables were formed:

Variables describing the problem of staff sufficiency:

1. Number of obstetrician-gynaecologist (from 12.5 to 33.2 per 1000 live births)
2. Number of midwives (from 38.3 to 75 per 1000 live births)
3. Number of paediatricians (from 13.8 to 34.1 per 1000 live births)

Variables describing the problem of “obstetrician aggression”:

1. Caesarian section (from 105.1 to 186.8 per 1000 live births)
2. % of early delivery<sup>23</sup> (from 2 to 3.4%)

Variables describing the particularities of geographical location:

3. Region (27 regions)
4. Type of settlement (rural zone, small towns, and big cities)
5. Average January temperature (from -7°C to 2.8°C)

<sup>22</sup> National Atlas of Ukraine - <http://wdc.org.ua/atlas/8020000.html>

<sup>23</sup> According to Ukrainian definition early deliveries are those that had taken place on 28<sup>th</sup> to 37<sup>th</sup> week (259 days) of pregnancy. - <http://i-medic.com.ua/index.php?newsid=10849>

6. Average July temperature (from 13°C to 29°C)
7. Amount of atmospheric precipitation (from 400 to 1500mm).

It should be noted that, for the first two groups of variables, only information at the level of regions is available, which testifies to the weakness of a model for explaining the dispersion of values and also predicts a low  $R^2$ . Detailed district data is available for the third group.

All variables except “region” and “type of settlements” are continuous. The above-mentioned two variables had to be transformed into dichotomous (dummy) variables. The number of regions is 27 units (including Kyiv and Sebastopol). However, for the type of residence, I decided to go beyond traditional division in urban and rural zones and classified this variable into rural areas, small towns, and big cities. Therefore, 496 units for rural areas and 496 units for small towns, supplemented by 44 big cities, made altogether 1036 observations.

The chosen model is a multiple linear regression.

#### a) Findings drawn from the maps

To have an idea about the variation of infant mortality across regions in Ukraine, primary maps were produced. They represent the infant mortality rate average for 2005-2010, specified by types of settlements. The range of indicators is split into five intervals according to standard deviation<sup>24</sup>, where the middle group absorbs observation that are slightly removed from the average; two neighbouring groups comprise units more evidently deviating from the average, and two closing groups include extremes. In the next step – extracting cities from the data, interval revision was NOT revised, in order to keep the same limits and see the changes.

Having mapped the results, some important points can be highlighted. First, variation among regions is visible implying that rates are higher in particular regions in the east, south-west and in the centre (*Figure 7.4*). When comparing urban and rural populations, urban inhabitants have lower infant mortality than rural people (9.1 vs. 10.9), as expected. However, contrary to expectations, the highly urbanized east has worse patterns than the rural west. One can observe this on the general map and be even more convinced by looking at the distribution of IMR for urban populations in particular. In other words, the urban

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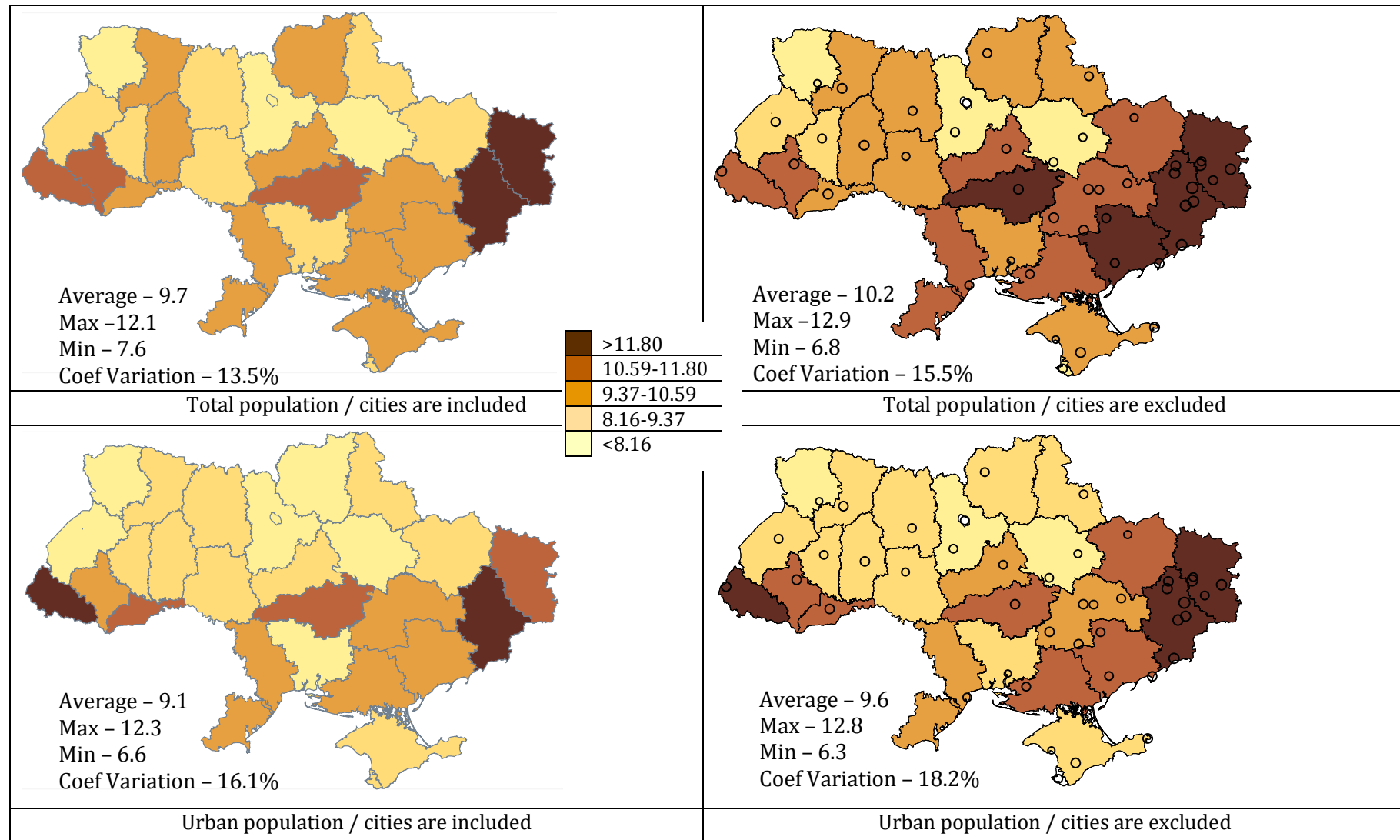
<sup>24</sup> 1) from  $min$  to  $x-sd$ ;  
 2) from  $x-sd$  to  $x-1/3*sd$ ;  
 3) from  $x-1/3*sd$  to  $x+1/3*sd$ ;  
 4) from  $x+1/3*sd$  to  $x+sd$ ;  
 5) from  $x+sd$  to  $max$ ,  
 where  $x$  is an average and  $sd$  – is the standard deviation.

population of the industrial basin is in a worse position than the urban population of the less developed west. This leads to a first conclusion that geographical belonging that especially matters.

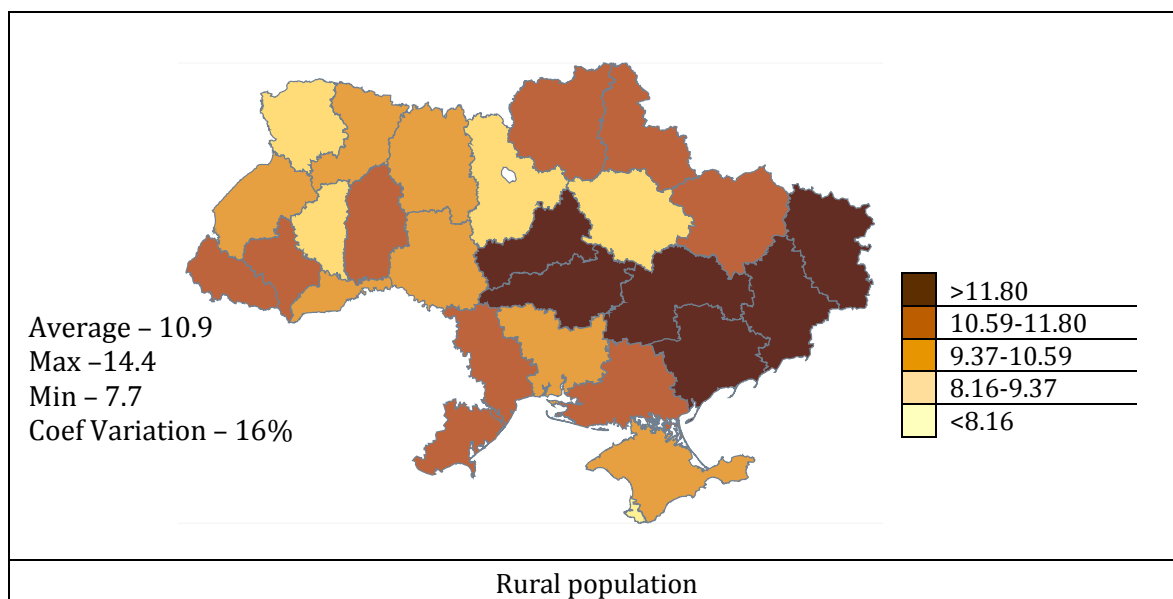
Moving forward in these directions, 44 large cities have been excluded from the data and maps were compared again. One can clearly see that, after purifying regional figures from the impact of cities, we obtained fairly homogenous belt of similarly high IMR in the south-east. The patterns in the west did not change considerably. This testifies to the existence of a contrast between east and west, and is a sign that there are some important determinants that make IMR in the east so high. In addition, cities in the east and west are also different, given the fact that they do change patterns in the east, and not so much in the west. This leads to a second conclusion that the characteristics of eastern metropolises are such that their inhabitants being benefit from exceptional health advantages, while the population outside of them equally shares great disadvantages. The characteristics of western cities are such that they are not much different from other types of settlements.

Let us now move to the level of small towns. Dealing only with urban populations and excluding big cities from the data, we come up with smaller urban settlements. The effect of excluding large cities is still clearly visible, signifying that residents of smaller urban settlements do not benefit from the same amenities as residents of large agglomerations.

Figure 7.4: Infant mortality rate for total, urban, and rural population of Ukraine, average for 2005-201







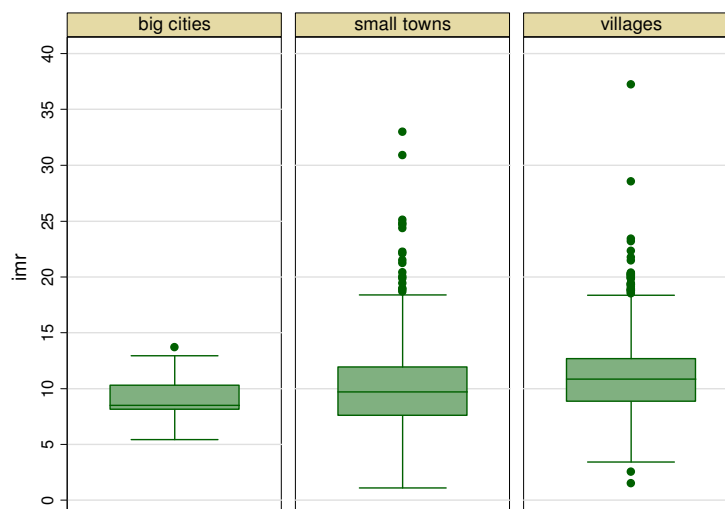
The other thing to note is that it is this category of urban settlements that drags eastern and some western regions to the bottom. However, this is not the case in north-western regions. Here, excluding big cities does not produce the same effect. In fact, the opposite occurs. This is because these cities are not actual metropolises, and even regional capitals resemble more provincial centres.

Finally, when looking at rural areas alone, the contrast between west and east is the sharpest. Villages of the urbanized east are in a worse position than villages of the mostly rural west.

In general, infant mortality in rural areas is constantly higher than in low-urbanized towns (10.9 vs. 9.6) or in big cities (10.9 vs. 9.3), as summarized in *Figure 7.5* below. The boxplot also certifies that variation of the indicator among villages is much higher than among other types of settlements. While IMR for big cities lies within limits (from 5 to 14 deaths per 1000), in cases of small towns and villages it may go up to 19, indicating also some outliers up to 40.

Such an advantageous situation for cities might be explained by different aspects, such as access to medical facilities, availability in hospitals of special equipment for preserving the life of infants, the higher economic status of residents, better living conditions, etc. On the other side of the spectrum are rural areas, where all these conveniences are missing. In the middle are small towns, where conditions sometimes might get even worse than in villages. These are district centres that have kept their administrative status since Soviet times. These centres also have over-used infrastructures as well as housing and communal services that ended up ruin. Medical facilities in hospitals are also outdated and medical personnel are never staffed with new specialists.

Figure 7.5: Box plot for IMR according to the type of place of residence, Ukraine, 2005-2010



#### b) Findings drawn from the descriptive analysis

To better understand the role of socio-economic factors, some extra information on medical facilities was used. Unfortunately, data are only available at the regional level, without details on the place of residence, etc. Therefore, I assumed that the level of parameter known on average for a region is the same for each district. Before running a multiple regression, it is interesting to see the correlations among the variables of the regression model.

When looking at *Table 7.1*, which presents the coefficients of pairwise correlation and levels of significance for the correlations, we can see at the first glance that it is not very informative. The indicator of infant mortality does not strongly correlate with any variable. The strongest direct correlation (0.143 and significant) is observed with the “percent of early delivery”. This seems coherent, as prematurely born babies are weaker. Questions arise about a direct correlation between the number of obstetrician-gynaecologists and paediatricians with the number of caesarean sections. According to the data, the more of specialists are in a region, the higher the infant mortality. It should be noted that there is no such relation with lower medical personnel such as midwives, for which the relation is even the opposite: in regions with a higher number of midwives, the mortality of babies is lower.

The picture becomes clearer if we look at the correlation among explanatory variables themselves. The highest correlation, almost 76%, is positive between number of gynaecologists and paediatricians, while correlations between each of these groups of specialists with the number of midwives are negative. That leads us to believe that some

regions are very well staffed with medical personnel (obstetricians, gynaecologists, and paediatricians) and they probably have more hospitals, while others are poorly staffed with only paramedical personnel. This judgment is reinforced by the numbers for caesarean sections performed. As such surgery needs to be performed by a doctor, it positively correlates with the number of obstetricians and negatively with the number of midwives. Concluding, one may note that regions sufficiently supplied with highly educated medical personnel tend to have higher infant mortality, because births at risk are occurring in places with more medical resources. This may also be somewhat a result of better statistics because as said in Chapter 3.3.2, the transition to a new definition was better implemented in the east. It could also be partly a result it could be also a result of “obstetrical aggression”, which was mentioned above.

Table 7.1: Matrix of pairwise correlation of selected variables<sup>25</sup>

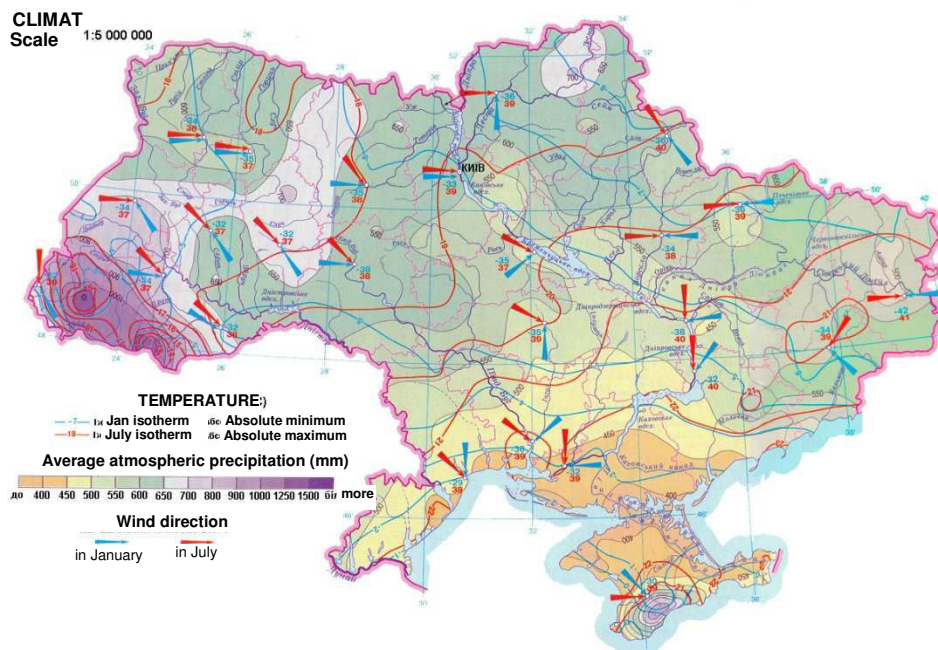
	IMR	Gynaecologist per 1000 live births	Paediatricians per 1000 live births	Midwives per 1000 live births	Caesarean sections per 1000 live births	% of early delivery	Average January t°	Average July t°	Atmospheric precipitation
Gynaecologist per 1000 live births	0.115 (0.000)	1							
Paediatricians per 1000 live births	0.039 (0.216)	0.758 (0.000)	1						
Midwives per 1000 live births	-0.141 (0.000)	-0.338 (0.000)	-0.158 (0.000)	1					
Caesarean sections per 1000 live births	0.084 (0.007)	0.243 (0.000)	0.063 (0.042)	-0.305 (0.000)	1				
% of early delivery	0.143 (0.000)	0.395 (0.000)	0.236 (0.000)	-0.428 (0.000)	0.091 (0.003)	1			
Average January t°	-0.004 (0.895)	-0.213 (0.000)	-0.193 (0.000)	-0.353 (0.000)	-0.069 (0.027)	0.019 (0.553)	1		
Average July t°	0.102 (0.001)	0.595 (0.000)	0.546 (0.000)	-0.597 (0.000)	0.262 (0.000)	0.461 (0.000)	0.347 (0.000)	1	
Atmospheric precipitation	0.016 (0.595)	-0.478 (0.000)	-0.471 (0.000)	0.305 (0.000)	-0.206 (0.000)	-0.236 (0.000)	-0.225 (0.000)	-0.741 (0.000)	1

<sup>25</sup> P-value is given in brackets: p < 0.001 – highly significant (\*\*\*); 0.001-0.01 – significant (\*\*); 0.01-0.05 – almost significant (\*).

As for caesarean sections, there are contrary opinions about the suitability of undertaking such measures. On the one hand, caesarean has proved to be a life-saving intervention for mothers and babies. And on the other hand, mortality in caesarean delivers is higher due to a higher risk profile for caesarean births, since the indication for operation would likely constitute a risk factor for mortality. Nevertheless, the number of such surgeries is growing from year to year in many countries, and so it is in Ukraine, even among women considered to be at low risk. Such an increase tends to accelerate, as a woman who has a primary caesarean section has a greater than 90 percent chance of having a subsequent caesarean delivery (McDorman *et al*, 2006).

As for climatic conditions a negative correlation with the average January temperature was established, though it was very low and insignificant. Some direct relation between IMR and the average July temperature is observed, envisaging higher mortality in hotter regions. As can be seen in *Figure 7.6*, isothermal curves cross Ukraine diagonally and the amount of atmospheric precipitation corresponds to the summer temperatures: hot and dry regions are in the south and east, the north and west are colder but abundantly moistened. Therefore, regions suffering high infant mortality are those that correlate inversely with the variable “precipitation” and directly with “July temperature”, meaning that they are dry regions situated in the south and east of Ukraine.

Figure 7.6: Climatic conditions in Ukraine



## c) Findings drawn from the regression analysis

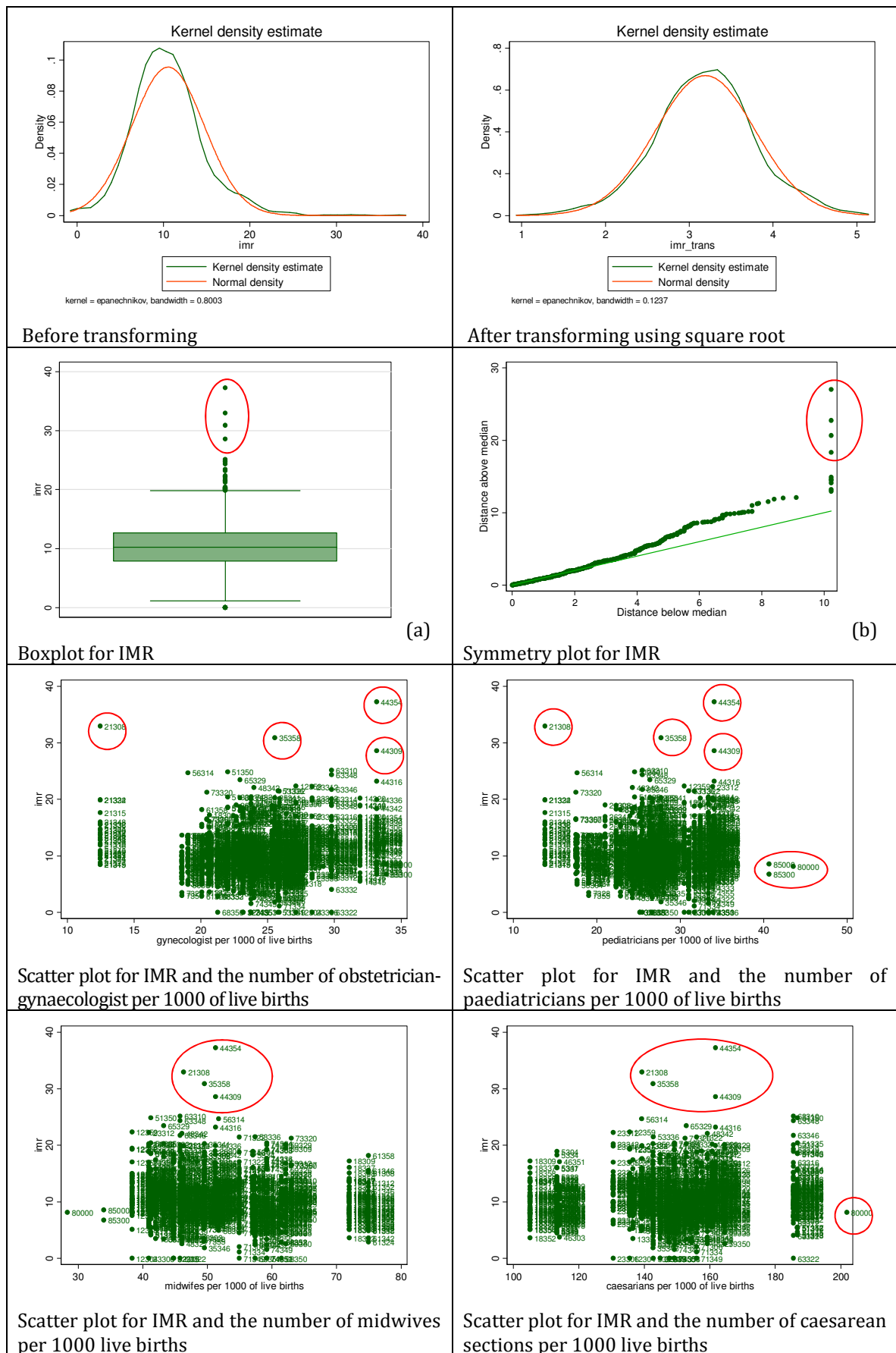
Before running any model, one needs to be certain on the issue of normality. A good model is one, which has normally distributed residuals. A common cause of non-normally distributed residuals is non-normally distributed outcome and/or predictor variables.

Below is *Figure 7.7*, which presents distributions of outcome and predictors. Initial distribution of IMR (Kernel density estimate), as indicated by boxplot and symmetry plot, is not normal and is skewed to the right. Therefore, I needed to reshape the distribution by transforming values using the square root (chi-square is the lowest). Graphs also indicate some outliers, data points that are more than 1.5 of the interquartile range above the 75<sup>th</sup> percentile. One of them (Kyiv) has also proven to be a leverage, which means that this extreme value has an effect on the estimate of regression coefficients. In order to not confuse the results, I deleted these observations. These were four observations for districts and two for the cities of Kyiv and Sebastopol.

The choice of variables was reviewed by also using multicollinearity test. The term of collinearity implies that two variables are near perfect linear combination of one another. Several variables were found that explain the same thing, particularly a variable on the number of obstetrician-gynaecologists that had to be removed in a favour of “caesarean sections” according to the *variance inflation factor*. Following the same logic, the variable on “precipitation” was eliminated in a favour of “average July temperature”.

Hence, I run three models. The first model includes only variables describing medical facilities. The second model controls for the place of residence. The third model accounts finally for geographical belonging of a district. For all three models, the F-test is statistically significant ( $\text{Prob} > F = 0.000$ ), which means that models are statistically significant. As I performed a square root transformation of the dependent variable, it became more difficult to interpret the regression coefficients; so I used beta coefficients, which give the relative importance of a parameter in the model.

Figure 7.7: Graphs visualizing diagnostic for normality



The first model (Table 7.2) has only one highly significant variable, early delivery, and it also has the highest beta coefficient. The number of caesarean sections also matters. This slightly increases the coefficient of infant mortality as well as the number of paediatricians, though the latter variable is statistically insignificant. The variable on the number of midwives has the opposite effect.

Table 7.2: Regression models of IMR for Ukraine, 2005-2010

	1st model			2nd model			3rd model		
	Coef	P> t  <sup>26</sup>	beta	Coef	P> t	beta	Coef <sup>27</sup>	P> t	beta
Const	2.547	0.000***		2.549	0.000***		3.520	0.000***	
Medical facilities									
Midwives	-0.003	0.077	-0.062	-0.005	0.004**	-0.095	-0.008	0.001***	-0.172
Caesareans	0.002	0.017*	0.076	0.002	0.003**	0.090	0.002	0.026*	0.094
Early delivery	0.154	0.000***	0.148	0.170	0.000***	0.164	0.142	0.011*	0.135
Paediatricians	0.002	0.463	0.024	0.009	0.001***	0.103	-0.021	0.000***	-0.248
Place of residence									
Big cities				-0.352	0.000***	-0.372	-0.366	0.000***	-0.388
Small towns				-0.232	0.000***	-0.244	-0.234	0.000***	-0.248
Region <sup>28</sup>									
Volynska (W)							-0.548	0.000***	-0.219
Kyivska (N)							-0.395	0.000***	-0.178
Mykolaivska (S)							-0.293	0.000***	-0.109
Poltavska (C)							-0.129	0.144	-0.054
Rivnenska (W)							-0.096	0.200	-0.040
Kharkivska (N)							-0.067	0.304	-0.035
Vinnytska (C)							-0.044	0.549	-0.019
Chernivetska (W)							-0.024	0.811	-0.008
Sumska (N)							0.070	0.458	0.024
Khersonska (S)							0.100	0.197	0.036
Dnipropetrovska (E)							0.134	0.105	0.081
Chernihivska (N)							0.213	0.046*	0.070
Ivano-Frankivska (W)							0.215	0.004**	0.090
Khmelnyska (W)							0.221	0.006**	0.087
Cherkaska (C)							0.236	0.014*	0.086
Zhytomyrska (N)							0.292	0.002**	0.116
Zaporizka (E)							0.314	0.001***	0.139
Kirovohradska (C)							0.325	0.000***	0.109
Donetska (E)							0.465	0.000***	0.304
Luhanska (E)							0.513	0.000***	0.242
Zakarpatska (W)							(omitted)		
Lvivska (W)							(omitted)		
Odeska (S)							(omitted)		
Ternopilka (W)							(omitted)		

<sup>26</sup> P-value: <0.001 – highly significant (\*\*\*); 0.001-0.01 – significant (\*\*); 0.01-0.05 – almost significant (\*)

<sup>27</sup> sorted by  $\beta$ -coefficients of the first

<sup>28</sup> W-West, E-East, N-North, S-South, C-Center

The next step is to control for the type of place of residence: what would the IMR be if all settlements were of the same type (rural areas are chosen for reference). Clearly, big cities as well as small towns demonstrate negative regression coefficients when compared to rural areas, and as the size of the settlement increases infant mortality rate decreases. That is, the regression coefficient for big cities is -0.352, while for small towns it is 0.232. Both dichotomous variables are highly significant.

The type of settlement matters much more in the model than do the health system variables. The modulus of beta coefficient for the former ranges from 0.24 to 0.37, whereas for the latter it is from 0.09 to 0.16. On the other hand, the relative importance of health care system variables has changed in comparison with the first model. The role of midwives in lowering IMR and of caesarean sections in augmenting IMR increased, and these coefficients became statistically significant. What is not clear is the role of paediatricians.

The figures above indicate the role of chosen variables on average for the country. In order to account for geographical location, I needed to control for the variable “region”. The reference group in this case is the AR of Crimea. I have chosen the peninsula as a reference because its infant mortality level corresponds to the average for Ukraine, and its geography is rather neutral. Further, I have sorted all regions in ascending order of regression coefficients. Regions at the top of the table perform much better than AR Crimea. Regions at the bottom perform much worse than AR Crimea. The middle indicates those where IMR is somewhere around the average. Logically, those regions that are at the edges demonstrate p-values which are statistically significant.

This model describes the role of each region in shaping IMR. Geographically, the distribution of regions is similar to the one shown on the first map of *Figure 7.4*. Specifically, Volynska, Kyivska, and Mykolaivska oblasts present the lowest regression coefficients but have the largest modulus of beta coefficients and the highest statistical significance. Notably, Poltavska oblast is not on the list, though it demonstrates exceptionally the low IMR for urban as well as for rural areas. These are probably no such variables in the model that could capture this exception. The highest regression coefficients are observed for Luhanska, Donetska, Kirovohradska, and Zaporizka oblast, which was expected.

Hence, just belonging to a specific region predetermines the level of infant mortality. On the other hand, when accounting for regions, the role of health system variables changes again. It is noteworthy that the role of midwives in decreasing IMR has increased even more (from 0.095 to 0.172), and its coefficient became highly significant. As for caesarean sections and early delivery, reversely, their introduction in the model does not change the fact that interregional variation does not matter much in this case. Lastly, the role of paediatricians



became highly significant. Purifying the corresponding coefficient from the impact of geographical belonging, I obtained negative beta coefficients. Therefore, the problem concerning paediatrics is a matter of performance in different regions.

Lastly, I tried to regress IMR on climatic variables. The result (not presented) was similar to the one obtained from correlation coefficients: there was a direct relation with summer and it reversed with winter temperatures. However, the p-values were so large and the explicative power of the model was so small that I neglected these variables.

#### d) Residuals

After using all possible information trying to explain variation in infant mortality, I obtained a coefficient of determination ( $R^2$ ) equal to 34%. This is quite a low level, and it means that a great deal of interregional variation is not explained by variables included in the model. *Figure 7.8* and *Table 7.3* present the distribution of residuals. *Figure 7.8a* certifies that the distribution of residuals is close to a normal distribution, which reasserts the model results. On the map, one may see for which regions values were overestimated (in blue) and for which they were underestimated (in yellow). In fact, regions of high mortality in the west are claimed to be overestimated, while regions of high mortality in the east, north and in the centre are underestimated by the variables included in the model. In other words, with available health resources, mortality in the west would be higher while lower in the east. Clearly some other factors (rather than health system resources) act to decrease the number of infant deaths in the west, while in the east some health system components are not functioning well.

Figure 7.8: Statistical and geographical distribution of residuals

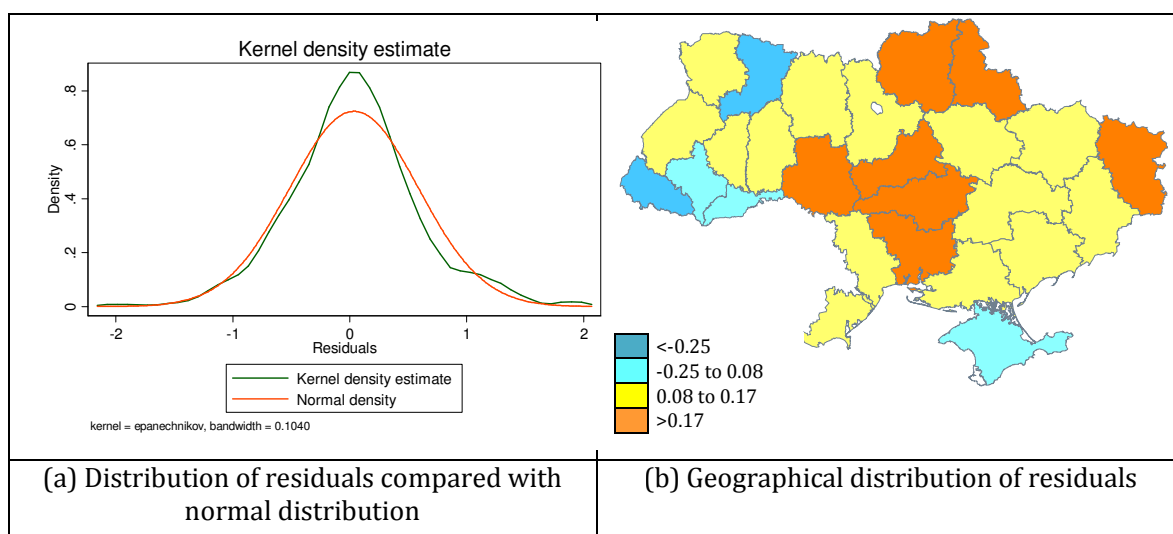


Table 7.3: Infant mortality rate actual and predicted by the model, average for 2005-2010

Region	IMR actual	IMR predicted	Residuals
AR Crimea	9.71	9.74	-0.03
Vinnyska	9.20	9.02	0.18
Volynska	7.69	7.62	0.08
Dnipropetrovska	10.12	10.03	0.09
Donetska	12.09	12.04	0.05
Zhytomyrska	9.22	9.12	0.11
Zakarpatska	11.38	11.95	-0.57
Zaporizka	10.50	10.40	0.10
Ivano-Frankivska	11.12	11.27	-0.15
Kyivska	7.78	7.64	0.14
Kirovohradska	11.75	11.47	0.28
Luhanska	12.11	11.78	0.33
Lvivska	8.74	8.73	0.01
Mykolaiivska	8.37	8.10	0.27
Odeska	10.23	10.20	0.04
Poltavska	7.61	7.58	0.03
Rivnenska	9.71	10.19	-0.47
Sumska	9.34	9.13	0.21
Ternopilska	8.72	8.56	0.16
Kharkivska	9.29	9.22	0.08
Khersonska	10.53	10.39	0.14
Khmelnyska	9.88	9.79	0.09
Cherkaska	10.44	10.17	0.27
Chernivetska	10.55	10.68	-0.13
Chernihivska	9.38	9.11	0.28
Kyiv	8.11		
Sevastopol	8.43		

Therefore, after reviewing geographical variation of infant mortality in recent years in Ukraine, two situations were brought into focus. First, that mortality of infants in urbanized, more developed, and richer eastern regions is higher than in the much less urbanized western part. Second, confusion appears from the fact that regions with a larger number of paediatricians and gynaecologist tend to have a larger number of infant deaths per 1000 live births.

I tried to explain the first situation with the use of maps. This shows the contrast between the east and west, and this contrast sharpened when I excluded big cities from the analysis. This means that only citizens of large urban agglomerations in the east benefit from the amenities of progress and well-being, while those living in small towns and rural areas suffer great problems. This conclusion is reinforced with the geographical visualization of IMR for rural areas, (which is rather homogenous regarding the size of settlements). The contrast is clearly

visible and the gradient of change from west to east goes, respectively, from the lowest to the highest death rates (with some exceptions in the centre).

The second aspect to pay attention to was an efficiency of using health care system resources. In fact, having great disparities in the health status of the population, Ukraine used to have such a health care system that neither reflected the health care needs of the population nor accounted for the regional characteristics of health service provisions. The health system is staffed and equipped according to norms based on the local population size rather than health needs (World Bank 2007). That might explain the problem of the ineffective use of paediatricians and the wrong impression regarding their uselessness in providing health services. The results from of modelling detected that the optimum number of paediatricians is not reached in every region. The direct relation between the number of obstetrician-gynaecologists and IMR is also confusing. The most likely explanation is that in regions where health resources permit such surgery, the incidence of interventions and rate of lethality is high. It is because risky cases would go to those places, which are better equipped. There might also be cases of surgical “aggression” when performing costly caesarean sections that are not always justified.

Finally, since all variables previewed by the model are at the community level, I would suggest that unexplained variation could be a result of individual behavior or household conditions. Such determinants are: mother’s or father’s education, power relationships within the household, value of children, beliefs about disease causation, food preferences, household income and conditions, daily practice of hygienic/preventive care, access to information, etc. (Masuy-Stroobant, 2001). Summarizing, the improvement of the newborn’s health and increase in their survival is manageable. However, it requires coordination of the efforts at the national as well as regional and individual levels.

### **7.3 Cause-of-death analysis**

This section describes how Standardized Mortality Ratios for both sexes combined (as not all data needed for calculation are available by sex) are distributed across 496 of Ukraine’s districts. As already mentioned above, SMR is an appropriate measure for having unbiased estimates when the calculation of life expectancy is not possible. In addition, it is suitable to compare mortality profiles by causes of death. For the interpretation of spatial patterns, I classified SMR into five intervals. The largest middle interval comprises 50% of all districts that have an SMR that is around average. Two “neighbouring” intervals include 20% of

districts where mortality is high/low, and two “tail” intervals that comprise extreme values of 5% each. The colour schemes were chosen to reflect two gradients: higher than average are in warm colours, and lower than average are in cool colours (blue or green to distinguish causes). The average class is in grey.

Theoretically, average SMR should correspond to the reference (average for Ukraine) and be equal to one. In practice, certain shifts to the left or to the right (more often) happen, which is a sign of large variation or polarization.

SMR for all causes across Ukraine’s districts is displayed in *Figure 7.9*. It is complemented by the map of SMR distribution across regions just to give an idea of how the general picture flattens out peculiarities. One may see that patterns are somewhat different at the district and regional levels. At the district level, big cities are not as visible as at the regional level because they change significantly only for the value of the district in which they are included, and district is a very small territory. When it concerns the largest cities with population measured in millions, the bias is considerable. This issue is explored more in Section 7.5 of this Chapter.

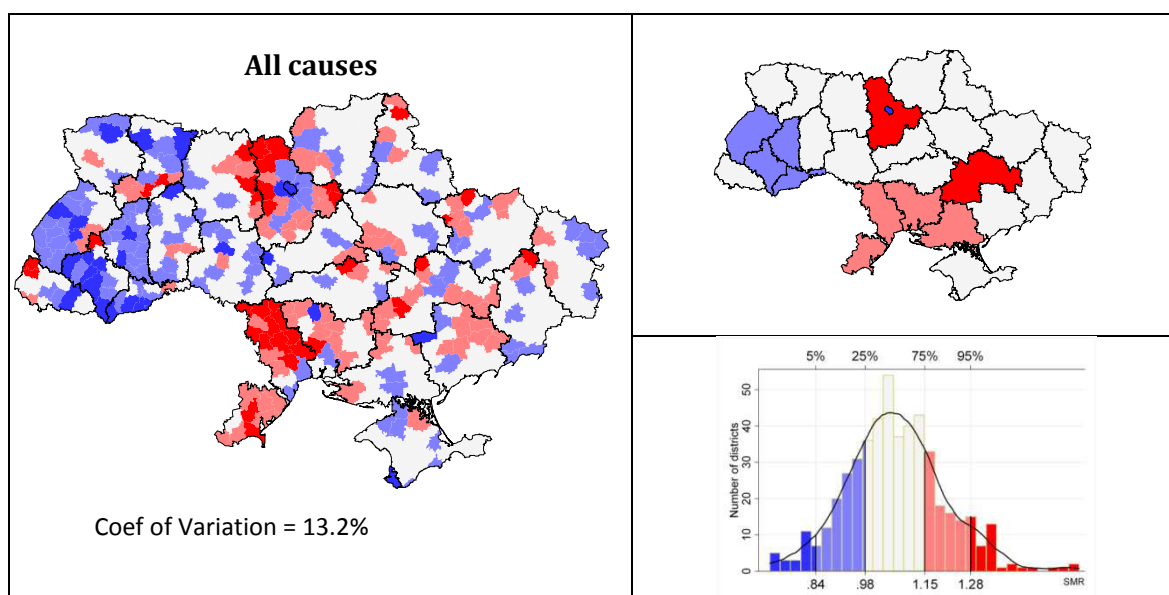
For better visual perception, the legend is presented by frequency distribution of districts.

Hence, there were four distinct areas in Ukraine in 2005-2010: low mortality in the west; the problematic region around the capital; high mortality in the south-eastern regions; and a scattered picture in remaining of regions. Such distribution is visible at the regional level as well as at district levels, though data by districts refines the patterns. For example, it is not that the entire Kyiv region is performing badly, but only its districts that are remote from the capital, while the city of Kyiv and its suburb are in a much more advantageous position compared to other districts in Ukraine. Moreover, the high mortality of the Kyiv region’s periphery does not have administrative borders, and this pattern is continuous toward the Zhytomyr region.

A high mortality zone is also observed in Odeska oblast. Similarly to Kyiv, the city of Odesa is left outside of high risk zone, while almost all of the remaining districts are pretty homogenous in regard to high SMRs.

By contrast, districts with low SMR are situated mainly in western Ukraine, allowing a number of western regions (namely Lvivska, Ternopil’ska, Ivano-Frankiv’ska and Chernivets’ka oblasts) to be clearly classified as low mortality regions.

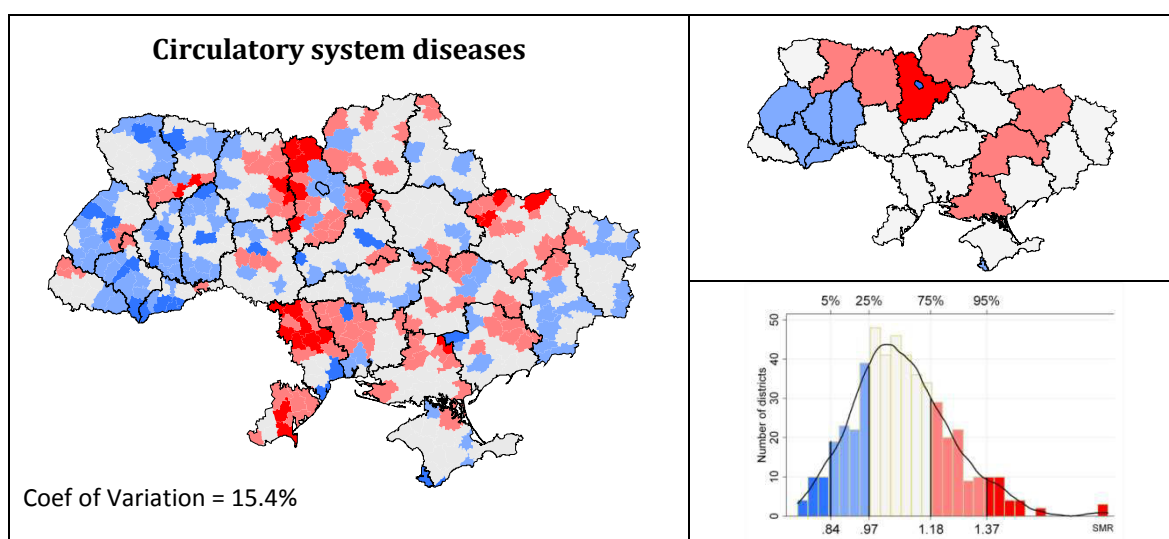
Figure 7.9: SMRs from all causes, average for 2005-2010, Ukraine



Source: Author calculation based on the data of the State Statistics Service of Ukraine

When looking at SMR by causes of death, some particular features can be noticed. As for circulatory system diseases, which represent the largest share of deaths, SMR is distributed in a manner similar to all-cause mortality. Kyiv and Odesa oblasts exhibit patterns of continuously high SMRs, whereas the pattern of adjacent districts with low SMRs prevails in the west (Figure 7.10). In general, the coefficient of variation is equal to 15.4%, which is not very high.

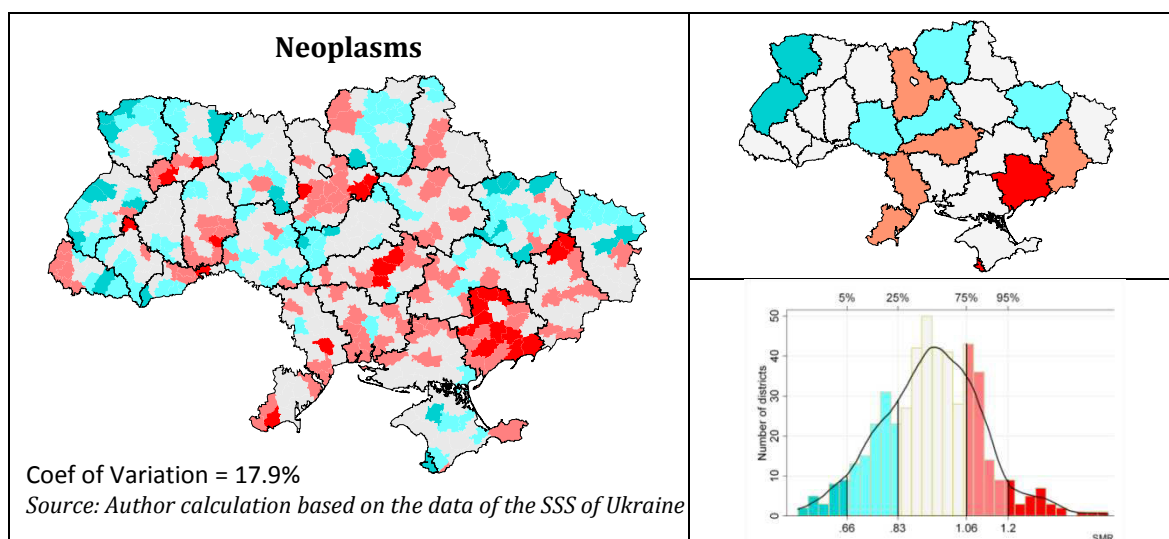
Figure 7.10: SMRs from circulatory system diseases, average for 2005-2010, Ukraine



Source: Author calculation based on the data of the State Statistics Service of Ukraine

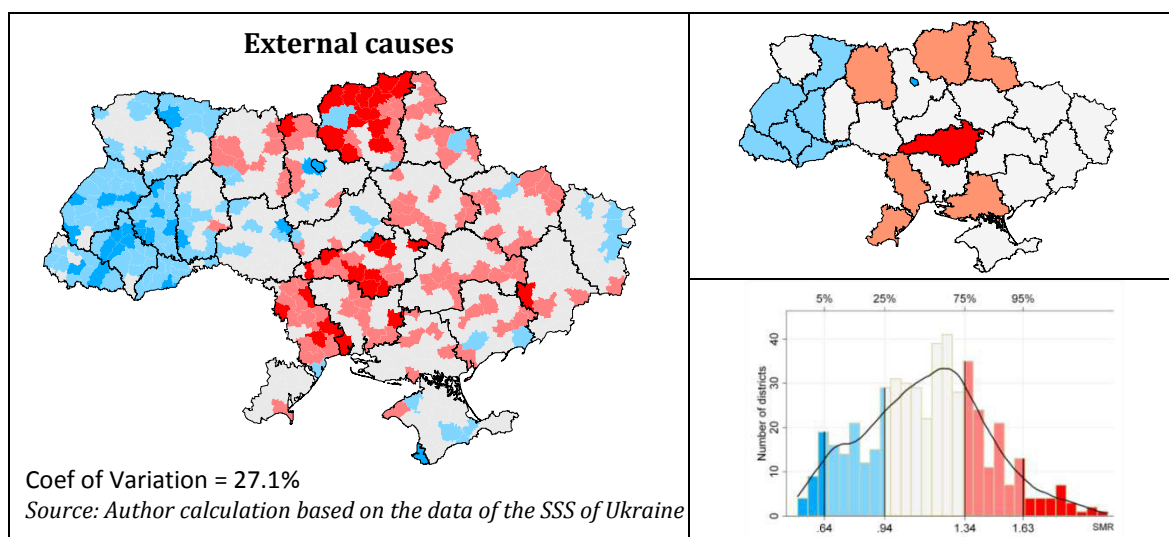
As for cancer mortality (*Figure 7.11*), regions cannot be clearly classified as having high or low mortality: SMR can be either intermediate or low/high in a particular district, and high/low in surrounding districts. The only region that is not ambiguous in this sense is Zaporizka oblast, where SMR is high in every district. The coefficient of variation of SMR across districts is higher at 17.4% than it is for circulatory system diseases.

Figure 7.11: SMRs from neoplasms, average for 2005-2010, Ukraine



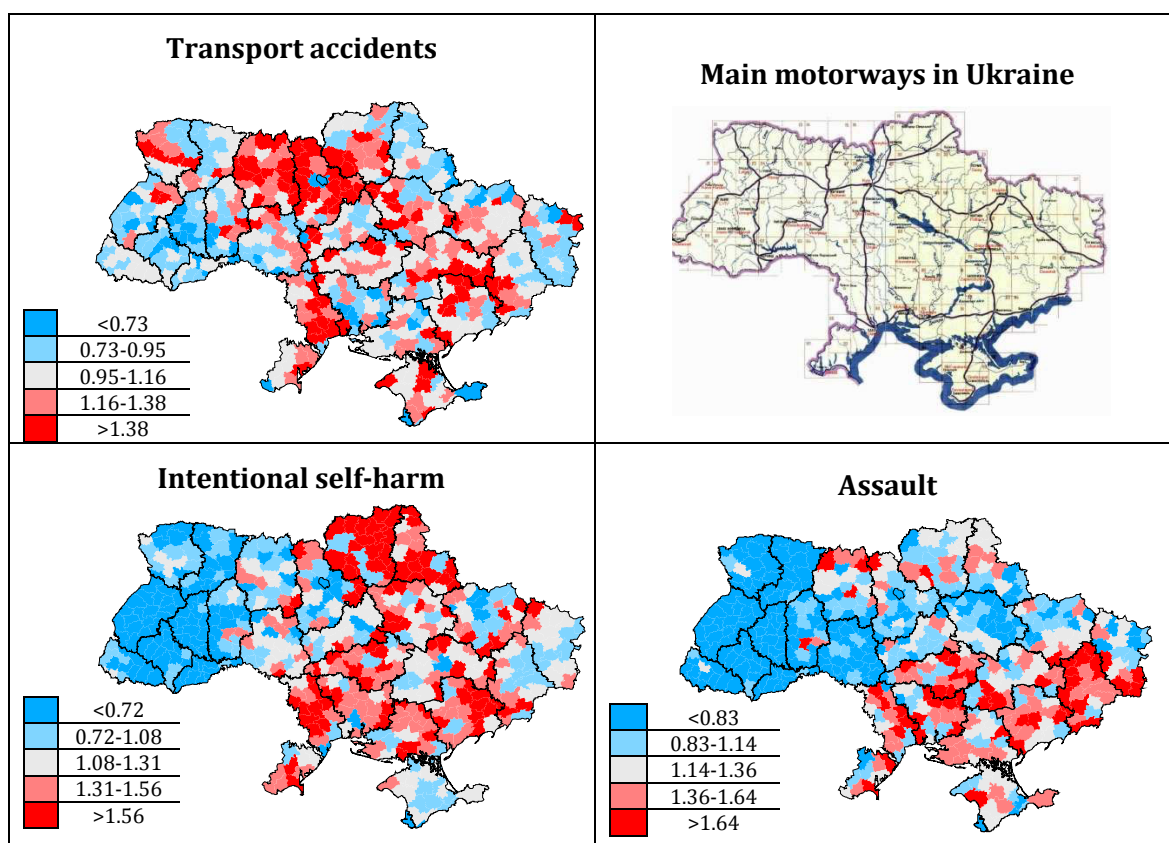
The spatial pattern of external causes (*Figure 7.12*) is specific in its own way, and not very much connected to the general pattern of all-cause mortality. The coefficient of variation increases up to 27%. The important feature here is that a sharp contrast between the west and the rest of Ukraine is visible. As some detailed data are available for this group of social importance, I made extra maps for SMR from transport accidents, suicides and homicides.

Figure 7.12: SMRs from external causes, average for 2005-2010, Ukraine



In Figure 7.13 one may observe the explicative power of maps. The highest transport mortality is fixed along the most important highways in Ukraine: E373, which is called Zhytomyr or Warsaw highway; E95, or Odesa highway; E40 to Poltava; and E50 to Donetsk. The most disadvantageous situation is also in the region of Kyiv, which sees in- and outflows of population from the suburban areas every day. Such patterns signify also that - in the case of accidents, when different security and health services react immediately - the deaths are fixed according to the place of death. Therefore certain regions are at risk of having higher mortality indicators, just because important transport routes are passing through them and not because of some survival phenomena.

Figure 7.13: SMRs for certain causes of violent mortality, average for 2005-2010, Ukraine



Source: Author calculation based on the data of the State Statistics Service of Ukraine

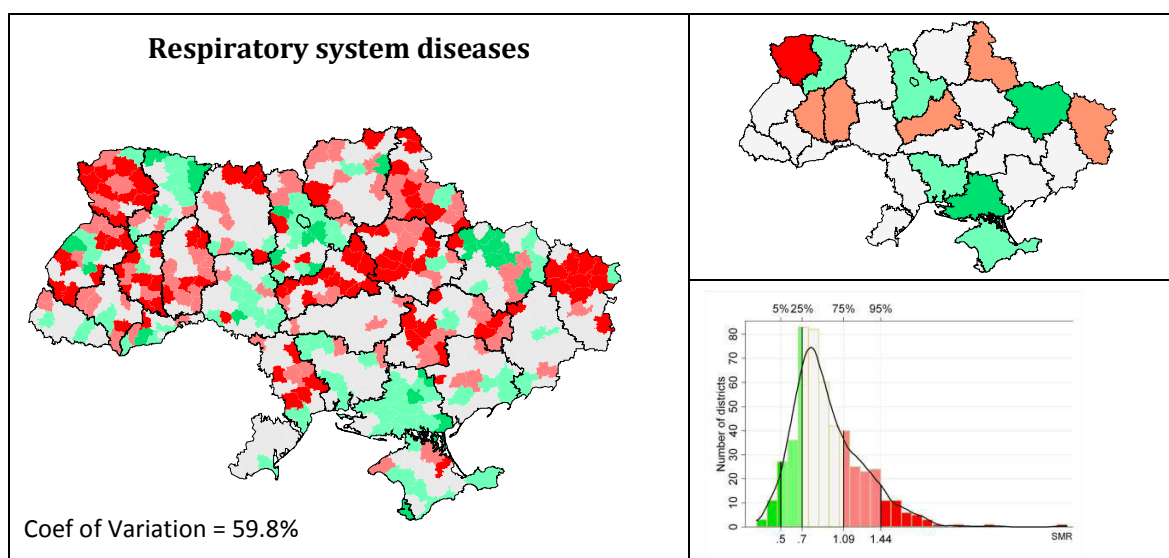
The patterns of SMRs from suicides and homicides are also curious. In both cases, the vertical contrast line is clearly marked; but in the case of suicides, it is mostly the north that has the highest rates, particularly Chernihivksa and Sumska oblasts. Meanwhile, in the case of homicides, it is south that suffers the highest death rates, particularly Donetska oblast. When these patterns overlap, the south and north create one continuous high mortality zone, which is more often designated as “east” in the opposition to the “west”.

A small point can be added to the “Chernihiv-case” investigation. As was discovered in previous chapters, low life expectancy in the Chernihiv region is due to high mortality from external causes of working age men. And among external causes, it is suicides that have the highest values. With the help of more detailed data, it was possible to see that every district of the Chernihiv region has high suicide rates. This reunites all these districts into a general red high-risk zone of suicide mortality in the north.

As for respiratory system diseases (*Figure 7.14*), this is the only group of causes that is characterized by a reverse geography compared to all-cause mortality, as mentioned in previous chapters. It also has the highest coefficient of variation of SMR, which reaches almost 60%. The high correlation coefficient indicates a different spread of risk factors for a given cause.

The distribution of SMRs across districts reinforces this conclusion and verifies that administrative belonging does not matter and that outlines are more or less continuous. In the centre, the pattern of Cherkaska oblast continues into Poltavaska and then into Kharkivska oblast. In the west, it is mostly Kmelnytska and Ternopilska oblasts for which high mortality crosses the border.

Figure 7.14: SMRs from respiratory system diseases, average for 2005-2010, Ukraine

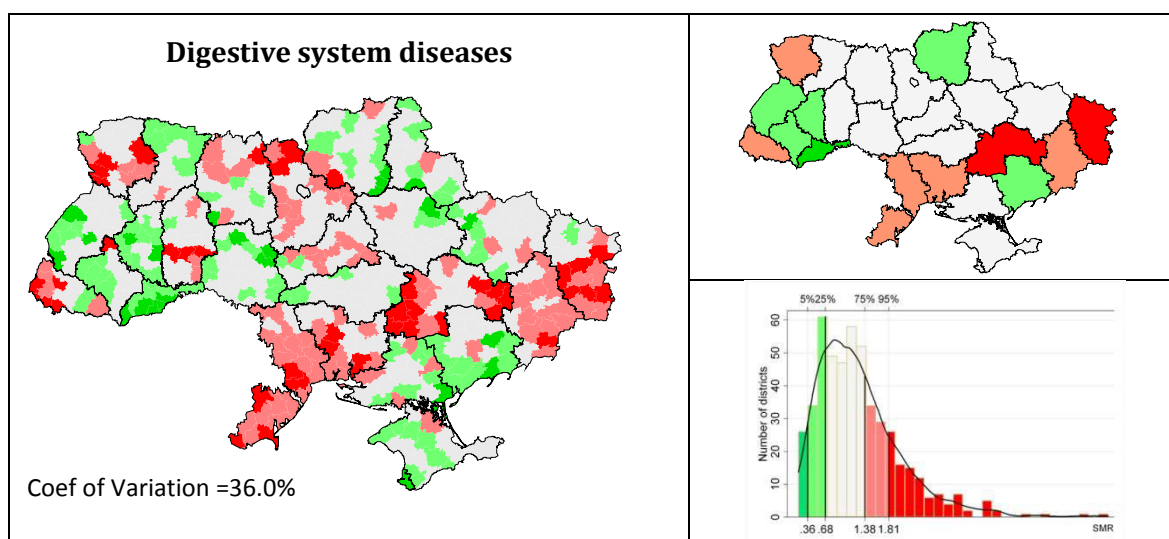


Source: Author calculation based on the data of the State Statistics Service of Ukraine

The picture of distribution of SMRs from digestive system diseases (*Figure 7.15*) illustrates as well that regional mortality differences go beyond the borders of administrative oblasts. This is especially characteristic of some southern regions, which shape a belt of high mortality. However, in this case, no specific regularities that are invisible at the regional level were discovered at the district level.



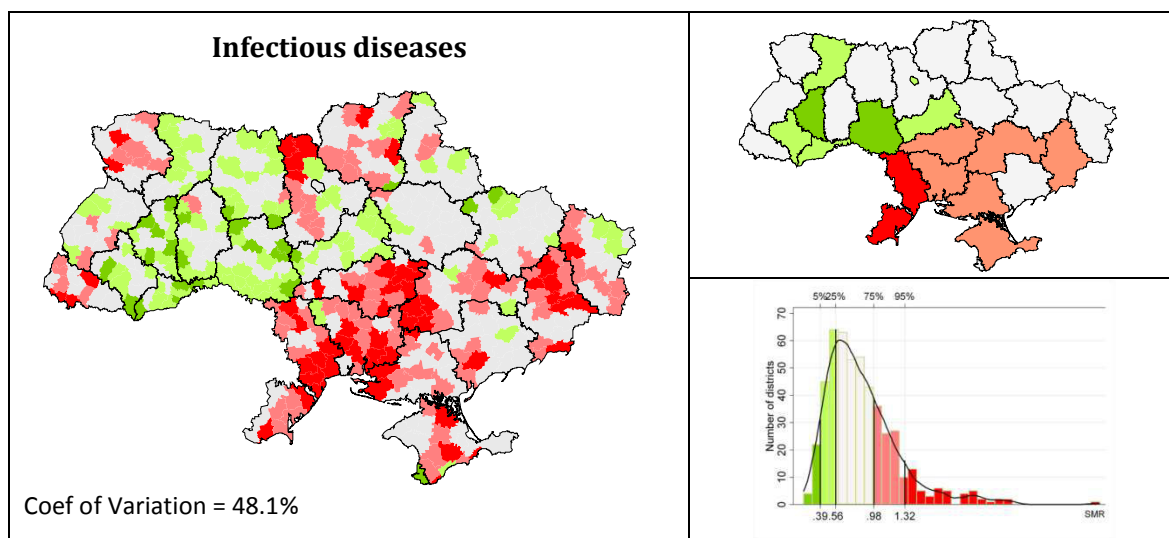
Figure 7.15: SMRs from digestive system diseases, average for 2005-2010, Ukraine



Source: Author calculation based on the data of the State Statistics Service of Ukraine

And finally, SMR for infectious and parasitic diseases are distributed generally as regional maps indicate (Figure 7.16). It is important to remember that it is mostly regions of the steppe zone (including the Crimean peninsula) that suffer high mortality from infections.

Figure 7.16: SMRs from infectious and parasitic diseases, average for 2005-2010, Ukraine



Source: Author calculation based on the data of the State Statistics Service of Ukraine

With the help of a district map one may see that the highest SMRs are found for big cities in the south, particularly: Odesa, Kherson, Mykolaiv, Donetsk and Kirovohrad. What is new on the district map is that, in some low-infectious mortality regions, there are sometimes particular districts with high SMR. Such a situation is seen to the north of Kyiv, and in some districts of Volyn and Zakarpattia. This spread is reflected in a coefficient of variation at the

level of almost 50%. The rest of the territory is pretty homogenous and continuous, thanks to similarly low SMRs in every district.

Therefore, one can see that there are causes that follow all-cause patterns (circulatory system diseases). However, there are also those that have completely individual spatial profiles (respiratory, digestive system diseases, infections, and external causes); but the share of these causes is low, which does not permit them to be seen on general maps. What should be remarked is that in the cases where SMR for certain causes are distributed differently or even contrary to the general pattern, the coefficient of variation also goes way up. This is the case of respiratory system and infectious diseases.

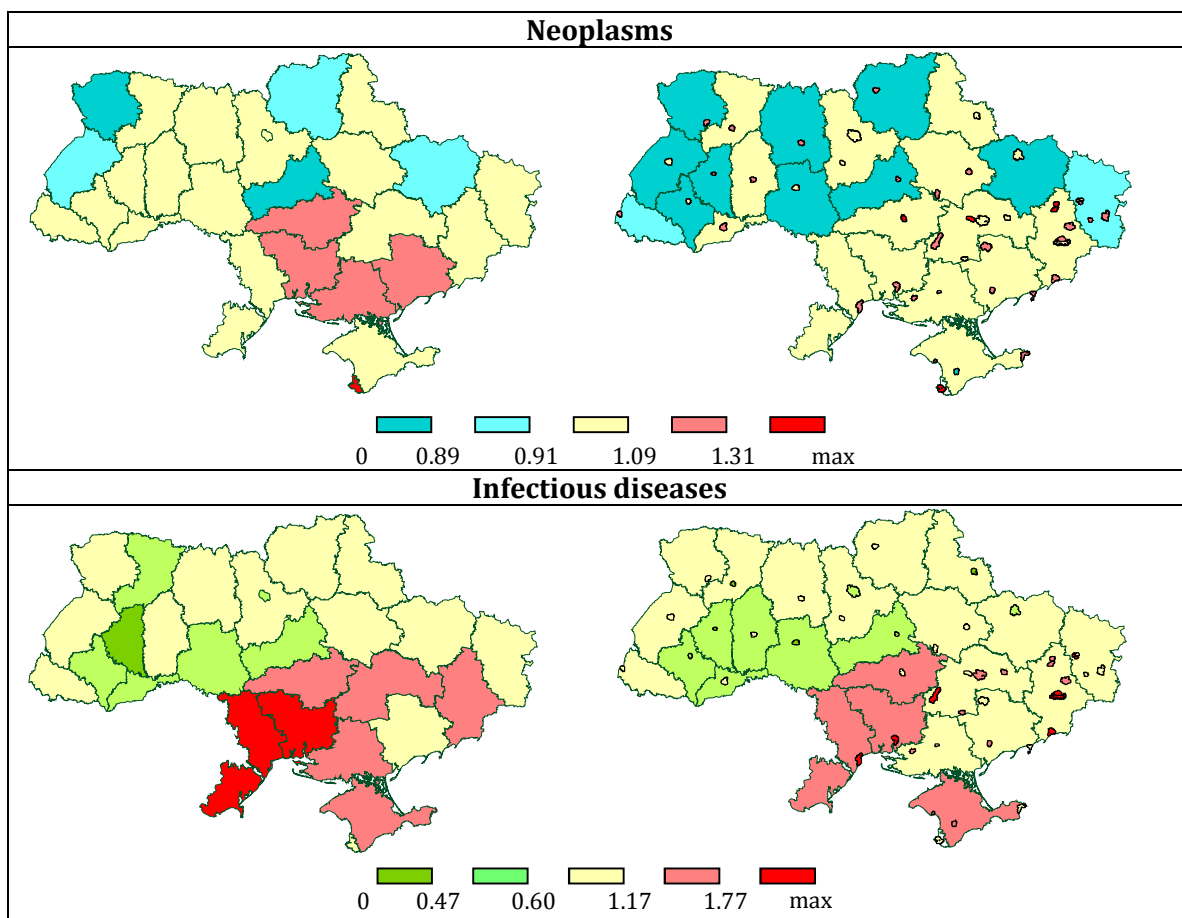
## **7.4 The situation in big cities**

In this short sub-chapter I tried to give another inside look at the regional variation of mortality. It envisages using detailed data by cities, which belong to the third level of administrative and territorial division in Ukraine; therefore, it was reasonable to place this investigation next to an analysis by districts rather than by regions. If large urban centres were excluded from the data, spatial patterns would modify. What is interesting is that there are certain changes, depending on the cause of death: in some cases the situation becomes better, and in others worse.

For neoplasms and infectious diseases, excluding big cities leads to the improvement of the situation (*Figure 7.17*). In the case of neoplasm the explanation that deserves consideration is that oncological hospitals are normally located in large population settlements, and when a person dies registration is done according to the place of death. A study on the Baltic States (Krumins et al, 2000) arrived at a similar conclusion, saying that urban disadvantages in the field of cancer may be artificially magnified because cancer deaths are registered better in urban zones.

Similar logic can be applied to infectious diseases, among which tuberculosis is the most important: tuberculosis treatment centres are also mostly found in urban agglomerations. On the other hand, infectious epidemics are likely to happen in densely populated places, and in recent years such risks were reinforced also by the spread of HIV-AIDS. What should be emphasized is that excluding cities from infectious death counts in some of western regions does not improve the situation but actually worsens it. This means that there are no such important infectious killers in western as in eastern cities - AIDs and tuberculosis are not the typical infections there.

Figure 7.17: SMR for different causes of death for regions where excluding big cities from the data produced positive changes, Ukraine 2005-2010



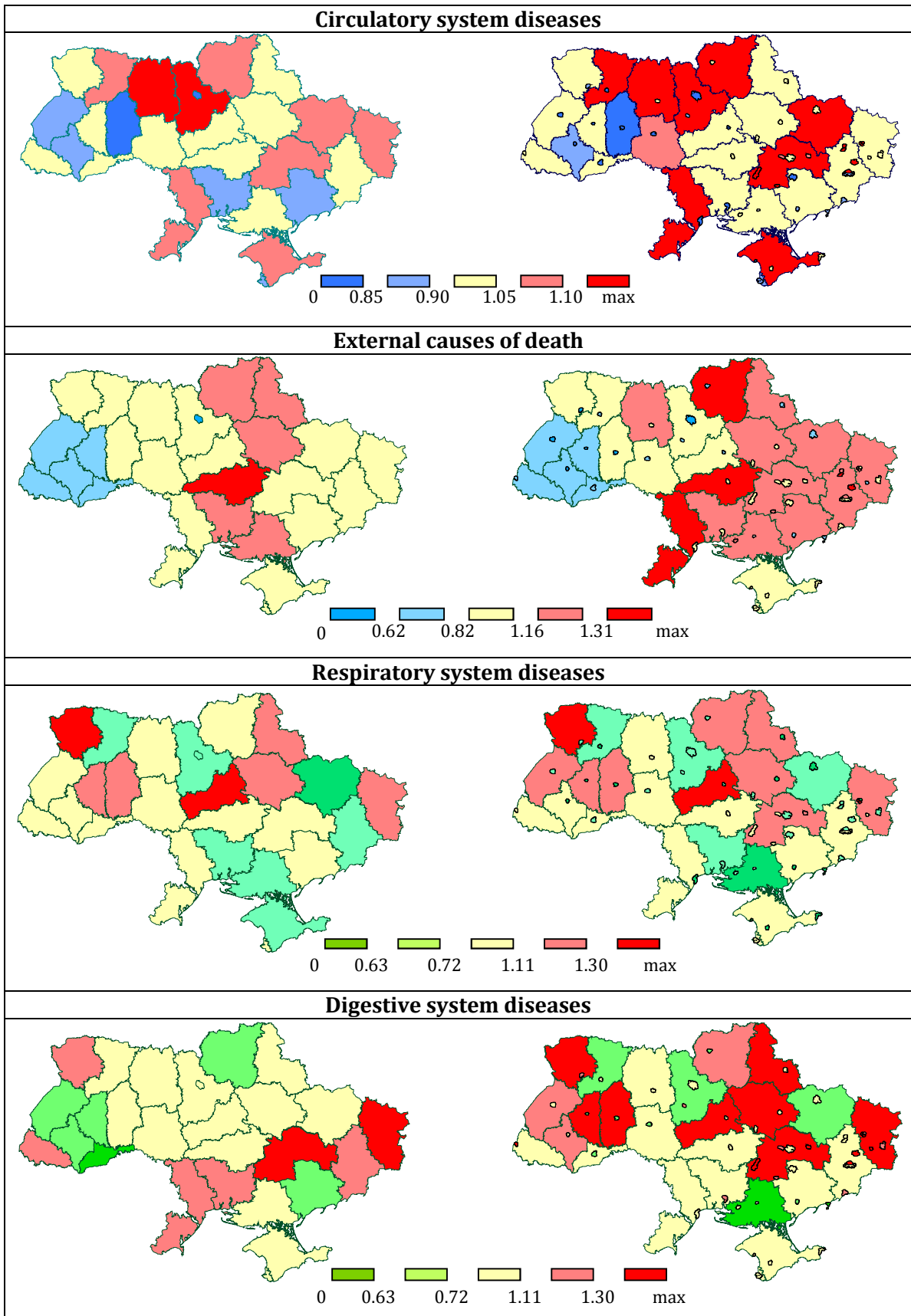
Source: Author calculation based on the data of the State Statistics Service of Ukraine

As for the remaining causes, excluding big cities from the data leads to worsening of patterns (Figure 7.18). Living in big cities in most cases is more advantageous than in small towns or villages. In fact, in the case of circulatory and digestive system diseases, patterns do not change significantly; while in case of external causes considering cities separately makes the pictures spectacularly different.

As for external causes, such manipulation generates an immense contrast between two parts of Ukraine where violent mortality prevails. Again, such exclusion seems to indicate that cities in the east and west have different survival profiles, since their exclusion changes only the eastern side of Ukraine profoundly but not the western.

A similar conclusion can be made about respiratory system diseases. With cities separated, the northern part of Ukraine is evenly affected. Excluding only the one city of Chernihiv in this region makes the entire oblast jump two levels down and change its group, which means that the Chernihiv region citizens living outside the administrative capital are more disadvantaged than those living in it.

Figure 7.18: SMR for different causes of death for regions where excluding big cities from the data produced negative changes, Ukraine 2005-2010



## 7.5 Spatial analysis

The visual inspection of mortality patterns across districts can be complemented by exploratory spatial analysis. This method provides objective measures to the extent that mortality is clustered spatially (Kibele 2012). Indexes of spatial analysis (as described in the Chapter 4.5) measure the strength of autocorrelating districts with their neighbours.

The global index is called the Moran index. It provides information about the presence of spatial autocorrelation. It is a global measure, and does not indicate the location where the spatial autocorrelation occurs. For this purpose, a local indicator of special autocorrelation called the LISA index is used. It indicates the presence of local spots of autocorrelation by measures the association around each observation and making it possible to map.

The Moran's and LISA indexes range between -1 and 1; -1 indicates a strong negative correlation (which is very rare in social studies), and +1 is a strong positive correlation. Positive spatial autocorrelation exists if districts with high SMRs are next to districts with high SMRs (in red on the map), or if districts with low SMRs border other districts with low SMRs (in blue on the map). Negative spatial autocorrelation therefore exists if districts with high SMR are surrounded by districts with low SMRs (and *vice versa*). But this was not observed in the given analysis. The remaining units demonstrate insignificant correlations.

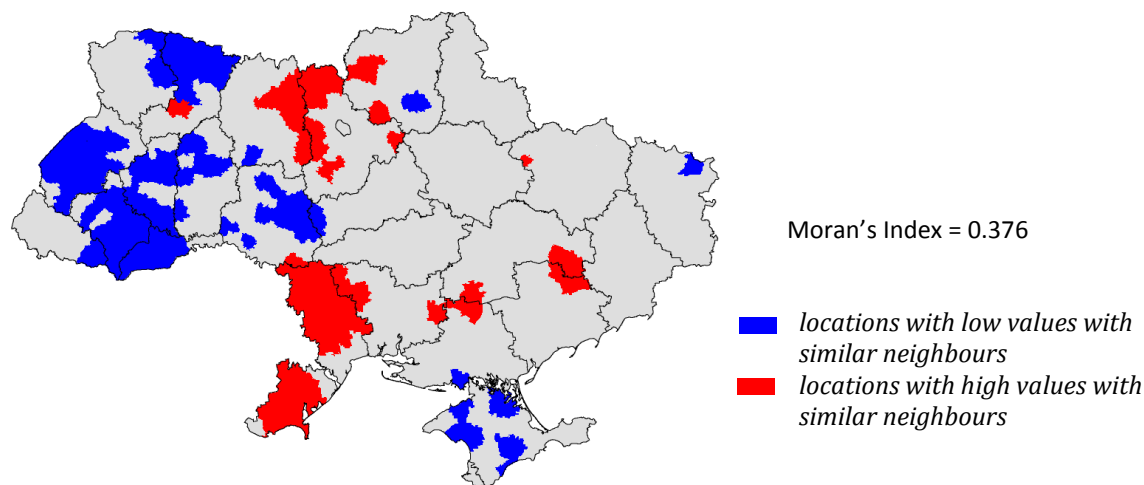
A correlation map in *Figure 7.19* reveals that mortality in certain parts is not spread randomly and that districts do influence each other through autocorrelation. More specifically, a contiguous area of low mortality (and, hence, of positive local spatial autocorrelation) is found in the west of Ukraine, stretching along the Carpathian Mountains and extending to the north. The positive influence of districts on each other is also fixed in the Crimean peninsula.

The same strong correlation (though of high SMR) is observed among the districts of Odeska oblast (in the south), which has the most awkward shape. Such a bizarre configuration may explain the tight spatial relations among its districts and, therefore, a high autocorrelation. Strong autocorrelation is also observed along where the Kyiv region borders the Zhytomyr region, which is an interesting phenomenon that indicates that mortality goes beyond administrative borders.

A different example is Dnipropetrovska oblast. Though a region is classified as one with high SMR (*Figure 7.9*), the more detailed map shows that there is no consistent pattern among districts. And the correlation map even shows that they do not correlate. One explanation could be that this region is split into parts by the river Dnieper.

In general Moran's index is equal to 0.376, which is not very high.

Figure 7.19: LISA Index by Ukraine districts, 2005-2010, all causes



Source: Author calculation based on the data of the State Statistics Service of Ukraine

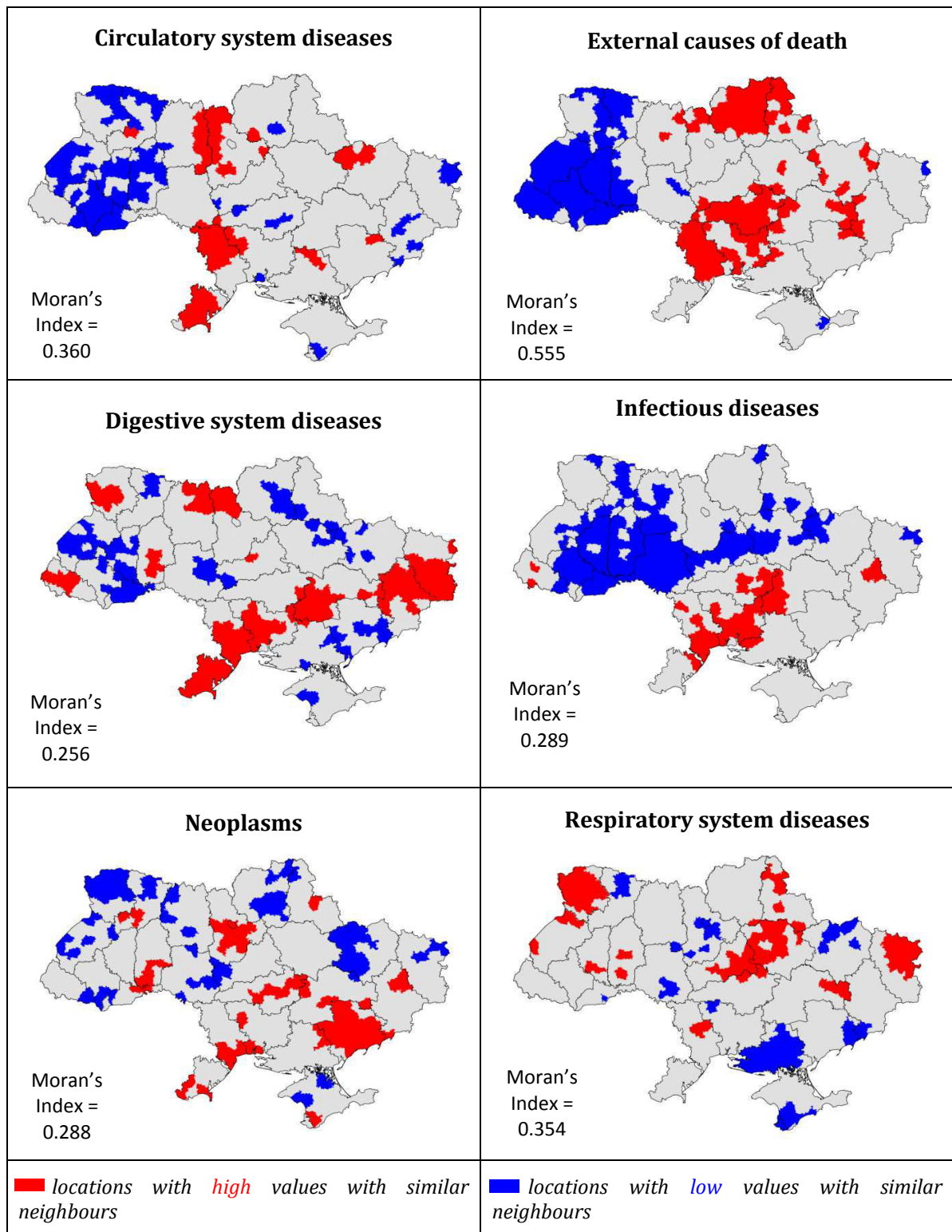
As for causes of death, some regularity can be observed as well (Figure 7.20). First, some vertical division between the eastern and western parts can be clearly seen for mortality from circulatory system diseases and external causes of death; there is a diagonal cut-off for digestive system diseases and infectious diseases; and some opposition exists between north and south for neoplasms and respiratory system diseases.

The highest index of global spatial autocorrelation is observed for SMR from external causes of death and is equal to 0.555, which is a sign that the social environment affects mortality significantly. According to the correlation index, second place belongs to circulatory system diseases (MI = 0.36). These two classes are the most important in the mortality structure of Ukraine: diseases of the circulatory system, because of their large relative weight; and violent mortality, because of its catastrophic level. The areas where intervention is prioritized to combat these groups of diseases are concentrated near the capital Kyiv and Odeska oblast in the south.

The lowest index of spatial autocorrelation is observed for digestive system diseases (0.256), though for other groups of causes it is not much higher, and such values are still quite low.

As was reviewed in previous chapters, Chernihivska oblast in the north is the one that lost its primary positions in life expectancy because of high violent mortality among males of working age. The analysis provides information that such a tendency is peculiar for every administrative subdivision of Chernihiv region, and that they highly influence each other. The same is true for Odeska and Kirovohradska oblasts.

Figure 7.20: LISA index by districts of Ukraine for different causes of death, 2005-2010



Source: Author calculation based on the data of the State Statistics Service of Ukraine

LISA maps of SMR reflect that regional clustering across districts is different, depending on cause of death. In other words, areas are contiguous in some cases and disjointed in others,

indicating that spatial interaction has a different nature for different groups of causes. The cluster of districts shaped in the north by external causes is completely dissolved when compared with any other group of causes of death. On the other hand, some local clusters emerge: Volynska oblast (when considering neoplasms of respiratory system diseases), Zaporizka oblast (neoplasms), Khersonska oblast (respiratory system diseases), Odesa-Luhansk belt (in the case of digestive system diseases), etc. It is most probable that a positive phenomenon could arise through partial dissolution of clusters where districts negatively “influence” each other could be a positive phenomenon leading to break up of harmful interlinks.

Generally, most western regions are merged by the cluster with the most significant positive local spatial autocorrelation, and low levels of SMRs. The east is more heterogeneous with respect to SMRs, contributing to a more equal spatial distribution of SMRs and, hence, to a lower overall spatial autocorrelation. The areas of significant spatial autocorrelation due to similarly high levels of SMR are located in the north, centre and south.

In general, saying that districts “influence” each other merely simplifies a more complex system of relations. Districts may “impact” each other via certain social networks, social environments and spaces. They may resemble each other in terms of transport networks, landscape, climate, etc. To investigate these relations, one should have detailed data on different variables by district in order to run spatial regression models. Since I did not have such data, the analysis is of a rather descriptive character.

## **7.6 Mortality in a region which suffered from the Chernobyl accident**

This subchapter pays specific attention to mortality in the city Slavutych, which was established to settle the population evacuated from the city Prypiat after the Chernobyl catastrophe. The city of Prypiat was founded in 1970 to accommodate population working in the Chernobyl Nuclear Power Plant (CNPP). Along with its prime goal of being home to the nuclear power plant's employees, Prypiat had been viewed as a major railroad and river cargo port in northern Ukraine<sup>29</sup>. Contrary to the common delusion, the city of Chernobyl never had anything to do with a nuclear plant - it was a small town situated 18 km away from the plant. However, it gave its name to the district where the plant was located and therefore

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<sup>29</sup> [http://www.ru.wikipedia.org/wiki/Припять\\_\(город\)](http://www.ru.wikipedia.org/wiki/Припять_(город))



to the plant itself. After the catastrophe, Chernobyl district was abolished and included in Ivankiv district<sup>30</sup>.

On the other hand, the city of Prypiat, found within 2 km of CNPP, is the one that was the most hit by the accident. It was an elite town with a concentration of highly-skilled engineers and industrial workers of the Soviet Union. Prypiat could boast a developed social infrastructure and high-level living conditions; it was on the list of cities with a right to the primary supply of goods and products, which was a right equally belonging to the capital cities. Prypiat was an exemplary city of the Soviet Union and living in it was a privilege.

The population of Prypiat was very young, one third of it represented by children. The average age of the population before the accident was 26 years<sup>31</sup>. On that fatal Saturday when a reactor exploded in the early morning (at 1:24), the city was unaware and celebrated 16 weddings<sup>32</sup>.

The 16-year old city Prypiat died due to the accident in one of four Chernobyl Nuclear Power Plant reactors, which became the biggest anthropogenic catastrophe in history. The evacuation of Prypiat's 49.4 thousand inhabitants and its surroundings lasted three days. Initially, people were sent to sanatoriums, resort complexes and to their relatives. However, in October of the same year an order was signed for the construction of a new city to accommodate people evacuated from the Chernobyl exclusion zone, and in spring of 1988 the first inhabitants moved into Slavutych.

In 2010, the population of Slavutych was around 24 thousand people, of which 8 thousand were still children in 1986. Paradoxically, just as Prypiat was, Slavutych is also young and attractive for its living conditions. According to indicators of socio-economic development, it takes second place after the capital Kyiv in the rating of Ukraine cities (Udovycheno 2005). The best architects of the Soviet Union worked on its fast construction and one can find the typical districts of eight Soviet republics there, with Estonian, Georgian, Armenian, and Lithuanian neighbourhoods, among others.

Ten programs have been launched to protect the vulnerable population, to fight drug and alcohol addiction, to rehabilitate the handicapped and to develop education and science. There are two universities in Slavutych: Kyiv and Chernihiv universities. Moreover, for the sake of its development, Slavutych was declared a special economic zone. And lastly,

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<sup>30</sup> [http://uk.wikipedia.org/wiki/Чорнобильський\\_район](http://uk.wikipedia.org/wiki/Чорнобильський_район)

<sup>31</sup> [http://www.ru.wikipedia.org/wiki/Припять\\_\(город\)](http://www.ru.wikipedia.org/wiki/Припять_(город))

<sup>32</sup> [http://www.bbc.co.uk/russian/specials/1550\\_chernobyl\\_chro/page5.shtml](http://www.bbc.co.uk/russian/specials/1550_chernobyl_chro/page5.shtml)

Slavutych is similarly to Prypiat in that most of its inhabitants still work at the Chernobyl Nuclear Power Plant.

Slavutych is physically located in Chernihiv and not in the Kyiv region (where the power plant is found), though it is administratively subordinate to the Kyiv region. It is 50 km away from the Chernobyl Power Plant. After the disaster in one of its four reactors, the remaining three continued working until the complete closure of CNPP in 2000. During all these years, half of the workable population of Slavutych (around 9 thousand) commuted every day, crossing regional borders and the river of Dnipro. The closure of the nuclear plant, which was a source of 85% of city's revenues, was a big shock for the population. Around three thousand left the city, although another three thousands are still working there as recovery operation workers, containment observers and scientific researchers within the framework of the "Shelter" program.

Even though the radiation levels are hundreds of times lower now than at the moment of the catastrophe, the pollution will still remain for many years. For those working in the contaminated zone, a strict control of daily doses is applied. Workers are careful themselves not to exceed the norm, as they are all afraid to lose their jobs before reaching the maximum allowed accumulated amount. Regarding the lifetime exposure to radiation by CNPP's employees, I would like to investigate the mortality profile in Slavutych and to compare it to the pattern observed in neighbouring regions, as well as in similar towns.

The accident at the Chernobyl nuclear power plant in 1986 was a tragic event for its victims. It caused serious social and psychological disruption in the lives of those affected and vast economic losses to the entire region. At the same time, while immediate demographic losses are known (death of firemen, radiation sickness of workers present on the site exposed to high doses, thyroid cancer reported in children and adolescents), the long-term consequences are less evident.

The initial surge of attention to the accident and the flow of financial assistance from the international community turned into a loss of interest and disappointment in the low efficiency of applied measures. The conclusion of specialists from UN organizations was that the primary negative consequences of irradiation were overestimated (Tokarevskyi 2006). Reports issued two decades after the accident state that there is no scientific evidence radiation exposure is related to increases in overall cancer incidence or mortality rates. The 2003-2005 Chernobyl Forum concluded: "It is impossible to assess reliably, with any precision, numbers of fatal cancers caused by radiation exposure due to the Chernobyl accident ... Small differences in the assumptions concerning radiation risks can lead to large differences in the predicted health consequences, which are therefore highly uncertain".

There is a tendency to attribute increases in the rates of all cancers over time to the Chernobyl accident, but it should be noted that increases were also observed before the accident in the affected areas (UNSCEAR, 2008). On the other hand, Ella Libanova (2007) argues that the increase in mortality of the affected population in the post-Soviet period was greater than among the rest of Ukrainians.

Childhood thyroid cancer caused by radioactive iodine fallout is one of the main health impacts of the accident. At the time of the accident, 5000 cases of thyroid cancer were diagnosed among children below 18 years of age in Ukraine, Belarus and the Russian Federation together (WHO 2006). The prognosis for an increase in thyroid cancer was made by experts from UNDP & UNICEF in 2002 and has recently been confirmed by data of the Centre of Medical Statistics. Among the evacuated population, the incidence rate of thyroid cancer increased by four times in 1998-2004 compared to 1980-1989 (Libanova, 2007). And according to the data of the Centre of Radiation Medicine at the Academy of Medical Sciences, there was observed an increase in child mortality up to 2000 (Pirozhkov, 2004).

Apart from the dramatic increase in thyroid cancer, there is no clearly demonstrated rise in the incidence of solid cancers or leukaemia due to radiation (UNDP & UNICEF, 2002). Officially, the increase in leukaemia incidence due to radiation is recognized only among the accident liquidators, and even these numbers are low. For example, out of a cohort of 110,645 liquidators, there were 101 cases of leukaemia registered (Torbin V). It should not be neglected, however, that the accumulated radiation might cause adverse effects many years after the exposure.

Among other problems, there are some testimonies of an increased prevalence of digestive system diseases, particularly chronic liver cirrhosis and hepatitis, and an increase in psychological problems among the affected population. The latter was caused by panic and anxiety, and was then compounded further by the depression, which followed the collapse of the Soviet Union. A UN study concludes that relocation and hand-outs have caused more illness than radiation (Brown, 2002). Finally, the sociological research regarding the consequences of the Chernobyl accident testifies to the fact that more than half of the total Ukrainian population believes that the catastrophe caused a bad impact on their health (Libanova 2007).

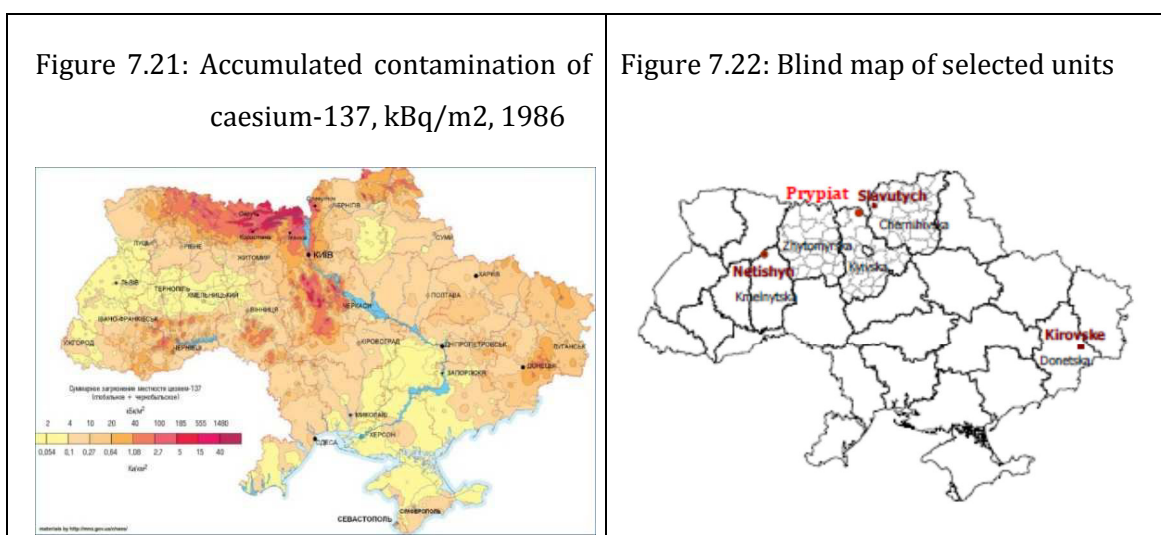
There is little development in the scientific study of demographic problems in regions that suffered from the accident. The main obstacle to this is the small size of the studied areas, which makes numbers insufficient for solid conclusions and allows only for crude indicators. This analysis tries to partially fill this gap, using detailed data on deaths by cause available for the city of Slavutych, as well as for neighbouring areas and other remote towns.

In order to compare the situation in such small town as Slavutych with adequate benchmarks, I needed data for administrative subdivisions and settlements. This is the third level of Ukraine's territorial division, and is represented by 490 districts and 174 cities. Luckily, Slavutych appears in the data, and thus I have two important pieces of information.

First, there is the census data for the end of 2001. Second, there is the number of deaths by medical causes and by place of residence, although with no age and sex specification. Hence, I deal only with total numbers for both sexes. The inconvenience comes from the fact that data on causes of death is available only from 2005. Therefore, the period of analysis refers to the recent years, 2005-2010, which is around 20 years after the catastrophe.

To see how the city of Slavutych compares to its neighbours, I selected all the districts of three oblasts: Chernihivska (where Slavutych is located), Kyivska (where Prypiat was located) and Zhytomyrska (which was among those hit hardest by the catastrophe). All of these form a northern belt of contaminated territory (*Figure 7.21*). This adds up to 70 districts (*Figure 7.22*). It should be noted that large cities, i.e. the capitals of these regions were not considered in order not to bias the results.

A comparison of Slavutych with neighbouring areas can give an idea of whether mortality patterns are common for the entire area, or if Slavutych differs in any particular way. On the other hand, we do know that a great deal of territory was contaminated and the consequences of radiation could have been reflected in the health of inhabitants of the entire polluted zone, including Slavutych.

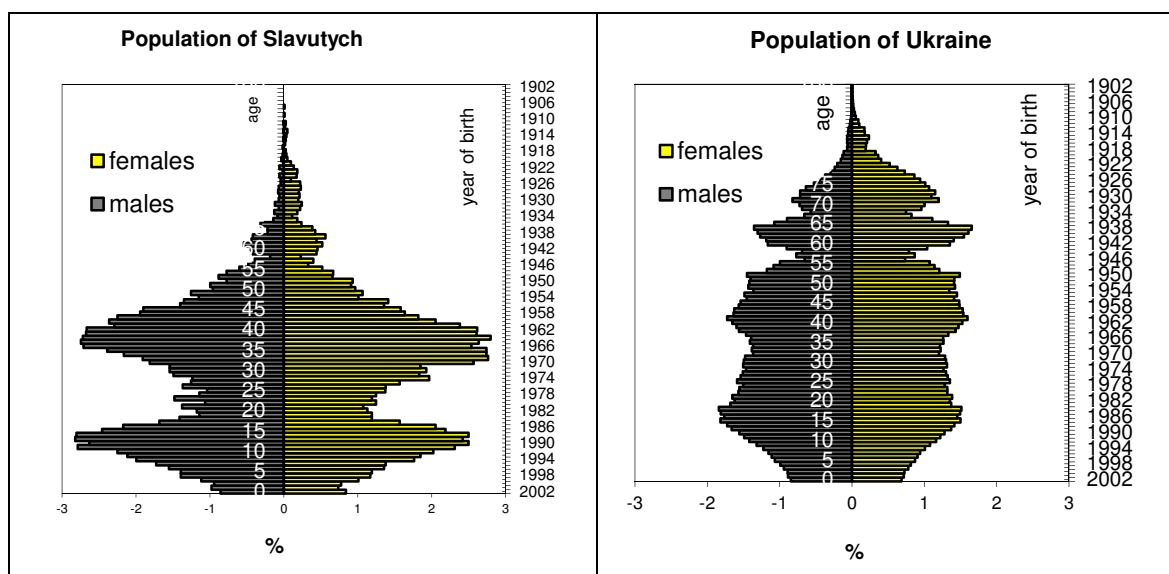


This is why for the second part of the analysis I chose another benchmark: towns similar to Slavutych with around the same population size and composition, but more remote from the site of the catastrophe. Selecting such towns, with socio-economic characteristics close to

those of Slavutych would allow one to control for a variety of factors that might shape the mortality level and suggest that the observed difference in mortality could be associated to the level of pollution.

The population of Slavutych is incredibly young, according to Ukrainian standards. It is so young that it was problematic to find another city of similar size with this specific population structure. Its peculiarity is that only two generations are represented, the generation of middle-aged parents and of their recently grown-up children (*Figure 7.23*). There are almost no old people in Slavutych at all. In contrast, the population of Ukraine overall is old, as ageing processes have touched almost all big and small cities, and all ages tend to be more or less adequately represented - with the exception of the oldest generations who suffered the catastrophes of the twentieth century.

Figure 7.23: Age-sex pyramids for the populations of Slavutych and Ukraine as a whole according to census data (end of 2001)



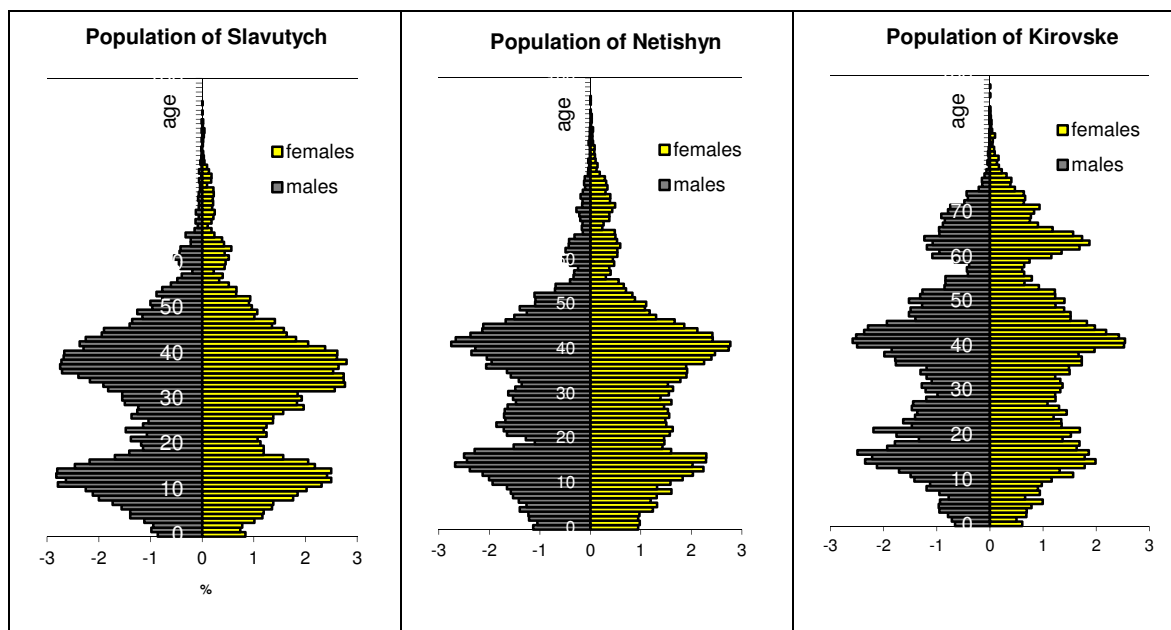
Source: Data of the State Statistics Service of Ukraine.

Eventually, out of all towns in Ukraine of around the same size, only three were found with a similar young age structure: Kuznetsovsk (Rivnenska oblast), Netishyn (Khmelnytska oblast) and Yuzhnoukrainsk (Mykolaiivska oblast). They are the youngest in Ukraine in both senses: they have young populations, and the cities themselves were constructed in the seventies. However, there is one important common feature for all three of them: the presence of a nuclear power plant.

In regard to this circumstance, I have chosen only Netishyn, which resembles the Slavutych population, the most. I then continued looking for another reference unit, which would not be

related to the nuclear industry. The search was made in an industrial region of Donbas, which was also developed relatively recently, and eventually I selected the town of Kirovske. As this town was founded in 1953, the population pyramid is different from Slavutych, in that it has a third generation of grand-parents (*Figure 7.24*).

Figure 7.24: Age-sex pyramids for populations of Slavutych, Netishyn and Kirovske according to census data (end of 2001)

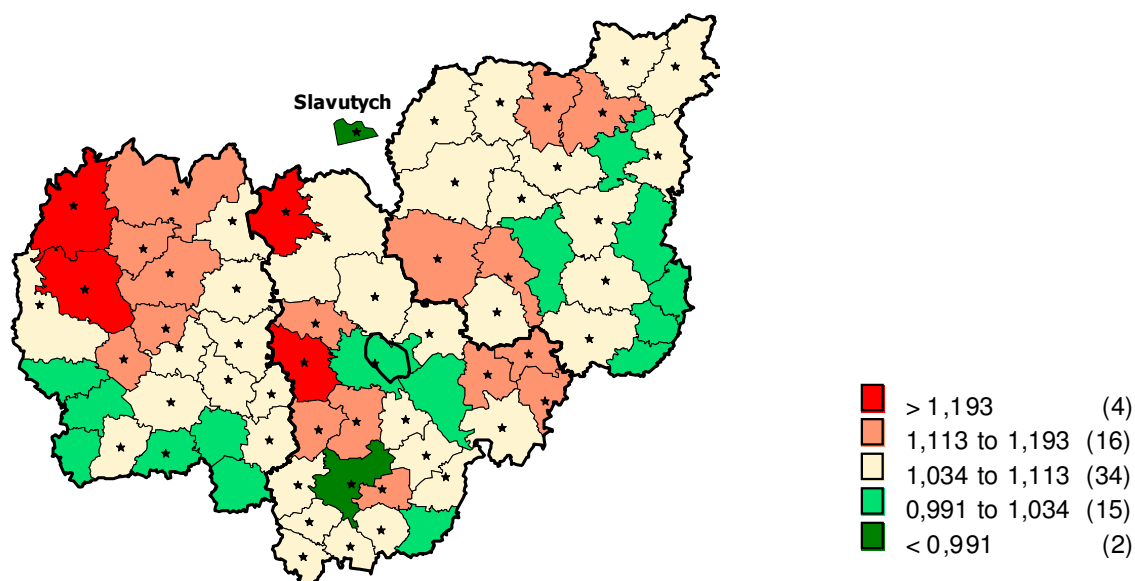


Source: data of the State Statistics Service of Ukraine.

All comparisons of calculated indicators for Slavutych and districts are visualized using thematic maps. Slavutych is zoomed and put outside the regional borders. Ranges were set in such a way that the middle class (in yellow) represents 50% of the values around the average values, two neighbour classes each comprise 20% of higher/lower than average values; and two classes at the edge each represents 5% of extremely high/low values. The highest levels of mortality are presented in red and the lowest levels in green (for SMR).

The total number of all deaths in Slavutych for 2005-2010 is 878. Slavutych belongs to the group of units with extremely low mortality (*Figure 7.25*). The confidence interval in its turn proves that the deviation from the all-Ukraine level is significant.

Figure 7.25: SMR from all causes of death for selected districts and Slavutych, 2005-2010



\* - Star indicates that the deviation from the average is significant

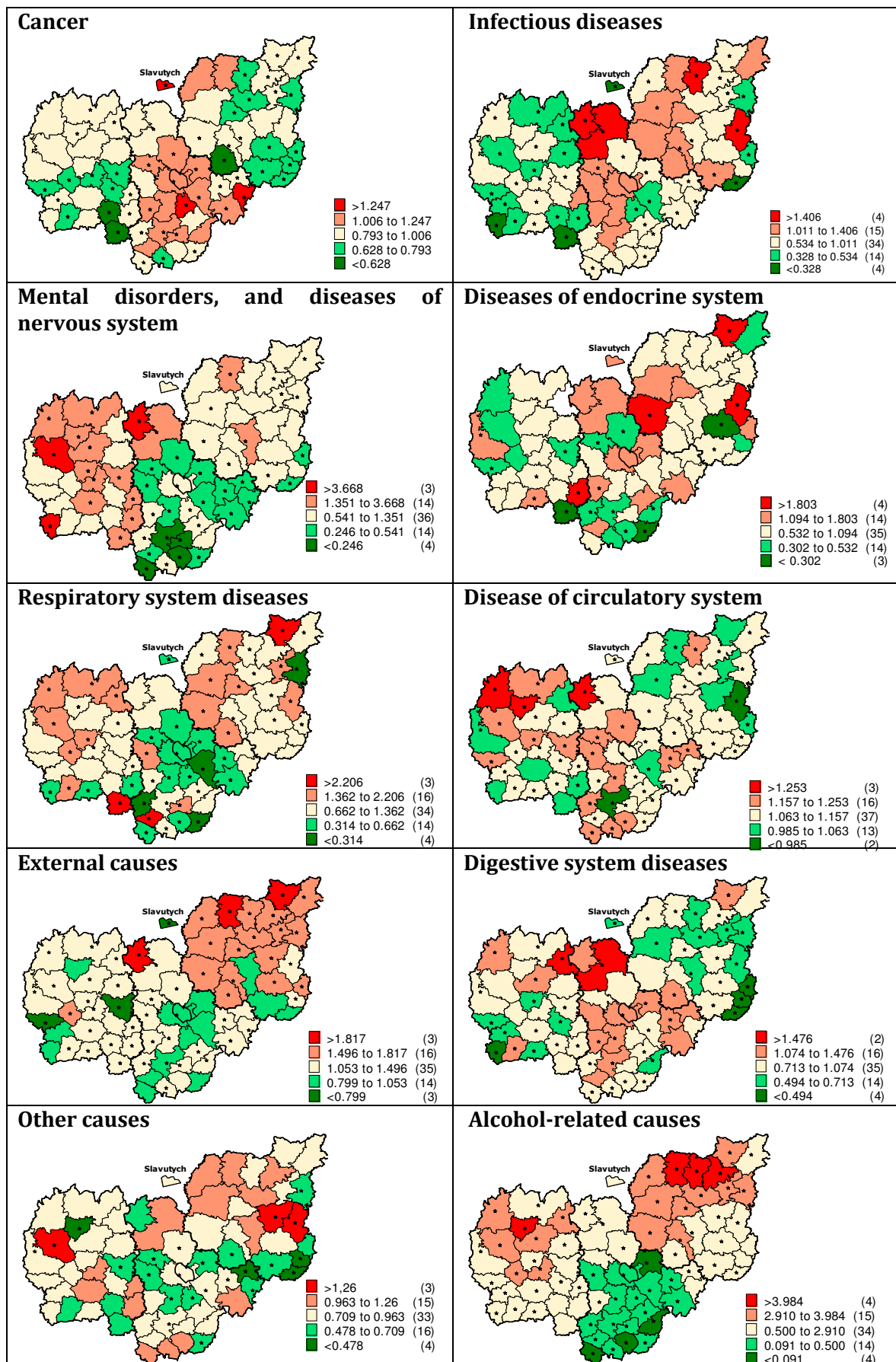
Source: Author calculation based on the data of the State Statistics Service of Ukraine

Against this background, it is interesting to see how SMR changes from cause to cause.

Based on the representation of SMR on the maps (*Figure 7.26*), I can classify causes of death into five groups:

1. Slavutych has extremely low SMR for infectious diseases, external causes of death.
2. Slavutych has low SMR for respiratory and digestive system diseases.
3. Slavutych has average SMR for mental and nervous system disorders, circulatory system disease, alcohol-related causes, and other causes of death.
4. Slavutych has elevated SMR for diseases of endocrine system.
5. Slavutych has high SMR for cancers.

Figure 7.26: SMR by cause of death for selected districts and Slavutych, 2005-2010





The geography of external causes of death is very much correlated with that of alcohol-related causes for the region, except for Slavutych. Mortality there from external causes is very low, though mortality from alcohol-related causes is at the level of average. It should be noted that alcohol-related causes include alcohol cardiomyopathy, alcohol liver disease, mental and behavioural disorders due to alcohol, and accidental poisoning by alcohol. Only accidental poisoning by alcohol belongs to external deaths. Since alcohol-related mortality in general and from accidental poisoning in particular are low in Slavutych, we can compare it to its neighbours and conclude that some different type of alcohol consumption may take place there. Mental and behavioural disorders due to alcohol present almost 50% of all alcohol-related causes there.

There is an opinion that widespread psychological reaction to the Chernobyl accident and the fear of radiation were just as responsible for the mortality increase as the radiation itself. The visible difference in mortality levels from mental disorders between the contaminated north and the rest of the territory supports this statement.

Lastly, SMR refers Slavutych to the extreme-group of those with a high risk of dying from cancer. Unfortunately, information of these types of cancers is not available, and therefore it is impossible to link this cause of death to radiation. However, if we consider that such elevated oncological lethality within the background of generally very low levels of mortality in the city, we cannot help but think that life-time exposure to radiation has serious consequences. The deduction made for cancers is also fair for diseases of the endocrine system.

The last step is to compare the mortality profile of Slavutych with the pattern of similar towns that are not located in the territory of contamination. First, let's look at the general demographic indicators.

Among selected towns (*Table 7.4*), Slavutych is the youngest; it has the largest share of children (27.8% compared to 25.4% in Netishyn and 18.8% in Kirovske) and the smallest share of elderly (2.7% compared to 4.6% in Netishyn and 10.1% in Kirovske), while for Ukraine as a whole the corresponding proportions in 2002 were 16.5 and 15.9%. Though the crude birth rate is relatively low in Slavutych, infant mortality and general mortality levels are low as well, providing a population increase of 3.3 persons per each 1000 of the population. A similar demographic profile is peculiar for another "nuclear" town, Netishyn, which enjoys an even more impressive population growth against the background of total depopulation in the country.

Kirovske, in the Donetsk region, has all the preconditions to maintain its population (high marriage rate, low divorce rate, high birth rate). However mortality exacerbates all advantages and results in a population decrease of 4.6 persons per each 1000 of the population. This is data about the natural increase in the population, which unfortunately could not be supplemented by migration data, as it is not available.

Given such a favourable demographic profile, Slavutych ends up having a generally lower SMR (0.93) than the all-Ukraine standard, which equals one. Even more impressive is Netishyn (0.73), which is another young nuclear town. Kirovske, however, appears at the other end of the spectrum with SMR equal to 1.05. When estimating SMR by causes of death (Table 7.5), SMR is the highest in Slavutych in the case of cancer, endocrine and circulatory system diseases. Therefore, two classes of causes (neoplasms and endocrine system diseases), which are most likely related to radiation, demonstrate alarming regularities.

Table 7.4: Some demographic indicators of Slavutych in comparison with selected towns and Ukraine as a whole

	Prypiat (1986)	Slavutych (2002)	Netishyn (2002)	Kirovske (2002)	Ukraine (2002)
Year of founding	1970	1988	1979	1954	
Population in thousands	49.4	24.4	34.3	30.9	48 032
Population <15 years , %	32.4	27.8	25.4	18.8	16.5
Population >65 years , %		2.7	4.6	10.1	15.9
Some rates, average for 2005-2010					
Marriage rate (per 1000 pop)		8.0	9.6	8.9	7.4
Divorce rate (per 1000 pop)		5.1	4.5	4.1	3.5
Crude birth rate (per 1000 pop)	16.8	9.3	12.2	8.7	10.4
Crude death rate (per 1000 pop)		6.0	5.9	13.3	16.1
Natural population increase/decrease (per 1000 pop)		+3.3	+6.3	-4.6	-5.7
Infant mortality rate (per 1000 live birth)		8.8	9.2	12.5	9.8

Source: Data from statistical form A-1 "Summary of natural change of population" of the State Statistics Service of Ukraine. Prypiat data is from <http://pripyat-city.ru>

Table 7.5: Standardized Mortality Ratios for selected towns by causes of death, 2005-2010

	Infectious diseases	Cancer	Endocrine system	Mental disorders, nervous system	Circulatory system	Respiratory	Digestive	External	Others	Alcohol related
Slavutyich	0.17	1.37	1.66	1.12	1.10	0.52	0.59	0.65	0.86	0.76
Netishyn	0.34	1.00	0.47	0.90	0.73	0.42	0.65	0.71	0.78	0.73
Kirovske	0.90	1.10	0.80	1.37	0.99	0.78	1.59	1.04	1.26	1.28

Source: Author calculation based on the data of the State Statistics Service of Ukraine

Hence, I tried to compare mortality levels from different causes of death in Slavutyich with those observed in areas surrounding it, as well as with those in more remote but very similar towns. In all cases of comparisons Slavutyich ends up having much higher mortality rates from cancers and diseases of the endocrine system against the background of a generally quite low level of mortality of the city.

Unfortunately, there is no data that allows us to investigate the type of cancer. On the one hand, such an elevated risk of cancer might be a result of monitoring closely those who received high doses of radiation in 1986 as well as those who are still working at the plant. It could also be due to more accurate identification and registration of the medical cause of death. However, intensified supervision is typical for other nuclear cities, and in Netishyn in particular, where mortality from given causes is much lower. Regardless, one should not neglect the oncological impact of the Chernobyl accident on the ill-being of the region.

Given that such analysis has a lot of restrictions regarding data availability, new pieces of information would be invaluable. Primarily, it would be interesting to know more about the epidemiologic situation of the region before 1986. Therefore, there is still room for new demographic insights into the situation of the Slavutyich population, particularly regarding people who suffered directly one of the biggest catastrophes of humanity.

## Conclusions

Having data for smaller administrative units, it was possible to investigate some patterns that are invisible at the regional level. It also made it possible to observe that cross-regional continuities clearly exist over Ukraine's regions. In particular, moving from the west to the east and south of Ukraine corresponds to moving from low to high mortality levels. Similar to

the findings of the study by Krumins and his colleagues (2000), the gradient of change in Ukraine depends on whether a region is more influenced by the Polish world or if its history has been closely linked to that of Russia.

Therefore, I first investigated infant mortality and found that variation among regions is clearly visible, implying that rates are higher in particular regions in the east, south-west and in the centre. As expected when comparing urban and rural populations, urban inhabitants have lower infant mortality than rural people (9.1 vs. 10.9). However, contrary to expectations, the highly urbanized east has worse patterns than the rural west. In addition, cities in the east and west are also different, given that their exclusion from data does change patterns in the east, and not much in the west. This leads to a second conclusion that the characteristic of eastern metropolises is such that its inhabitants benefit from exceptional health advantages while the populations outside of them equally share great disadvantages. The characteristic of western cities is such that they are not much different from other types of settlements.

When considering rural areas alone, the contrast between west and east is the sharpest. Villages of the urbanized east are in a worse position regarding infant mortality than villages in the mostly rural west. In general, infant mortality in rural areas is constantly higher than in low-urbanized towns (10.9 vs. 9.6), or in big cities (10.9 vs. 9.3).

To investigate mortality from all causes, I used the distribution of each SMR over the territory of Ukraine, which suggests that there are four distinct types of areas in Ukraine: areas in the west with low mortality; the problematic region around the capital; the south-eastern regions with high mortality; and a scattered picture in the remaining regions. Such a distribution is visible at the regional level, as well as at district levels, though data by districts refines the patterns.

As for circulatory system diseases, which represent the largest share of deaths, SMR is distributed in a manner similar to all-cause mortality. Kyiv and Odesa oblasts exhibit patterns of continuously high SMRs, whereas the pattern of adjacent districts with low SMRs prevails in the west. As for cancer mortality, regions cannot be clearly classified as of high or low mortality. The only region, which is not ambiguous in this sense, is Zaporizka oblast, where SMR is high in every district.

The spatial pattern of external causes is specific in its own way and not very much connected to the general pattern of all-cause mortality. Clearly readable is a contrast between west and east, where homicides and suicides prevail.

Generally, the cluster with the most significant positive local spatial autocorrelation, i.e. with low levels of SMRs, merges most western regions. East is more heterogeneous with respect to SMRs, contributing to a more equal spatial distribution of SMR and hence to a smaller overall spatial autocorrelation. The areas of significant spatial autocorrelation due to similarly high levels of SMR are located in the north, in the center and in the south.

Excluding big cities from the data produced different effects. In the case of cancers and infectious diseases, high deaths rates in cities give rise to the region's overall mortality. For the remaining group of causes, the situation is quite the opposite, and living in a big metropolis is an advantage to surviving.

Finally, reviewing the case of the city of Slavutych, whose population is suspected to have been the hardest hit by the accident at the Chernobyl Nuclear Power Plant, I found out that Slavutych has elevated death rates from cancers and diseases of the endocrine system when compared to the background of the generally quite low mortality of the city. These high death rates are seen in both cases of comparison, i.e with neighbouring areas and with remote towns.

## General conclusions

The aim of this study was to investigate regional mortality differences, cause-of-death patterns and trends at different spatial scales in Ukraine. Using knowledge gained from analysis in the previous chapters, the responses to the researched questions raised in the beginning can be formulated.

1) The first question was “*How large are geographical variations in mortality in Ukraine?*”

This question needed to be addressed by relying on own calculation using raw data from the State Statistics Service of Ukraine (and not already made by it calculations). In the data, few corrections were made to account for existing data problems. Such flaws had arisen from the particularities of administrative division, the approach to civil data registration, and the method of population estimation in the intercensal period. While it was possible to deal with some tasks (e.g. rearranging the administrative units, and correcting the infant mortality rate), some others were impossible to accomplish (e.g. reestimating the population in the intercensal period). Regardless, the population data provided by the State Statistics Service was satisfactory for the analysis, as the possible inaccuracies concern mostly ages (young and working-age), where mortality is rather low.

In general, data (availability by causes, districts etc.) becomes more complete with time. In 2005, Ukraine switched to the 10th revision of International Classification of Diseases, and new changes and practices went into force: new statistical forms became published and new attitudes in classifying causes of death appeared.

Using these data, different mortality indicators were calculated in order to detect interregional mortality patterns and to measure variation. First of all, in regard to life expectancy at birth, one may see some visible geographical opposition: in the case of males it is between the west and east of Ukraine, while in the case of females the contrast is rather

between the west and south-east. Regions in the worst situation form a belt that starts from Odeska oblast, passes through the southern areas, and ends up in Donbas. Regions with the best mortality are found in the west, in the zone around the Carpathian Mountains.

For every region, life expectancy at birth for men is always lower than for women. For males, the average for Ukraine LE is equal to 62 years, and for females it is 73.5 years.

Mortality disparities among regions are also seen when considering different age groups. However, there is an interesting feature: the general geographical regularity remains almost the same, because - as was proven by correlation analysis - age groups are tightly connected and, if a certain region is characterized by elevated mortality in some age group, it is likely that it is elevated over the entire age span. On the other hand, if some region has a level that is lower than Ukraine's average in a certain age group, one may expect that it is lower in every age group. Age-decomposition analysis added that the advantage of better-performing regions was larger than the disadvantage of poorly-performing regions. This is true for all age groups, but especially so for the elderly. The regions that succeeded the most in increasing life expectancy are those characterized by decreased mortality at older ages. This stresses the importance of reorganizing the health care system in order to meet the needs of the ageing population, which would also give a considerable rise to life expectancy.

From the analysis of age-sex patterns, one could receive evidence about the arrangement of Ukraine regions into contradictory categories: regions with favourable mortality in all age groups versus regions with unfavourable mortality in all age groups; plus an intermediate group with favourable infant mortality but a disadvantageous situation in the remaining age groups. It is notable that these categories could be associated to geographical location. The first group is found uniquely in the west, the second in the south-east, and the last includes regions in the centre and north.

Having data for smaller administrative units, it was possible to investigate some patterns that are invisible at the regional level. It was discovered that districts in the west merge into a continuously homogenous area of low mortality, which is the case for ages and causes. Such regions are homogenous within themselves, as well as across the entire west of Ukraine. With the use of spatial correlation indexes, it was proven that these districts positively "affect" each other. Similarly homogenous and tightly correlating districts were also found in Odeska oblast, where areas, nonetheless, influence each other "negatively".

It was discovered that big cities are very distinguished from the remaining settlements in the region, which appear on the map as highlighted zones. In most cases, it is not only the city itself but also its suburban areas that enjoy lower mortality rates. The situation is especially

visible in the case of Kyiv and Odessa. This motivated me to perform some detailed investigations, i.e. to model situation with big cities (population of more than 100 000) both included and excluded from the data. The effects were different, depending on cause of death: in the case of cancers and infectious diseases, high death rates in cities elevated the region's overall mortality. The situation is quite the opposite for the remaining group of causes and living in a big metropolis is an advantage to surviving.

Finally, I reviewed the case of the city of Slavutych, whose population is suspected to have been the hardest hit by the accident at the Chernobyl Nuclear Power Plant, and found out that Slavutych has elevated death rates from cancers and diseases of the endocrine system when compared to the background of the generally quite low mortality of the city, as well as when keeping in mind the overall declining trend in cancer mortality.

2) The next question was: *“What are the main medical causes of death behind geographical variations in mortality?”*

Regarding causes of death, the three most important killers shape the patterns: diseases of the circulatory system, cancers, and external causes of death. Each of them has its own particularity. Diseases of the circulatory system are an acute problem in every region of Ukraine although they prevail in the north and some regions in the south; cancers don't show any geographical regularity; and external causes of death do provoke a sharp contrast between the west and the rest of Ukraine.

Cause-specific mortality profiles also change with age. External causes play an important role at a young ages (particularly: transport accidents, suicides, and accidental drowning) and middle age (suicide, accidental poisoning by alcohol, and homicides). Suicides appeared to be the biggest killer at age 20-44 and no less serious problem until 60 years. By-district analysis discovered a sharp contrast between more religious western regions and the rest of Ukraine. In general, external causes decrease life expectancy in the eastern regions by around one year (in comparison to the average for all of Ukraine), and they give an advantage of around one and a half years to the western regions.

The infectious diseases – largely represented by tuberculosis - are important at working age (especially for males). However, this age is even lower (25-30 years) for some southern regions (Odeska and Mykolaivska oblasts), after which curves of death rates decline sharply.

Mortality curves for cancers and respiratory system diseases across ages are similar - death rates increase exponentially with age. Here, the biggest killers are chronic bronchitis among respiratory system diseases, while cancer of the respiratory organs is the highest among



cancers (though mortality from cancer of digestive system organs is also high at old age). In some cases, respiratory system diseases prevail largely over cancers at old age (80-84 years), and in others they never predominate. The last group is less numerous (AR Crimea, Donetsk, Zaporiska, Kyivska, Mykolaiivska, Khersonska oblasts and the city of Kyiv).

Circulatory system diseases prevail largely at old age. It is also notable that this is the largest group of causes that includes several important subcategories (ischaemic heart diseases, cerebrovascular diseases, and the diseases of the arteries, arterioles and capillaries), each of which has its own pattern of mortality, and these patterns perfectly overlap. This forces conclusions about cause-of-death registrations that are prejudiced toward circulatory system diseases, which in turn necessitates treating them together in order to avoid biased conclusions.

Considering all medical causes of death, one may summarize that Ukrainian regions are at different stages in the fight against man-made and degenerative diseases. For some of them, there remain a load of infectious diseases. Western regions managed to make the most progress: they are distinguished by self-preserving behavior and modern attitudes toward health. Northern areas – where mortality from the circulatory system diseases prevails – tend to begin a transition toward a contemporary nosological structure. However, they still lack the effective means for fighting these killers. On the other hand, eastern and southern regions are characterized by an archaic mortality structure: they have a high risk of dying from digestive and infectious diseases, as well as from external causes. Digestive diseases are more probably related to alcohol consumption and, consequently, to man-made diseases.

3) And the last question: *“How have mortality variations changed since the collapse of the USSR?”*

As known, starting from the 1960s (and with exception of the short period of anti-alcohol campaign), life expectancy was degrading in Ukraine. During the last two decades – which were the focus of this study - it has experienced a sharp decrease, then stagnation, and only recently started to show signs of recovery. Different regions experienced changes at a different pace: in some regions, the decline in life expectancy occurred faster than in others and, as a result, the difference between maximum and minimum values increased. Lifespan disparity also increased for most regions. Finally, the coefficient of variation almost doubled in consequent years when compared to the beginning of the study period.

As for best and worst performing regions, earlier research found that, that the worst situation was in the south while the most favourable was in Kyiv and in Chernihiv region; however, this

study found that patterns have changed over the last twenty years, which were marked by numerous social and economic transformations.

The opposition transformed between the north-west and south-east, which was visible in Soviet times. First, after the country went through the economic crisis and the situation degraded everywhere, such a contrast became blurred. Later, the situation ameliorated for a number of the western regions (though it has never reached the 1989 level). The situation did not improve for the eastern regions, which still bear the deep scar of crisis. Therefore, the lowest mortality rates are always observed in the west, while the seat of high risks for males has moved from the south to the east (Donetska oblast). In the case of females, the highest mortality rates are still detected in the south (Odeska oblast).

As for the causes of death, the patterns observed after the recovery are not a mirror image of the initial patterns observed at the end of Soviet times. While at first glance it seemed that Ukraine had regained what it had lost during the years of transformations and stagnation, a closer look convinces us that this is not completely true, and that the internal processes were complex. Only trends of death rates for the largest groups of causes (circulatory system diseases and external causes) fluctuated. Meanwhile, the trends in death rates from the remaining causes continued their course, which was the one that started at the beginning of the study period. Namely, cancer and respiratory system mortality constantly declined; while digestive system diseases and infectious mortality constantly grew.

During the whole period, circulatory system diseases preserved their role as a major killer and no advances were made in their prevention and treatment. This class of diseases is responsible for 60 to 70 percent of all deaths, and the trend increased throughout the whole period though it fluctuated at the end of the 1990s. A small improvement was recently observed, although it is not yet clear how long it will last.

Diseases of the circulatory system shape the main patterns of regional mortality. The basic characteristic of the interregional variation of SDR from circulatory system diseases is a total degradation of the situation in the north. The appearance of the most nearly poorly performing Chernihiv oblast on the map after 2001 is a phenomenon of recent times; no such feature was ever observed before. It may also be associated with the Chernobyl disaster.

Second, the SDRs for neoplasms were constantly decreasing. Mortality curves for all regions showed a clear downward trend, which is completely unlinked to political, economic or social circumstances in the country. Maps for cancer mortality do not indicate any geographical regularity. There are few regions that constantly demonstrate the highest death rates in Ukraine. However, this could actually mean that they are most organized regions in

diagnosing cancers and in financing special treatment centres. This is the case of Zaporizka oblast and the city of Kyiv.

Third, after boosting, mortality from external causes returned to its initial level, which is however, menacingly high. The sharpest contrast between eastern and western Ukraine is observed for this group of causes of death. The situation had greatly worsened during the 1990s, reflecting the consequences of the economic crisis. External causes proved to be very sensitive to changes in society, and mortality levels have returned to their pre-crisis position after a big jump.

Diseases of the respiratory system are the only group of causes that prevails in western Ukraine more than elsewhere. However, as the situation improves, this contrast is smoothed over. Patterns of mortality from infectious and digestive system diseases somewhat overlap. To be precise, diseases of these classes prevail in the south and east of Ukraine, and also in Zakarpatska oblast.

Summarizing, mortality patterns are not constant over time. Some regions may make definitive progress while others may degrade (like Chernihivska and Odeska oblast). The general vector of mortality change in Ukraine remains the same – from the west to east. In response to socio-economic events in the country regional trends may converge or diverge. When looking at maps of Ukraine's mortality observed in 70-80s, historical traces are visible: unique patterns in the west, centre and south-east. With time, this contrast became distorted and Ukraine's population started to resemble a more homogenous group. As the Ukrainian mortality rate accelerated sharply in the 1990s with profound socioeconomic changes, a dramatic decline in life expectancy and divergence in cause-specific mortality trends created new interregional contrasts. The centre and north no longer resemble a unique area, because the situation degraded in the northern regions but not in the central. Together, north and south now compose an area, which is often called "the east", though each part within it has its own idiosyncrasies. Moreover, these peculiarities depend greatly on causes of death.

Roughly speaking, moving from the west to the east and south of Ukraine corresponds to moving from low to high mortality levels. The gradient of change in Ukraine depends on whether a region is more influenced by the Polish world or if its history has been closely linked to that of Russia. Eastern regions accepted Soviet ideology (which did not encourage individual initiative in health matters) much more easily than western regions, and they also have difficulties in adapting themselves to post-Soviet realities.

In summary, if all these larger and smaller changes that happened over the last few decades are disregarded, no important breakthroughs happened in any Ukraine region. There were no

efficient strategies, measures or reforms implemented that would allow substantial improvements (such as the cardiovascular revolution or even the prevention of avoidable mortality) in the health of the population. The health care system is old-fashioned, outdated and suffering from an immense shortage in financing, even though the intention to implement mandatory health insurance has been on the agenda for many years.

However, it is curious to see how patterns developed in recent times. In 2008-2013, a clear increase in life expectancy and improvement in patterns was underway. Despite this, 2014 was marked by a number of tragic events: the loss of part of the territory and the anti-terrorist operation in the east of Ukraine, which totally changed the population composition in the regions. Under these circumstances, the necessity to organize a census - which has already been delayed for four years - has become even more urgent. New census data would open wide opportunities to evaluate mortality situation: first, because it will give accurate population numbers that would account for migration; second, because new population figures will enable re-estimating the population in intercensal period by districts.

It would also be interesting and useful to find out whether there were notable regional variations in the mortality responses to the socio-economic and political events. Detailed by regions and ideally by districts, socio-economic data would contribute to a better understanding of the factors behind mortality fluctuations. Further mortality research in Ukraine should put more emphasis on quantifying the impact on mortality of certain risk factors, such as: alcohol, smoking, diet, harmful working conditions, environmental pollution, stress, etc. Mortality disparities can also be investigated in respect to different population sub-groups that are specified: by place of residence, educational level, occupation, etc.

Needless to say, deep retrospective information is invaluable in understanding historical developments, and digitalizing regional information for years earlier than 1988 would open the gate for new research.

Regardless, the performed research added some new knowledge which can be used further. The results might serve in establishing a mortality hypothesis while developing separate demographic projections for every region. Understanding mortality patterns should assist policy makers in developing regional demographic policies in the framework of current political restructuring. Different mortality profiles need to be accounted for while redistributing the resources of the health care system in order to be better equipped for meeting new demographic challenges. Finally, demographic processes in Ukraine are also of special interest for international researchers, as Ukraine is not only a part of the European region, but is a country situated on the border of the European Union and the Russian Federation, which inherits the demographic patterns of both neighbours.



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# **Annexes**

## Annex A. Administrative division of Ukraine



Table 1: List of regions (oblasts):

№	Code	Région	Oblast	Nombre de raions (districts)
	0	Ukraine	Україна	490
1	1	AR Krym (w/o Sebastopol)	АР Крим (виключаючи Севастополь)	14
2	5	Vinnytska	Вінницька	27
3	7	Volynska	Волинська	16
4	12	Dnipropetrovska	Дніпропетровська	22
5	14	Donetska	Донецька	18
6	18	Zhytomyrska	Житомирська	23
7	21	Zakarpatska	Закарпатська	13
8	23	Zaporizka	Запорізька	20
9	26	Ivano-Frankivska	Івано-Франківська	14
10	32	Kyivska	Київська	25
11	35	Kirovohrad'ska	Кіровоградська	21
12	44	Luhanska	Луганська	18
13	46	Lvivska	Львівська область	20
14	48	Mykolayivska	Миколаївська	19
15	51	Odeska	Одеська	26
16	53	Poltavska	Полтавська	25
17	56	Rivnenska	Рівненська	16
18	59	Sumska	Сумська	18
19	61	Ternopil'ska	Тернопільська	17
20	63	Kharkivska	Харківська	27
21	65	Khersonska	Херсонська	18
22	68	Khmelnytska	Хмельницька	20
23	71	Cherkaska	Черкаська	20
24	73	Chernivetska	Чернівецька	11
25	74	Chernihivska	Чернігівська	22
26	80	City of Kyiv	Київ	-
27	85	Sebastopol Agglomeration	Севастополь (міськрада)	-

Annex B. Administrative division of Ukraine on districts



## Annex C. List of districts (raions) at the moment of census of 2001

№	Code	District	Raion	Region	Oblast
1	01204	Bakhchysaraiskyi	Бахчисарайський	AR Krym	АР Крим
2	01207	Bilohirskyi	Білогірський	AR Krym	АР Крим
3	01211	Dzhankoisnyi	Джанкойський	AR Krym	АР Крим
4	01216	Kirovskyi	Кіровський	AR Krym	АР Крим
5	01220	Krasnohvargiisnyi	Красногвардійський	AR Krym	АР Крим
6	01223	Krasnoperekopskyi	Красноперекопський	AR Krym	АР Крим
7	01227	Leninskyi	Ленінський	AR Krym	АР Крим
8	01231	Nyzhnohirskyi	Нижньогірський	AR Krym	АР Крим
9	01235	Pervomaiskyi	Первомайський	AR Krym	АР Крим
10	01239	Rozdolnenskyi	Роздольненський	AR Krym	АР Крим
11	01243	Sakskyi	Сакський	AR Krym	АР Крим
12	01247	Simferopolskyi	Сімферопольський	AR Krym	АР Крим
13	01252	Sovietskyi	Советський	AR Krym	АР Крим
14	01256	Chornomorskyi	Чорноморський	AR Krym	АР Крим
15	05201	Barskyi	Барський	Vynnytska	Вінницька
16	05202	Bershadskyi	Бершадський	Vynnytska	Вінницька
17	05206	Vynnytskyi	Вінницький	Vynnytska	Вінницька
18	05208	Gaisynskyi	Гайсинський	Vynnytska	Вінницька
19	05210	Zgmerynskyi	Жмеринський	Vynnytska	Вінницька
20	05212	Illinetskyi	Іллінецький	Vynnytska	Вінницька
21	05213	Kalynivskyi	Калинівський	Vynnytska	Вінницька
22	05214	Koziatynskyi	Козятинський	Vynnytska	Вінницька
23	05219	Kryzhopilskyi	Крижопільський	Vynnytska	Вінницька
24	05222	Lypovetskyi	Липовецький	Vynnytska	Вінницька
25	05224	Litynskyi	Літинський	Vynnytska	Вінницька
26	05226	Mogyliiv-Podilskyi	Могилів-Подільський	Vynnytska	Вінницька
27	05228	Murovanokurylovetskyi	Мурованокуриловецький	Vynnytska	Вінницька
28	05230	Nemyrivskyi	Немирівський	Vynnytska	Вінницька
29	05231	Orativskyi	Оратівський	Vynnytska	Вінницька
30	05232	Pischanskyi	Піщанський	Vynnytska	Вінницька
31	05234	Pogrebyschenskyi	Погребищенський	Vynnytska	Вінницька
32	05237	Teplotytskyi	Теплицький	Vynnytska	Вінницька
33	05238	Tuvrivskyi	Тиврівський	Vynnytska	Вінницька
34	05239	Tomashpilskyi	Томашпільський	Vynnytska	Вінницька
35	05241	Trostianetskyi	Тростянецький	Vynnytska	Вінницька
36	05243	Tulchynskyi	Тульчинський	Vynnytska	Вінницька
37	05248	Khmilnytskyi	Хмільницький	Vynnytska	Вінницька
38	05249	Chernivetskyi	Чернівецький	Vynnytska	Вінницька
39	05250	Chechelnytskyi	Чечельницький	Vynnytska	Вінницька
40	05253	Shargorodskyi	Шаргородський	Vynnytska	Вінницька
41	05256	Yampilskyi	Ямпільський	Vynnytska	Вінницька
42	07205	Volodymyr-Volynskyi	Володимир-Волинський	Volynska	Волинська
43	07208	Gorohivskyi	Горохівський	Volynska	Волинська
44	07211	Ivanychivskyi	Іваничівський	Volynska	Волинська
45	07214	Kamin-Kashyrskyi	Камінь-Каширський	Volynska	Волинська
46	07218	Kivertsivskyi	Ківерцівський	Volynska	Волинська
47	07221	Kovelskyi	Ковельський	Volynska	Волинська
48	07224	Lokachynskyi	Локачинський	Volynska	Волинська
49	07228	Lutskyi	Луцький	Volynska	Волинська
50	07231	Liubeshivskyi	Любешівський	Volynska	Волинська
51	07233	Liubomlskyi	Любомльський	Volynska	Волинська
52	07236	Manevytskyi	Маневіцький	Volynska	Волинська
53	07242	Ratnivskyi	Ратнівський	Volynska	Волинська
54	07245	Rozhyschenskyi	Рожищенський	Volynska	Волинська
55	07250	Starovyzhivskyi	Старовижівський	Volynska	Волинська
56	07255	Turiyskyi	Турійський	Volynska	Волинська
57	07257	Shatskyi	Шацький	Volynska	Волинська
58	12203	Apostolivskyi	Апостолівський	Dnipropetrovska	Дніпропетровська
59	12207	Vasylkivskyi	Васильківський	Dnipropetrovska	Дніпропетровська
60	12210	Verhniiodniprovskyi	Верхньодніпровський	Dnipropetrovska	Дніпропетровська
61	12214	Dnipropetrovskyi	Дніпропетровський	Dnipropetrovska	Дніпропетровська
62	12218	Kryvorizkyi	Криворізький	Dnipropetrovska	Дніпропетровська
63	12220	Krynichanskyi	Криничанський	Dnipropetrovska	Дніпропетровська
64	12223	Magdalynivskyi	Магдалинівський	Dnipropetrovska	Дніпропетровська
65	12226	Mezhevskyi	Межівський	Dnipropetrovska	Дніпропетровська
66	12229	Nikipolskyi	Нікопольський	Dnipropetrovska	Дніпропетровська
67	12232	Novomoskovskyi	Новомосковський	Dnipropetrovska	Дніпропетровська
68	12235	Pavlogradskyi	Павлоградський	Dnipropetrovska	Дніпропетровська
69	12237	Petrykivskyi	Петриківський	Dnipropetrovska	Дніпропетровська
70	12238	Petrodavilskyi	Петропавлівський	Dnipropetrovska	Дніпропетровська



71	12242	Pokrovskiy	Покровський	Dnipropetrovska	Дніпропетровська
72	12245	Pjatyhatskyi	П'ятихатський	Dnipropetrovska	Дніпропетровська
73	12248	Synelnykovskiy	Синельниківський	Dnipropetrovska	Дніпропетровська
74	12250	Solonianskyi	Солонянський	Dnipropetrovska	Дніпропетровська
75	12252	Sofiivskiy	Софіївський	Dnipropetrovska	Дніпропетровська
76	12254	Tomakivskiy	Томаківський	Dnipropetrovska	Дніпропетровська
77	12256	Tsarychanskyi	Царичанський	Dnipropetrovska	Дніпропетровська
78	12258	Shyrovskiy	Широківський	Dnipropetrovska	Дніпропетровська
79	12259	Yuriivskiy	Юр'ївський	Dnipropetrovska	Дніпропетровська
80	14206	Amvrosiivskiy	Амвросіївський	Donetska	Донецька
81	14209	Artemivskiy	Артемівський	Donetska	Донецька
82	14212	Velykonovosilkivskiy	Великоновосілівський	Donetska	Донецька
83	14215	Volnovaskiy	Волноваський	Donetska	Донецька
84	14217	Volodarskyi	Володарський	Donetska	Донецька
85	14220	Dobropilskiy	Добропільський	Donetska	Донецька
86	14224	Kostiantynivskiy	Костянтинівський	Donetska	Донецька
87	14227	Krasnoarmiiskiy	Красноармійський	Donetska	Донецька
88	14230	Krasnolymanskyi	Красноліманський	Donetska	Донецька
89	14233	Mariivskiy	Мар'їнський	Donetska	Донецька
90	14236	Novoazovskiy	Новоазовський	Donetska	Донецька
91	14237	Oleksandrivskiy	Олександрівський	Donetska	Донецька
92	14239	Pershotravnevyyi	Першотравневий	Donetska	Донецька
93	14242	Slovianskyi	Слов'янський	Donetska	Донецька
94	14245	Starobeshivskiy	Старобешівський	Donetska	Донецька
95	14248	Telmanivskiy	Тельманівський	Donetska	Донецька
96	14252	Shahtarskyi	Шахтарський	Donetska	Донецька
97	14255	Yasynuvatskyi	Ясинуватський	Donetska	Донецька
98	18203	Andrushivskiy	Андрушівський	Zhytomyrska	Житомирська
99	18206	Baranivskiy	Баранівський	Zhytomyrska	Житомирська
100	18208	Berdychivskiy	Бердичівський	Zhytomyrska	Житомирська
101	18209	Brusylivskiy	Брусилівський	Zhytomyrska	Житомирська
102	18211	Volodarsko-Volynskiy	Володарсько-Волинський	Zhytomyrska	Житомирська
103	18214	Dzerzhynskiy	Дзержинський	Zhytomyrska	Житомирська
104	18217	Emilchynskiy	Ємільчинський	Zhytomyrska	Житомирська
105	18220	Zhytomyrskiy	Житомирський	Zhytomyrska	Житомирська
106	18223	Korostenskyi	Коростенський	Zhytomyrska	Житомирська
107	18225	Korostyshivskiy	Коростишівський	Zhytomyrska	Житомирська
108	18228	Lugynskiy	Лугинський	Zhytomyrska	Житомирська
109	18231	Liubarskyi	Любарський	Zhytomyrska	Житомирська
110	18234	Malynskiy	Малинський	Zhytomyrska	Житомирська
111	18237	Narodytskyi	Народичський	Zhytomyrska	Житомирська
112	18240	Novograd-Volynskiy	Новоград-Волинський	Zhytomyrska	Житомирська
113	18242	Ovrutskiy	Овруцький	Zhytomyrska	Житомирська
114	18244	Olevskiy	Олевський	Zhytomyrska	Житомирська
115	18247	Popilnianskyi	Попільнянський	Zhytomyrska	Житомирська
116	18250	Radomyshl'skyi	Радомишльський	Zhytomyrska	Житомирська
117	18252	Ruzhynskiy	Ружинський	Zhytomyrska	Житомирська
118	18254	Chervonoarmiiskiy	Червоноармійський	Zhytomyrska	Житомирська
119	18256	Chernihivskiy	Черняхівський	Zhytomyrska	Житомирська
120	18258	Chudnivskiy	Чуднівський	Zhytomyrska	Житомирська
121	21204	Beregivskiy	Берегівський	Zakarpatska	Закарпатська
122	21208	Velykobereznianskyi	Великоберезнянський	Zakarpatska	Закарпатська
123	21212	Vynogradivskiy	Виноградівський	Zakarpatska	Закарпатська
124	21215	Volovetskyi	Воловецький	Zakarpatska	Закарпатська
125	21219	Irshavskiy	Іршавський	Zakarpatska	Закарпатська
126	21224	Mizhgirskiy	Міжгірський	Zakarpatska	Закарпатська
127	21227	Mukachivskiy	Мукачівський	Zakarpatska	Закарпатська
128	21232	Perechynskiy	Перечинський	Zakarpatska	Закарпатська
129	21236	Rahivskiy	Рахівський	Zakarpatska	Закарпатська
130	21240	Svaliavskiy	Свалявський	Zakarpatska	Закарпатська
131	21244	Tiachivskiy	Тячівський	Zakarpatska	Закарпатська
132	21248	Uzhgorodskiy	Ужгородський	Zakarpatska	Закарпатська
133	21253	Hustskiy	Хустський	Zakarpatska	Закарпатська
134	23206	Berdianskyi	Бердянський	Zaporizka	Запорізька
135	23209	Vasylivskiy	Василівський	Zaporizka	Запорізька
136	23211	Velykobilozerskyi	Великобілозерський	Zaporizka	Запорізька
137	23212	Veselivskiy	Веселівський	Zaporizka	Запорізька
138	23215	Vilnianskyi	Вільнянський	Zaporizka	Запорізька
139	23218	Gulajpilskyi	Гуляйпільський	Zaporizka	Запорізька
140	23221	Zaporizkyi	Запорізький	Zaporizka	Запорізька
141	23224	Kamiansko-Dniprovskiy	Кам'янсько-Дніпровський	Zaporizka	Запорізька
142	23227	Kuibyshevskiy	Куйбишевський	Zaporizka	Запорізька

143	23230	Melitopolskyi	Мелітопольський	Zaporizka	Запорізька
144	23233	Myhailivskyi	Михайлівський	Zaporizka	Запорізька
145	23236	Novomykolaivskyi	Новомиколаївський	Zaporizka	Запорізька
146	23239	Orihivskyi	Оріхівський	Zaporizka	Запорізька
147	23242	Polohivskyi	Пологівський	Zaporizka	Запорізька
148	23245	Pryazovskiy	Приазовський	Zaporizka	Запорізька
149	23248	Prymorskyi	Приморський	Zaporizka	Запорізька
150	23249	Rozivskyi	Розівський	Zaporizka	Запорізька
151	23252	Tokmatskyi	Токамацький	Zaporizka	Запорізька
152	23255	Chernihivskyi	Чернігівський	Zaporizka	Запорізька
153	23256	Yakymivskyi	Якимівський	Zaporizka	Запорізька
154	26204	Bogorodchanskyi	Богородчанський	Ivano-Frankivska	Івано-Франківська
155	26208	Verhovynskyi	Верховинський	Ivano-Frankivska	Івано-Франківська
156	26212	Galytskyi	Галицький	Ivano-Frankivska	Івано-Франківська
157	26216	Gorodenkivskyi	Городенківський	Ivano-Frankivska	Івано-Франківська
158	26220	Dolynskyi	Долинський	Ivano-Frankivska	Івано-Франківська
159	26228	Kaluskiy	Калуський	Ivano-Frankivska	Івано-Франківська
160	26232	Kolomyiskyi	Коломийський	Ivano-Frankivska	Івано-Франківська
161	26236	Kosivskyi	Косівський	Ivano-Frankivska	Івано-Франківська
162	26240	Nadvirnianskyi	Надвірнянський	Ivano-Frankivska	Івано-Франківська
163	26244	Rogatynskyi	Рогатинський	Ivano-Frankivska	Івано-Франківська
164	26248	Rozhniativskyi	Рожнятівський	Ivano-Frankivska	Івано-Франківська
165	26252	Sniatynskyi	Снятинський	Ivano-Frankivska	Івано-Франківська
166	26254	Tysmenytskyi	Тисменицький	Ivano-Frankivska	Івано-Франківська
167	26256	Tlumatskyi	Тлумацький	Ivano-Frankivska	Івано-Франківська
168	32202	Baryshivskyi	Баришівський	Kyivska	Київська
169	32204	Bilotserkivskyi	Білоцерківський	Kyivska	Київська
170	32206	Boguslavskyi	Богуславський	Kyivska	Київська
171	32208	Boryspilskyi	Бориспільський	Kyivska	Київська
172	32210	Borodianskyi	Бородянський	Kyivska	Київська
173	32212	Brovarskyi	Броварський	Kyivska	Київська
174	32214	Vasyilkivskyi	Васильківський	Kyivska	Київська
175	32215	Vyshgorodskyi	Вишгородський	Kyivska	Київська
176	32216	Volodarskyi	Володарський	Kyivska	Київська
177	32219	Zgurivskyi	Згурівський	Kyivska	Київська
178	32220	Ivankivskyi	Іванківський	Kyivska	Київська
179	32222	Kagarlytskyi	Кагарлицький	Kyivska	Київська
180	32224	Kyevy-Sviatoshytskyi	Києво-Святошинський	Kyivska	Київська
181	32227	Makarivskyi	Макарівський	Kyivska	Київська
182	32229	Myronivskyi	Миронівський	Kyivska	Київська
183	32231	Obuhivskyi	Обухівський	Kyivska	Київська
184	32233	Pereiaslav-Chmelytskyi	Переяслав-Хмельницький	Kyivska	Київська
185	32235	Poliskyi	Поліський	Kyivska	Київська
186	32237	Rokytynskyi	Рокитнянський	Kyivska	Київська
187	32240	Skvyrskyi	Сквирський	Kyivska	Київська
188	32242	Stavyschenskyi	Ставищенський	Kyivska	Київська
189	32244	Taraschanskyi	Таращанський	Kyivska	Київська
190	32246	Tetiivskyi	Тетіївський	Kyivska	Київська
191	32249	Fastivskyi	Фастівський	Kyivska	Київська
192	32255	Yagotynskyi	Яготинський	Kyivska	Київська
193	35208	Bobrynetskyi	Бобринецький	Kirovohradska	Кіровоградська
194	35209	Vilshanskyi	Вільшанський	Kirovohradska	Кіровоградська
195	35211	Gaivoronskyi	Гайворонський	Kirovohradska	Кіровоградська
196	35214	Golovanivskyi	Голованівський	Kirovohradska	Кіровоградська
197	35217	Dobrovelychkivskyi	Добровеличківський	Kirovohradska	Кіровоградська
198	35219	Dolynskyi	Долинський	Kirovohradska	Кіровоградська
199	35222	Znamianskyi	Знам'янський	Kirovohradska	Кіровоградська
200	35225	Kirovogradskyi	Кіровоградський	Kirovohradska	Кіровоградська
201	35228	Kompaniivskyi	Компаніївський	Kirovohradska	Кіровоградська
202	35231	Malovyskivskyi	Маловисківський	Kirovohradska	Кіровоградська
203	35234	Novgorodkivskyi	Новгородківський	Kirovohradska	Кіровоградська
204	35236	Novoarhangelskyi	Новоархангельський	Kirovohradska	Кіровоградська
205	35238	Novomyrhorodskyi	Новомиргородський	Kirovohradska	Кіровоградська
206	35240	Novoukrainkyi	Новоукраїнський	Kirovohradska	Кіровоградська
207	35241	Oleksandrivskyi	Олександрівський	Kirovohradska	Кіровоградська
208	35242	Oleksandriivskyi	Олександрійський	Kirovohradska	Кіровоградська
209	35246	Onufriivskyi	Онуфріївський	Kirovohradska	Кіровоградська
210	35249	Petrivskyi	Петрівський	Kirovohradska	Кіровоградська
211	35252	Svitlovodskyi	Світловодський	Kirovohradska	Кіровоградська
212	35255	Ulianovskiy	Уляновський	Kirovohradska	Кіровоградська
213	35258	Ustynivskyi	Устинівський	Kirovohradska	Кіровоградська
214	44203	Antracytivskyi	Антрацитівський	Luhanska	Луганська
215	44206	Bilovodskyi	Біловодський	Luhanska	Луганська

216	44209	Biloukrainskyi	Білокуракинський	Luhanska	Луганська
217	44214	Krasnodonskyi	Краснодонський	Luhanska	Луганська
218	44216	Kreminskyi	Кремінський	Luhanska	Луганська
219	44222	Lutuhynskyi	Лутугинський	Luhanska	Луганська
220	44225	Markivskyi	Марківський	Luhanska	Луганська
221	44228	Milovskyi	Міловський	Luhanska	Луганська
222	44231	Novoaidarskyi	Новоайдарський	Luhanska	Луганська
223	44233	Novopskovskyi	Новопсковський	Luhanska	Луганська
224	44236	Perevalskyi	Перевальський	Luhanska	Луганська
225	44238	Popasnianskyi	Попаснянський	Luhanska	Луганська
226	44240	Svativskyi	Сватівський	Luhanska	Луганська
227	44242	Sverdlovskyi	Свердловський	Luhanska	Луганська
228	44245	Sloviano-Serbskyi	Слов'яносербський	Luhanska	Луганська
229	44248	Stanychno-Luhanskyi	Станично-Луганський	Luhanska	Луганська
230	44251	Starobilskyi	Старобільський	Luhanska	Луганська
231	44254	Troiitskyi	Троїцький	Luhanska	Луганська
232	46203	Brodivskyi	Бродівський	Lvivska	Львівська
233	46206	Buskyi	Буський	Lvivska	Львівська
234	46209	Horodotskyi	Городоцький	Lvivska	Львівська
235	46212	Drohobyttskyi	Дрогобицький	Lvivska	Львівська
236	46215	Zgydachivskyi	Жидачівський	Lvivska	Львівська
237	46217	Zhovkivskyi	Жовківський	Lvivska	Львівська
238	46218	Zolochivskyi	Золочівський	Lvivska	Львівська
239	46221	Kamianka-Buzkyi	Кам'янка-Бузький	Lvivska	Львівська
240	46222	Mykolaivskyi	Миколаївський	Lvivska	Львівська
241	46224	Mostyskyi	Мостиський	Lvivska	Львівська
242	46233	Peremyslhianskyi	Перемишлянський	Lvivska	Львівська
243	46236	Pustomyivskyi	Пустомитівський	Lvivska	Львівська
244	46239	Radehivskyi	Радехівський	Lvivska	Львівська
245	46242	Sambirskyi	Самбірський	Lvivska	Львівська
246	46245	Skolivskyi	Сколівський	Lvivska	Львівська
247	46248	Sokalskyi	Сокальський	Lvivska	Львівська
248	46251	Starosambirskyi	Старосамбірський	Lvivska	Львівська
249	46253	Stryivskyi	Стрийський	Lvivska	Львівська
250	46255	Turkivskyi	Турківський	Lvivska	Львівська
251	46258	Yavorivskyi	Яворівський	Lvivska	Львівська
252	48203	Arbuzynskyi	Арбузинський	Mykolayivska	Миколаївська
253	48206	Bashtanskyi	Баштанський	Mykolayivska	Миколаївська
254	48209	Berezanskyi	Березанський	Mykolayivska	Миколаївська
255	48211	Berezhnuevatskyi	Березнегубатський	Mykolayivska	Миколаївська
256	48214	Bratskyi	Братський	Mykolayivska	Миколаївська
257	48217	Veselynivskyi	Веселинівський	Mykolayivska	Миколаївська
258	48220	Voznesenskyi	Вознесенський	Mykolayivska	Миколаївська
259	48223	Vradiivskyi	Врадіївський	Mykolayivska	Миколаївська
260	48227	Domanivskyi	Доманівський	Mykolayivska	Миколаївська
261	48230	Yelanetskyi	Єланецький	Mykolayivska	Миколаївська
262	48233	Zhovtnevyi	Жовтневий	Mykolayivska	Миколаївська
263	48236	Kazankivskyi	Казанківський	Mykolayivska	Миколаївська
264	48239	Kryvoozerskyi	Кривоозерський	Mykolayivska	Миколаївська
265	48242	Mykolaivskyi	Миколаївський	Mykolayivska	Миколаївська
266	48245	Novobuzkyi	Новобузький	Mykolayivska	Миколаївська
267	48248	Novoodeskyi	Новоодеський	Mykolayivska	Миколаївська
268	48251	Ochakivskyi	Очаківський	Mykolayivska	Миколаївська
269	48254	Pervomaiskyi	Первомайський	Mykolayivska	Миколаївська
270	48257	Snihurivskyi	Снігурівський	Mykolayivska	Миколаївська
271	51202	Ananivskyi	Ананівський	Odeska	Одеська
272	51204	Artsyzkyi	Арцизький	Odeska	Одеська
273	51206	Baltskyi	Балтський	Odeska	Одеська
274	51208	Bilhorod-Dnistrovskyi	Білгород-Дністровський	Odeska	Одеська
275	51210	Biliiivskyi	Біляївський	Odeska	Одеська
276	51212	Berezivskyi	Березівський	Odeska	Одеська
277	51214	Bolgradskyi	Болградський	Odeska	Одеська
278	51216	Velukomyhailivskyi	Великомахайлівський	Odeska	Одеська
279	51218	Ivanivskyi	Іванівський	Odeska	Одеська
280	51220	Izmailskyi	Ізмальський	Odeska	Одеська
281	51223	Kiliivskyi	Кілійський	Odeska	Одеська
282	51225	Kodymskyi	Кодимський	Odeska	Одеська
283	51227	Kominternivskyi	Комінтернівський	Odeska	Одеська
284	51229	Kotovskiy	Котовський	Odeska	Одеська
285	51231	Krasnooknianskyi	Красноокнянський	Odeska	Одеська
286	51233	Liubashivskyi	Любашівський	Odeska	Одеська
287	51235	Mykolaivskyi	Миколаївський	Odeska	Одеська
288	51237	Ovidiopolivskyi	Овідіопольський	Odeska	Одеська

289	51238	Reniiskyi	Ренійський	Odeska	Одеська
290	51239	Rozdilnianskyi	Роздільнянський	Odeska	Одеська
291	51243	Savranskyi	Савранський	Odeska	Одеська
292	51245	Saratskyi	Саратський	Odeska	Одеська
293	51247	Tarutynskyi	Тарутинський	Odeska	Одеська
294	51250	Tatarbunarskyi	Татарбунарський	Odeska	Одеська
295	51252	Frunzivskyi	Фрунзівський	Odeska	Одеська
296	51254	Shyriaiivskyi	Ширяївський	Odeska	Одеська
297	53202	Belykobahachanskyi	Великобагачанський	Poltavska	Полтавська
298	53204	Hadiatskyi	Гадяцький	Poltavska	Полтавська
299	53206	Hlobynskyi	Глобинський	Poltavska	Полтавська
300	53208	Hrebinkivskyi	Гребінківський	Poltavska	Полтавська
301	53210	Dykanskyi	Диканський	Poltavska	Полтавська
302	53213	Zinkivskyi	Зіньківський	Poltavska	Полтавська
303	53216	Karlivskyi	Карлівський	Poltavska	Полтавська
304	53218	Kobeliatskyi	Кобеляцький	Poltavska	Полтавська
305	53220	Kozelshchynskyi	Козельщинський	Poltavska	Полтавська
306	53222	Kotelevskyi	Котелевський	Poltavska	Полтавська
307	53224	Kremenchutskyi	Кременчуцький	Poltavska	Полтавська
308	53226	Lohvytskyi	Лохвицький	Poltavska	Полтавська
309	53228	Lubenskyi	Лубенський	Poltavska	Полтавська
310	53230	Mashivskyi	Машівський	Poltavska	Полтавська
311	53232	Myrhorodskyi	Миргородський	Poltavska	Полтавська
312	53234	Novosanzharskyi	Новосанжарський	Poltavska	Полтавська
313	53236	Orzhytskyi	Оржицький	Poltavska	Полтавська
314	53238	Pyriatynskyi	Пирятинський	Poltavska	Полтавська
315	53240	Poltavskyi	Полтавський	Poltavska	Полтавська
316	53242	Reshetlivskyi	Решетилівський	Poltavska	Полтавська
317	53245	Semenivskyi	Семенівський	Poltavska	Полтавська
318	53248	Horolskyi	Хорольський	Poltavska	Полтавська
319	53251	Chornuhynskyi	Чорнухинський	Poltavska	Полтавська
320	53254	Chutivskyi	Чутівський	Poltavska	Полтавська
321	53257	Shyshatskyi	Шишацький	Poltavska	Полтавська
322	56204	Bereznivskyi	Березнівський	Rivnenska	Рівненська
323	56208	Volodymyrets'kyi	Володимирецький	Rivnenska	Рівненська
324	56212	Hoshchanskyi	Гоцанський	Rivnenska	Рівненська
325	56214	Demydivskyi	Демидівський	Rivnenska	Рівненська
326	56216	Dubenskyi	Дубенський	Rivnenska	Рівненська
327	56218	Dubrovnytskyi	Дубровицький	Rivnenska	Рівненська
328	56222	Zarichenskyi	Зарічненський	Rivnenska	Рівненська
329	56226	Zdolbunivskyi	Здолбунівський	Rivnenska	Рівненська
330	56230	Koretskyi	Корецький	Rivnenska	Рівненська
331	56234	Kostopilskyi	Костопільський	Rivnenska	Рівненська
332	56238	Mlynivskyi	Млинівський	Rivnenska	Рівненська
333	56242	Ostrozkyi	Острозький	Rivnenska	Рівненська
334	56244	Radyvylivskyi	Радивилівський	Rivnenska	Рівненська
335	56246	Rivnenskyi	Рівненський	Rivnenska	Рівненська
336	56250	Rokytnivskyi	Рокитнівський	Rivnenska	Рівненська
337	56254	Sarnenskyi	Сарненський	Rivnenska	Рівненська
338	59206	Bilopilskyi	Білопільський	Sumska	Сумська
339	59209	Burynskyi	Буринський	Sumska	Сумська
340	59212	Velykopysarivskyi	Великописарівський	Sumska	Сумська
341	59215	Hluhivskyi	Глухівський	Sumska	Сумська
342	59220	Konotoplyi	Конотопський	Sumska	Сумська
343	59223	Krasnopilskyi	Краснопільський	Sumska	Сумська
344	59226	Krolevetskyi	Кролевецький	Sumska	Сумська
345	59229	Lebedynskyi	Лебединський	Sumska	Сумська
346	59232	Lypovolodynskyi	Липоводолінський	Sumska	Сумська
347	59235	Nedryhailivskyi	Недригайлівський	Sumska	Сумська
348	59236	Ohtyrskyi	Охтирський	Sumska	Сумська
349	59238	Putyvlskyi	Путівльський	Sumska	Сумська
350	59241	Romenskyi	Роменський	Sumska	Сумська
351	59244	Seredyno-Budskyi	Середино-Будський	Sumska	Сумська
352	59247	Sumskyi	Сумський	Sumska	Сумська
353	59250	Trotianetskyi	Тростянецький	Sumska	Сумська
354	59253	Shostkynskyi	Шосткинський	Sumska	Сумська
355	59256	Yampil'skyi	Ямпільський	Sumska	Сумська
356	61204	Berezhanskyi	Бережанський	Ternopil'ska	Тернопільська
357	61208	Borshchivskyi	Борщівський	Ternopil'ska	Тернопільська
358	61212	Buchatskyi	Буцацький	Ternopil'ska	Тернопільська
359	61216	Husiatynskyi	Гусятинський	Ternopil'ska	Тернопільська
360	61220	Zalishchytskyi	Заліщицький	Ternopil'ska	Тернопільська
361	61224	Zbarazkyi	Збаразький	Ternopil'ska	Тернопільська
362	61226	Zborivskyi	Зборівський	Ternopil'ska	Тернопільська

363	61230	Kozivskyi	Козівський	Ternopilska	Тернопільська
364	61234	Kremenetskyi	Кременецький	Ternopilska	Тернопільська
365	61238	Lanovetskyi	Лановецький	Ternopilska	Тернопільська
366	61242	Monastyrskyi	Монастирський	Ternopilska	Тернопільська
367	61246	Pidvolochyskyi	Підволочиський	Ternopilska	Тернопільська
368	61248	Pidhaetskyi	Підгаєцький	Ternopilska	Тернопільська
369	61250	Terebovlianskyi	Теребовлянський	Ternopilska	Тернопільська
370	61252	Ternopilskyi	Тернопільський	Ternopilska	Тернопільська
371	61255	Chortkivskyi	Чортківський	Ternopilska	Тернопільська
372	61258	Shumskyi	Шумський	Ternopilska	Тернопільська
373	63202	Balakiyskyi	Балаклійський	Kharkivska	Харківська
374	63204	Barvinkivskyi	Барвінківський	Kharkivska	Харківська
375	63206	Blyzniukivskyi	Близуківський	Kharkivska	Харківська
376	63208	Bohodyhivskyi	Богодухівський	Kharkivska	Харківська
377	63210	Borivskyi	Борівський	Kharkivska	Харківська
378	63212	Valkivskyi	Валківський	Kharkivska	Харківська
379	63214	Velykoburlutskyi	Великобурлуцький	Kharkivska	Харківська
380	63216	Vovchanskyi	Вовчанський	Kharkivska	Харківська
381	63218	Dvorichanskyi	Дворічанський	Kharkivska	Харківська
382	63220	Derhachivskyi	Дергачівський	Kharkivska	Харківська
383	63222	Zachepylivskyi	Зачепилівський	Kharkivska	Харківська
384	63224	Zmiivskyi	Зміївський	Kharkivska	Харківська
385	63226	Zolochivskyi	Золочівський	Kharkivska	Харківська
386	63228	Iziumskyi	Ізюмський	Kharkivska	Харківська
387	63231	Keguchivskyi	Кегичівський	Kharkivska	Харківська
388	63232	Kolomatskyi	Коломацький	Kharkivska	Харківська
389	63233	Krasnogradskyi	Красноградський	Kharkivska	Харківська
390	63235	Krasnokutskyi	Краснокутський	Kharkivska	Харківська
391	63237	Kupianskyi	Куп'янський	Kharkivska	Харківська
392	63239	Lozivskyi	Лозівський	Kharkivska	Харківська
393	63242	Novovodolazkyi	Нововодолазький	Kharkivska	Харківська
394	63245	Pervomaiskyi	Первомайський	Kharkivska	Харківська
395	63246	Pechenizkyi	Печенізький	Kharkivska	Харківська
396	63248	Sahnovshchynskyi	Сахновщинський	Kharkivska	Харківська
397	63251	Kharkivskyi	Харківський	Kharkivska	Харківська
398	63253	Chuhuivskyi	Чугувський	Kharkivska	Харківська
399	63257	Shevchenkivskyi	Шевченківський	Kharkivska	Харківська
400	65206	Beryslavskyi	Бериславський	Khersonska	Херсонська
401	65207	Bilozerskyi	Білозерський	Khersonska	Херсонська
402	65208	Velykolepetyskyi	Великолепетиський	Khersonska	Херсонська
403	65209	Velykooleksandrivskyi	Великоолександрівський	Khersonska	Херсонська
404	65215	Verhniorogachutskyi	Верхньорогачицький	Khersonska	Херсонська
405	65218	Vysokopilskyi	Високопільський	Khersonska	Херсонська
406	65221	Henicheskyi	Генічеський	Khersonska	Херсонська
407	65223	Holoprystanskyi	Голопристанський	Khersonska	Херсонська
408	65226	Hornostaivskyi	Горностаївський	Khersonska	Херсонська
409	65229	Ivanivskyi	Іванівський	Khersonska	Херсонська
410	65232	Kalanchatskyi	Каланчацький	Khersonska	Херсонська
411	65235	Kahovskyi	Каховський	Khersonska	Херсонська
412	65238	Nyzhnosirohovskyi	Нижньосірогозький	Khersonska	Херсонська
413	65241	Novovorontsovskyi	Нововоронцовський	Khersonska	Херсонська
414	65244	Novotroitskyi	Новотроїцький	Khersonska	Херсонська
415	65247	Skadovskyi	Скадовський	Khersonska	Херсонська
416	65250	Tsiuriupynskyi	Цюрупинський	Khersonska	Херсонська
417	65254	Chaplynskyi	Чаплінський	Khersonska	Херсонська
418	68203	Bilohirskyi	Білогірський	Khmelnytska	Хмельницька
419	68206	Vinkovetskyi	Вінковецький	Khmelnytska	Хмельницька
420	68209	Volochyskyi	Волочиський	Khmelnytska	Хмельницька
421	68212	Gorodotskyi	Городоцький	Khmelnytska	Хмельницька
422	68215	Derazhnianskyi	Деражнянський	Khmelnytska	Хмельницька
423	68218	Dunaevetskyi	Дунаєвецький	Khmelnytska	Хмельницька
424	68221	Iziaslavskyi	Ізяславський	Khmelnytska	Хмельницька
425	68224	Kamianets-Podilskyi	Каміанець-Подільський	Khmelnytska	Хмельницька
426	68227	Krasylivskyi	Красилівський	Khmelnytska	Хмельницька
427	68230	Letchivskyi	Летичівський	Khmelnytska	Хмельницька
428	68233	Novoushytskyi	Новоушицький	Khmelnytska	Хмельницька
429	68236	Polonskyi	Полонський	Khmelnytska	Хмельницька
430	68239	Slavutskyi	Славутський	Khmelnytska	Хмельницька
431	68242	Starokostiantynivskyi	Старокостянтинівський	Khmelnytska	Хмельницька
432	68244	Starosyniavskyi	Старосинявський	Khmelnytska	Хмельницька
433	68247	Teofipolskyi	Теофіпольський	Khmelnytska	Хмельницька
434	68250	Khmelnytskyi	Хмельницький	Khmelnytska	Хмельницька
435	68252	Chemerovetskyi	Чемеровецький	Khmelnytska	Хмельницька

436	68255	Shepetivskiyi	Шепетівський	Khmelnyska	Хмельницька
437	68258	Yarmolynetskiy	Ярмолинецький	Khmelnyska	Хмельницька
438	71203	Gorodyschchenskiy	Городищенський	Cherkaska	Черкаська
439	71206	Drabivskiyi	Драбівський	Cherkaska	Черкаська
440	71209	Zhashkivskiyi	Жашківський	Cherkaska	Черкаська
441	71212	Zvenyhorodskiyi	Звенигородський	Cherkaska	Черкаська
442	71215	Zolotinskiy	Золотоніський	Cherkaska	Черкаська
443	71218	Kamianskiy	Кам'янський	Cherkaska	Черкаська
444	71220	Kanivskiyi	Канівський	Cherkaska	Черкаська
445	71222	Katerynopilskiyi	Катеринопільський	Cherkaska	Черкаська
446	71225	Korsun-Shevchenkivskiyi	Корсунь-Шевченківський	Cherkaska	Черкаська
447	71228	Lysianskiy	Лисянський	Cherkaska	Черкаська
448	71231	Mankivskiyi	Маньківський	Cherkaska	Черкаська
449	71234	Monastyrshchenskiy	Монастирищенський	Cherkaska	Черкаська
450	71237	Smilianskiy	Смілянський	Cherkaska	Черкаська
451	71240	Talnivskiyi	Тальнівський	Cherkaska	Черкаська
452	71243	Umanskiy	Уманський	Cherkaska	Черкаська
453	71246	Khrystynivskiyi	Христинівський	Cherkaska	Черкаська
454	71249	Cherkaskiyi	Черкаський	Cherkaska	Черкаська
455	71254	Chyhyrynskiyi	Чигиринський	Cherkaska	Черкаська
456	71255	Chornobaiivskiyi	Чорнобаївський	Cherkaska	Черкаська
457	71257	Shpolianskiy	Шполянський	Cherkaska	Черкаська
458	73205	Vyzhnytskyi	Вижницький	Chernivetska	Чернівецька
459	73207	Hertsaiivskiyi	Герцаївський	Chernivetska	Чернівецька
460	73210	Hlybotskiy	Глибоцький	Chernivetska	Чернівецька
461	73215	Zastavniivskiyi	Заставнівський	Chernivetska	Чернівецька
462	73220	Kelmenetskiy	Кельменецький	Chernivetska	Чернівецька
463	73225	Kitsmanskiy	Кіцманський	Chernivetska	Чернівецька
464	73230	Novoseletskiy	Новоселицький	Chernivetska	Чернівецька
465	73235	Putylskiy	Путильський	Chernivetska	Чернівецька
466	73240	Sokyrianskiy	Сокирянський	Chernivetska	Чернівецька
467	73245	Storozhynetskiy	Сторожинецький	Chernivetska	Чернівецька
468	73250	Hotynskiy	Хотинський	Chernivetska	Чернівецька
469	74203	Bahmatskiy	Бахмацький	Chernihivska	Чернігівська
470	74206	Bobrovyskiy	Бобровицький	Chernihivska	Чернігівська
471	74208	Borznianskiy	Борзнянський	Chernihivska	Чернігівська
472	74211	Varynyskiy	Варвинський	Chernihivska	Чернігівська
473	74214	Horodnianskiy	Городнянський	Chernihivska	Чернігівська
474	74217	Ichnianskiy	Ічнянський	Chernihivska	Чернігівська
475	74220	Kozeletskiy	Козелецький	Chernihivska	Чернігівська
476	74222	Koropskiy	Коропський	Chernihivska	Чернігівська
477	74224	Koriukivskiy	Корюківський	Chernihivska	Чернігівська
478	74227	Kulykivskiy	Куликівський	Chernihivska	Чернігівська
479	74230	Menskiy	Менський	Chernihivska	Чернігівська
480	74233	Nizgynskiy	Ніжинський	Chernihivska	Чернігівська
481	74236	Novhorod-Siverskiy	Новгород-Сіверський	Chernihivska	Чернігівська
482	74238	Nosivskiy	Носівський	Chernihivska	Чернігівська
483	74241	Prylutskiy	Прилуцький	Chernihivska	Чернігівська
484	74244	Ripkynskiy	Ріпкинський	Chernihivska	Чернігівська
485	74247	Semenivskiy	Семенівський	Chernihivska	Чернігівська
486	74249	Sosnytskiy	Сосницький	Chernihivska	Чернігівська
487	74251	Sribnianskiy	Срібнянський	Chernihivska	Чернігівська
488	74253	Talalaiivskiy	Талалаївський	Chernihivska	Чернігівська
489	74255	Chernihivskiy	Чернігівський	Chernihivska	Чернігівська
490	74258	Shchorkiy	Щорський	Chernihivska	Чернігівська

Annex D. List of cities with a status of regional (oblast) or republican importance at the moment of census of 2001 (agg – urban agglomeration)

№	Code	District	Raion	Region	Oblast
1	01103	Alushta (agg)	Алушта (міськрада)	AR Krym	АР Крим
2	01105	Armiansk	Армянськ (міськрада)	AR Krym	АР Крим
3	01106	Dzgan'koi	Джанкой	AR Krym	АР Крим
4	01109	Evpatoria (agg)	Євпаторія (міськрада)	AR Krym	АР Крим
5	01112	Kerch	Керч	AR Krym	АР Крим
6	01113	Krasnoperekopsk	Красноперекопськ	AR Krym	АР Крим
7	01114	Saky	Саки	AR Krym	АР Крим
8	01101	Simferopol (agg)	Сімферополь (міськрада)	AR Krym	АР Крим
9	01117	Sudak (agg)	Судак (міськрада)	AR Krym	АР Крим
10	01118	Feodosiia (agg)	Феодосія (міськрада)	AR Krym	АР Крим
11	01119	Yalta (agg)	Ялта (міськрада)	AR Krym	АР Крим
12	05101	Vinnytsia	Вінниця	Vinnytska	Вінницька
13	05103	Zhmerynka	Жмеринка	Vinnytska	Вінницька
14	05105	Koziatyn (agg)	Козятин (міськрада)	Vinnytska	Вінницька
15	05106	Ladyzhyn (agg)	Ладижин (міськрада)	Vinnytska	Вінницька
16	05107	Mogylyv-Podilskyi (agg)	Могилів-Подільськ (міськрада)	Vinnytska	Вінницька
17	05109	Khmilnyk	Хмільник	Vinnytska	Вінницька
18	07101	Lutsk	Луцьк	Volynska	Волинська
19	07102	Volodymyr-Volynskyi	Володимир-Волинський	Volynska	Волинська
20	07104	Kovel	Ковель	Volynska	Волинська
21	07107	Novovolynsk (agg)	Нововолинськ (міськрада)	Volynska	Волинська
22	12101	Dnipropetrovsk (agg)	Дніпропетровськ (міськрада)	Dnipropetrovska	Дніпропетровська
23	12102	Vilnohirsk	Вільногірськ	Dnipropetrovska	Дніпропетровська
24	12104	Dniprodzerzhynsk (agg)	Дніпродзержинськ (міськрада)	Dnipropetrovska	Дніпропетровська
25	12107	Zhovti Vody (agg)	Жовті Води (міськрада)	Dnipropetrovska	Дніпропетровська
26	12110	Kryvyi Rig (agg)	Кривий Ріг (міськрада)	Dnipropetrovska	Дніпропетровська
27	12113	Marganets (agg)	Марганець (міськрада)	Dnipropetrovska	Дніпропетровська
28	12116	Nikopol	Нікополь	Dnipropetrovska	Дніпропетровська
29	12119	Novomoskovsk	Новомосковськ	Dnipropetrovska	Дніпропетровська
30	12121	Ordzhonikidze (agg)	Орджонікідзе (міськрада)	Dnipropetrovska	Дніпропетровська
31	12124	Pavlograd	Павлоград	Dnipropetrovska	Дніпропетровська
32	12126	Pershotravensk	Першотравенськ	Dnipropetrovska	Дніпропетровська
33	12130	Synelnykove	Синельникове	Dnipropetrovska	Дніпропетровська
34	12135	Ternivka (agg)	Тернівка (міськрада)	Dnipropetrovska	Дніпропетровська
35	14101	Donetsk (agg)	Донецьк (міськрада)	Donetska	Донецька
36	14102	Avdiivka	Авдіївка	Donetska	Донецька
37	14103	Artemivsk (agg)	Артемівськ (міськрада)	Donetska	Донецька
38	14104	Vugledar	Вугледар	Donetska	Донецька
39	14106	Gorlivka (agg)	Горлівка (міськрада)	Donetska	Донецька
40	14109	Debaltseve (agg)	Дебальцеве (міськрада)	Donetska	Донецька
41	14110	Dzerzhynsk (agg)	Дзержинськ (міськрада)	Donetska	Донецька
42	14113	Dymytrov (agg)	Димитров (міськрада)	Donetska	Донецька
43	14115	Dobropillia (agg)	Добропілля (міськрада)	Donetska	Донецька
44	14116	Dokuchaivsk (agg)	Докучаївськ (міськрада)	Donetska	Донецька
45	14117	Druzhkivka (agg)	Дружківка (міськрада)	Donetska	Донецька
46	14120	Enakieve (agg)	Єнакіївка (міськрада)	Donetska	Донецька
47	14121	Zhdanivka (agg)	Жданівка (міськрада)	Donetska	Донецька
48	14125	Kirovske	Кіровське	Donetska	Донецька
49	14126	Kostiantynivka	Костянтинівка	Donetska	Донецька
50	14129	Kramatorsk (agg)	Ржищів	Donetska	Донецька
51	14130	Krasnyi Lyman (agg)	Красний Ліман (міськрада)	Donetska	Донецька
52	14132	Krasnoarmiisk (agg)	Красноармійськ (міськрада)	Donetska	Донецька
53	14133	Makiivka (agg)	Макіївка (міськрада)	Donetska	Донецька
54	14134	Mariupol (agg)	Маріуполь (міськрада)	Donetska	Донецька
55	14136	Novgorodivka	Новгородівка	Donetska	Донецька
56	14138	Selydove (agg)	Селидове (міськрада)	Donetska	Донецька
57	14141	Sloviansk (agg)	Слов'янськ (міськрада)	Donetska	Донецька
58	14144	Snizhne (agg)	Сніжне (міськрада)	Donetska	Донецька
59	14147	Torez (agg)	Торез (міськрада)	Donetska	Донецька
60	14150	Khartsyzk (agg)	Харцизьк (міськрада)	Donetska	Донецька
61	14153	Shahtarsk (agg)	Шахтарськ (міськрада)	Donetska	Донецька

62	14155	Yasynuvata	Ясинувата	Donetska	Донецька
63	18101	Zhytomyr	Житомир	Zhytomyrska	Житомирська
64	18104	Berdychiv	Бердичів	Zhytomyrska	Житомирська
65	18107	Korosten	Коростень	Zhytomyrska	Житомирська
66	18110	Novograd-Volynskiy	Новоград-Волинський	Zhytomyrska	Житомирська
67	21101	Uzhgorod	Ужгород	Zakarpatska	Закарпатська
68	21102	Beregove (agg)	Берегове (міськрада)	Zakarpatska	Закарпатська
69	21104	Mukacheve	Мукачеве	Zakarpatska	Закарпатська
70	21108	Hust (agg)	Хуст (міськрада)	Zakarpatska	Закарпатська
71	23101	Zaporizzia (agg)	Запоріжжя (міськрада)	Zaporizka	Запорізька
72	23104	Berdiansk (agg)	Бердянськ (міськрада)	Zaporizka	Запорізька
73	23105	Energodar	Енергодар	Zaporizka	Запорізька
74	23107	Melitopol	Мелітополь	Zaporizka	Запорізька
75	23110	Tokmak	Токмак	Zaporizka	Запорізька
76	26101	Ivano-Frankivsk (agg)	Івано-Франківськ (міськрада)	Ivano-Frankivska	Івано-Франківська
77	26102	Bolehiv (agg)	Болехівськ (міськрада)	Ivano-Frankivska	Івано-Франківська
78	26104	Kalush	Калуш	Ivano-Frankivska	Івано-Франківська
79	26106	Kolomyia	Коломия	Ivano-Frankivska	Івано-Франківська
80	26110	Yaremcha (agg)	Яремча (міськрада)	Ivano-Frankivska	Івано-Франківська
81	32103	Bila Tserkva	Біла Церква	Kyivska	Київська
82	32104	Berezan	Березань	Kyivska	Київська
83	32105	Boryspil (agg)	Бориспіль (міськрада)	Kyivska	Київська
84	32106	Brovary	Бровари	Kyivska	Київська
85	32107	Vasylkiv	Васильків	Kyivska	Київська
86	32109	Irpın (agg)	Ірпін (міськрада)	Kyivska	Київська
87	32110	Pereiaslav-Chmelnytskyi	Переяслав-Хмельницький	Kyivska	Київська
88	32113	Rzhyschiv	Ржищів	Kyivska	Київська
89	32115	Slavutych	Славутич	Kyivska	Київська
90	32116	Fastiv	Фастів	Kyivska	Київська
91	35101	Kirovograd (agg)	Кіровоград (міськрада)	Kirovohradska	Кіровоградська
92	35102	Znamianka (agg)	Знам'янка (міськрада)	Kirovohradska	Кіровоградська
93	35103	Olexandria (agg)	Олександрія (міськрада)	Kirovohradska	Кіровоградська
94	35109	Svitlovodsk (agg)	Світловодськ (міськрада)	Kirovohradska	Кіровоградська
95	44101	Luhansk (agg)	Луганськ (міськрада)	Luhanska	Луганська
96	44102	Alchevsk	Алчевськ	Luhanska	Луганська
97	44103	Antratsyiv (agg)	Антрацит (міськрада)	Luhanska	Луганська
98	44105	Brianka (agg)	Брянка (міськрада)	Luhanska	Луганська
99	44110	Kirovsk (agg)	Кіров (міськрада)	Luhanska	Луганська
100	44114	Krasnodon (agg)	Краснодон (міськрада)	Luhanska	Луганська
101	44116	Krasnyi Luch (agg)	Красний Луч (міськрада)	Luhanska	Луганська
102	44118	Lysychansk (agg)	Лисичанськ (міськрада)	Luhanska	Луганська
103	44121	Pervomaik (agg)	Первомайськ (міськрада)	Luhanska	Луганська
104	44123	Rovenky (agg)	Ровеньків (міськрада)	Luhanska	Луганська
105	44125	Rubizhne	Рубіжне	Luhanska	Луганська
106	44127	Sverdlovsk (agg)	Свердловськ (міськрада)	Luhanska	Луганська
107	44129	Severodonetsk (agg)	Северодонецьк (міськрада)	Luhanska	Луганська
108	44131	Stahanov (agg)	Стаханов (міськрада)	Luhanska	Луганська
109	46101	Lviv (agg)	Львів (міськрада)	Lvivska	Львівська
110	46103	Boryslav (agg)	Борислав (міськрада)	Lvivska	Львівська
111	46106	Drogobytch (agg)	Дрогобич (міськрада)	Lvivska	Львівська
112	46109	Sambir	Самбір	Lvivska	Львівська
113	46112	Stryi	Стрий	Lvivska	Львівська
114	46115	Truskavets	Трускавець	Lvivska	Львівська
115	46118	Chervonohrad (agg)	Червоноград (міськрада)	Lvivska	Львівська
116	48101	Mykolaiv	Миколаїв	Mykolayivska	Миколаївська
117	48102	Voznesensk	Вознесенськ	Mykolayivska	Миколаївська
118	48103	Ochakov	Очаків	Mykolayivska	Миколаївська
119	48104	Pervomaik	Первомайськ	Mykolayivska	Миколаївська
120	48108	Yuzhoukrainsk	Южноукраїнськ	Mykolayivska	Миколаївська
121	51101	Odesa	Одеса	Odeska	Одеська
122	51103	Bilhorod-Dnistrovskiy (agg)	Білгород-Дністровський (міськрада)	Odeska	Одеська
123	51106	Izmail	Ізмаїл	Odeska	Одеська
124	51108	Illichivsk (agg)	Іллічівськ (міськрада)	Odeska	Одеська
125	51112	Kotovsk	Котовськ	Odeska	Одеська
126	51115	Teplodar	Теплодар	Odeska	Одеська
127	51117	Yuzhne	Южне	Odeska	Одеська
128	53101	Poltava	Полтава	Poltavska	Полтавська
129	53102	Komsomolsk (agg)	Комсомольськ (міськрада)	Poltavska	Полтавська
130	53104	Kremenchuk	Кременчук	Poltavska	Полтавська
131	53107	Lubny	Лубни	Poltavska	Полтавська



132	53109	Myrgorod	Миргород	Poltavska	Полтавська
133	56101	Rivne	Рівне	Sumska	Рівненська
134	56103	Dubno	Дубно	Sumska	Рівненська
135	56107	Kuznetsovsk	Кузнецовськ	Sumska	Рівненська
136	56109	Ostrog	Острог	Sumska	Рівненська
137	59101	Sumy (agg)	Суми (міськрада)	Sumska	Сумська
138	59103	Gluhiv (agg)	Глухів (міськрада)	Sumska	Сумська
139	59104	Konotop (agg)	Конотоп (міськрада)	Sumska	Сумська
140	59105	Lebedyn (agg)	Лебедин (міськрада)	Sumska	Сумська
141	59106	Ohtyrka (agg)	Охтирка (міськрада)	Sumska	Сумська
142	59107	Romny (agg)	Ромни (міськрада)	Sumska	Сумська
143	59110	Shostka	Шостка	Sumska	Сумська
144	61101	Ternopil	Тернопіль	Ternopilska	Тернопільська
145	63101	Kharkiv	Харків	Kharkivska	Харківська
146	63104	Izium	Ізюм	Kharkivska	Харківська
147	63107	Kupiansk (agg)	Купя'нськ (міськрада)	Kharkivska	Харківська
148	63110	Lozova (agg)	Лозова (міськрада)	Kharkivska	Харківська
149	63112	Liubotyn (agg)	Люботин (міськрада)	Kharkivska	Харківська
150	63115	Pervomaiskyi (agg)	Первомайський (міськрада)	Kharkivska	Харківська
151	63120	Chuhuiv (agg)	Чугуїв (міськрада)	Kharkivska	Харківська
152	65101	Kherson (agg)	Херсон (міськрада)	Khersonska	Херсонська
153	65103	Nova Kahovka (agg)	Нова Каховка (міськрада)	Khersonska	Херсонська
154	65104	Kahovka	Каховка	Khersonska	Херсонська
155	68101	Kmelnytskyi	Хмельницький	Khmelnyska	Хмельницька
156	68104	Kamianets-Podilskyi	Кам'янець-Подільський	Khmelnyska	Хмельницька
157	68105	Netishyn	Нетішин	Khmelnyska	Хмельницька
158	68106	Slavuta	Славута	Khmelnyska	Хмельницька
159	68108	Starokostiantyniv	Старокостянтинів	Khmelnyska	Хмельницька
160	68109	Shepetivka	Шепетівка	Khmelnyska	Хмельницька
161	71101	Cherkasy (agg)	Черкаси (міськрада)	Cherkaska	Черкаська
162	71102	Vatutine (agg)	Ватутіне (міськрада)	Cherkaska	Черкаська
163	71103	Kaniv	Канів	Cherkaska	Черкаська
164	71104	Zolotonosha (agg)	Золотоноша (міськрада)	Cherkaska	Черкаська
165	71105	Smila (agg)	Сміла (міськрада)	Cherkaska	Черкаська
166	71108	Uman	Умань	Cherkaska	Черкаська
167	73101	Chernivtsi	Чернівці	Chernivetska	Чернівецька
168	73106	Novodnistrovsk	Новодністровськ	Chernivetska	Чернівецька
169	74101	Chernihiv	Чернігів	Chernihivska	Чернігівська
170	74104	Nizhyn	Ніжин	Chernihivska	Чернігівська
171	74107	Pryluky	Прилуки	Chernihivska	Чернігівська
172	80000	Kyiv	Київ	Kyiv	Київ
173	85000	Sevastopol (agg)	Севастополь (міськрада)	Sevastopol (agg)	Севастополь (міськрада)

Annex E. List of districts received after affiliation cities with “special status” to corresponding area, data of census of 2001 (in yellow – agglomerations that could not be affiliated)

<b>№</b>	<b>Code</b>	<b>District</b>	<b>Cities</b>	<b>Region</b>	<b>Oblast</b>
1	01303	Alushta (agg)	Alushta (agg)	AR Krym	АР Крим
2	01304	Bakhchysaraiskyi		AR Krym	АР Крим
3	01307	Bilohirskyi		AR Krym	АР Крим
4	01311	Dzhankoiskyi	Dzgankoi	AR Krym	АР Крим
5	01316	Kirovskyi		AR Krym	АР Крим
6	01317	Sudak (agg)	Sudak (agg)	AR Krym	АР Крим
7	01318	Feodosiia (agg)	Feodosiia (agg)	AR Krym	АР Крим
8	01319	Yalta (agg)	Yalta (agg)	AR Krym	АР Крим
9	01320	Krasnohvarhiyskyi		AR Krym	АР Крим
10	01323	Krasnoperekopskyi	Krasnoperekopsk, Armiansk	AR Krym	АР Крим
11	01327	Leninskyi	Kerch	AR Krym	АР Крим
12	01331	Nyzhnohirskyi		AR Krym	АР Крим
13	01335	Pervomaiskyi		AR Krym	АР Крим
14	01339	Rozdolnenskyi		AR Krym	АР Крим
15	01343	Sakskyi	Saky, Evpatoria (agg)	AR Krym	АР Крим
16	01347	Simferopolskyi	Simferopol (agg)	AR Krym	АР Крим
17	01352	Sovietskyi		AR Krym	АР Крим
18	01356	Chornomorskyi		AR Krym	АР Крим
19	05301	Barskyi		Vinnytska	Вінницька
20	05302	Bershadskyi		Vinnytska	Вінницька
21	05306	Vinnytskyi	Vinnytsia	Vinnytska	Вінницька
22	05308	Gaisynskyi	Ladyzhyn (agg)	Vinnytska	Вінницька
23	05310	Zgmerynskyi	Zhmerynka	Vinnytska	Вінницька
24	05312	Illinetskyi		Vinnytska	Вінницька
25	05313	Kalynivskyi		Vinnytska	Вінницька
26	05314	Koziatynskyi	Koziatyn (agg)	Vinnytska	Вінницька
27	05319	Kryzhopilskyi		Vinnytska	Вінницька
28	05322	Lypovetskyi		Vinnytska	Вінницька
29	05324	Litynskyi		Vinnytska	Вінницька
30	05326	Mogyliiv-Podilskyi	Mogyliiv-Podilskyi (agg)	Vinnytska	Вінницька
31	05328	Murovanokurylovetskyi		Vinnytska	Вінницька
32	05330	Nemyrivskyi		Vinnytska	Вінницька
33	05331	Orativskyi		Vinnytska	Вінницька
34	05332	Pischanskyi		Vinnytska	Вінницька
35	05334	Pogrebyschenskyi		Vinnytska	Вінницька
36	05337	Teplotytskyi		Vinnytska	Вінницька
37	05338	Tuvrivskyi		Vinnytska	Вінницька
38	05339	Tomashpilskyi		Vinnytska	Вінницька
39	05341	Trostianetskyi		Vinnytska	Вінницька
40	05343	Tulchynskyi		Vinnytska	Вінницька
41	05348	Khmilnytskyi	Khmilnyk	Vinnytska	Вінницька
42	05349	Chernivetskyi		Vinnytska	Вінницька
43	05350	Chechelnytskyi		Vinnytska	Вінницька
44	05353	Shargorodskyi		Vinnytska	Вінницька
45	05356	Yampilskyi		Vinnytska	Вінницька
46	07305	Volodymyr-Volynskyi	Volodymyr-Volynskyi	Volynska	Волинська
47	07308	Gorohivskyi		Volynska	Волинська
48	07311	Ivanychivskyi	Novovolynsk (agg)	Volynska	Волинська
49	07314	Kamin-Kashyrskyi		Volynska	Волинська
50	07318	Kivertsivskyi		Volynska	Волинська
51	07321	Kovel'skyi	Kovel	Volynska	Волинська
52	07324	Lokachynskyi		Volynska	Волинська
53	07328	Lutskyi	Lutsk	Volynska	Волинська
54	07331	Liubeshivskyi		Volynska	Волинська
55	07333	Liuboml'skyi		Volynska	Волинська
56	07336	Manevytskyi		Volynska	Волинська
57	07342	Ratnivskyi		Volynska	Волинська
58	07345	Rozhyschenskyi		Volynska	Волинська
59	07350	Starovyzhivskyi		Volynska	Волинська
60	07355	Turiiskyi		Volynska	Волинська
61	07357	Shatskyi		Volynska	Волинська
62	12303	Apostolivskyi		Dnipropetrovska	Дніпропетровська
63	12304	Dniprodzerzhynsk (agg)	Dniprodzerzhynsk (agg)	Dnipropetrovska	Дніпропетровська
64	12307	Vasylkivskyi		Dnipropetrovska	Дніпропетровська
65	12310	Verhniodniprovskyi	Vilnohirsk	Dnipropetrovska	Дніпропетровська
66	12314	Dnipropetrovskyi	Dnipropetrovsk (agg)	Dnipropetrovska	Дніпропетровська
67	12318	Kryvorizkyi	Kryvyi Rig (agg)	Dnipropetrovska	Дніпропетровська

68	12320	Krynychanskyi		Dnipropetrovska	Дніпропетровська
69	12323	Magdalynivskyi		Dnipropetrovska	Дніпропетровська
70	12326	Mezhevskyi		Dnipropetrovska	Дніпропетровська
71	12329	Nikipolskyi	Nikopol, Marganets (agg), Ordzhonikidze (agg)	Dnipropetrovska	Дніпропетровська
72	12332	Novomoskovskyi	Novomoskovsk	Dnipropetrovska	Дніпропетровська
73	12335	Pavlogradskyi	Pavlograd, Ternivka (agg)	Dnipropetrovska	Дніпропетровська
74	12337	Petrykivskyi		Dnipropetrovska	Дніпропетровська
75	12338	Petropavlivskyi	Pershotravensk	Dnipropetrovska	Дніпропетровська
76	12342	Pokrovskyi		Dnipropetrovska	Дніпропетровська
77	12345	Pjatyhatskyi	Zhovti Vody (agg)	Dnipropetrovska	Дніпропетровська
78	12348	Synelnkovskyi	Synelnkove	Dnipropetrovska	Дніпропетровська
79	12350	Solonianskyi		Dnipropetrovska	Дніпропетровська
80	12352	Sofiivskyi		Dnipropetrovska	Дніпропетровська
81	12354	Tomakivskyi		Dnipropetrovska	Дніпропетровська
82	12356	Tsarychanskyi		Dnipropetrovska	Дніпропетровська
83	12358	Shyrokivskyi		Dnipropetrovska	Дніпропетровська
84	12359	Yuriiivskyi		Dnipropetrovska	Дніпропетровська
85	14306	Amvrosiivskyi		Donetska	Донецька
86	14309	Artemivskyi	Artemivsk (agg), Gorlivka (agg), Debaltseve (agg)	Donetska	Донецька
87	14312	Velykonovosilkivskyi		Donetska	Донецька
88	14315	Volnovaskyi	Dokuchaivsk (agg)	Donetska	Донецька
89	14317	Volodarskyi		Donetska	Донецька
90	14320	Dobropilskyi	Dobropillia (agg)	Donetska	Донецька
91	14324	Kostiantynivskyi	Kostiantynivka, Druzhkivka (agg), Dzerzhynsk (agg), Kirovske	Donetska	Донецька
92	14327	Krasnoarmiiskyi	Krasnoarmiisk (agg), Dymytrov (agg), Selydove (agg), Novgorodivka	Donetska	Донецька
93	14330	Krasnolymanskyi	Krasnyi Lyman (agg)	Donetska	Донецька
94	14333	Mariinskyi	Vugledar	Donetska	Донецька
95	14336	Novoazovskiy	Mariupol (agg)	Donetska	Донецька
96	14337	Oleksandrivskyi		Donetska	Донецька
97	14339	Pershotravnevyi		Donetska	Донецька
98	14342	Slovianskyi	Sloviansk (agg), Kramatorsk (agg)	Donetska	Донецька
99	14345	Starobeshivskyi		Donetska	Донецька
100	14348	Telmanivskyi		Donetska	Донецька
101	14352	Shahtarskyi	Shahtarsk (agg), Torez (agg), Snizhne (agg), Donetsk (agg), Makiivka (agg), Zhdanivka (agg), Khartsyzk (agg)	Donetska	Донецька
102	14355	Yasynuvatskyi	Yasynuvata, Avdiivka, Enakieve (agg)	Donetska	Донецька
103	18303	Andrushivskyi		Zhytomyrska	Житомирська
104	18306	Baranivskyi		Zhytomyrska	Житомирська
105	18308	Berdychivskyi	Berdychiv	Zhytomyrska	Житомирська
106	18309	Brusylivskyi		Zhytomyrska	Житомирська
107	18311	Volodarsko-Volynskyi		Zhytomyrska	Житомирська
108	18314	Dzerzhynskyi		Zhytomyrska	Житомирська
109	18317	Emilchynskyi		Zhytomyrska	Житомирська
110	18320	Zhytomyrskyi	Zhytomyr	Zhytomyrska	Житомирська
111	18323	Korostenskyi	Korosten	Zhytomyrska	Житомирська
112	18325	Korostyshivskyi		Zhytomyrska	Житомирська
113	18328	Lugynskyi		Zhytomyrska	Житомирська
114	18331	Liubarskyi		Zhytomyrska	Житомирська
115	18334	Malynskyi		Zhytomyrska	Житомирська
116	18337	Narodytskyi		Zhytomyrska	Житомирська
117	18340	Novograd-Volynskyi	Novograd-Volynskyi	Zhytomyrska	Житомирська
118	18342	Ovrutskyi		Zhytomyrska	Житомирська
119	18344	Olevskyi		Zhytomyrska	Житомирська
120	18347	Popilnianskyi		Zhytomyrska	Житомирська
121	18350	Radomyshl'skyi		Zhytomyrska	Житомирська
122	18352	Ruzhynskyi		Zhytomyrska	Житомирська
123	18354	Chervonoarmiiskyi		Zhytomyrska	Житомирська
124	18356	Chernihivskyi		Zhytomyrska	Житомирська
125	18358	Chudnivskyi		Zhytomyrska	Житомирська
126	21304	Beregivskyi	Beregove (agg)	Zakarpatska	Закарпатська

127	21308	Velykobereznianskyi		Zakarpatska	Закарпатська
128	21312	Vynogradivskyi		Zakarpatska	Закарпатська
129	21315	Volovetskyi		Zakarpatska	Закарпатська
130	21319	Irshavskyi		Zakarpatska	Закарпатська
131	21324	Mizhgirskyi		Zakarpatska	Закарпатська
132	21327	Mukachivskyi	Mukacheve	Zakarpatska	Закарпатська
133	21332	Perechynskyi		Zakarpatska	Закарпатська
134	21336	Rahivskyi		Zakarpatska	Закарпатська
135	21340	Svaliavskyi		Zakarpatska	Закарпатська
136	21344	Tiachivskyi		Zakarpatska	Закарпатська
137	21348	Uzhgorodskyi	Uzhgorod	Zakarpatska	Закарпатська
138	21353	Hustskyi	Hust (agg)	Zakarpatska	Закарпатська
139	23306	Berdianskyi	Berdiansk (agg)	Zaporizka	Запорізька
140	23309	Vasylivskyi		Zaporizka	Запорізька
141	23311	Velykobilozerskyi		Zaporizka	Запорізька
142	23312	Veselivskyi		Zaporizka	Запорізька
143	23315	Vilnianskyi		Zaporizka	Запорізька
144	23318	Guliajpilskyi		Zaporizka	Запорізька
145	23321	Zaporizkyi	Zaporizzia (agg)	Zaporizka	Запорізька
146	23324	Kamiansko-Dniprovskyi	Energodar	Zaporizka	Запорізька
147	23327	Kuibyshevskyi		Zaporizka	Запорізька
148	23330	Melitopolskyi	Melitopol	Zaporizka	Запорізька
149	23333	Myhailivskyi		Zaporizka	Запорізька
150	23336	Novomykolaivskyi		Zaporizka	Запорізька
151	23339	Orihivskyi		Zaporizka	Запорізька
152	23342	Polohivskyi		Zaporizka	Запорізька
153	23345	Pryazovskyi		Zaporizka	Запорізька
154	23348	Prymorskyi		Zaporizka	Запорізька
155	23349	Rozivskyi		Zaporizka	Запорізька
156	23352	Tokmatskyi	Tokmak	Zaporizka	Запорізька
157	23355	Chernihivskyi		Zaporizka	Запорізька
158	23356	Yakymivskyi		Zaporizka	Запорізька
159	26304	Bogorodchanskyi		Ivano-Frankivska	Івано-Франківська
160	26308	Verhovynskyi		Ivano-Frankivska	Івано-Франківська
161	26312	Galytskyi		Ivano-Frankivska	Івано-Франківська
162	26316	Gorodenkivskyi		Ivano-Frankivska	Івано-Франківська
163	26320	Dolynskyi	Boleliv (agg)	Ivano-Frankivska	Івано-Франківська
164	26328	Kaluskyi	Kalush	Ivano-Frankivska	Івано-Франківська
165	26332	Kolomyyskyi	Kolomyia	Ivano-Frankivska	Івано-Франківська
166	26336	Kosivskyi		Ivano-Frankivska	Івано-Франківська
167	26340	Nadvirnianskyi	Yaremcha (agg)	Ivano-Frankivska	Івано-Франківська
168	26344	Rogatynskyi		Ivano-Frankivska	Івано-Франківська
169	26348	Rozhniativskyi		Ivano-Frankivska	Івано-Франківська
170	26352	Sniatynskyi		Ivano-Frankivska	Івано-Франківська
171	26354	Tysmenytskyi	Ivano-Frankivsk (agg)	Ivano-Frankivska	Івано-Франківська
172	26356	Tlumatskyi		Ivano-Frankivska	Івано-Франківська
173	32302	Baryshivskyi	Berezan	Kyivska	Київська
174	32304	Bilotserkivskyi	Bila Tserkva	Kyivska	Київська
175	32306	Boguslavskyi		Kyivska	Київська
176	32308	Boryspilskyi	Boryspil (agg)	Kyivska	Київська
177	32310	Borodianskyi		Kyivska	Київська
178	32312	Brovarskyi	Brovary	Kyivska	Київська
179	32314	Vasylkivskyi	Vasylkiv	Kyivska	Київська
180	32315	Vyshgorodskyi		Kyivska	Київська
181	32316	Volodarskyi		Kyivska	Київська
182	32319	Zgurivskyi		Kyivska	Київська
183	32320	Ivankivskyi		Kyivska	Київська
184	32322	Kagarlytskyi	Rzhyschiv	Kyivska	Київська
185	32324	Kyevy-Sviatoshynskyi	Irpyn (agg), Kyiv	Kyivska	Київська
186	32327	Makarivskyi		Kyivska	Київська
187	32329	Myronivskyi		Kyivska	Київська
188	32331	Obuhivskyi		Kyivska	Київська
189	32333	Pereiaslav-Chmelnytskyi	Pereiaslav-Chmelnytskyi	Kyivska	Київська
190	32335	Poliskyi		Kyivska	Київська
191	32337	Rokytnianskyi		Kyivska	Київська
192	32340	Skvyrskyi		Kyivska	Київська
193	32342	Stavyschenskyi		Kyivska	Київська
194	32344	Taraschanskyi		Kyivska	Київська
195	32346	Tetiivskyi		Kyivska	Київська
196	32349	Fastivskyi	Fastiv	Kyivska	Київська
197	32355	Yagotynskyi		Kyivska	Київська
198	35308	Bobrynetskyi		Kirovohradska	Кіровоградська
199	35309	Vilshanskyi		Kirovohradska	Кіровоградська
200	35311	Gaivoronskyi		Kirovohradska	Кіровоградська

201	35314	Golovanivskiy		Kirovohradska	Кіровоградська
202	35317	Dobrovelychkivskiy		Kirovohradska	Кіровоградська
203	35319	Dolynskiy		Kirovohradska	Кіровоградська
204	35322	Znamianskiy	Znamianka (agg)	Kirovohradska	Кіровоградська
205	35325	Kirovohradskiy	Kirovograd (agg)	Kirovohradska	Кіровоградська
206	35328	Kompaniivskiy		Kirovohradska	Кіровоградська
207	35331	Malovyskivskiy		Kirovohradska	Кіровоградська
208	35334	Novgorodkivskiy		Kirovohradska	Кіровоградська
209	35336	Novoarhangelskiy		Kirovohradska	Кіровоградська
210	35338	Novomyrhorodskiy		Kirovohradska	Кіровоградська
211	35340	Novoukrainskiy		Kirovohradska	Кіровоградська
212	35341	Oleksandrivskiy		Kirovohradska	Кіровоградська
213	35342	Oleksandriiskiy	Olexandria (agg)	Kirovohradska	Кіровоградська
214	35346	Onufriivskiy		Kirovohradska	Кіровоградська
215	35349	Petrivskiy		Kirovohradska	Кіровоградська
216	35352	Svitlovodskiy	Svitlovodsk (agg)	Kirovohradska	Кіровоградська
217	35355	Ulianovskiy		Kirovohradska	Кіровоградська
218	35358	Ustynivskiy		Kirovohradska	Кіровоградська
219	44303	Antracytivskiy	Antratsytiv (agg), Rovenky (agg), Krasnyi Luch (agg)	Luhanska	Луганська
220	44306	Bilovodskiy		Luhanska	Луганська
221	44309	Biloukrainskiy		Luhanska	Луганська
222	44314	Krasnodonskiy	Krasnodon (agg)	Luhanska	Луганська
223	44316	Kreminskiy	Rubizhne	Luhanska	Луганська
224	44322	Lutuhynskiy		Luhanska	Луганська
225	44325	Markivskiy		Luhanska	Луганська
226	44328	Milovskiy		Luhanska	Луганська
227	44331	Novoaidarskiy		Luhanska	Луганська
228	44333	Novopskovskiy		Luhanska	Луганська
229	44336	Perevalskiy	Alchevsk, Brianka (agg)	Luhanska	Луганська
230	44338	Popasnianskiy	Kirovsk (agg), Severodonetsk (agg), Lysychansk (agg), Pervomaisk (agg)	Luhanska	Луганська
231	44340	Svativskiy		Luhanska	Луганська
232	44342	Sverdlovskiy	Sverdlovsk (agg)	Luhanska	Луганська
233	44345	Sloviano-Serbskiy	Stahanov (agg)	Luhanska	Луганська
234	44348	Stanychno-Luhanskiy	Luhansk (agg)	Luhanska	Луганська
235	44351	Starobilskiy		Luhanska	Луганська
236	44354	Troiitskiy		Luhanska	Луганська
237	46303	Brodivskiy		Lvivska	Львівська
238	46306	Buskiy		Lvivska	Львівська
239	46309	Horodotskiy		Lvivska	Львівська
240	46312	Drohobyt'skiy	Drogobytch(agg), Truskavets, Boryslav(agg)	Lvivska	Львівська
241	46315	Zgydachivskiy		Lvivska	Львівська
242	46317	Zhovkivskiy		Lvivska	Львівська
243	46318	Zolochivskiy		Lvivska	Львівська
244	46321	Kamianka-Buzkiy		Lvivska	Львівська
245	46322	Mykolaivskiy		Lvivska	Львівська
246	46324	Mostyskiy		Lvivska	Львівська
247	46333	Peremyshlianskiy		Lvivska	Львівська
248	46336	Pustomyivskiy	Lviv (agg)	Lvivska	Львівська
249	46339	Radehivskiy		Lvivska	Львівська
250	46342	Sambirskiy	Sambir	Lvivska	Львівська
251	46345	Skolivskiy		Lvivska	Львівська
252	46348	Sokalskiy	Chervonohrad (agg)	Lvivska	Львівська
253	46351	Starosambirskiy		Lvivska	Львівська
254	46353	Stryiskiy	Stryi	Lvivska	Львівська
255	46355	Turkivskiy		Lvivska	Львівська
256	46358	Yavorivskiy		Lvivska	Львівська
257	48303	Arbuzynskiy	Yuzhoukrainsk	Mykolayivska	Миколаївська
258	48306	Bashtanskiy		Mykolayivska	Миколаївська
259	48309	Berezanskiy		Mykolayivska	Миколаївська
260	48311	Berezhnhevatskiy		Mykolayivska	Миколаївська
261	48314	Bratskiy		Mykolayivska	Миколаївська
262	48317	Veselynivskiy		Mykolayivska	Миколаївська
263	48320	Voznesenskiy	Voznesensk	Mykolayivska	Миколаївська
264	48323	Vradiyivskiy		Mykolayivska	Миколаївська
265	48327	Domanivskiy		Mykolayivska	Миколаївська
266	48330	Yelanetskiy		Mykolayivska	Миколаївська
267	48333	Zhovtnevyi		Mykolayivska	Миколаївська
268	48336	Kazankivskiy		Mykolayivska	Миколаївська

269	48339	Kryvoozerskyi		Mykolayivska	Миколаївська
270	48342	Mykolaivskyi	Mykolaiv	Mykolayivska	Миколаївська
271	48345	Novobuzkyi		Mykolayivska	Миколаївська
272	48348	Novoodeskyi		Mykolayivska	Миколаївська
273	48351	Ochakivskyi	Ochakov	Mykolayivska	Миколаївська
274	48354	Pervomaiskyi	Pervomaisk	Mykolayivska	Миколаївська
275	48357	Snihurivskyi		Mykolayivska	Миколаївська
276	51302	Ananivskyi		Odeska	Одеська
277	51304	Artsyzkyi		Odeska	Одеська
278	51306	Baltskyi		Odeska	Одеська
279	51308	Bilhorod-Dnistrovskyi	Bilhorod-Dnistrovskyi (agg)	Odeska	Одеська
280	51310	Biliaivskyi	Teplodar	Odeska	Одеська
281	51312	Berezivskyi		Odeska	Одеська
282	51314	Bolgradskyi		Odeska	Одеська
283	51316	Velukomyhailivskyi		Odeska	Одеська
284	51318	Ivanivskyi		Odeska	Одеська
285	51320	Izmailskyi	Izmail	Odeska	Одеська
286	51323	Kiliivskyi		Odeska	Одеська
287	51325	Kodymskyi		Odeska	Одеська
288	51327	Kominternivskyi	Yuzhne	Odeska	Одеська
289	51329	Kotovskiy	Kotovsk	Odeska	Одеська
290	51331	Krasnooknianskyi		Odeska	Одеська
291	51333	Liubashivskyi		Odeska	Одеська
292	51335	Mykolaiivskyi		Odeska	Одеська
293	51337	Ovidiopol'skyi	Odesa, Illichivsk (agg)	Odeska	Одеська
294	51338	Reniivskyi		Odeska	Одеська
295	51339	Rozdilnianskyi		Odeska	Одеська
296	51343	Savranskyi		Odeska	Одеська
297	51345	Saratskyi		Odeska	Одеська
298	51347	Tarutynskyi		Odeska	Одеська
299	51350	Tatarbunarskyi		Odeska	Одеська
300	51352	Frunzivskyi		Odeska	Одеська
301	51354	Shyriaivskyi		Odeska	Одеська
302	53302	Belykobahachanskyi		Poltavska	Полтавська
303	53304	Hadiatskyi		Poltavska	Полтавська
304	53306	Hlobynskyi		Poltavska	Полтавська
305	53308	Hrebinkivskyi		Poltavska	Полтавська
306	53310	Dykanskyi		Poltavska	Полтавська
307	53313	Zinkivskyi		Poltavska	Полтавська
308	53316	Karlivskyi		Poltavska	Полтавська
309	53318	Kobeliatskyi		Poltavska	Полтавська
310	53320	Kozelshchynskyi		Poltavska	Полтавська
311	53322	Kotelevskyi		Poltavska	Полтавська
312	53324	Kremenchutskyi	Kremenchuk, Komsomolsk (agg)	Poltavska	Полтавська
313	53326	Lohvytskyi		Poltavska	Полтавська
314	53328	Lubenskyi	Lubny	Poltavska	Полтавська
315	53330	Mashivskyi		Poltavska	Полтавська
316	53332	Myrhorodskyi	Myrhorod	Poltavska	Полтавська
317	53334	Novosanzharskyi		Poltavska	Полтавська
318	53336	Orzhytskyi		Poltavska	Полтавська
319	53338	Pyriatynskyi		Poltavska	Полтавська
320	53340	Poltavskyi	Poltava	Poltavska	Полтавська
321	53342	Reshetylivskyi		Poltavska	Полтавська
322	53345	Semenivskyi		Poltavska	Полтавська
323	53348	Horolskyi		Poltavska	Полтавська
324	53351	Chornuhynskyi		Poltavska	Полтавська
325	53354	Chutivskyi		Poltavska	Полтавська
326	53357	Shyshatskyi		Poltavska	Полтавська
327	56304	Bereznivskyi		Rivnenska	Рівненська
328	56308	Volodymyrets'kyi	Kuznetsovsk	Rivnenska	Рівненська
329	56312	Hoshchanskyi		Rivnenska	Рівненська
330	56314	Demydivskyi		Rivnenska	Рівненська
331	56316	Dubenskyi	Dubno	Rivnenska	Рівненська
332	56318	Dubrovytskyi		Rivnenska	Рівненська
333	56322	Zarichenskyi		Rivnenska	Рівненська
334	56326	Zdolbunivskyi		Rivnenska	Рівненська
335	56330	Koretskyi		Rivnenska	Рівненська
336	56334	Kostopil'skyi		Rivnenska	Рівненська
337	56338	Mlynivskyi		Rivnenska	Рівненська
338	56342	Ostrozkyi	Ostrog	Rivnenska	Рівненська
339	56344	Radyvylivskyi		Rivnenska	Рівненська
340	56346	Rivnenskyi	Rivne	Rivnenska	Рівненська

341	56350	Rokytnivskiy		Rivnenska	Рівненська
342	56354	Sarnenskiy		Rivnenska	Рівненська
343	59306	Bilopilskiy		Sumska	Сумська
344	59309	Burynskiy		Sumska	Сумська
345	59312	Velykopysarivskiy		Sumska	Сумська
346	59315	Hluhivskiy	Gluhiv (agg)	Sumska	Сумська
347	59320	Konotopslyi	Konotop (agg)	Sumska	Сумська
348	59323	Krasnopilskiy		Sumska	Сумська
349	59326	Krolevetskiy		Sumska	Сумська
350	59329	Lebedynskiy	Lebedyn (agg)	Sumska	Сумська
351	59332	Lypovolodynskiy		Sumska	Сумська
352	59335	Nedryhailivskiy		Sumska	Сумська
353	59336	Ohtyrskiy	Ohtyrka (agg)	Sumska	Сумська
354	59338	Putyvlskiy		Sumska	Сумська
355	59341	Romenskiy	Romny (agg)	Sumska	Сумська
356	59344	Seredyno-Budskiy		Sumska	Сумська
357	59347	Sumskiy	Sumy (agg)	Sumska	Сумська
358	59350	Trotianetskiy		Sumska	Сумська
359	59353	Shostkynskiy	Shostka	Sumska	Сумська
360	59356	Yampilskiy		Sumska	Сумська
361	61304	Berezhanskiy		Ternopilska	Тернопільська
362	61308	Borshchivskiy		Ternopilska	Тернопільська
363	61312	Buchatskiy		Ternopilska	Тернопільська
364	61316	Husiatynskiy		Ternopilska	Тернопільська
365	61320	Zalishchytskiy		Ternopilska	Тернопільська
366	61324	Zbarazkiy		Ternopilska	Тернопільська
367	61326	Zborivskiy		Ternopilska	Тернопільська
368	61330	Kozivskiy		Ternopilska	Тернопільська
369	61334	Kremenetskiy		Ternopilska	Тернопільська
370	61338	Lanovetskiy		Ternopilska	Тернопільська
371	61342	Monastyrskiy		Ternopilska	Тернопільська
372	61346	Pidvolochyskiy		Ternopilska	Тернопільська
373	61348	Pidhaetskiy		Ternopilska	Тернопільська
374	61350	Terebovlianskiy		Ternopilska	Тернопільська
375	61352	Ternopilskiy	Ternopil	Ternopilska	Тернопільська
376	61355	Chortkivskiy		Ternopilska	Тернопільська
377	61358	Shumskiy		Ternopilska	Тернопільська
378	63302	Balakliyskiy		Kharkivska	Харківська
379	63304	Barvinkivskiy		Kharkivska	Харківська
380	63306	Blyzniukivskiy		Kharkivska	Харківська
381	63308	Bohodyhivskiy		Kharkivska	Харківська
382	63310	Borivskiy		Kharkivska	Харківська
383	63312	Valkivskiy		Kharkivska	Харківська
384	63314	Velykoburlutskiy		Kharkivska	Харківська
385	63316	Vovchanskiy		Kharkivska	Харківська
386	63318	Dvorichanskiy		Kharkivska	Харківська
387	63320	Derhachivskiy		Kharkivska	Харківська
388	63322	Zachepylivskiy		Kharkivska	Харківська
389	63324	Zmiivskiy		Kharkivska	Харківська
390	63326	Zolochivskiy		Kharkivska	Харківська
391	63328	Iziunskiy	Izium	Kharkivska	Харківська
392	63331	Keguchivskiy		Kharkivska	Харківська
393	63332	Kolomatskiy		Kharkivska	Харківська
394	63333	Krasnogradskiy		Kharkivska	Харківська
395	63335	Krasnokutskiy		Kharkivska	Харківська
396	63337	Kupianskiy	Kupiansk (agg)	Kharkivska	Харківська
397	63339	Lozivskiy	Lozova (agg)	Kharkivska	Харківська
398	63342	Novovodolazkiy		Kharkivska	Харківська
399	63345	Pervomaiskiy	Pervomaiskiy (agg)	Kharkivska	Харківська
400	63346	Pechenizkiy		Kharkivska	Харківська
401	63348	Sahnovshchynskiy		Kharkivska	Харківська
402	63351	Kharkivskiy	Kharkiv, Liubotyn (agg)	Kharkivska	Харківська
403	63353	Chuhivskiy	Chuhiv (agg)	Kharkivska	Харківська
404	63357	Shevchenkivskiy		Kharkivska	Харківська
405	65306	Beryslavskiy		Khersonska	Херсонська
406	65307	Bilozerskiy	Kherson (agg)	Khersonska	Херсонська
407	65308	Velykolepetyskiy		Khersonska	Херсонська
408	65309	Velykooleksandrivskiy		Khersonska	Херсонська
409	65315	Verhniorogachutskiy		Khersonska	Херсонська
410	65318	Vysokopilskiy		Khersonska	Херсонська
411	65321	Henicheskiy		Khersonska	Херсонська
412	65323	Holoprystanskiy		Khersonska	Херсонська
413	65326	Hornostavskiy		Khersonska	Херсонська

414	65329	Ivanivskiy		Khersonska	Херсонська
415	65332	Kalanchatskiy		Khersonska	Херсонська
416	65335	Kahovskiy	Kahovka, Nova Kahovka (agg)	Khersonska	Херсонська
417	65338	Nyzhnosirohozkiy		Khersonska	Херсонська
418	65341	Novovorontsovskiy		Khersonska	Херсонська
419	65344	Novotroitskiy		Khersonska	Херсонська
420	65347	Skadovskiy		Khersonska	Херсонська
421	65350	Tsiuriupynskiy		Khersonska	Херсонська
422	65354	Chaplynskiy		Khersonska	Херсонська
423	68303	Bilohirskiy		Khmelnyska	Хмельницька
424	68306	Vinkovetskiy		Khmelnyska	Хмельницька
425	68309	Volochyskiy		Khmelnyska	Хмельницька
426	68312	Gorodotskiy		Khmelnyska	Хмельницька
427	68315	Derazhnianskiy		Khmelnyska	Хмельницька
428	68318	Dunaevetskiy		Khmelnyska	Хмельницька
429	68321	Iziaslavskiy		Khmelnyska	Хмельницька
430	68324	Kamianets-Podilskiy	Kamianets-Podilskiy	Khmelnyska	Хмельницька
431	68327	Krasylivskiy		Khmelnyska	Хмельницька
432	68330	Letchivskiy		Khmelnyska	Хмельницька
433	68333	Novoushytskiy		Khmelnyska	Хмельницька
434	68336	Polonskiy		Khmelnyska	Хмельницька
435	68339	Slavutskiy	Slavuta, Netishyn	Khmelnyska	Хмельницька
436	68342	Starokostiantynivskiy	Starokostiantyniv	Khmelnyska	Хмельницька
437	68344	Starosyniavskiy		Khmelnyska	Хмельницька
438	68347	Teofipolskiy		Khmelnyska	Хмельницька
439	68350	Khmelnyskiy	Khmelnyskiy	Khmelnyska	Хмельницька
440	68352	Chemerovetskiy		Khmelnyska	Хмельницька
441	68355	Shepetivskiy	Shepetivka	Khmelnyska	Хмельницька
442	68358	Yarmolynetskiy		Khmelnyska	Хмельницька
443	71303	Gorodyshchenskiy		Cherkaska	Черкаська
444	71306	Drabivskiy		Cherkaska	Черкаська
445	71309	Zhashkivskiy		Cherkaska	Черкаська
446	71312	Zvenyhorodskiy	Vatutine (agg)	Cherkaska	Черкаська
447	71315	Zolotinskiy	Zolotonosha (agg)	Cherkaska	Черкаська
448	71318	Kamianskiy		Cherkaska	Черкаська
449	71320	Kanivskiy	Kaniv	Cherkaska	Черкаська
450	71322	Katerynopilskiy		Cherkaska	Черкаська
451	71325	Korsun-Shevchenkivskiy		Cherkaska	Черкаська
452	71328	Lysianskiy		Cherkaska	Черкаська
453	71331	Mankivskiy		Cherkaska	Черкаська
454	71334	Monastyrshchenskiy		Cherkaska	Черкаська
455	71337	Smilianskiy	Smila (agg)	Cherkaska	Черкаська
456	71340	Talnivskiy		Cherkaska	Черкаська
457	71343	Umanskiy	Uman	Cherkaska	Черкаська
458	71346	Khrystynivskiy		Cherkaska	Черкаська
459	71349	Cherkaskiy	Cherkasy (agg)	Cherkaska	Черкаська
460	71354	Chyhyrynskiy		Cherkaska	Черкаська
461	71355	Chornobaivskiy		Cherkaska	Черкаська
462	71357	Shpolianskiy		Cherkaska	Черкаська
463	73305	Vyzhnytskiy		Chernivetska	Чернівецька
464	73307	Hertsaiivskiy		Chernivetska	Чернівецька
465	73310	Hlybotskiy		Chernivetska	Чернівецька
466	73315	Zastavnivskiy	Chernivtsi	Chernivetska	Чернівецька
467	73320	Kelmenetskiy		Chernivetska	Чернівецька
468	73325	Kitsmanskiy		Chernivetska	Чернівецька
469	73330	Novoseletskiy		Chernivetska	Чернівецька
470	73335	Putylskiy		Chernivetska	Чернівецька
471	73340	Sokyrianskiy	Novodnistrovsk	Chernivetska	Чернівецька
472	73345	Storozhynetskiy		Chernivetska	Чернівецька
473	73350	Hotynskiy		Chernivetska	Чернівецька
474	74303	Bahmatskiy		Chernihivska	Чернігівська
475	74306	Bobrovyskiy		Chernihivska	Чернігівська
476	74308	Borznianskiy		Chernihivska	Чернігівська
477	74311	Varvynskiy		Chernihivska	Чернігівська
478	74314	Horodnianskiy		Chernihivska	Чернігівська
479	74317	Ichnianskiy		Chernihivska	Чернігівська
480	74320	Kozeletskiy		Chernihivska	Чернігівська
481	74322	Koropskiy		Chernihivska	Чернігівська
482	74324	Koriukivskiy		Chernihivska	Чернігівська
483	74327	Kulykivskiy		Chernihivska	Чернігівська
484	74330	Menskiy		Chernihivska	Чернігівська
485	74333	Nizhynskiy	Nizhyn	Chernihivska	Чернігівська



486	74336	Novhorod-Siverskyi		Chernihivska	Чернігівська
487	74338	Nosivskyi		Chernihivska	Чернігівська
488	74341	Prylutskyi	Pryluky	Chernihivska	Чернігівська
489	74344	Ripkynskyi		Chernihivska	Чернігівська
490	74347	Semenivskyi		Chernihivska	Чернігівська
491	74349	Sosnytskyi		Chernihivska	Чернігівська
492	74351	Sribnianskyi		Chernihivska	Чернігівська
493	74353	Talalaiivskyi		Chernihivska	Чернігівська
494	74355	Chernihivskyi	Chernihiv	Chernihivska	Чернігівська
495	74358	Shchorkyi		Chernihivska	Чернігівська
496	85000	Sevastopol (agg)		Sevastopol (agg)	Севастополь (міськрада)

## Annex F. Classification of diseases according to Ukrainian Classification of 1994 (ICD9), data available for regions

Row № рядка	Code in C8	Причини смерті	Causes of death
<b>001</b>		<b>1 - 44, 206</b>	<b><i>Class I. Certain infectious and parasitic diseases</i></b>
002	001	Холера	Cholera
003	002	Черевний тиф	Typhoid fever
004	003	Паратифи	Paratyphoid fever
005	004	Інші сальмонельозні інфекції	Other salmonella infections
006	005	Шигельоз (дизентерія)	Shigellosis (dysentery)
007	006	Харчові отруєння (бактеріальні), за винятком сальмонельозу	Bacterial food borne intoxications excluding salmonella infections
008	007	Кишкові інфекції, що визвані іншими збудниками, включаючи амебіаз та інші протозойні кишкові хвороби	Intestinal infections due to other micro-organisms including amoebiasis and other protozoal intestinal diseases
009	008	Гострі кишкові інфекції	Acute intestinal infections due to unspecified micro-organisms and ill-defined, including toxic dyspepsia
010	009	Туберкульоз органів дихання	Respiratory tuberculosis
011	010	Туберкульоз оболонок мозку та центральної нервової системи	Tuberculosis of nervous system
012	011	Туберкульоз кишечника	Tuberculosis of intestines, peritoneum and mesenteric glands
013	012	Туберкульоз кісток та суглобів	Tuberculosis of bones and joints
014	013	Інші форми туберкульозу	Other tuberculosis excluding late effects
<b>015</b>		<b>9 - 13</b>	<b>Tuberculosis</b>
016	014	Чума	Plague
017	015	Сибірська виразка	Anthrax (Siberian ulcer)
018	016	Бруцельоз	Brucellosis
019	017	Лепра (проказа)	Leprosy
020	018	Дифтерія	Diphtheria
021	019	Коклюш (кашлюк)	Whooping cough
022	020	Стрептококова ангіна	Streptococcal sore throat
023	021	Скарлатина	Scarlet fever
024	022	Бешиха (рожа)	Erysipelas
025	023	Менінгококова інфекція	Meningococcal infection
026	024	Стовбняк (правець)	Tetanus
027	025	Септицемія	Septicaemia
028	026	Інші бактеріальні інфекції	Other bacterial infections excluding foodborne intoxications
029	027	Гострий поліомієліт	Acute poliomyelitis
030	028	Кір	Measles
031	029	Вірусний енцефаліт	Viral encephalitis
032	030	Вірусний гепатит (хвороба Боткіна)	Viral hepatitis
033	031	Сказ	Rabies
034	032	Інші хвороби, що визвані вірусами	Other viral diseases
035	033	Сипний тиф (епідемічний)	Epidemic louse-borne typhus fever
036	034	Інші рикеттсіози	Other rickettsioses
037	035	Малярія	Malaria
038	036	Поворотний тиф	Relapsing fever
039	037	Сифіліс (всі форми)	Syphilis (all forms)
040	038	Інші інфекційні хвороби	Other infectious diseases
041	039	Ехінококкоз	Echinococcosis
042	040	Філяріатози та дракункульоз	Filarial infection and dracunculiasis

043	041	Інші гельмінтози	Other helminthiasis
044	042	Інші паразитарні хвороби	Other parasitic diseases
045	043	Віддалені наслідки туберкульозу	Late effects of tuberculosis
046	044	Віддалені наслідки інших інфекційних хвороб	Late effects of other infectious and parasitic diseases , including late effects of poliomyelitis
047	206	СНІД	AIDS
<b>048</b>		<b>45 - 67</b>	<b><i>Class II. Neoplasms</i></b>
049	045	Злоякісні новоутворення губи, порожнини рота та глотки	Malignant neoplasm of lip, oral cavity and pharynx
050	046	Злоякісні новоутворення стравоходу	Malignant neoplasm of oesophagus
051	047	Злоякісні новоутворення шлунку	Malignant neoplasm of stomach
052	048	Злоякісні новоутворення тонкого кишечника	Malignant neoplasm of small intestine, including duodenum
053	049	Злоякісні новоутворення ободової (товстої) кишки	Malignant neoplasm of colon
054	050	Злоякісні новоутворення прямої кишки	Malignant neoplasm of rectum, recto-sigmoid junction and anus
055	051	Злоякісні новоутворення інших органів травлення	Malignant neoplasm of other digestive organs
<b>056</b>		<b>45 - 51</b>	<b>Malignant neoplasm of digestive organs</b>
057	052	Злоякісні новоутворення гортані	Malignant neoplasm of larynx
058	053	Злоякісні новоутворення трахеї, бронхів, легенів	Malignant neoplasm of trachea, bronchus and lung
059	054	Злоякісні новоутворення інших органів дихання	Malignant neoplasm of other respiratory and intrathoracic organs (thyroid gland, heart and mediastinum)
<b>060</b>		<b>52 - 54</b>	<b>Malignant neoplasm of respiratory organs</b>
061	055	Злоякісні новоутворення кісток	Malignant neoplasm of bones
062	056	Злоякісні новоутворення шкіри	Malignant neoplasm of skin
063	057	Злоякісні новоутворення молочної залози	Malignant neoplasm of breast
064	058	Злоякісні новоутворення шийки матки	Malignant neoplasm of cervix uteri
065	059	Інші злоякісні новоутворення матки	Malignant neoplasm of uterus
066	060	Злоякісні новоутворення інших жіночих статевих органів	Malignant neoplasm of other and unspecified female genital organs
<b>067</b>		<b>58 - 60</b>	<b>Malignant neoplasm of female genital organs</b>
068	061	Злоякісні новоутворення передміхурової залози	Malignant neoplasm of prostate
069	062	Злоякісні новоутворення інших чоловічих статевих органів	Malignant neoplasm of other male genital organs
070	063	Злоякісні новоутворення сечових органів	Malignant neoplasm of urinary organs
071	064	Злоякісні новоутворення інших та неуточнених локалізацій	Malignant neoplasm of other and unspecified sites
072	065	Лейкемія	Leukaemia
073	066	Інші злоякісні новоутворення лімфатичної тканини	Other malignant neoplasms of lymphoid and histiocytic tissue
<b>074</b>		<b>45 - 66</b>	<b>Malignant neoplasms</b>
075	067	Доброякісні новоутворення та новоутворення неточно визначені	Benign and unspecified neoplasm
076		<b>68 - 70</b>	<b><i>Class III. Endocrine, nutritional and</i></b>

			<b>metabolic diseases</b>
077	068	Цукровий діабет	Diabetes mellitus
078	069	Хвороби інших ендокринних залоз	Diseases of other endocrinous glands
079	070	Розлад харчування	Nutritional and metabolic disorders and disorders involving the immune mechanism
<b>080</b>		<b>71, 72</b>	<b>Class IV. Diseases of the blood and blood-forming organs</b>
081	071	Анемія	Anaemia
082	072	Інші хвороби крові та кровотворних органів	Other diseases of blood and blood forming organs
<b>083</b>		<b>73 - 77</b>	<b>Class V. Mental and behavioural disorders</b>
084	073	Алкогольні психози	Alcoholic psychosis
085	074	Інші психози	Other psychosis
086	075	Алкоголізм хронічний	Chronic alcoholism
087	076	Токсикоманія	Drug dependence
088	077	Розумова відсталість	Mental retardation (oligophrenia)
<b>089</b>		<b>78 - 83</b>	<b>Class VI. Diseases of the nervous system</b>
090	078	Менінгіт	Meningitis, excluding infectious and parasitic meningitis
091	079	Розсіяний склероз	Multiple sclerosis
092	080	Інші запальні хвороби центральної нервової системи	Other inflammatory diseases of the central nervous system
093	081	Епілепсія	Epilepsy
094	082	Запалення середнього вуха і мастоїдіт	Inflammation of middle ear and mastoiditis
095	083	Інші хвороби нервової системи і органів почуттів	Other diseases of the nervous system and sense organs
<b>096</b>		<b>84 - 102</b>	<b>Class VII. Diseases of circulatory system</b>
097	084	Активний ревматизм (ревматизм в активній фазі)	Acute rheumatic fever
098	085	Хронічні ревматичні хвороби серця	Chronic rheumatic heart disease
099	086	Гіпертонічна хвороба серця	Hypertensive heart disease
100	087	Гіпертонічна хвороба нирок	Hypertensive renal disease
101	088	Гіпертонічна хвороба серця і нирок	Hypertensive heart and renal disease
102	089	Інші форми гіпертонічної хвороби	Other and unspecified hypertensive disease
103	090	Гострий інфаркт міокарду з гіпертонічною хворобою	Acute myocardial infarction with hypertensive disease
104	091	Гострий інфаркт міокарду без гіпертонічної хвороби	Acute myocardial infarction without hypertensive disease
105	092	Кардіосклероз атеросклеротичний з гіпертонічною хворобою	Atherosclerotic cardiosclerosis with hypertensive disease
106	093	Кардіосклероз атеросклеротичний без гіпертонічної хвороби	Atherosclerotic cardiosclerosis without hypertensive disease
107	094	Інші форми ішемічної хвороби серця з гіпертонічною хворобою	Other ischaemic heart diseases with hypertensive disease
108	095	Інші форми ішемічної хвороби серця без гіпертонічної хвороби	Other ischaemic heart diseases without hypertensive disease
<b>109</b>		<b>90 - 95</b>	<b>Ischaemic heart diseases</b>
110	096	Неуточнені ураження перикарду	Unspecified disorders of pericardium, mitral and aortic valves
111	097	Інші форми хвороб серця	Other heart diseases
112	098	Судинні ураження мозку з	Cerebrovascular disorders with

		гіпертонічною хворобою	hypertensive disease
<b>113</b>		<b>86 - 90, 92, 94, 98</b>	
114	099	Судинні ураження мозку без гіпертонічної хвороби	Cerebrovascular disorders without hypertensive disease
115	100	Хвороби артерій, артеріол і капілярів	Diseases of arteries, arterioles and capillaries
116	101	Флебіт, тромбофлебіт	Phlebitis and thrombophlebitis, venous embolism and thrombosis
117	102	Інші хвороби системи кровообігу	Other diseases of circulatory system
<b>118</b>		<b>103 - 114</b>	<b><i>Class VIII. Diseases of respiratory system</i></b>
119	103	Гострі респіраторні інфекції	Acute respiratory infections
120	104	Грип	Influenza
121	105	Вірусна пневмонія	Viral pneumonia
122	106	Пневмококова пневмонія	Pneumococcal pneumonia
123	107	Інші гострі пневмонії	Other acute pneumonias
<b>124</b>		<b>105 - 107</b>	<b><i>Pneumonia</i></b>
125	108	Бронхіт хронічний	Chronic bronchitis and emphysema
126	109	Бронхіальна астма	Asthma
127	110	Бронхоектатична хвороба	Bronchiectasis and other obstructive pulmonary diseases
128	111	Пневмоконіози та інші легеневі хвороби	Pneumoconiosis and other lung diseases due to external agents
129	112	Емпієма, абсцес легенів та середостіння	Empyema, lung or mediastinal abscess
130	113	Застойні та гіпостатичні хвороби легенів	Pulmonary congestion and hypostasis, post inflammatory fibrosis
131	114	Інші хвороби органів дихання	Other diseases of respiratory system
<b>132</b>		<b>115 - 127</b>	<b><i>Class IX. Diseases of digestive system</i></b>
133	115	Виразка шлунку	Gastric ulcer
134	116	Виразка дванадцятипалої кишки	Duodenal ulcer and digestive ulcer of unspecified site
135	117	Гастрит і дуоденіт	Gastritis and duodenitis
136	118	Апендицит	Appendicitis
137	119	Грижа очеревинної порожнини	Hernia of abdominal cavity
138	120	Неінфекційний ентерит і коліт	Non-infectious enteritis and colitis
139	121	Непрохідність кишечника без згадування про грижу	Intestinal obstruction without mention of hernia
140	122	Алкогольний цироз печінки	Alcoholic cirrhosis of liver
141	123	Інші цирози печінки	Other cirrhosis of liver
142	124	Жовчокам'яна хвороба і холецистит	Gallstone diseases and cholecystitis
143	125	Інші хвороби печінки та жовчних шляхів	Other diseases of liver and biliary tract
144	126	Хвороби підшлункової залози	Diseases of pancreas
145	127	Інші хвороби органів травлення	Other diseases of digestive system
<b>146</b>		<b>128 - 134</b>	<b><i>Class X. Diseases of the genitourinary system</i></b>
147	128	Гострий нефрит і гломерулонефрит	Acute nephritis and glomerulonephritis
148	129	Інші нефрити і нефрози	Other nephritis and nephrosis, nephrotic syndrome
149	130	Інфекції нирок	Infections of kidney
150	131	Камні сечових шляхів	Calculus of urinary tract
151	132	Інші хвороби системи сечовиділення	Other diseases of urinary system
152	133	Гіперплазія передміхурової залози	Hyperplasia of prostate

153	134	Інші хвороби статевих органів	Other diseases of genital organs
<b>154</b>		<b>135 - 141</b>	<b><i>Class XI. Complications of pregnancy, childbirth and the puerperium</i></b>
155	135	Позаматкова вагітність	Ectopic pregnancy
156	136	Штучний медичинський аборт	Legally induced abortion
157	137	Аборти позалікувальної установи	Abortion started out of the hospital and unspecified
158	138	Кровотеча при вагітності та пологах	Haemorrhage in pregnancy and childbirth
159	139	Токсикози вагітності	Toxaemia in pregnancy
160	140	Сепсис під час пологів	Septicaemia in childbirth and the puerperium
161	141	Інші ускладнення вагітності, пологів	Other complications of pregnancy, childbirth and the puerperium
<b>162</b>	<b>142</b>	<b>Хвороби шкіри</b>	<b><i>Class XII. Diseases of the skin</i></b>
<b>163</b>		<b>143, 144</b>	<b><i>Class XIII. Diseases of the musculoskeletal system</i></b>
164	143	Остеомієліт і періостит	Osteomyelitis and periostitis
165	144	Інші хвороби кістково-м'язової системи	Other diseases of musculoskeletal system and connective tissue
<b>166</b>		<b>145 - 150</b>	<b><i>Class XIV. Congenital malformations, deformations and chromosomal abnormalities</i></b>
167	145	Spina bifida і вроджена гідроцефалія	Spina bifida and congenital hydrocephalus
168	146	Інші вроджені аномалії центральної нервової системи	Other congenital anomalies of central nervous system
169	147	Вроджені аномалії серця	Congenital anomalies of heart
170	148	Інші вроджені аномалії системи кровообігу	Other congenital anomalies of circulatory system
171	149	Вроджені аномалії органів травлення	Congenital anomalies of digestive organs
172	150	Інші вроджені аномалії	Other congenital anomalies
<b>173</b>		<b>151 - 157</b>	<b><i>Class XV. Certain conditions originating in the perinatal period</i></b>
174	151	Пологова травма	Birth trauma
175	152	Внутрішньоматочна гіпоксія і асфіксія	Intrauterine hypoxia and birth asphyxia
176	153	Вроджена і аспіраційна пневмонія	Congenital pneumonia and pneumonia due to aspiration
177	154	Інший респіраторний стан	Other respiratory conditions
178	155	Гемолітична хвороба	Haemolytic disease and other perinatal jaundices
179	156	Сепсис	Septicaemia
180	157	Інші причини перинатальної смертності	Other conditions originating in the perinatal period
<b>181</b>		<b>158, 159</b>	<b><i>Class XVI. Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified</i></b>
182	158	Старість без згадування про психоз	Senility without mention of psychosis
183	159	Симптоми та інші недостатньо позначені стани	Symptoms and other unspecified conditions

<b>184</b>		<b>160 - 176</b>	<b><i>Class XVII. External causes of morbidity and mortality</i></b>
185	160	Нещасні випадки, що пов'язані з мототранспортом	Motor vehicle traffic accident
186	161	Нещасні випадки, що пов'язані з автомо- транспортом на дорозі або наїзді на пішохода	Motor vehicle traffic accident involving collision with pedestrian
187	162	Нещасні випадки, що пов'язані з іншими транспортними засобами	Other transport accidents
188	163	Випадкові отруєння алкоголем	Accidental poisoning by alcohol
189	164	Інші випадкові отруєння	Other accidental poisoning
190	165	Нещасні випадки під час лікування	Misadventures to patients during medical care
191	166	Випадкові падіння	Accidental falls
192	167	Нещасні випадки, викли- кані вогнем та полум'ям	Accident caused by fire
193	168	Випадкове утоплення	Accidental drowning and submersion
194	169	Випадкове механічне задушення	Accidental inhalation and ingestion causing obstruction of respiratory tract, foreign body entering other orifices
195	170	Нещасні випадки викликані вогнепальною зброєю	Accident caused by firearm missile
196	171	Нещасні випадки, виклика- ні електричним струмом	Accident caused by electric current
197	172	Всі інші нещасні випадки	Other accidents
198	173	Самогубства	Suicide and self-inflicted injury
199	174	Вбивства	Homicide and injury purposely inflicted by other persons, including legal execution
200	175	Пошкодження без уточнення	Injury undetermined whether accidentally or purposely inflicted
201	176	Голодування (виснаження)	Hunger
<b>202</b>		<b>Всього вимерлих від усіх причин (1 - 176, 206)</b>	<b>Total deaths</b>
203	176a	на основі розтину	Based on autopsy
204	176b	за станом алкогольного сп'яніння	Under alcohol poisoning
<b>205</b>		<b>186 - 195</b>	<b><i>Class XVII. External causes of morbidity and mortality</i></b>
206	186	Переломи кісток черепа	Fracture of skull
207	187	Переломи хребта та кісток тулуба	Fracture of vertebral column with spinal cord injury
208	188	Переломи кінцівок	Fracture of limb
209	189	Внутрішньочерепні травми	Intracranial injury
210	190	Травми внутрішніх органів	Trauma of internal organs
211	191	Відкриті рани	Open wound
212	192	Наслідки проникнення інородних тіл	Effects of foreign body entering through orifice
213	193	Опіки	Burns
214	194	Несприятлива реакція на речовини	Toxic effects of substances
215	195	Всі інші та неуточнені нещасні випадки	Other and unspecified effects of external causes
216	196	Субарахноїдальний крововилив з гіпертонічною хворобою	Subarachnoid hemorrhage with mention of hypertension
217	197	Субарахноїдальний крововилив без гіпертонічної хвороби	Subarachnoid hemorrhage without mention of hypertension
218	198	Внутрішньомозковий крововилив з	Intracerebral hemorrhage with mention

		гіпертонічною хворобою	of hypertension
219	199	Внутрішньомозковий крововилив без гіпертонічної хвороби	Intracerebral hemorrhage without mention of hypertension
220	200	Закупорка мозкових артерій з гіпертонічною хворобою	Occlusion and stenosis of precerebral arteries with mention of hypertension
221	201	Закупорка мозкових артерій без гіпертонічної хвороби	Occlusion and stenosis of precerebral arteries without mention of hypertension
222	202	Гострі, але неточно визначені цереброваскулярні хвороби з гіпертонічною хворобою	Acute, but ill-defined, cerebrovascular disease with mention of hypertension
223	203	Гострі, але неточно визначені цереброваскулярні хвороби без гіпертонічної хвороби	Acute, but ill-defined, cerebrovascular disease without mention of hypertension
224	204	Церебральний атеросклероз з гіпертонічною хворобою	Cerebral atherosclerosis with mention of hypertension
225	205	Церебральний атеросклероз без гіпертонічної хвороби	Cerebral atherosclerosis without mention of hypertension
226	207	Злоякісні новоутворення губи	Malignant neoplasm of lip
227	208	Злоякісні новоутворення ротової порожнини	Malignant neoplasm of oral cavity
228	209	Злоякісні новоутворення глотки	Malignant neoplasm of pharynx
229	210	Злоякісні новоутворення стравоходу	Malignant neoplasm of oesophagus
230	211	Злоякісні новоутворення шлунку	Malignant neoplasm of stomach
231	212	Злоякісні новоутворення тонкого кишечника	Malignant neoplasm of small intestine, including duodenum
232	213	Злоякісні новоутворення ободової (товстої) кишки	Malignant neoplasm of colon
233	214	Злоякісні новоутворення прямої кишки	Malignant neoplasm of rectum, recto-sigmoid junction and anus
234	215	Злоякісні новоутворення печінки	Malignant neoplasm of liver
235	216	Злоякісні новоутворення жовчного міхура	Malignant neoplasm of gallbladder
236	217	Злоякісні новоутворення підшлункової залози	Malignant neoplasm of pancreas
237	218	Злоякісні новоутворення інших органів травлення та черевині	Malignant neoplasm of other digestive organs
238	219	Злоякісні новоутворення гортані	Malignant neoplasm of larynx
239	220	Злоякісні новоутворення трахеї, бронхів, легенів	Malignant neoplasm of trachea, bronchus and lung
240	221	Злоякісні новоутворення інших органів дихання	Malignant neoplasm of other respiratory organs
241	222	Злоякісні новоутворення кісток та суглобових хрящів	Malignant neoplasm of bones and articular cartilage
242	223	Злоякісні новоутворення інших м'яких тканин	Malignant neoplasm of other connective tissue
243	224	Злоякісна меланома шкіри	Malignant neoplasm of skin
244	225	Інші злоякісні новоутворення шкіри	Other malignant neoplasm of skin
245	226	Злоякісне новоутворення молочної залози	Malignant neoplasm of breast
246	227	Злоякісне новоутворення шийки матки	Malignant neoplasm of cervix uteri
247	228	Злоякісне новоутворення плаценти	Malignant neoplasm of placenta
248	229	Злоякісне новоутворення тіла матки	Malignant neoplasm of uterus
249	230	Інші злоякісні новоутворення матки	Other malignant neoplasm of uterus
250	231	Злоякісні новоутворення яєчника	Malignant neoplasm of ovary
251	232	Злоякісне новоутворення інших	Malignant neoplasm of other and



		жіночих статевих органів	unspecified female genital organs
252	233	Злоякісні новоутворення передміхурової залози	Malignant neoplasm of prostate
253	234	Злоякісні новоутворення інших чоловічих статевих органів	Malignant neoplasm of other male genital organs
254	235	Злоякісні новоутворення сечового міхура	Malignant neoplasm of urinary organs
255	236	Злоякісні новоутворення нирки	Malignant neoplasm of kidney
256	237	Злоякісне новоутворення інших сечових органів	Malignant neoplasm of other and unspecified sites
257	238	Злоякісні новоутворення ока	Malignant neoplasm of kidney
258	239	Злоякісні новоутворення головного мозку	Malignant neoplasm of brain
259	240	Злоякісне новоутворення інших відділів нервової системи	Malignant neoplasm of other and unspecified parts of nervous system
260	241	Злоякісні новоутворення щитовидної залози	Malignant neoplasm of thyroid gland
261	242	Злоякісні новоутворення інших ендокринних залоз	Malignant neoplasm of other endocrine glands and related structures
262	243	Злоякісні новоутворення інших локалізацій	Malignant neoplasm of other and ill-defined sites
263	244	Лімфосаркома, ретикулосаркома, інші злоякісні новоутворення лімфоїдної гистіоцитарної тканини	Lymphosarcoma and reticulosarcoma and other malignant neoplasms of lymphoid and histiocytic tissue
264	245	Лімфогрануломатоз	lymphogranulomatosis
265	246	Множинна мієлома та імунопроліферативні новоутворення	Multiple myeloma and immunoproliferative neoplasms
266	247	Лімфолейкоз	Lymphoid leukemia
267	248	Мієлолейкоз	Myeloid leukemia
268	249	Моноцитарний лейкоз	Monocytic leukemia
269	250	Інші уточнені та не уточнені лейкози	Other specified and unspecified leukemia

Annex F. Classification of diseases according to Ukrainian Classification of 1994 (ICD9), data available for regions

Row № рядка	Code in C8	Причини смерті	Causes of death
<b>001</b>		<b>1 - 44, 206</b>	<b><i>Class I. Certain infectious and parasitic diseases</i></b>
002	001	Холера	Cholera
003	002	Черевний тиф	Typhoid fever
004	003	Паратифи	Paratyphoid fever
005	004	Інші сальмонельозні інфекції	Other salmonella infections
006	005	Шигельоз (дизентерія)	Shigellosis (dysentery)
007	006	Харчові отруєння (бактеріальні), за винятком сальмонельозу	Bacterial food borne intoxications excluding salmonella infections
008	007	Кишкові інфекції, що визвані іншими збудниками, включаючи амебіаз та інші протозойні кишкові хвороби	Intestinal infections due to other micro-organisms including amoebiasis and other protozoal intestinal diseases
009	008	Гострі кишкові інфекції	Acute intestinal infections due to unspecified micro-organisms and ill-defined, including toxic dyspepsia
010	009	Туберкульоз органів дихання	Respiratory tuberculosis
011	010	Туберкульоз оболонок мозку та центральної нервової системи	Tuberculosis of nervous system
012	011	Туберкульоз кишечника	Tuberculosis of intestines, peritoneum and mesenteric glands
013	012	Туберкульоз кісток та суглобів	Tuberculosis of bones and joints
014	013	Інші форми туберкульозу	Other tuberculosis excluding late effects
<b>015</b>		<b>9 - 13</b>	<b>Tuberculosis</b>
016	014	Чума	Plague
017	015	Сибірська виразка	Anthrax (Siberian ulcer)
018	016	Бруцельоз	Brucellosis
019	017	Лепра (проказа)	Leprosy
020	018	Дифтерія	Diphtheria
021	019	Коклюш (кашлюк)	Whooping cough
022	020	Стрептококова ангіна	Streptococcal sore throat
023	021	Скарлатина	Scarlet fever
024	022	Бешиха (рожа)	Erysipelas
025	023	Менінгококова інфекція	Meningococcal infection
026	024	Стовбняк (правець)	Tetanus
027	025	Септицемія	Septicaemia
028	026	Інші бактеріальні інфекції	Other bacterial infections excluding foodborne intoxications
029	027	Гострий поліомієліт	Acute poliomyelitis
030	028	Кір	Measles
031	029	Вірусний енцефаліт	Viral encephalitis
032	030	Вірусний гепатит (хвороба Боткіна)	Viral hepatitis
033	031	Сказ	Rabies
034	032	Інші хвороби, що визвані вірусами	Other viral diseases
035	033	Сипний тиф (епідемічний)	Epidemic louse-borne typhus fever
036	034	Інші рикеттсіози	Other rickettsioses
037	035	Малярія	Malaria
038	036	Поворотний тиф	Relapsing fever
039	037	Сифіліс (всі форми)	Syphilis (all forms)
040	038	Інші інфекційні хвороби	Other infectious diseases
041	039	Ехінококкоз	Echinococcosis
042	040	Філяріатози та дракункульоз	Filarial infection and dracunculiasis

043	041	Інші гельмінтози	Other helminthiasis
044	042	Інші паразитарні хвороби	Other parasitic diseases
045	043	Віддалені наслідки туберкульозу	Late effects of tuberculosis
046	044	Віддалені наслідки інших інфекційних хвороб	Late effects of other infectious and parasitic diseases , including late effects of poliomyelitis
047	206	СНІД	AIDS
<b>048</b>		<b>45 - 67</b>	<b><i>Class II. Neoplasms</i></b>
049	045	Злоякісні новоутворення губи, порожнини рота та глотки	Malignant neoplasm of lip, oral cavity and pharynx
050	046	Злоякісні новоутворення стравоходу	Malignant neoplasm of oesophagus
051	047	Злоякісні новоутворення шлунку	Malignant neoplasm of stomach
052	048	Злоякісні новоутворення тонкого кишечника	Malignant neoplasm of small intestine, including duodenum
053	049	Злоякісні новоутворення ободової (товстої) кишки	Malignant neoplasm of colon
054	050	Злоякісні новоутворення прямої кишки	Malignant neoplasm of rectum, recto-sigmoid junction and anus
055	051	Злоякісні новоутворення інших органів травлення	Malignant neoplasm of other digestive organs
<b>056</b>		<b>45 - 51</b>	<b>Malignant neoplasm of digestive organs</b>
057	052	Злоякісні новоутворення гортані	Malignant neoplasm of larynx
058	053	Злоякісні новоутворення трахеї, бронхів, легенів	Malignant neoplasm of trachea, bronchus and lung
059	054	Злоякісні новоутворення інших органів дихання	Malignant neoplasm of other respiratory and intrathoracic organs (thyroid gland, heart and mediastinum)
<b>060</b>		<b>52 - 54</b>	<b>Malignant neoplasm of respiratory organs</b>
061	055	Злоякісні новоутворення кісток	Malignant neoplasm of bones
062	056	Злоякісні новоутворення шкіри	Malignant neoplasm of skin
063	057	Злоякісні новоутворення молочної залози	Malignant neoplasm of breast
064	058	Злоякісні новоутворення шийки матки	Malignant neoplasm of cervix uteri
065	059	Інші злоякісні новоутворення матки	Malignant neoplasm of uterus
066	060	Злоякісні новоутворення інших жіночих статевих органів	Malignant neoplasm of other and unspecified female genital organs
<b>067</b>		<b>58 - 60</b>	<b>Malignant neoplasm of female genital organs</b>
068	061	Злоякісні новоутворення передміхурової залози	Malignant neoplasm of prostate
069	062	Злоякісні новоутворення інших чоловічих статевих органів	Malignant neoplasm of other male genital organs
070	063	Злоякісні новоутворення сечових органів	Malignant neoplasm of urinary organs
071	064	Злоякісні новоутворення інших та неуточнених локалізацій	Malignant neoplasm of other and unspecified sites
072	065	Лейкемія	Leukaemia
073	066	Інші злоякісні новоутворення лімфатичної тканини	Other malignant neoplasms of lymphoid and histiocytic tissue
<b>074</b>		<b>45 - 66</b>	<b>Malignant neoplasms</b>
075	067	Доброякісні новоутворення та новоутворення неточно визначені	Benign and unspecified neoplasm
<b>076</b>		<b>68 - 70</b>	<b><i>Class III. Endocrine, nutritional and</i></b>

			<b>metabolic diseases</b>
077	068	Цукровий діабет	Diabetes mellitus
078	069	Хвороби інших ендокринних залоз	Diseases of other endocrinous glands
079	070	Розлад харчування	Nutritional and metabolic disorders and disorders involving the immune mechanism
<b>080</b>		<b>71, 72</b>	<b>Class IV. Diseases of the blood and blood-forming organs</b>
081	071	Анемія	Anaemia
082	072	Інші хвороби крові та кровотворних органів	Other diseases of blood and blood forming organs
<b>083</b>		<b>73 - 77</b>	<b>Class V. Mental and behavioural disorders</b>
084	073	Алкогольні психози	Alcoholic psychosis
085	074	Інші психози	Other psychosis
086	075	Алкоголізм хронічний	Chronic alcoholism
087	076	Токсикоманія	Drug dependence
088	077	Розумова відсталість	Mental retardation (oligophrenia)
<b>089</b>		<b>78 - 83</b>	<b>Class VI. Diseases of the nervous system</b>
090	078	Менінгіт	Meningitis, excluding infectious and parasitic meningitis
091	079	Розсіяний склероз	Multiple sclerosis
092	080	Інші запальні хвороби центральної нервової системи	Other inflammatory diseases of the central nervous system
093	081	Епілепсія	Epilepsy
094	082	Запалення середнього вуха і мастоїдіт	Inflammation of middle ear and mastoiditis
095	083	Інші хвороби нервової системи і органів почуттів	Other diseases of the nervous system and sense organs
<b>096</b>		<b>84 - 102</b>	<b>Class VII. Diseases of circulatory system</b>
097	084	Активний ревматизм (ревматизм в активній фазі)	Acute rheumatic fever
098	085	Хронічні ревматичні хвороби серця	Chronic rheumatic heart disease
099	086	Гіпертонічна хвороба серця	Hypertensive heart disease
100	087	Гіпертонічна хвороба нирок	Hypertensive renal disease
101	088	Гіпертонічна хвороба серця і нирок	Hypertensive heart and renal disease
102	089	Інші форми гіпертонічної хвороби	Other and unspecified hypertensive disease
103	090	Гострий інфаркт міокарду з гіпертонічною хворобою	Acute myocardial infarction with hypertensive disease
104	091	Гострий інфаркт міокарду без гіпертонічної хвороби	Acute myocardial infarction without hypertensive disease
105	092	Кардіосклероз атеросклеротичний з гіпертонічною хворобою	Atherosclerotic cardiosclerosis with hypertensive disease
106	093	Кардіосклероз атеросклеротичний без гіпертонічної хвороби	Atherosclerotic cardiosclerosis without hypertensive disease
107	094	Інші форми ішемічної хвороби серця з гіпертонічною хворобою	Other ischaemic heart diseases with hypertensive disease
108	095	Інші форми ішемічної хвороби серця без гіпертонічної хвороби	Other ischaemic heart diseases without hypertensive disease
<b>109</b>		<b>90 - 95</b>	<b>Ischaemic heart diseases</b>
110	096	Неуточнені ураження перикарду	Unspecified disorders of pericardium, mitral and aortic valves
111	097	Інші форми хвороб серця	Other heart diseases
112	098	Судинні ураження мозку з	Cerebrovascular disorders with

		гіпертонічною хворобою	hypertensive disease
<b>113</b>		<b>86 - 90, 92, 94, 98</b>	
114	099	Судинні ураження мозку без гіпертонічної хвороби	Cerebrovascular disorders without hypertensive disease
115	100	Хвороби артерій, артеріол і капілярів	Diseases of arteries, arterioles and capillaries
116	101	Флебіт, тромбофлебіт	Phlebitis and thrombophlebitis, venous embolism and thrombosis
117	102	Інші хвороби системи кровообігу	Other diseases of circulatory system
<b>118</b>		<b>103 - 114</b>	<b><i>Class VIII. Diseases of respiratory system</i></b>
119	103	Гострі респіраторні інфекції	Acute respiratory infections
120	104	Грип	Influenza
121	105	Вірусна пневмонія	Viral pneumonia
122	106	Пневмококова пневмонія	Pneumococcal pneumonia
123	107	Інші гострі пневмонії	Other acute pneumonias
<b>124</b>		<b>105 - 107</b>	<b><i>Pneumonia</i></b>
125	108	Бронхіт хронічний	Chronic bronchitis and emphysema
126	109	Бронхіальна астма	Asthma
127	110	Бронхоектатична хвороба	Bronchiectasis and other obstructive pulmonary diseases
128	111	Пневмоконіози та інші легеневі хвороби	Pneumoconiosis and other lung diseases due to external agents
129	112	Емпієма, абсцес легенів та середостіння	Empyema, lung or mediastinal abscess
130	113	Застойні та гіпостатичні хвороби легенів	Pulmonary congestion and hypostasis, post inflammatory fibrosis
131	114	Інші хвороби органів дихання	Other diseases of respiratory system
<b>132</b>		<b>115 - 127</b>	<b><i>Class IX. Diseases of digestive system</i></b>
133	115	Виразка шлунку	Gastric ulcer
134	116	Виразка дванадцятипалої кишки	Duodenal ulcer and digestive ulcer of unspecified site
135	117	Гастрит і дуоденіт	Gastritis and duodenitis
136	118	Апендицит	Appendicitis
137	119	Грижа очеревинної порожнини	Hernia of abdominal cavity
138	120	Неінфекційний ентерит і коліт	Non-infectious enteritis and colitis
139	121	Непрохідність кишечника без згадування про грижу	Intestinal obstruction without mention of hernia
140	122	Алкогольний цироз печінки	Alcoholic cirrhosis of liver
141	123	Інші цирози печінки	Other cirrhosis of liver
142	124	Жовчокам'яна хвороба і холецистит	Gallstone diseases and cholecystitis
143	125	Інші хвороби печінки та жовчних шляхів	Other diseases of liver and biliary tract
144	126	Хвороби підшлункової залози	Diseases of pancreas
145	127	Інші хвороби органів травлення	Other diseases of digestive system
<b>146</b>		<b>128 - 134</b>	<b><i>Class X. Diseases of the genitourinary system</i></b>
147	128	Гострий нефрит і гломерулонефрит	Acute nephritis and glomerulonephritis
148	129	Інші нефрити і нефрози	Other nephritis and nephrosis, nephrotic syndrome
149	130	Інфекції нирок	Infections of kidney
150	131	Камні сечових шляхів	Calculus of urinary tract
151	132	Інші хвороби системи сечовиділення	Other diseases of urinary system
152	133	Гіперплазія передміхурової залози	Hyperplasia of prostate

153	134	Інші хвороби статевих органів	Other diseases of genital organs
<b>154</b>		<b>135 - 141</b>	<b><i>Class XI. Complications of pregnancy, childbirth and the puerperium</i></b>
155	135	Позаматкова вагітність	Ectopic pregnancy
156	136	Штучний медичинський аборт	Legally induced abortion
157	137	Аборти позалікувальної установи	Abortion started out of the hospital and unspecified
158	138	Кровотеча при вагітності та пологах	Haemorrhage in pregnancy and childbirth
159	139	Токсикози вагітності	Toxaemia in pregnancy
160	140	Сепсис під час пологів	Septicaemia in childbirth and the puerperium
161	141	Інші ускладнення вагітності, пологів	Other complications of pregnancy, childbirth and the puerperium
<b>162</b>	<b>142</b>	<b>Хвороби шкіри</b>	<b><i>Class XII. Diseases of the skin</i></b>
<b>163</b>		<b>143, 144</b>	<b><i>Class XIII. Diseases of the musculoskeletal system</i></b>
164	143	Остеомієліт і періостит	Osteomyelitis and periostitis
165	144	Інші хвороби кістково-м'язової системи	Other diseases of musculoskeletal system and connective tissue
<b>166</b>		<b>145 - 150</b>	<b><i>Class XIV. Congenital malformations, deformations and chromosomal abnormalities</i></b>
167	145	Spina bifida і вроджена гідроцефалія	Spina bifida and congenital hydrocephalus
168	146	Інші вроджені аномалії центральної нервової системи	Other congenital anomalies of central nervous system
169	147	Вроджені аномалії серця	Congenital anomalies of heart
170	148	Інші вроджені аномалії системи кровообігу	Other congenital anomalies of circulatory system
171	149	Вроджені аномалії органів травлення	Congenital anomalies of digestive organs
172	150	Інші вроджені аномалії	Other congenital anomalies
<b>173</b>		<b>151 - 157</b>	<b><i>Class XV. Certain conditions originating in the perinatal period</i></b>
174	151	Пологова травма	Birth trauma
175	152	Внутрішньоматочна гіпоксія і асфіксія	Intrauterine hypoxia and birth asphyxia
176	153	Вроджена і аспіраційна пневмонія	Congenital pneumonia and pneumonia due to aspiration
177	154	Інший респіраторний стан	Other respiratory conditions
178	155	Гемолітична хвороба	Haemolytic disease and other perinatal jaundices
179	156	Сепсис	Septicaemia
180	157	Інші причини перинатальної смертності	Other conditions originating in the perinatal period
<b>181</b>		<b>158, 159</b>	<b><i>Class XVI. Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified</i></b>
182	158	Старість без згадування про психоз	Senility without mention of psychosis
183	159	Симптоми та інші недостатньо позначені стани	Symptoms and other unspecified conditions

<b>184</b>		<b>160 - 176</b>	<b><i>Class XVII. External causes of morbidity and mortality</i></b>
185	160	Нещасні випадки, що пов'язані з мототранспортом	Motor vehicle traffic accident
186	161	Нещасні випадки, що пов'язані з автомо- транспортом на дорозі або наїзді на пішохода	Motor vehicle traffic accident involving collision with pedestrian
187	162	Нещасні випадки, що пов'язані з іншими транспортними засобами	Other transport accidents
188	163	Випадкові отруєння алкоголем	Accidental poisoning by alcohol
189	164	Інші випадкові отруєння	Other accidental poisoning
190	165	Нещасні випадки під час лікування	Misadventures to patients during medical care
191	166	Випадкові падіння	Accidental falls
192	167	Нещасні випадки, викли- кані вогнем та полум'ям	Accident caused by fire
193	168	Випадкове утоплення	Accidental drowning and submersion
194	169	Випадкове механічне задушення	Accidental inhalation and ingestion causing obstruction of respiratory tract, foreign body entering other orifices
195	170	Нещасні випадки викликані вогнепальною зброєю	Accident caused by firearm missile
196	171	Нещасні випадки, виклика- ні електричним струмом	Accident caused by electric current
197	172	Всі інші нещасні випадки	Other accidents
198	173	Самогубства	Suicide and self-inflicted injury
199	174	Вбивства	Homicide and injury purposely inflicted by other persons, including legal execution
200	175	Пошкодження без уточнення	Injury undetermined whether accidentally or purposely inflicted
201	176	Голодування (виснаження)	Hunger
<b>202</b>		<b>Всього вимерлих від усіх причин (1 - 176, 206)</b>	<b>Total deaths</b>
203	176a	на основі розтину	Based on autopsy
204	176b	за станом алкогольного сп'яніння	Under alcohol poisoning
<b>205</b>		<b>186 - 195</b>	<b><i>Class XVII. External causes of morbidity and mortality</i></b>
206	186	Переломи кісток черепа	Fracture of skull
207	187	Переломи хребта та кісток тулуба	Fracture of vertebral column with spinal cord injury
208	188	Переломи кінцівок	Fracture of limb
209	189	Внутрішньочерепні травми	Intracranial injury
210	190	Травми внутрішніх органів	Trauma of internal organs
211	191	Відкриті рани	Open wound
212	192	Наслідки проникнення інородних тіл	Effects of foreign body entering through orifice
213	193	Опіки	Burns
214	194	Несприятлива реакція на речовини	Toxic effects of substances
215	195	Всі інші та неуточнені нещасні випадки	Other and unspecified effects of external causes
216	196	Субарахноїдальний крововилив з гіпертонічною хворобою	Subarachnoid hemorrhage with mention of hypertension
217	197	Субарахноїдальний крововилив без гіпертонічної хвороби	Subarachnoid hemorrhage without mention of hypertension
218	198	Внутрішньомозковий крововилив з	Intracerebral hemorrhage with mention

		гіпертонічною хворобою	of hypertension
219	199	Внутрішньомозковий крововилив без гіпертонічної хвороби	Intracerebral hemorrhage without mention of hypertension
220	200	Закупорка мозкових артерій з гіпертонічною хворобою	Occlusion and stenosis of precerebral arteries with mention of hypertension
221	201	Закупорка мозкових артерій без гіпертонічної хвороби	Occlusion and stenosis of precerebral arteries without mention of hypertension
222	202	Гострі, але неточно визначені цереброваскулярні хвороби з гіпертонічною хворобою	Acute, but ill-defined, cerebrovascular disease with mention of hypertension
223	203	Гострі, але неточно визначені цереброваскулярні хвороби без гіпертонічної хвороби	Acute, but ill-defined, cerebrovascular disease without mention of hypertension
224	204	Церебральний атеросклероз з гіпертонічною хворобою	Cerebral atherosclerosis with mention of hypertension
225	205	Церебральний атеросклероз без гіпертонічної хвороби	Cerebral atherosclerosis without mention of hypertension
226	207	Злоякісні новоутворення губи	Malignant neoplasm of lip
227	208	Злоякісні новоутворення ротової порожнини	Malignant neoplasm of oral cavity
228	209	Злоякісні новоутворення глотки	Malignant neoplasm of pharynx
229	210	Злоякісні новоутворення стравоходу	Malignant neoplasm of oesophagus
230	211	Злоякісні новоутворення шлунку	Malignant neoplasm of stomach
231	212	Злоякісні новоутворення тонкого кишечника	Malignant neoplasm of small intestine, including duodenum
232	213	Злоякісні новоутворення ободової (товстої) кишки	Malignant neoplasm of colon
233	214	Злоякісні новоутворення прямої кишки	Malignant neoplasm of rectum, recto-sigmoid junction and anus
234	215	Злоякісні новоутворення печінки	Malignant neoplasm of liver
235	216	Злоякісні новоутворення жовчного міхура	Malignant neoplasm of gallbladder
236	217	Злоякісні новоутворення підшлункової залози	Malignant neoplasm of pancreas
237	218	Злоякісні новоутворення інших органів травлення та черевині	Malignant neoplasm of other digestive organs
238	219	Злоякісні новоутворення гортані	Malignant neoplasm of larynx
239	220	Злоякісні новоутворення трахеї, бронхів, легенів	Malignant neoplasm of trachea, bronchus and lung
240	221	Злоякісні новоутворення інших органів дихання	Malignant neoplasm of other respiratory organs
241	222	Злоякісні новоутворення кісток та суглобових хрящів	Malignant neoplasm of bones and articular cartilage
242	223	Злоякісні новоутворення інших м'яких тканин	Malignant neoplasm of other connective tissue
243	224	Злоякісна меланома шкіри	Malignant neoplasm of skin
244	225	Інші злоякісні новоутворення шкіри	Other malignant neoplasm of skin
245	226	Злоякісне новоутворення молочної залози	Malignant neoplasm of breast
246	227	Злоякісне новоутворення шийки матки	Malignant neoplasm of cervix uteri
247	228	Злоякісне новоутворення плаценти	Malignant neoplasm of placenta
248	229	Злоякісне новоутворення тіла матки	Malignant neoplasm of uterus
249	230	Інші злоякісні новоутворення матки	Other malignant neoplasm of uterus
250	231	Злоякісні новоутворення яєчника	Malignant neoplasm of ovary
251	232	Злоякісне новоутворення інших	Malignant neoplasm of other and



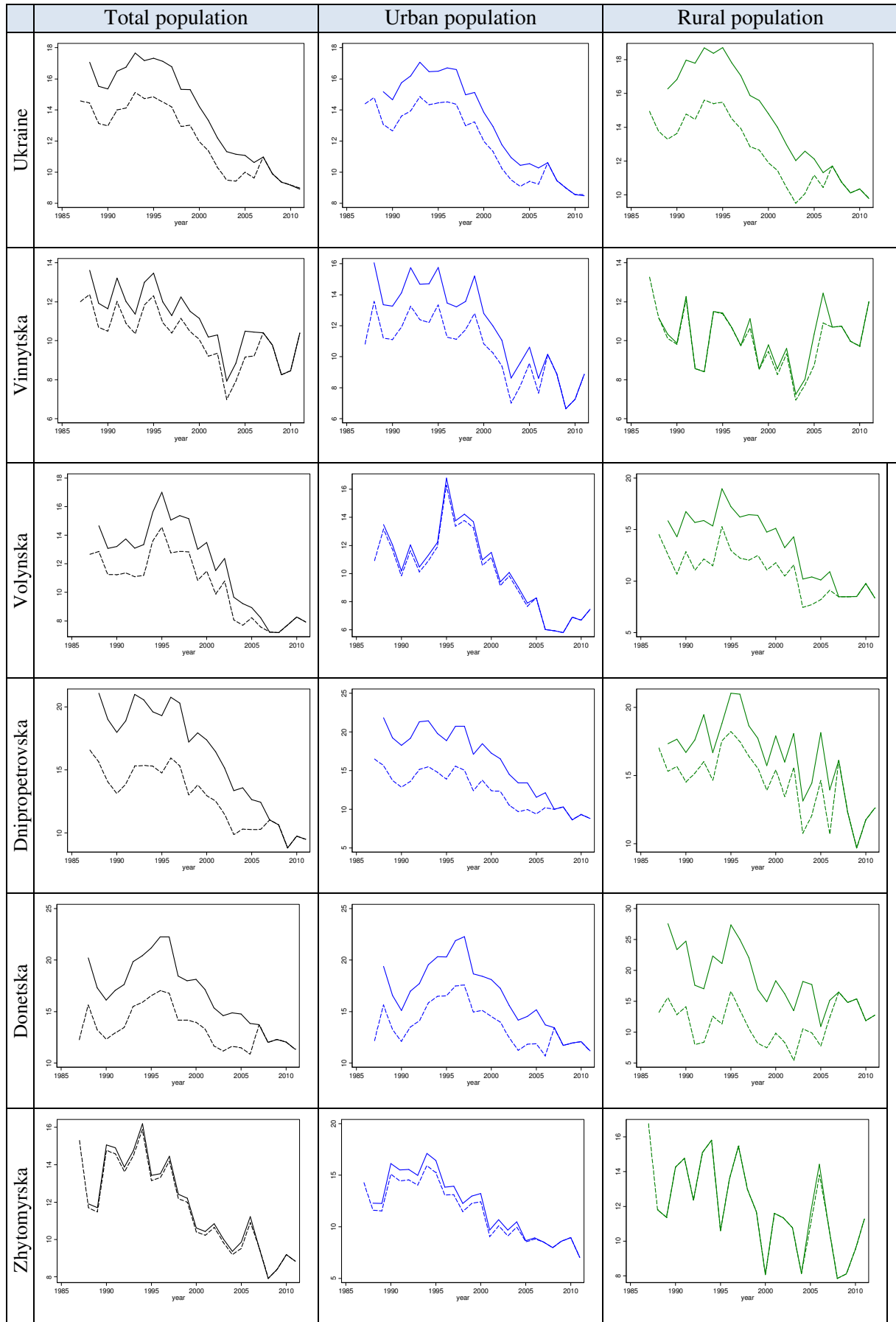
		жіночих статевих органів	unspecified female genital organs
252	233	Злоякісні новоутворення передміхурової залози	Malignant neoplasm of prostate
253	234	Злоякісні новоутворення інших чоловічих статевих органів	Malignant neoplasm of other male genital organs
254	235	Злоякісні новоутворення сечового міхура	Malignant neoplasm of urinary organs
255	236	Злоякісні новоутворення нирки	Malignant neoplasm of kidney
256	237	Злоякісне новоутворення інших сечових органів	Malignant neoplasm of other and unspecified sites
257	238	Злоякісні новоутворення ока	Malignant neoplasm of kidney
258	239	Злоякісні новоутворення головного мозку	Malignant neoplasm of brain
259	240	Злоякісне новоутворення інших відділів нервової системи	Malignant neoplasm of other and unspecified parts of nervous system
260	241	Злоякісні новоутворення щитовидної залози	Malignant neoplasm of thyroid gland
261	242	Злоякісні новоутворення інших ендокринних залоз	Malignant neoplasm of other endocrine glands and related structures
262	243	Злоякісні новоутворення інших локалізацій	Malignant neoplasm of other and ill-defined sites
263	244	Лімфосаркома, ретикулосаркома, інші злоякісні новоутворення лімфоїдної гистіоцитарної тканини	Lymphosarcoma and reticulosarcoma and other malignant neoplasms of lymphoid and histiocytic tissue
264	245	Лімфогрануломатоз	lymphogranulomatosis
265	246	Множинна мієлова та імунопроліферативні новоутворення	Multiple myeloma and immunoproliferative neoplasms
266	247	Лімфолейкоз	Lymphoid leukemia
267	248	Мієлолейкоз	Myeloid leukemia
268	249	Моноцитарний лейкоз	Monocytic leukemia
269	250	Інші уточнені та не уточнені лейкози	Other specified and unspecified leukemia

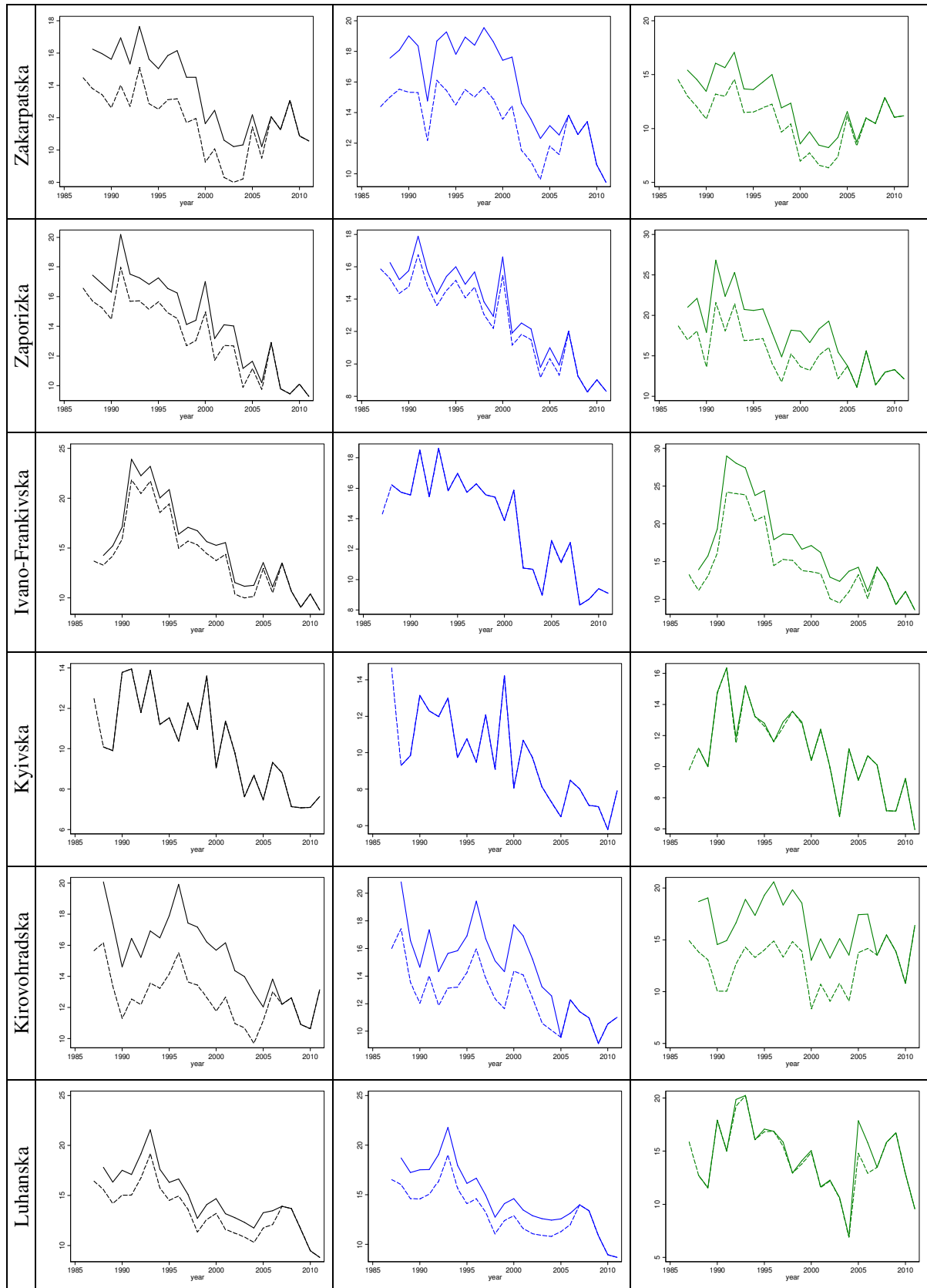
Annex H. Classification of diseases according to Ukrainian Classification of 2005 (ICD10), data available for districts

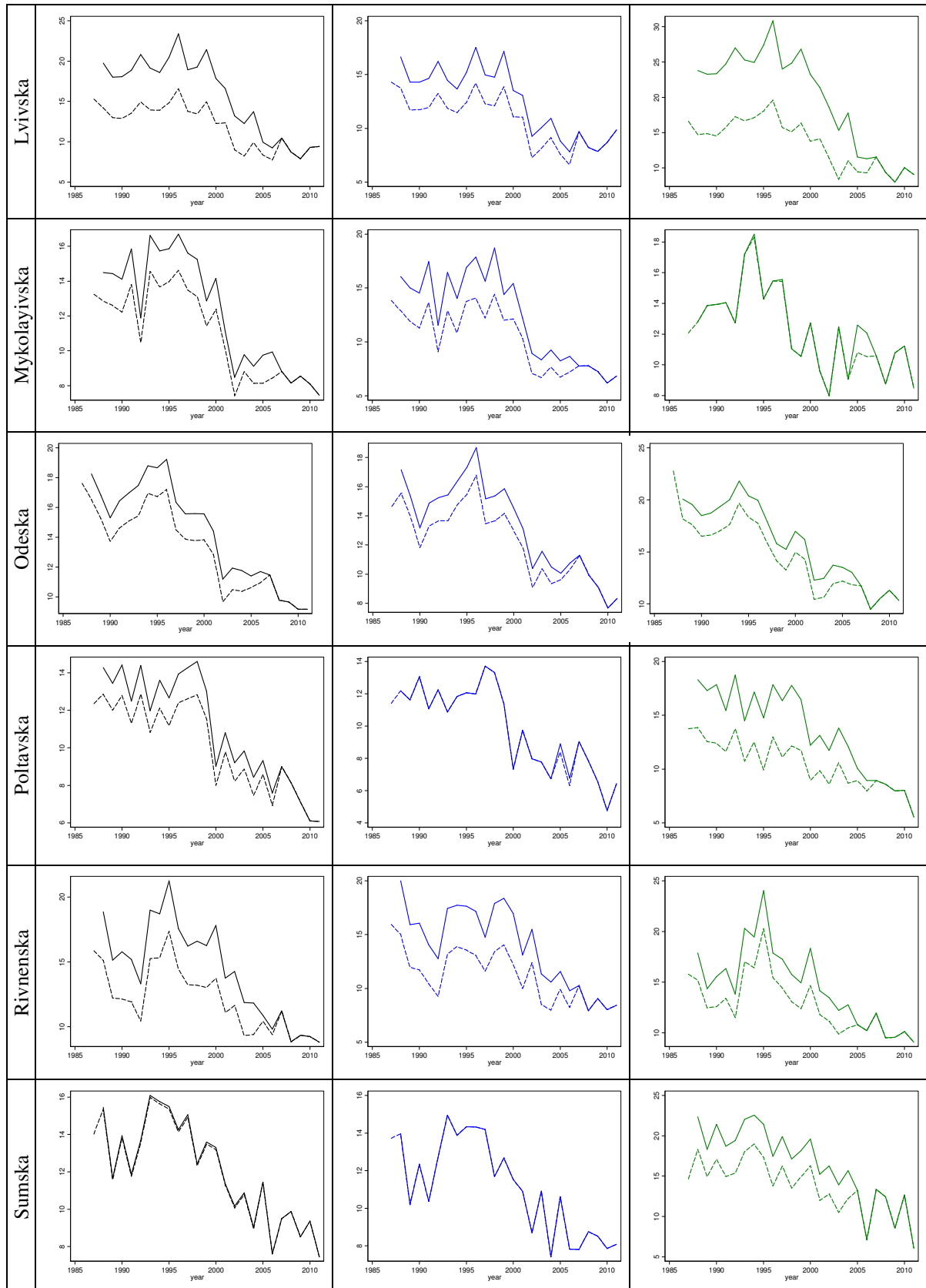
N	Причини смерті	Causes of death
1	<b>КЛАС 1. Деякі інфекційні та паразитарні хвороби</b>	<b>CHAPTER I Certain infectious and parasitic diseases</b>
2	Туберкульоз	Tuberculosis
3	Хвороба, зумовлена вірусом імунодефіциту людини (ВІЛ)	Human immunodeficiency virus [HIV] disease
4	<b>КЛАС II. Новоутворення</b>	<b>CHAPTER II Neoplasms</b>
5	<b>КЛАС III. Хвороби крові й кровотворних органів та окремі порушення із залученням імунного механізму</b>	<b>CHAPTER III Diseases of the blood and blood-forming organs and certain disorders involving</b>
6	<b>КЛАС IV. Ендокринні хвороби, розлади харчування та порушення обміну речовин</b>	<b>CHAPTER IV Endocrine, nutritional and metabolic diseases</b>
7	<b>КЛАС V. Розлади психіки та поведінки</b>	<b>CHAPTER V Mental and behavioural disorders</b>
8	Розлади психіки та поведінки внаслідок вживання алкоголю	Mental and behavioural disorders due to use of alcohol
9	Психічні розлади внаслідок вживання інших психоактивних речовин	Mental disorders due to use of other psychoactive substance
10	<b>КЛАС VI. Хвороби нервової системи</b>	<b>CHAPTER VI Diseases of the nervous system</b>
11	<b>КЛАС VII. Хвороби ока та його придаткового апарату</b>	<b>CHAPTER VII Diseases of the eye and adnexa</b>
12	<b>КЛАС VIII. Хвороби вуха та соскоподібного відростка</b>	<b>CHAPTER VIII Diseases of the ear and mastoid process</b>
13	<b>КЛАС IX. Хвороби системи кровообігу</b>	<b>CHAPTER IX Diseases of the circulatory system</b>
14	Алкогольна кардіоміопатія	Alcoholic cardiomyopathy
15	Ішемічна хвороба серця	Ischaemic heart diseases
16	Цереброваскулярні хвороби	Cerebrovascular diseases
17	<b>КЛАС X. Хвороби органів дихання</b>	<b>CHAPTER X Diseases of the respiratory system</b>
18	<b>КЛАС XI. Хвороби органів травлення</b>	<b>CHAPTER XI Diseases of the digestive system</b>
19	Алкогольна хвороба печінки	Alcoholic liver disease
20	Інші хвороби печінки	Other diseases of liver
21	<b>КЛАС XII. Хвороби шкіри та підшкірної клітковини</b>	<b>CHAPTER XII Diseases of the skin and subcutaneous tissue</b>
22	<b>КЛАС XIII. Хвороби кістково-м'язової системи та сполучної тканини</b>	<b>CHAPTER XIII Diseases of the musculoskeletal system and connective tissue</b>
23	<b>КЛАС XIV. Хвороби сечостатевої системи</b>	<b>CHAPTER XIV Diseases of the genitourinary system</b>
24	<b>КЛАС XV. Вагітність, пологи та післяпологовий період</b>	<b>CHAPTER XV Pregnancy, childbirth and the puerperium</b>
25	<b>КЛАС XVI. Окремі стани, що виникають в перинатальному періоді</b>	<b>CHAPTER XVI Certain conditions originating in the perinatal period</b>
26	<b>КЛАС XVII. Природжені вади розвитку, деформації та хромосомні аномалії</b>	<b>CHAPTER XVII Congenital malformations, deformations and chromosomal abnormalities</b>
27	<b>КЛАС XVIII. Симптоми, ознаки та відхилення від норми, що виявлені при клінічних і лабораторних дослідженнях, не класифіковані в інших рубриках</b>	<b>CHAPTER XVIII Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere</b>

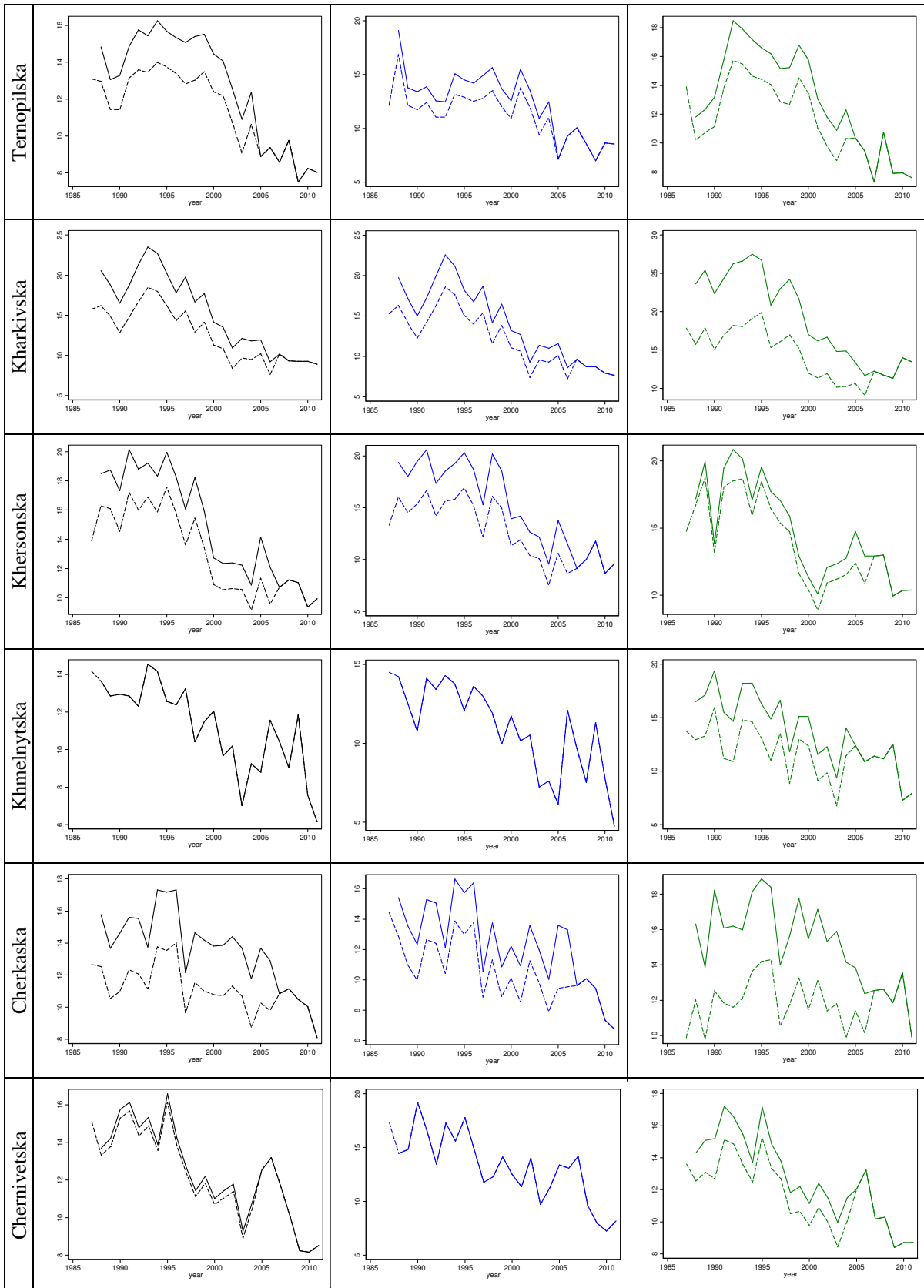
<b>28</b>	<b>КЛАС XX. Зовнішні причини смертності</b>	<b>CHAPTER XX External causes of mortality</b>
29	Транспортні нещасні випадки	Transport accidents
30	Випадкове утоплення та занурення у воду	Accidental drowning and submersion
31	Випадкове отруєння та дія алкоголю	Accidental poisoning by and exposure to alcohol
32	Навмисне самоушкодження	Suicide and selfinflicted injury
33	Наслідки нападу з метою убивства чи нанесення ушкодження	Homicide and injury purposely inflicted by other persons, including legal execution
34	Випадкове отруєння речовинами, що містяться у спожитих грибах	Toxic effect of other noxious substances eaten as food (ingested mushrooms )
35	Випадкове отруєння, спричинене іншими отруйними речовинами	Toxic effect of other and unspecified substances

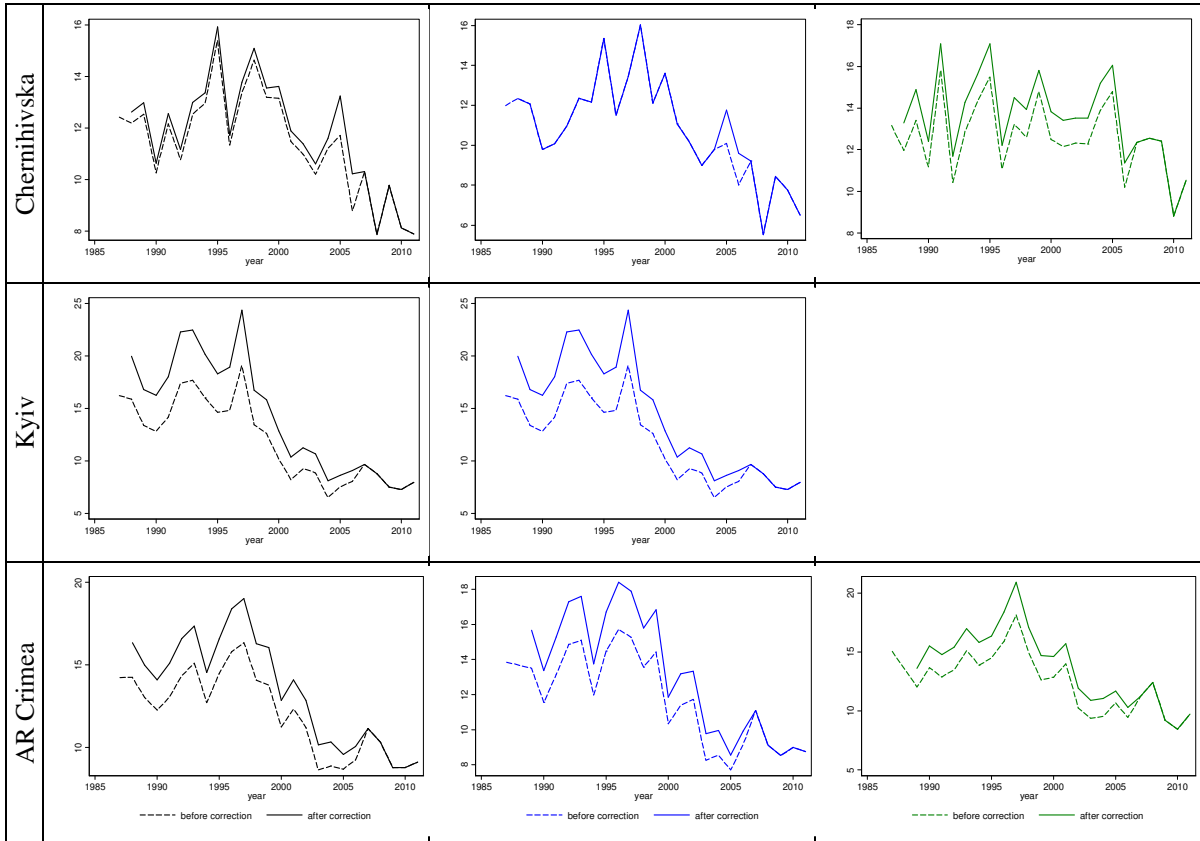
Annex I. Infant mortality rate original and corrected, 1987-2011











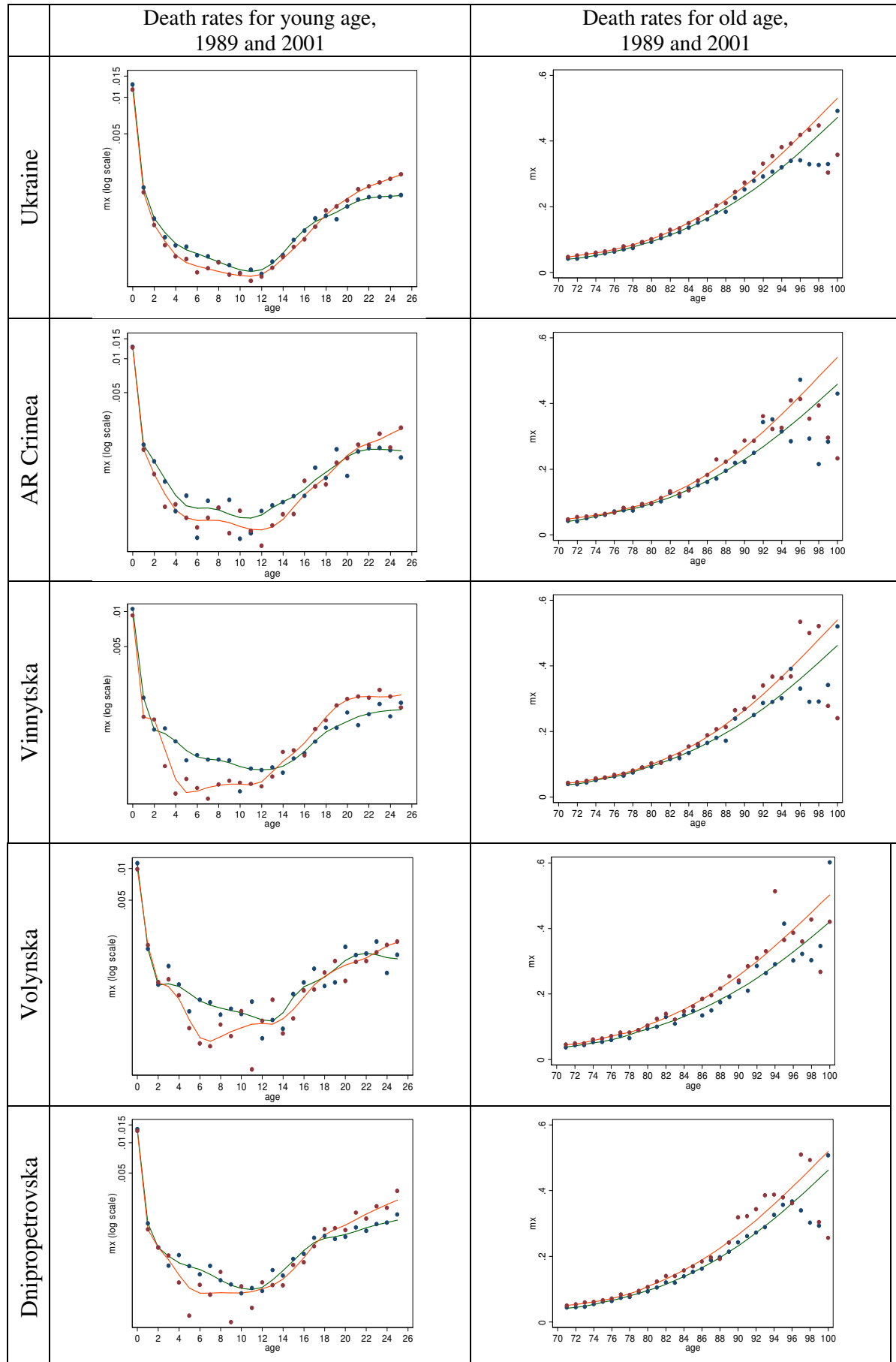


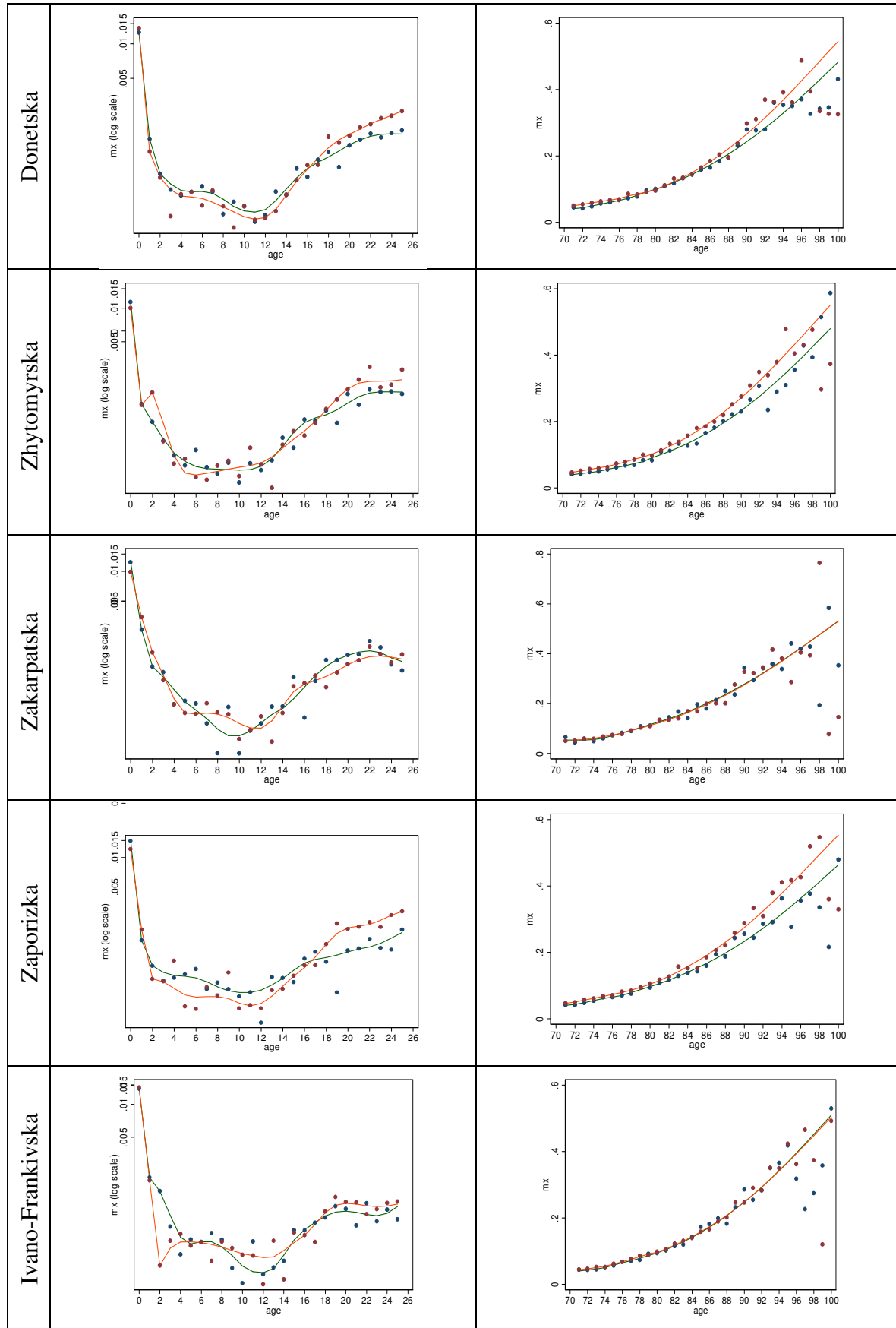
Annex J. Exact 95 and 99 percent confidence intervals when observed numbers of death are less than 100

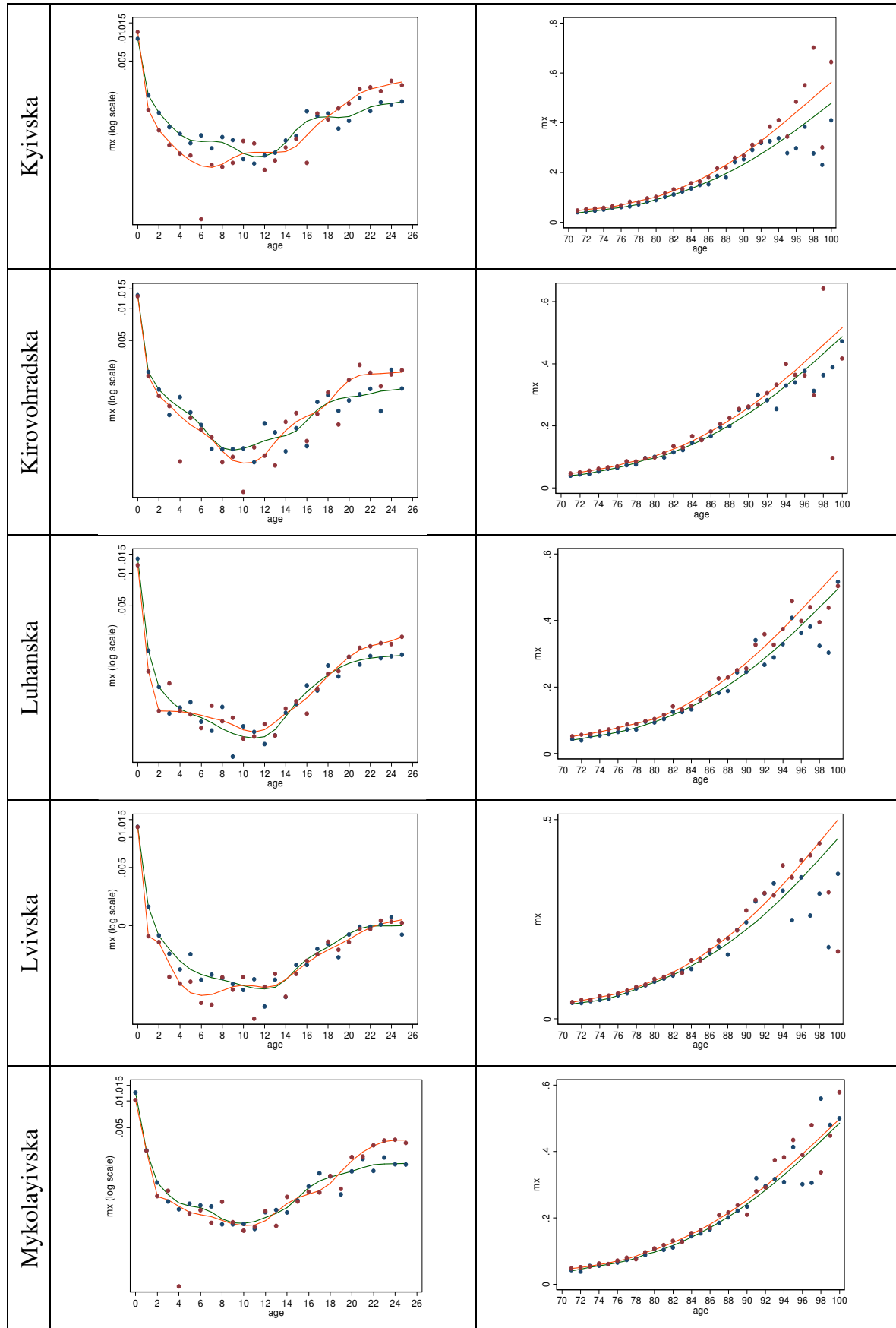
Observed number of death	95 per cent confidence interval		99 per cent confidences interval	
	Lower limit	Upper limit	Lower limit	Upper limit
0	0.0000	3.6889	0.0000	5.2983
1	0.0253	5.5716	0.0050	7.4301
2	0.2422	7.2247	0.1035	9.2738
3	0.6187	8.7673	0.3379	10.9775
4	1.0899	10.2416	0.6722	12.5941
5	1.6235	11.6683	1.0779	14.1498
6	2.2019	13.0595	1.5369	15.6597
7	2.8144	14.4227	2.0373	17.1336
8	3.4538	15.7632	2.5711	18.5782
9	4.1154	17.0848	3.1324	19.9984
10	4.7954	18.3904	3.7169	21.3978
11	5.4912	19.6820	4.3214	22.7793
12	6.2006	20.9616	4.9431	24.1449
13	6.9220	22.2304	5.5801	25.4967
14	7.6539	23.4896	6.2307	26.8360
15	8.3954	24.7402	6.8934	28.1641
16	9.1454	25.9830	7.5670	29.4820
17	9.9031	27.2186	8.2506	30.7906
18	10.6679	28.4478	8.9434	32.0907
19	11.4392	29.6709	9.6445	33.3830
20	12.2165	30.8884	10.3533	34.6680
21	12.9993	32.1007	11.0692	35.9463
22	13.7873	33.3083	11.7918	37.2183
23	14.5800	34.5113	12.5207	38.4844
24	15.3773	35.7101	13.2553	39.7450
25	16.1787	36.9049	13.9954	41.0004
26	16.9841	38.0960	14.7406	42.2510
27	17.7932	39.2836	15.4906	43.4969
28	18.6058	40.4678	16.2452	44.7384
29	19.4218	41.6488	17.0042	45.9758
30	20.2409	42.8269	17.7672	47.2093
31	21.0630	44.0020	18.5342	48.4391
32	21.8880	45.1745	19.3049	49.6652
33	22.7157	46.3443	20.0791	50.8880
34	23.5460	47.5116	20.8567	52.1074
35	24.3788	48.6765	21.6376	53.3238
36	25.2140	49.8392	22.4215	54.5372
37	26.0514	50.9996	23.2085	55.7477
38	26.8911	52.1580	23.9983	56.9554
39	27.7328	53.3143	24.7908	58.1605
40	28.5766	54.4686	25.5860	59.3631
41	29.4223	55.6211	26.3837	60.5631
42	30.2699	56.7718	27.1838	61.7609
43	31.1193	57.9207	27.9864	62.9563
44	31.9705	59.0679	28.7912	64.1495
45	32.8233	60.2135	29.5982	65.3405
46	33.6778	61.3576	30.4073	66.5295
47	34.5338	62.5000	31.2185	67.7165
48	35.3914	63.6410	32.0317	68.9016
49	36.2505	64.7806	32.8468	70.0847
50	37.1110	65.9188	33.6638	71.2661
51	37.9728	67.0556	34.4826	72.4457
52	38.8361	68.1911	35.3032	73.6235
53	39.7006	69.3253	36.1255	74.7997

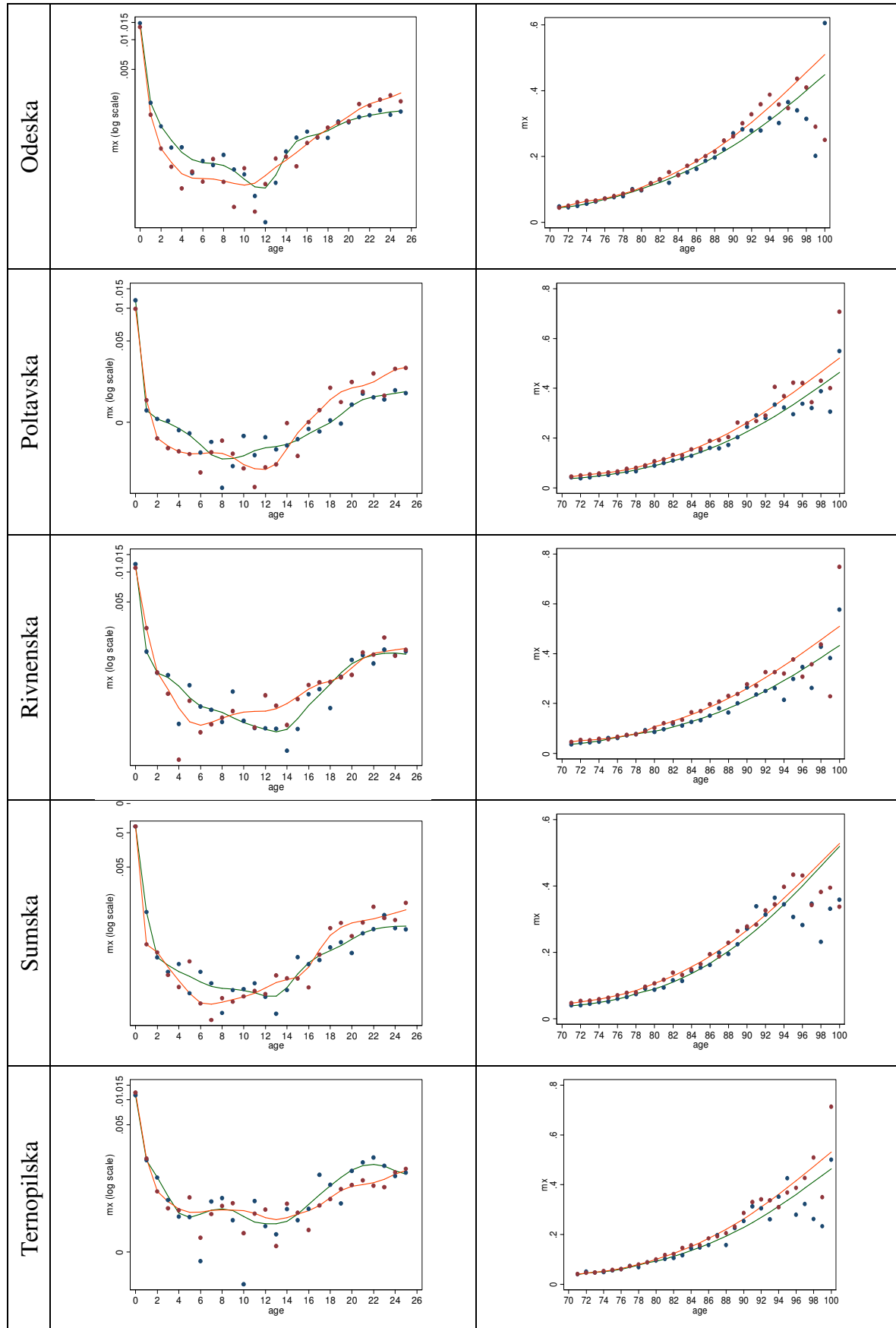
54	40.5665	70.4583	36.9494	75.9742
55	41.4335	71.5901	37.7750	77.1472
56	42.3018	72.7207	38.6022	78.3186
57	43.1712	73.8501	39.4309	79.4886
58	44.0418	74.9784	40.2611	80.6570
59	44.9135	76.1057	41.0927	81.8241
60	45.7863	77.2319	41.9258	82.9898
61	46.6602	78.3571	42.7602	84.1541
62	47.5350	79.4812	43.5960	85.3170
63	48.4109	80.6044	44.4332	86.4787
64	49.2878	81.7266	45.2716	87.6392
65	50.1656	82.8478	46.1112	88.7984
66	51.0444	83.9682	46.9521	89.9564
67	51.9241	85.0876	47.7942	91.1132
68	52.8047	86.2062	48.6375	92.2689
69	53.6861	87.3239	49.4819	93.4234
70	54.5684	88.4408	50.3274	94.5769
71	55.4516	89.5568	51.1741	95.7292
72	56.3356	90.6721	52.0218	96.8806
73	57.2203	91.7865	52.8705	98.0308
74	58.1059	92.9002	53.7203	99.1801
75	58.9923	94.0131	54.5711	100.3284
76	59.8794	95.1253	55.4229	101.4757
77	60.7672	96.2368	56.2757	102.6220
78	61.6558	97.3475	57.1294	103.7674
79	62.5450	98.4576	57.9841	104.9119
80	63.4350	99.5669	58.8396	106.0555
81	64.3257	100.6756	59.6961	107.1982
82	65.2170	101.7836	60.5535	108.3401
83	66.1090	102.8910	61.4117	109.4811
84	67.0017	103.9977	62.2707	110.6212
85	67.8950	105.1038	63.1307	111.7605
86	68.7889	106.2093	63.9914	112.8991
87	69.6834	107.3142	64.8529	114.0368
88	70.5786	108.4185	65.7152	115.1737
89	71.4743	109.5222	66.5783	116.3099
90	72.3706	110.6253	67.4422	117.4453
91	73.2675	111.7278	68.3069	118.5800
92	74.1650	112.8298	69.1722	119.7139
93	75.0630	113.9313	70.0383	120.8472
94	75.9616	115.0322	70.9051	121.9797
95	76.8607	116.1326	71.7727	123.1115
96	77.7603	117.2324	72.6409	124.2427
97	78.6605	118.3318	73.5098	125.3731
98	79.5611	119.4360	74.3794	126.5029
99	80.4623	120.5289	75.2496	127.6321

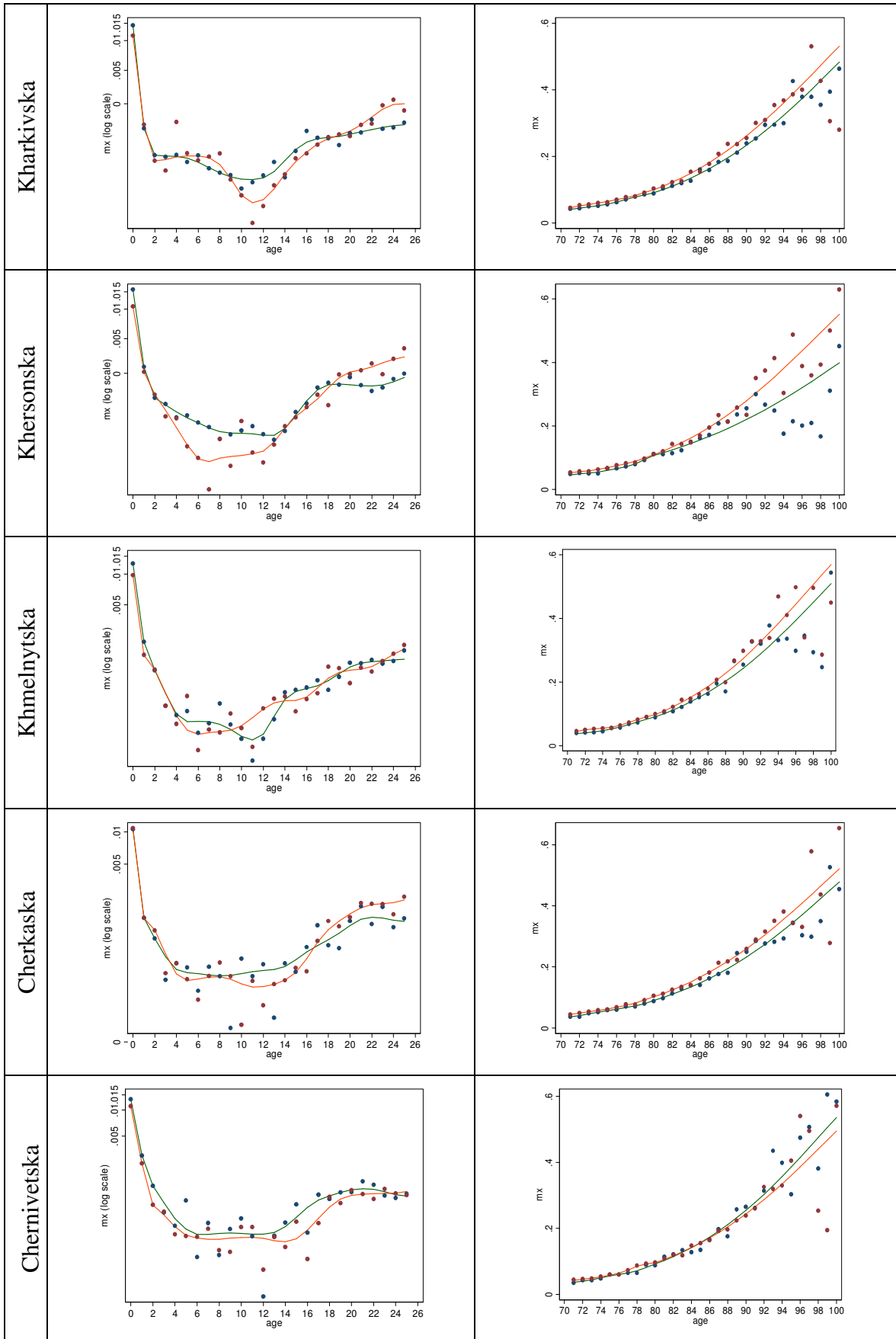
Annex K. Estimated ASDR at young (using running average smoothing) and old age (Kannisto smoothing) by regions of Ukraine, both sexes

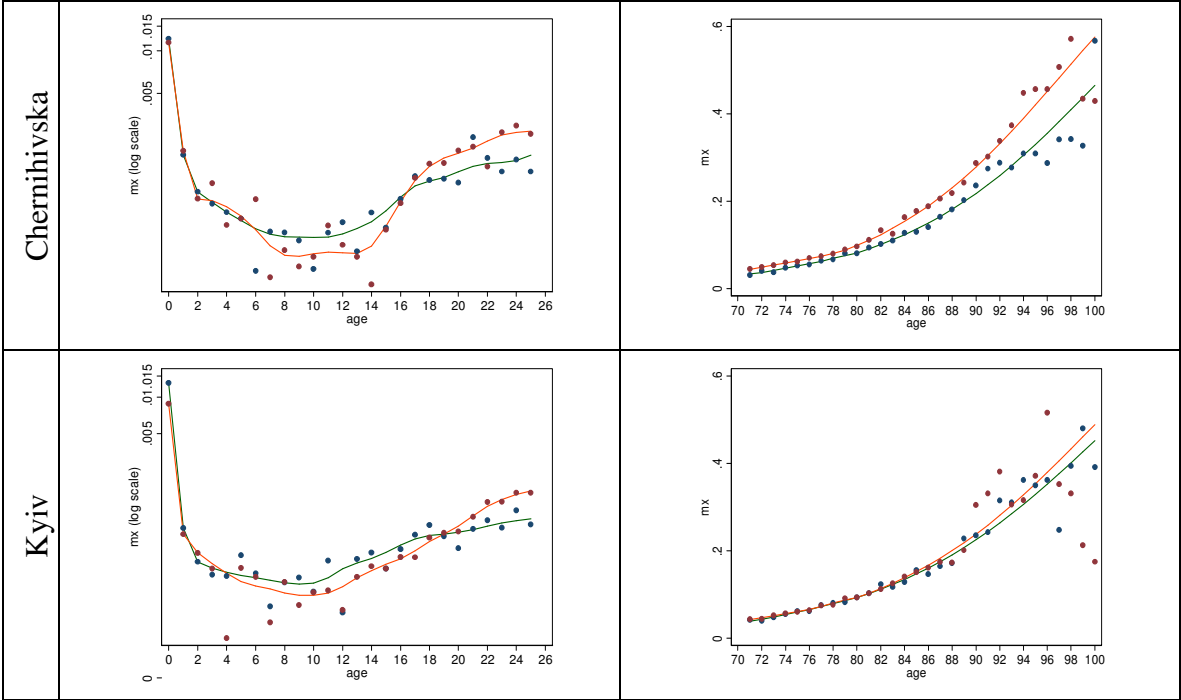






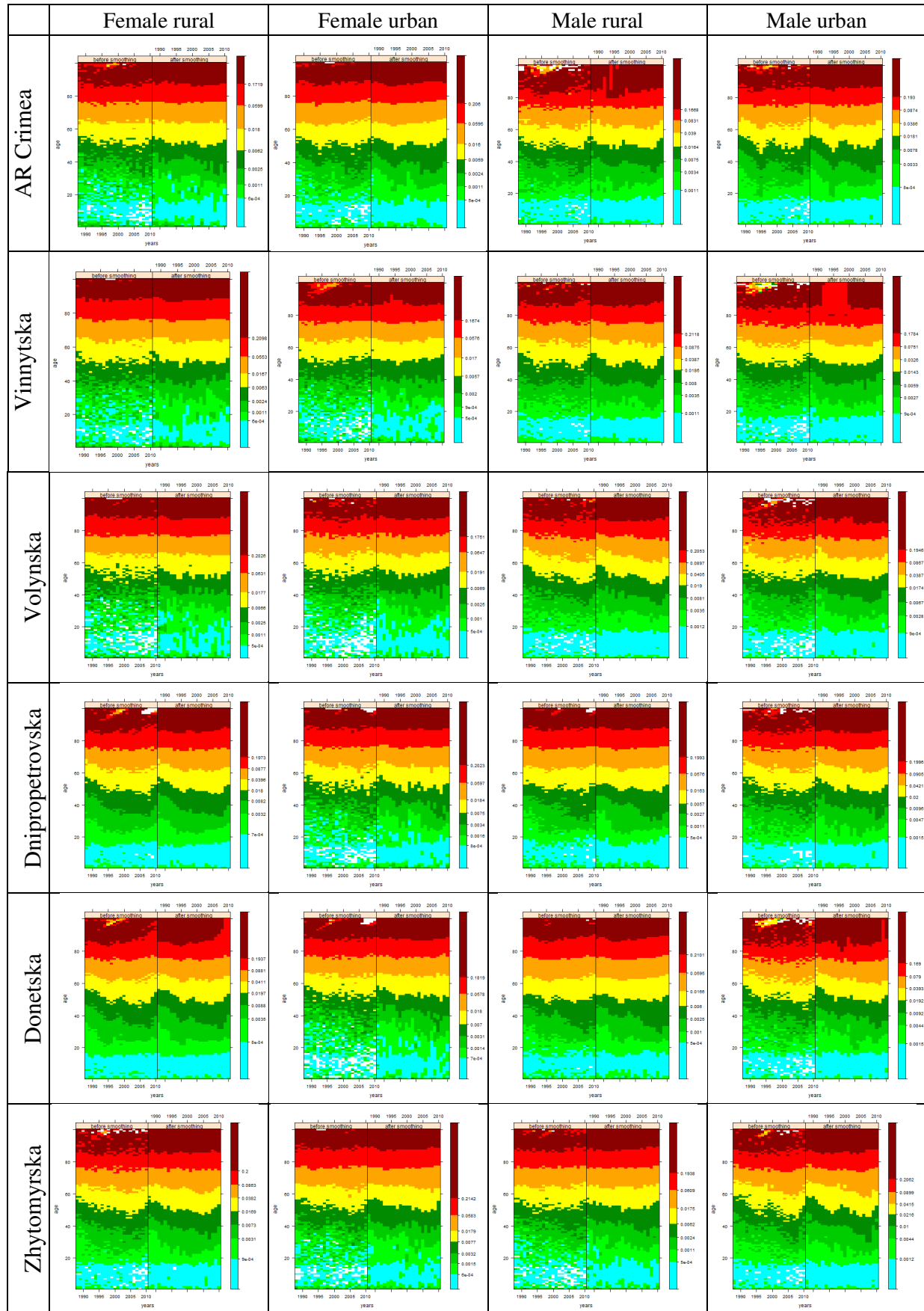


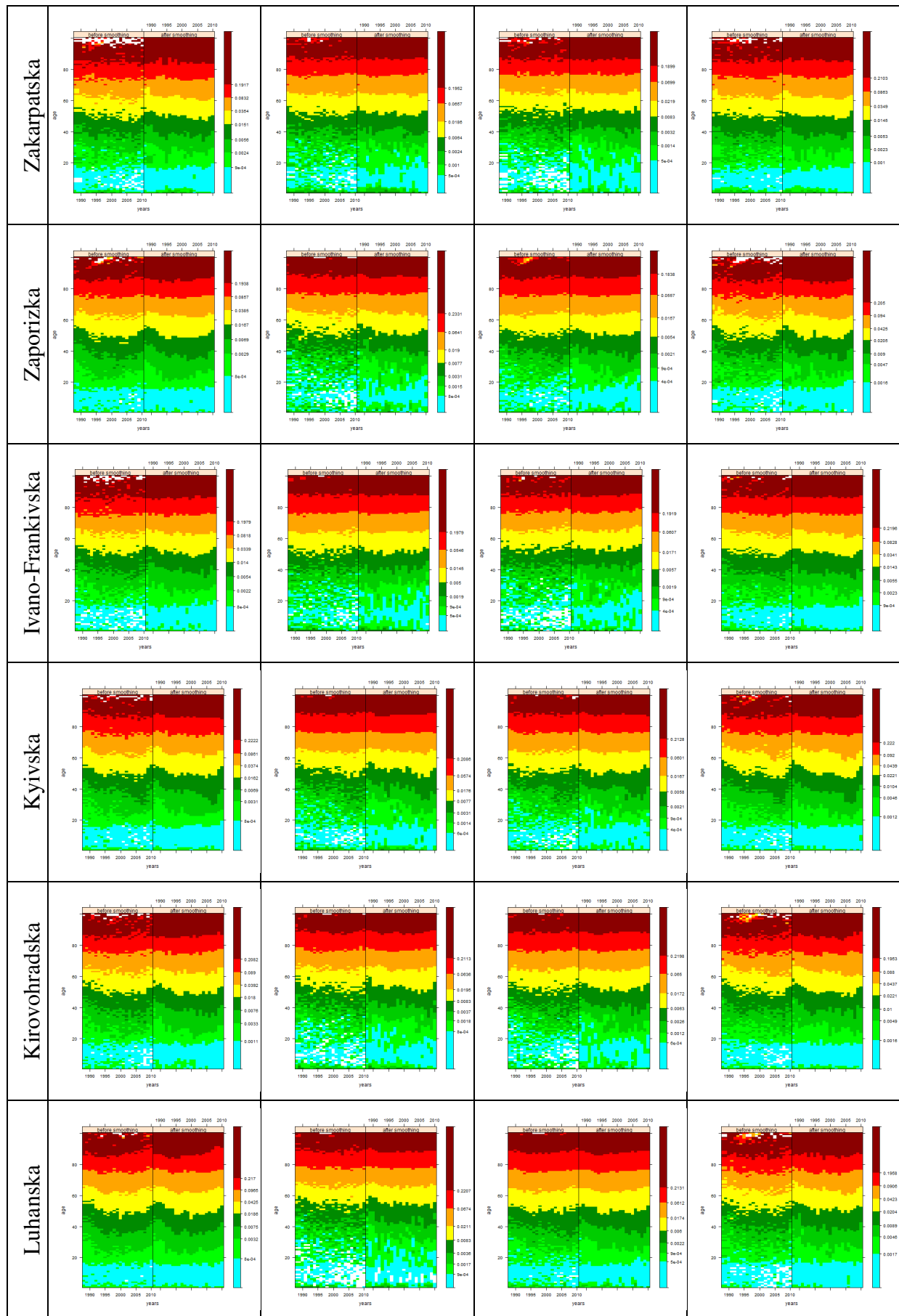


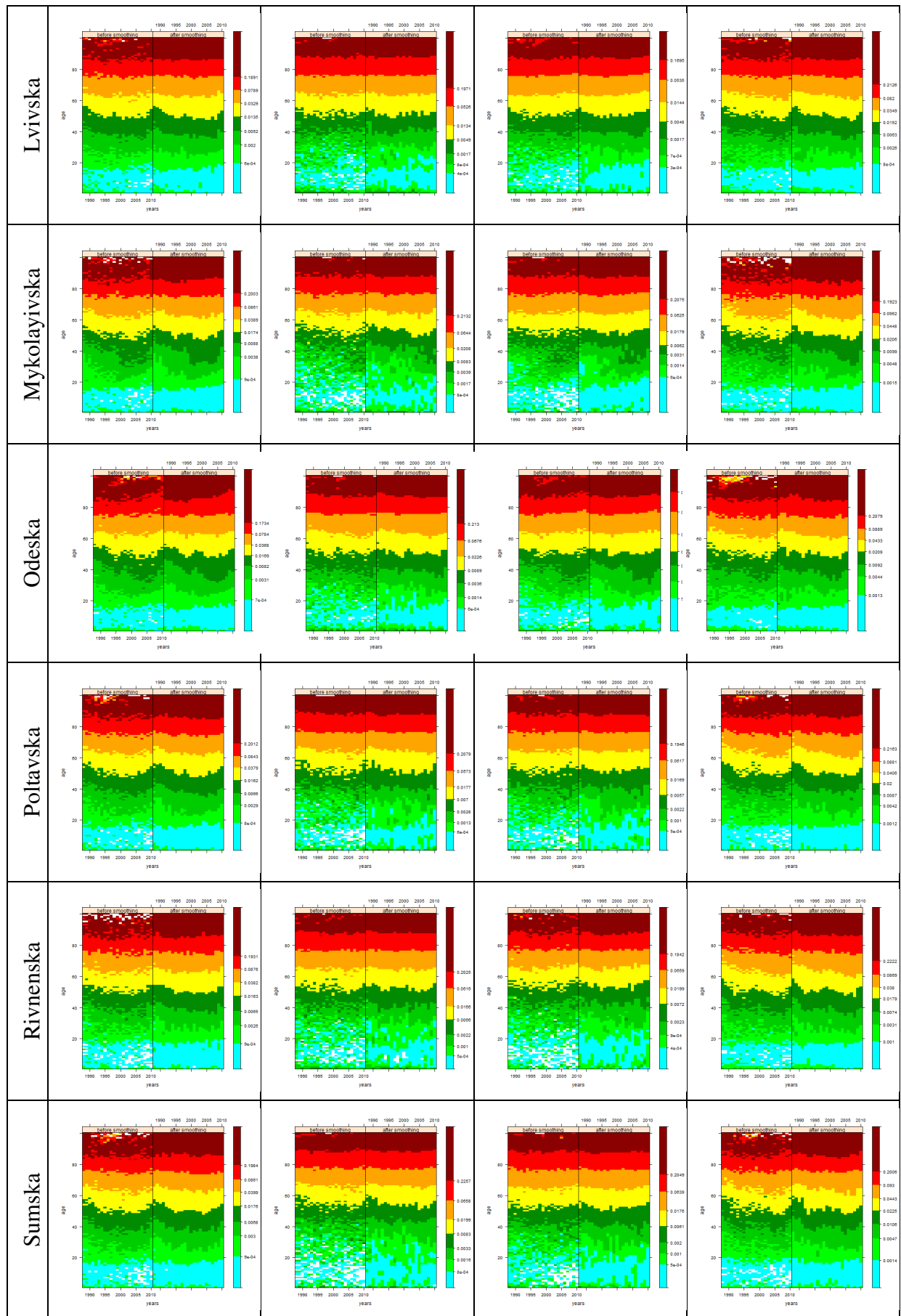


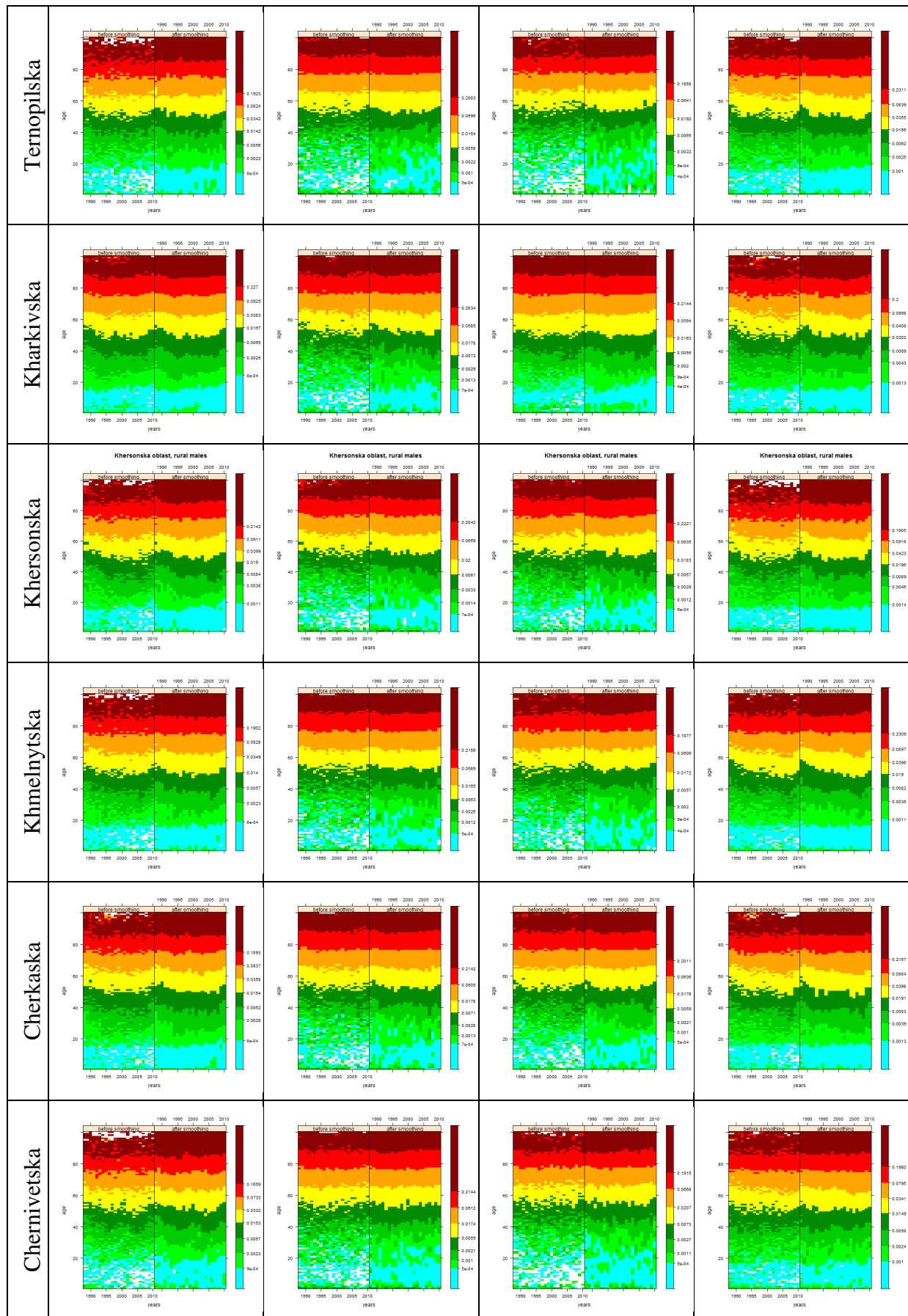


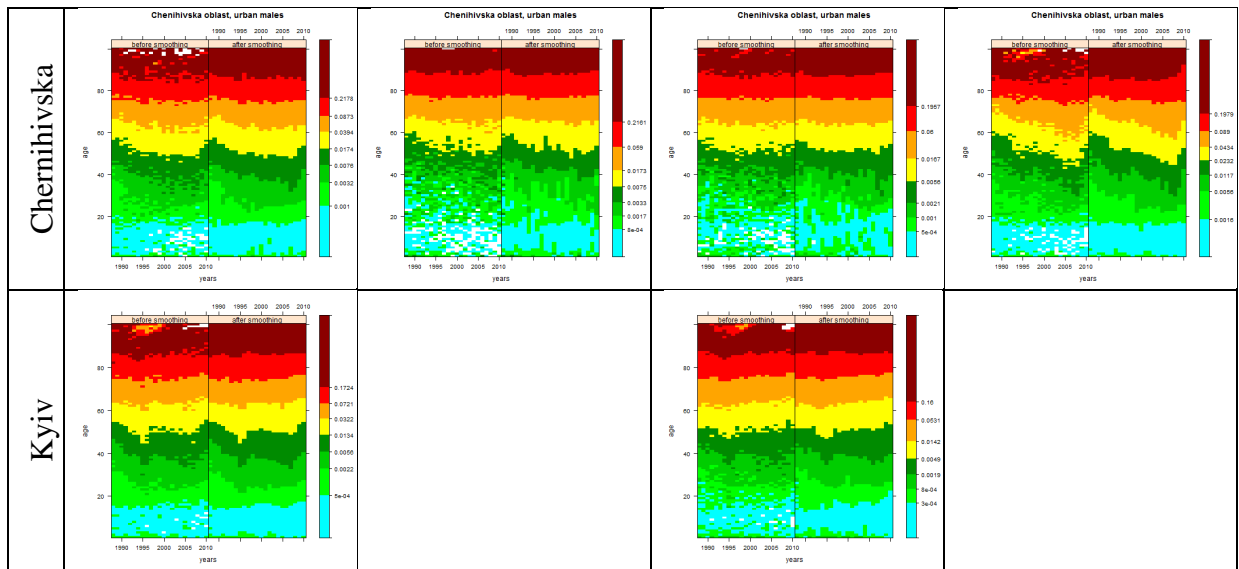
Annex L. Death rates observed and smoothed using moving average, both sexes











Annex M: SMR vs PMR

Figure 1: SMR vs PMR for INFECTIOUS DISEASES in Ukraine, 2005-2010

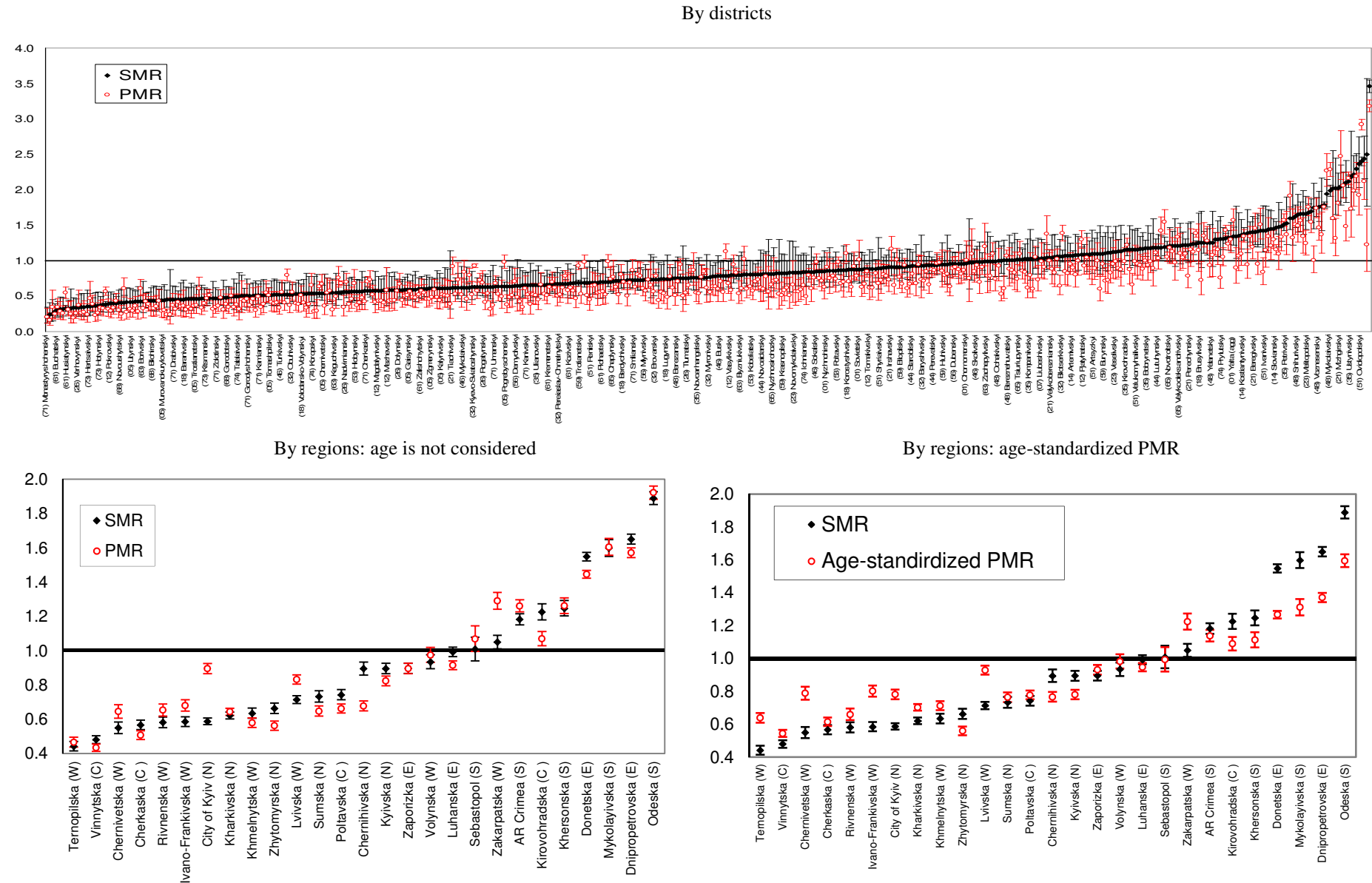
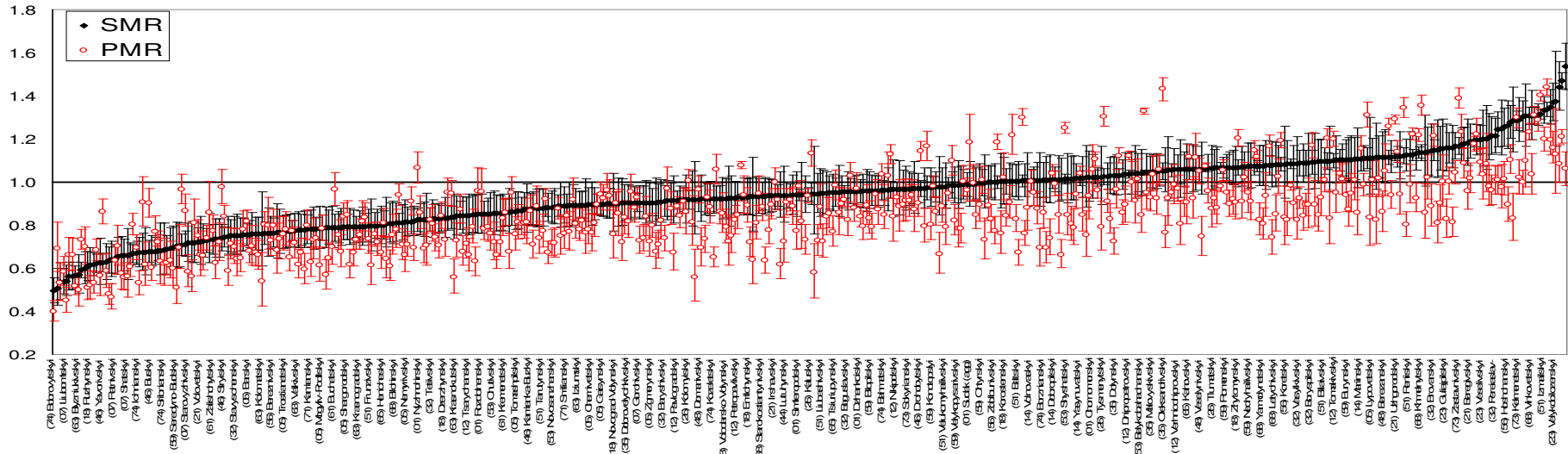
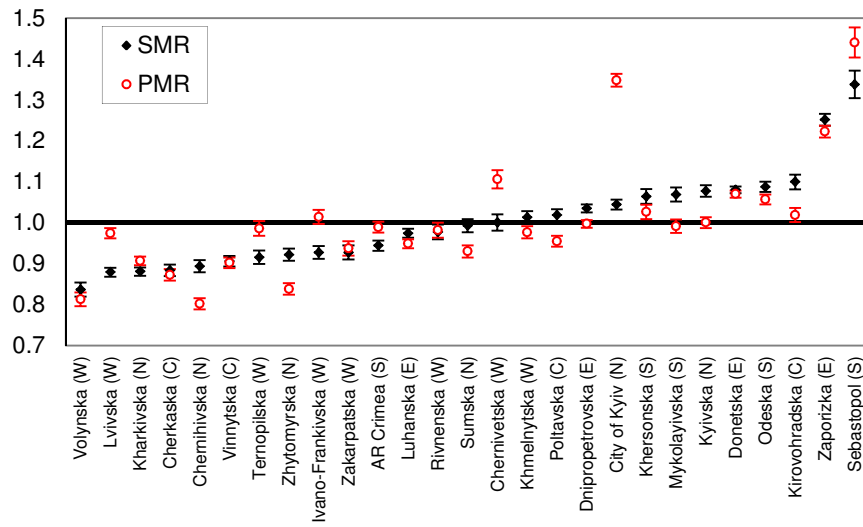


Figure 2: SMR vs PMR for CANCER in Ukraine, 2005-2010

By districts



By regions: age is not considered



By regions: age-standardized PMR

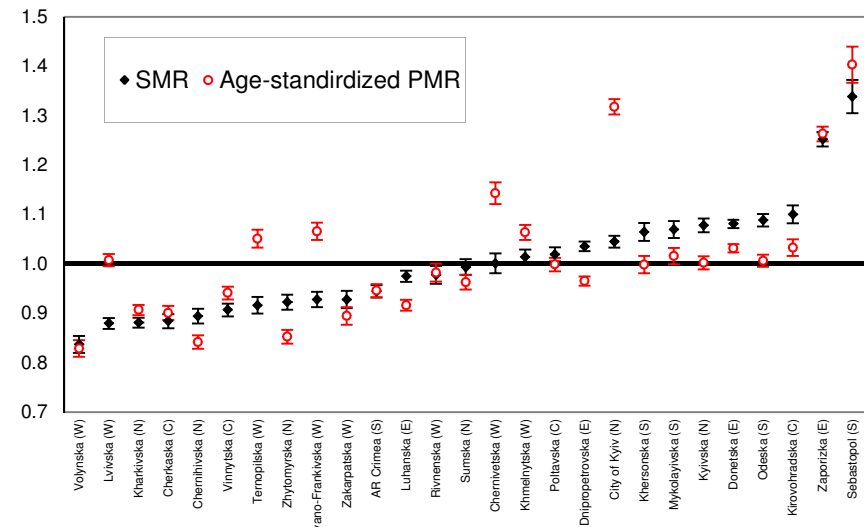
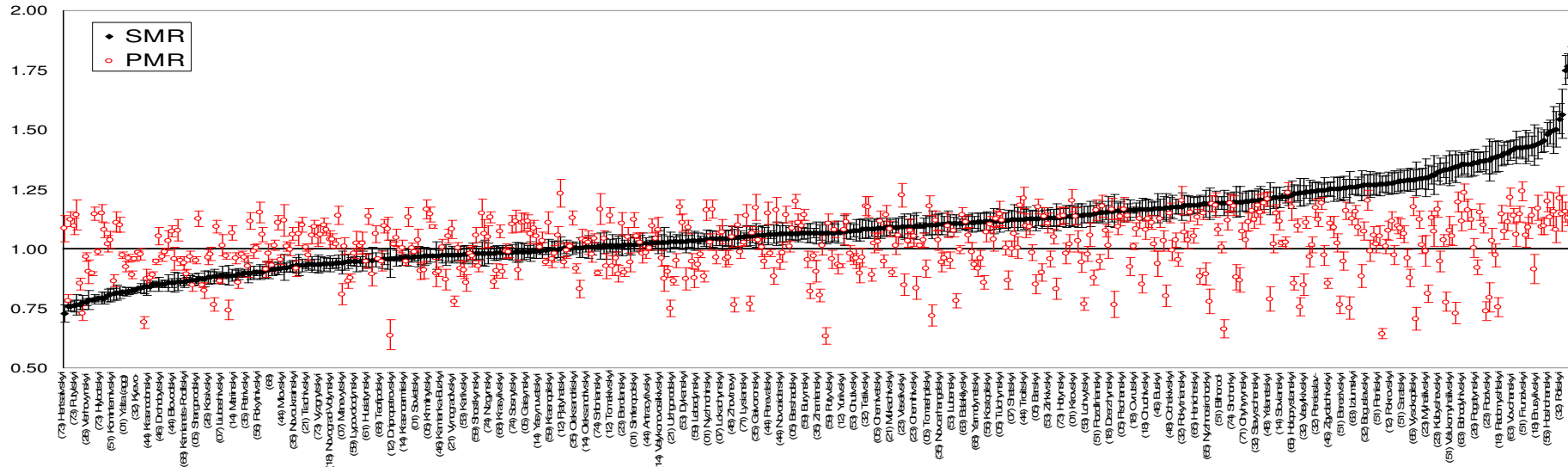
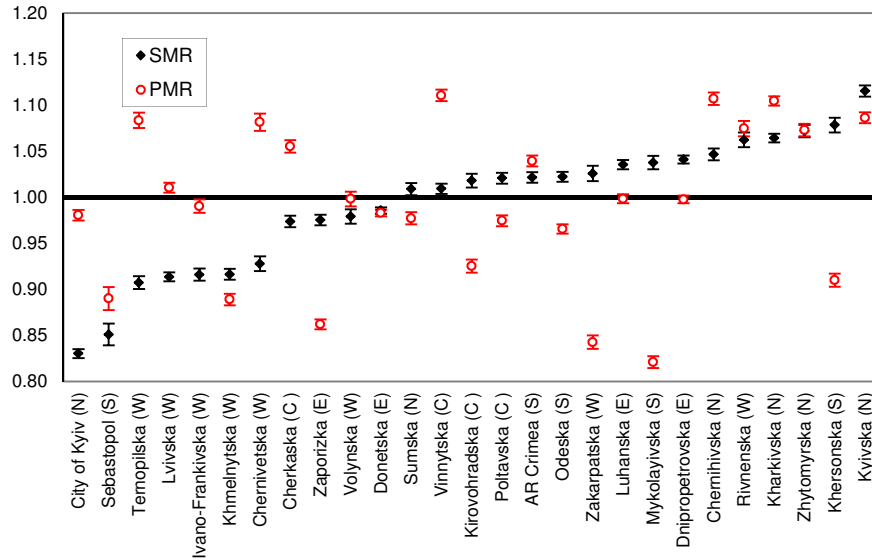


Figure 3: SMR vs PMR for CIRCULATORY SYSTEM DISEASES in Ukraine, 2005-2010

By districts



By regions: age is not considered



By regions: age-standardized PMR

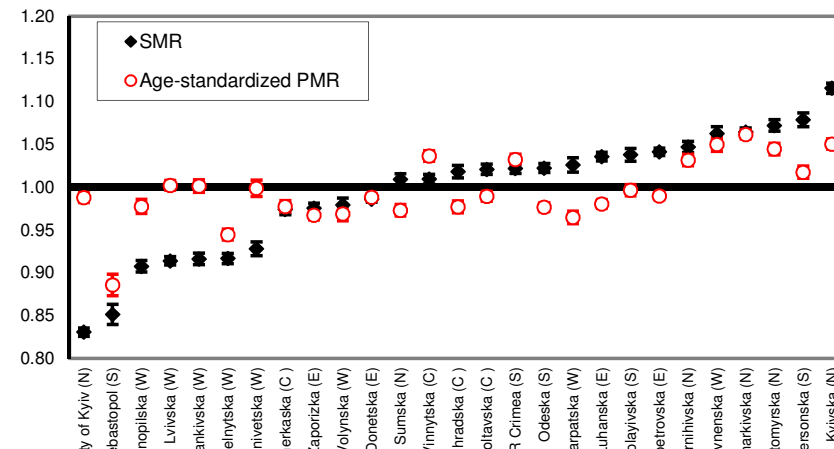
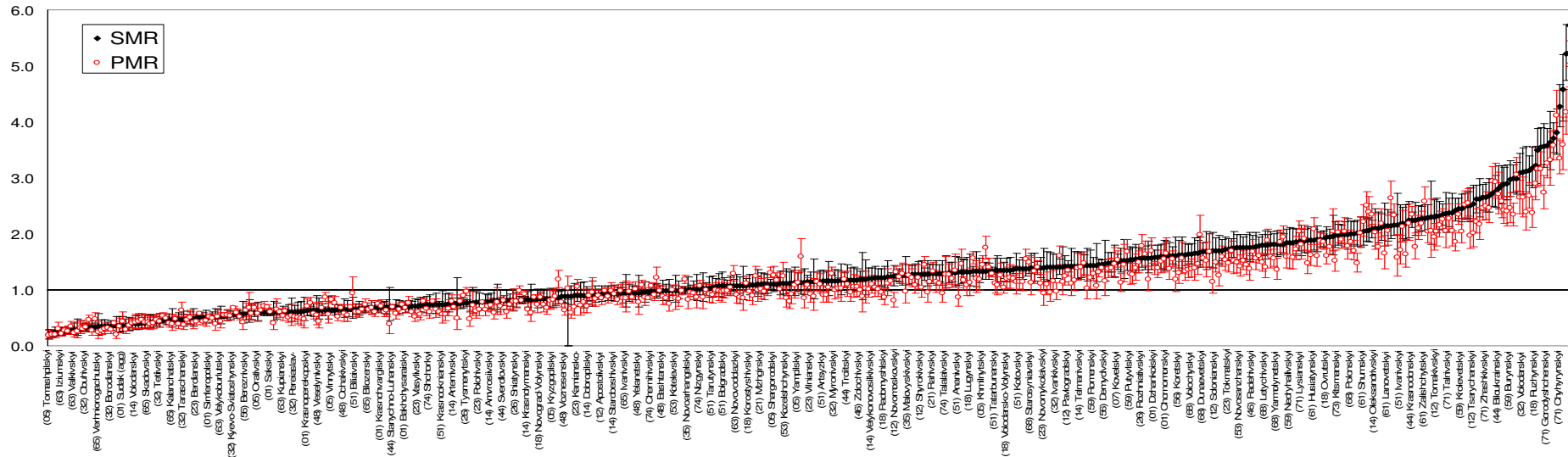


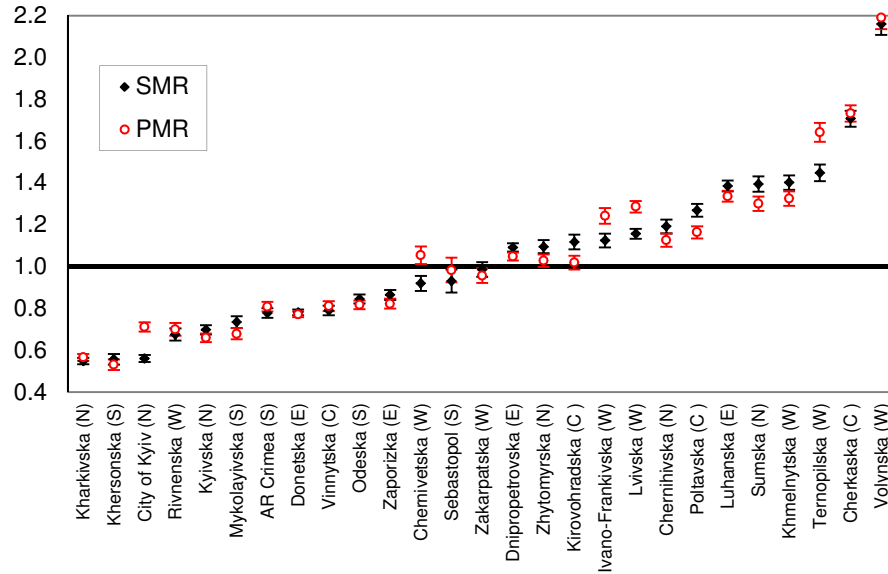


Figure 4: SMR vs PMR for RESPIRATORY SYSTEM DISEASES in Ukraine, 2005-2010

By districts



By regions: age is not considered



By regions: age-standardized PMR

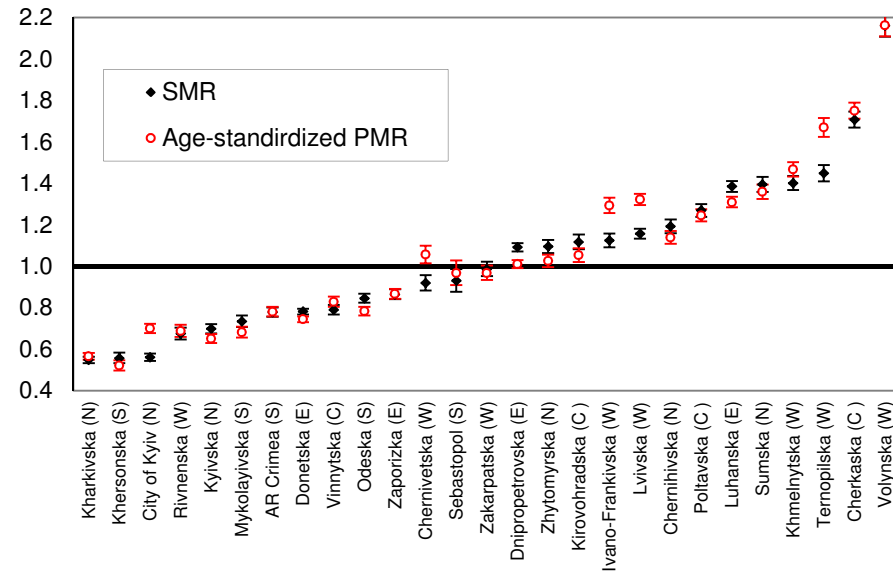
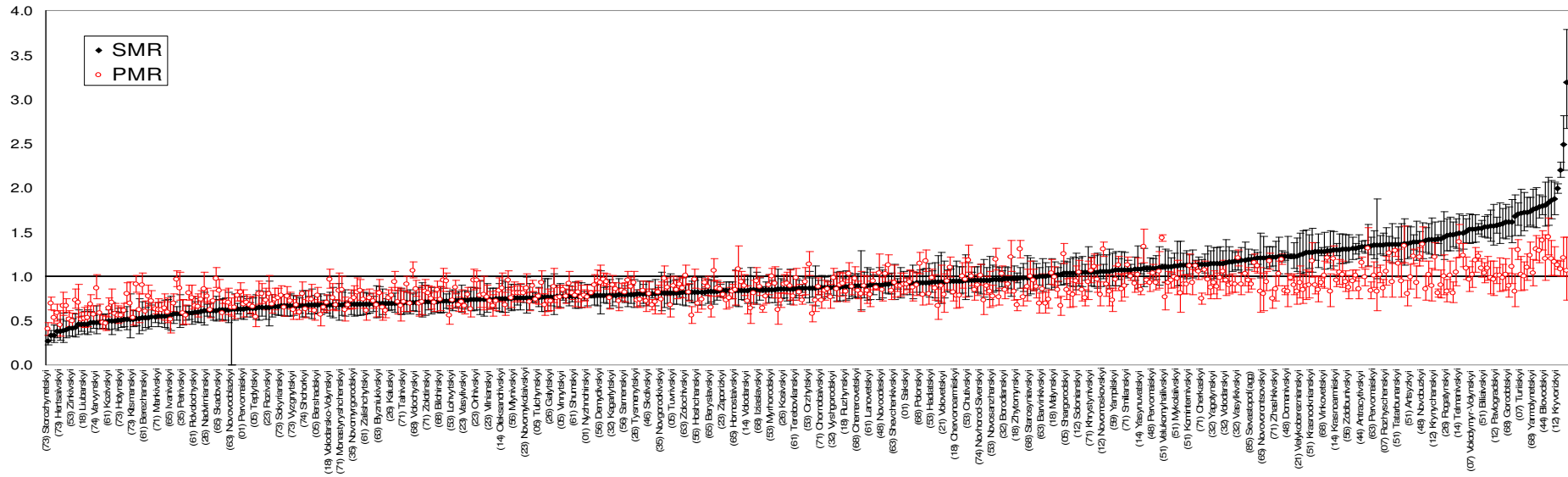
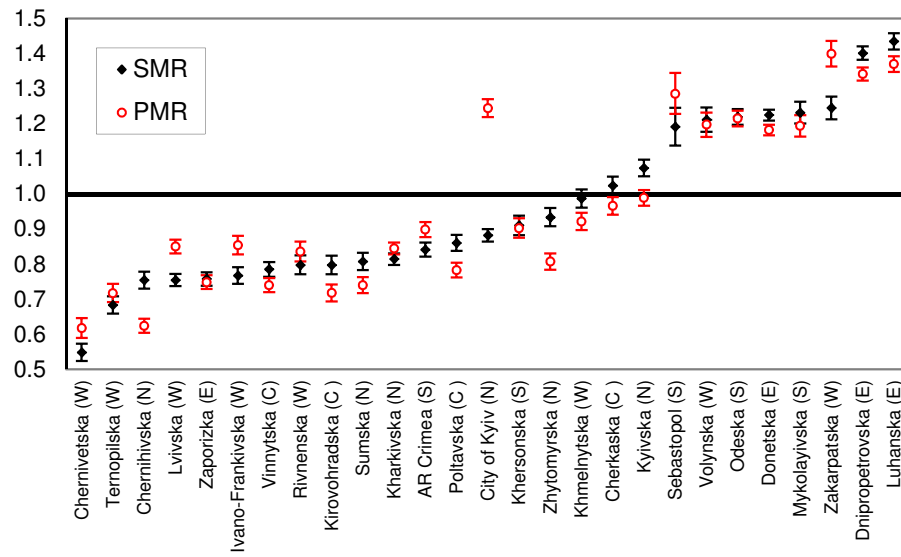


Figure 5: SMR vs PMR for DIGESTIVE SYSTEM DISEASES in Ukraine, 2005-2010

By districts



By regions: age is not considered



By regions: age-standardized PMR

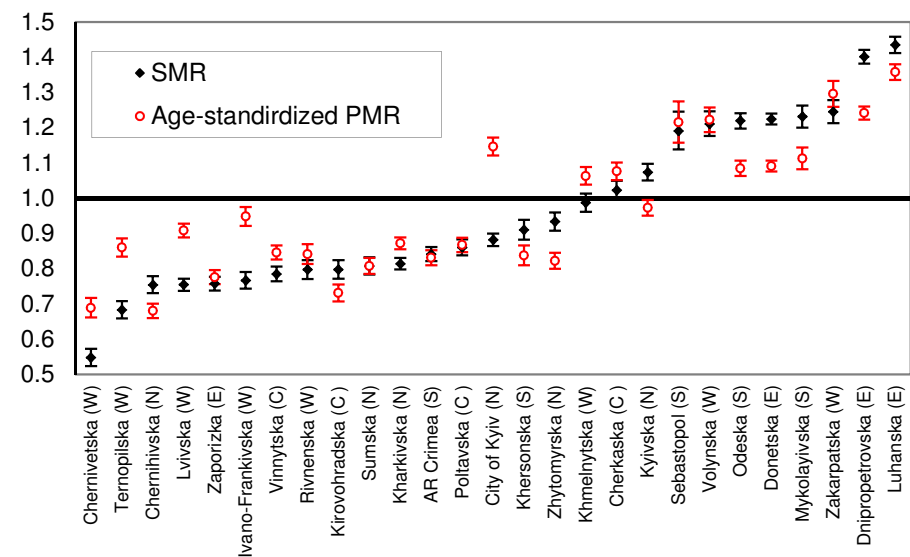
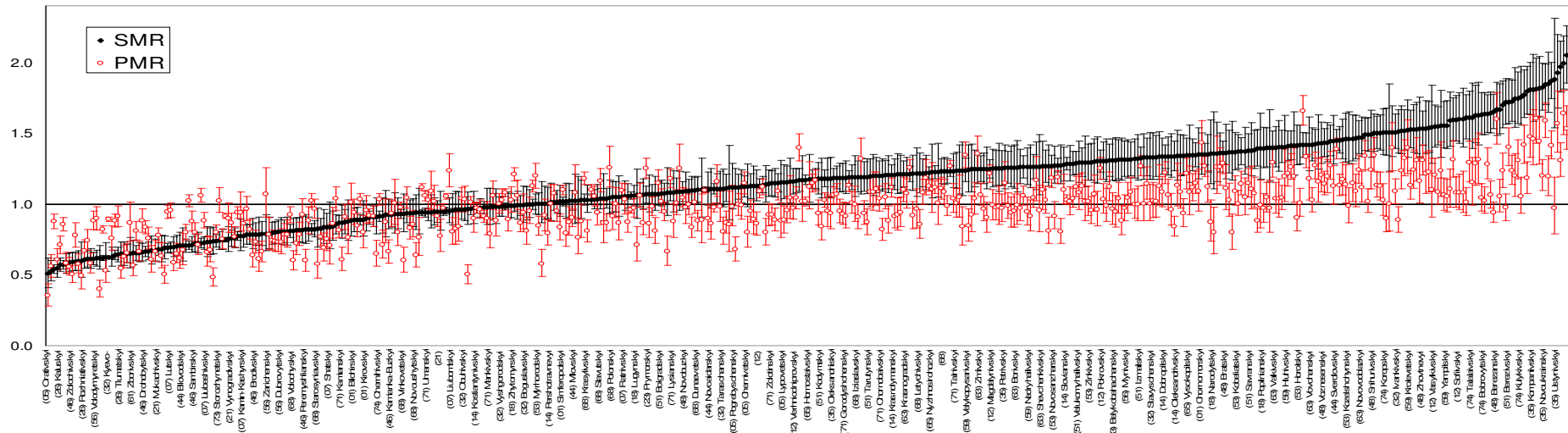
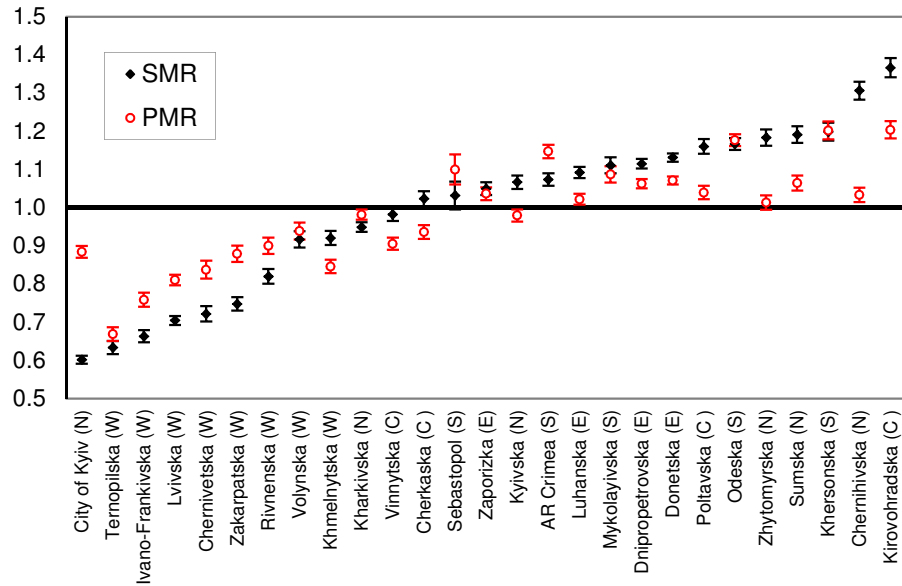


Figure 6: SMR vs PMR for EXTERNAL CAUSES OF MORTALITY in Ukraine, 2005-2010

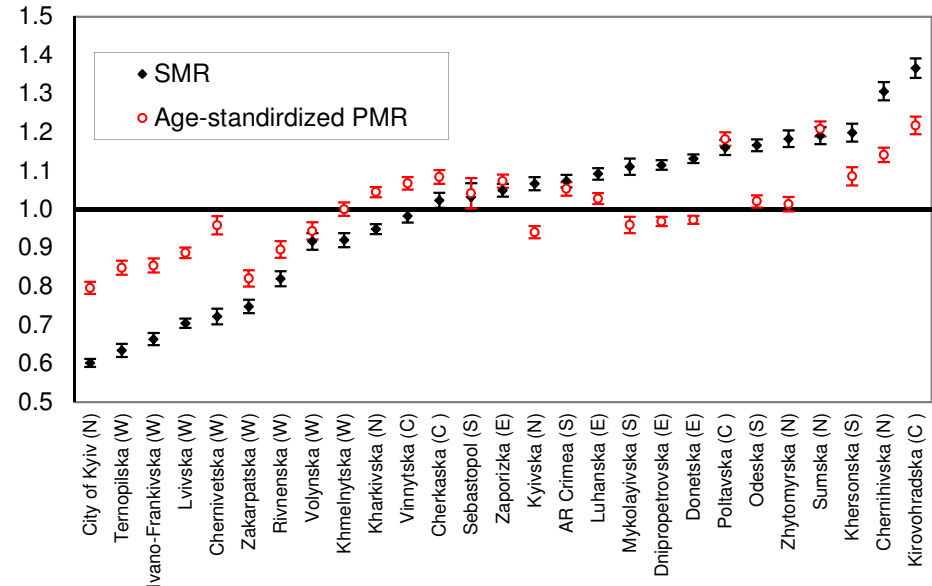
By districts



By regions: age is not considered



By regions: age-standardized PMR



## Annex N: Life expectancy at birth

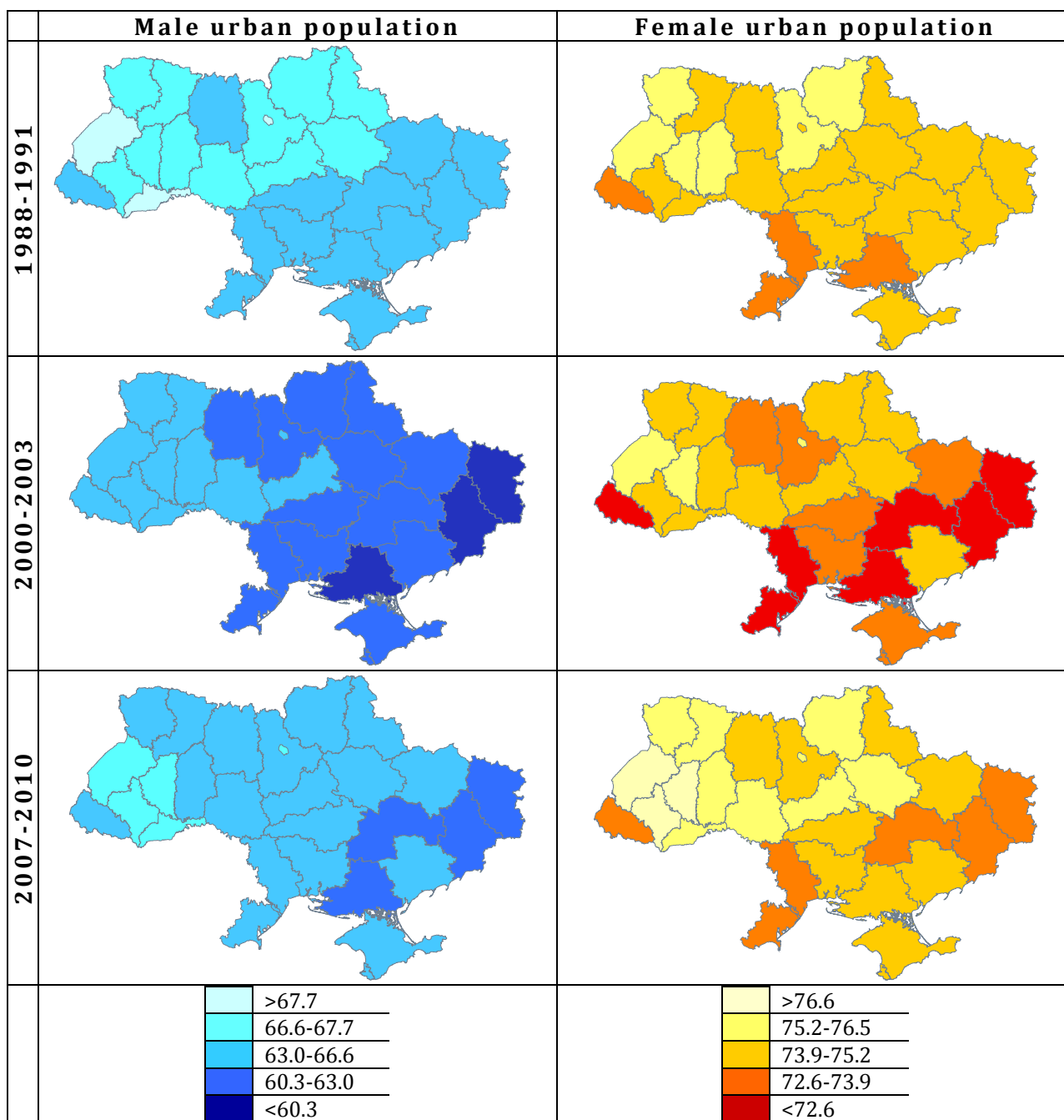
**Table 2: Life expectancy at birth and its confidence interval by sex, place of residence and regions in Ukraine, average for 2000-2003**

Code	Male total	Female total	Males urban	Female urban	Male rural	Female rural
Ukraine	62.04 (62.04-62.04)	73.47 (73.47-73.47)	62.31 (62.31-62.31)	73.52 (73.52-73.52)	61.5 (61.5-61.5)	73.31 (73.31-73.31)
AR Crimea	62.14 (62.14-62.15)	73.31 (73.3-73.31)	62.23 (62.23-62.24)	73.43 (73.43-73.44)	62 (61.99-62)	73.09 (73.09-73.1)
Vinnyska	63.44 (63.44-63.45)	74.16 (74.15-74.16)	64.32 (64.31-64.32)	74.29 (74.28-74.29)	62.65 (62.64-62.65)	73.97 (73.96-73.97)
Volynska	62.81 (62.8-62.81)	74.03 (74.03-74.04)	63.19 (63.18-63.2)	73.93 (73.92-73.94)	62.39 (62.38-62.4)	74.13 (74.12-74.14)
Dnipropetrovska	60.57 (60.57-60.58)	72.43 (72.43-72.43)	60.77 (60.77-60.77)	72.52 (72.52-72.52)	59.56 (59.54-59.57)	71.9 (71.89-71.92)
Donetska	60.07 (60.07-60.07)	72.46 (72.46-72.46)	60.06 (60.05-60.06)	72.4 (72.39-72.4)	60.12 (60.1-60.14)	72.99 (72.97-73.02)
Zhytomyrska	61.3 (61.3-61.31)	73.42 (73.42-73.43)	62.19 (62.18-62.19)	73.8 (73.8-73.81)	60.12 (60.11-60.13)	72.77 (72.76-72.78)
Zakarpatska	64.38 (64.38-64.38)	73.17 (73.16-73.17)	63.5 (63.48-63.51)	72.46 (72.45-72.48)	64.88 (64.87-64.88)	73.58 (73.58-73.59)
Zaporizka	60.96 (60.96-60.97)	73.38 (73.38-73.39)	61.76 (61.76-61.77)	73.95 (73.95-73.96)	58.7 (58.68-58.72)	71.69 (71.67-71.71)
Ivano-Frankivska	64.86 (64.85-64.86)	74.99 (74.99-75)	65.14 (65.13-65.15)	74.91 (74.89-74.92)	64.66 (64.65-64.66)	74.99 (74.98-75)
Kyivska	61.58 (61.57-61.58)	73.61 (73.61-73.61)	62.85 (62.84-62.85)	73.86 (73.86-73.87)	59.8 (59.79-59.81)	73.05 (73.05-73.06)
Kirovohradska	60.38 (60.37-60.39)	72.58 (72.58-72.59)	61.13 (61.12-61.15)	72.85 (72.84-72.87)	59.25 (59.23-59.26)	72.08 (72.07-72.1)
Luhanska	60.27 (60.27-60.28)	72.65 (72.64-72.65)	60.23 (60.22-60.23)	72.6 (72.6-72.6)	60.47 (60.45-60.49)	72.81 (72.79-72.83)
Lvivska	64.68 (64.67-64.68)	75.22 (75.21-75.22)	65.29 (65.28-65.29)	75.31 (75.31-75.32)	63.86 (63.85-63.87)	75.12 (75.11-75.12)
Mykolayivska	59.88 (59.87-59.88)	72.21 (72.21-72.22)	60.33 (60.33-60.34)	72.6 (72.59-72.61)	59.07 (59.06-59.08)	71.49 (71.48-71.51)
Odeska	61.00 (61.00-61.00)	71.52 (71.52-71.52)	62.01 (62-62.01)	72.55 (72.54-72.55)	59.36 (59.36-59.37)	69.9 (69.9-69.91)
Poltavska	61.98 (61.98-61.99)	73.76 (73.76-73.76)	62.86 (62.86-62.87)	74.17 (74.17-74.18)	60.64 (60.63-60.65)	72.98 (72.97-72.99)
Rivnenska	63.12 (63.11-63.12)	74.03 (74.03-74.04)	63.36 (63.35-63.37)	74.06 (74.05-74.08)	62.86 (62.85-62.86)	73.95 (73.94-73.96)
Sumska	61.64 (61.64-61.65)	73.88 (73.87-73.88)	62.73 (62.72-62.74)	74.27 (74.26-74.27)	59.66 (59.64-59.68)	72.97 (72.95-72.99)
Ternopilaska	65.12 (65.11-65.12)	75.63 (75.63-75.64)	65.59 (65.57-65.6)	75.65 (75.64-75.66)	64.73 (64.72-64.74)	75.55 (75.54-75.56)
Kharkivska	62.28 (62.28-62.29)	73.51 (73.5-73.51)	62.77 (62.76-62.77)	73.57 (73.57-73.57)	60.4 (60.39-60.42)	73.08 (73.07-73.1)
Khersonska	59.64 (59.63-59.64)	72.4 (72.39-72.4)	60.16 (60.15-60.17)	72.59 (72.58-72.6)	58.88 (58.87-58.89)	72.11 (72.1-72.12)
Khmelnytska	63.64 (63.63-63.64)	74.83 (74.82-74.83)	64.76 (64.75-64.77)	75.19 (75.19-75.2)	62.32 (62.31-62.33)	74.26 (74.25-74.27)
Cherkaska	62.61 (62.6-62.61)	73.75 (73.75-73.76)	63.84 (63.83-63.85)	74.27 (74.26-74.28)	61.19 (61.18-61.2)	73.05 (73.04-73.07)
Chernivetska	65.65 (65.64-65.66)	74.92 (74.91-74.92)	65.85 (65.83-65.87)	74.9 (74.89-74.92)	65.53 (65.52-65.54)	74.97 (74.97-74.98)
Chernihivska	60.69 (60.68-60.69)	74.14 (74.13-74.14)	61.89 (61.88-61.9)	74.12 (74.11-74.13)	58.67 (58.66-58.69)	73.77 (73.75-73.78)
City of Kyiv	65.97 (65.97-65.97)	75.28 (75.28-75.28)	65.97 (65.97-65.97)	75.28 (75.28-75.28)		

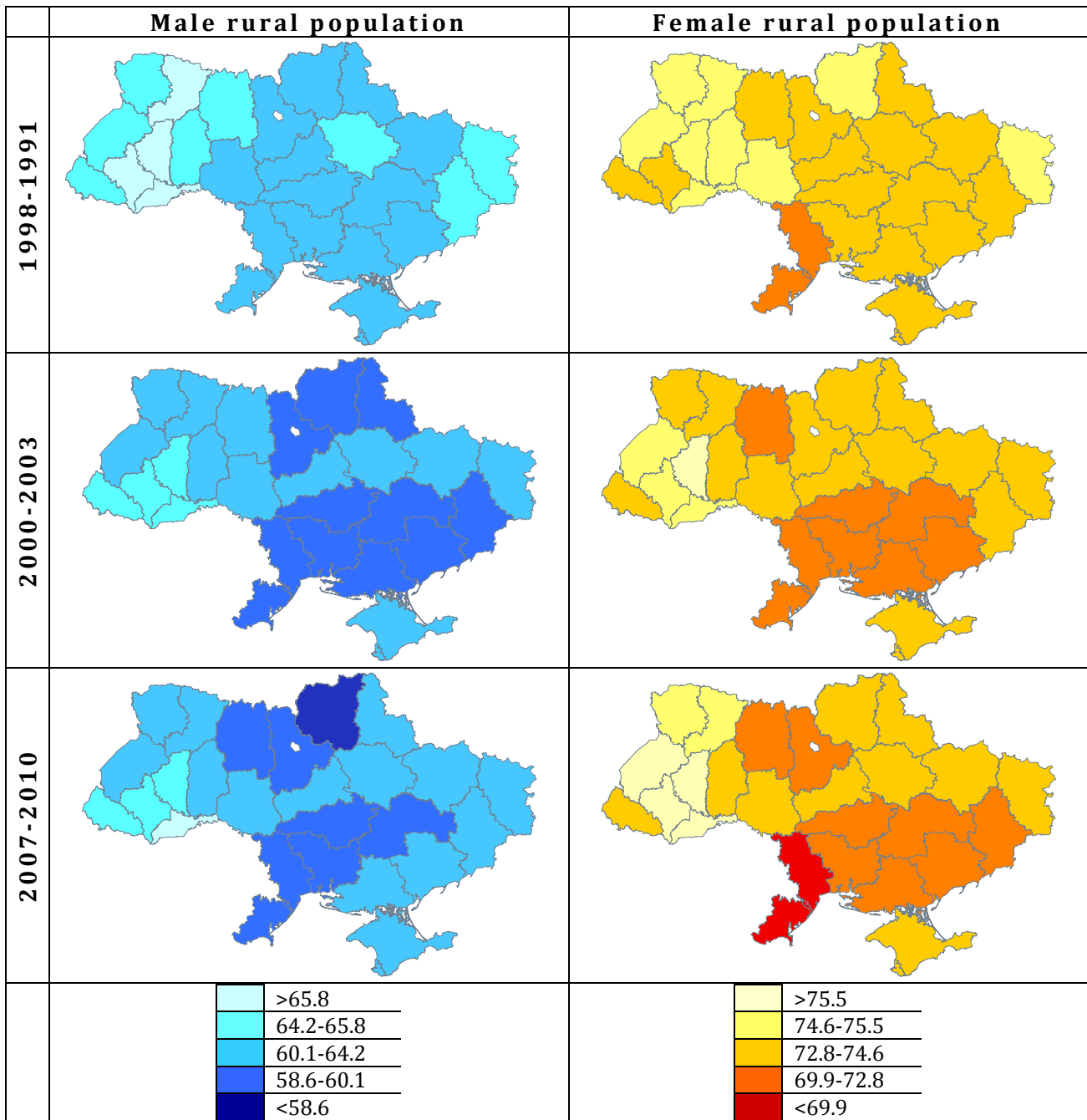
**Table 3: Life expectancy at birth in three periods, by sex and regions, Ukraine**

Region	1988-1991			2000-2003			2007-2010		
	male	female	diff	males	female	diff	male	female	diff
AR Crimea	65.31	74.56	9.3	62.14	73.31	11.2	63.18	74.36	11.2
Vinnitska	65.57	74.72	9.2	63.44	74.16	10.7	64.37	75.34	11.0
Volynska	66.58	75.27	8.7	62.81	74.03	11.2	63.25	75.35	12.1
Dnipropetrovska	65.18	74.31	9.1	60.57	72.43	11.9	61.80	73.08	11.3
Donetska	65.13	74.37	9.2	60.07	72.46	12.4	61.47	73.21	11.7
Zhytomyrska	65.82	74.76	8.9	61.30	73.42	12.1	61.39	73.76	12.4
Zakarpatska	65.84	73.22	7.4	64.38	73.17	8.8	64.47	73.25	8.8
Zaporizka	65.15	74.50	9.3	60.96	73.38	12.4	63.42	74.46	11.0
Ivano-Frankivska	66.92	74.80	7.9	64.86	74.99	10.1	65.82	76.46	10.6
Kyivska	65.42	74.97	9.6	61.58	73.61	12.0	61.92	73.76	11.8
Kirovohradska	64.07	74.18	10.1	60.38	72.58	12.2	61.66	73.42	11.8
Luhanska	65.00	74.39	9.4	60.27	72.65	12.4	62.42	73.73	11.3
Lvivska	66.84	75.39	8.6	64.68	75.22	10.5	65.78	76.55	10.8
Mykolayivska	64.15	74.12	10.0	59.88	72.21	12.3	61.70	73.03	11.3
Odeska	64.01	72.81	8.8	61.00	71.52	10.5	62.66	72.40	9.7
Poltavska	66.07	75.08	9.0	61.98	73.76	11.8	63.38	74.53	11.2
Rivnenska	66.38	75.09	8.7	63.12	74.03	10.9	63.73	75.23	11.5
Sumska	65.55	75.07	9.5	61.64	73.88	12.2	63.22	74.69	11.5
Ternopilaska	66.76	75.63	8.9	65.12	75.63	10.5	66.18	77.02	10.8
Kharkivska	65.06	74.45	9.4	62.28	73.51	11.2	64.46	74.74	10.3
Khersonska	63.33	73.70	10.4	59.64	72.40	12.8	61.99	73.56	11.6
Khmelnitska	66.13	75.38	9.3	63.64	74.83	11.2	64.14	75.53	11.4
Cherkaska	65.38	74.94	9.6	62.61	73.75	11.1	63.84	74.83	11.0
Chernivetska	66.89	74.95	8.1	65.65	74.92	9.3	66.43	76.15	9.7
Chernihivska	65.88	75.73	9.9	60.69	74.14	13.5	60.90	74.59	13.7
City of Kyiv	67.78	74.78	7.0	65.97	75.28	9.3	67.40	76.45	9.1
<i>Ukraine</i>	<i>65.54</i>	<i>74.61</i>	<i>9.1</i>	<i>62.04</i>	<i>73.47</i>	<i>11.4</i>	<i>63.36</i>	<i>74.41</i>	<i>11.0</i>

**Figure 7: Life expectancy at birth for urban population by sex and by regions in Ukraine in tree periods**

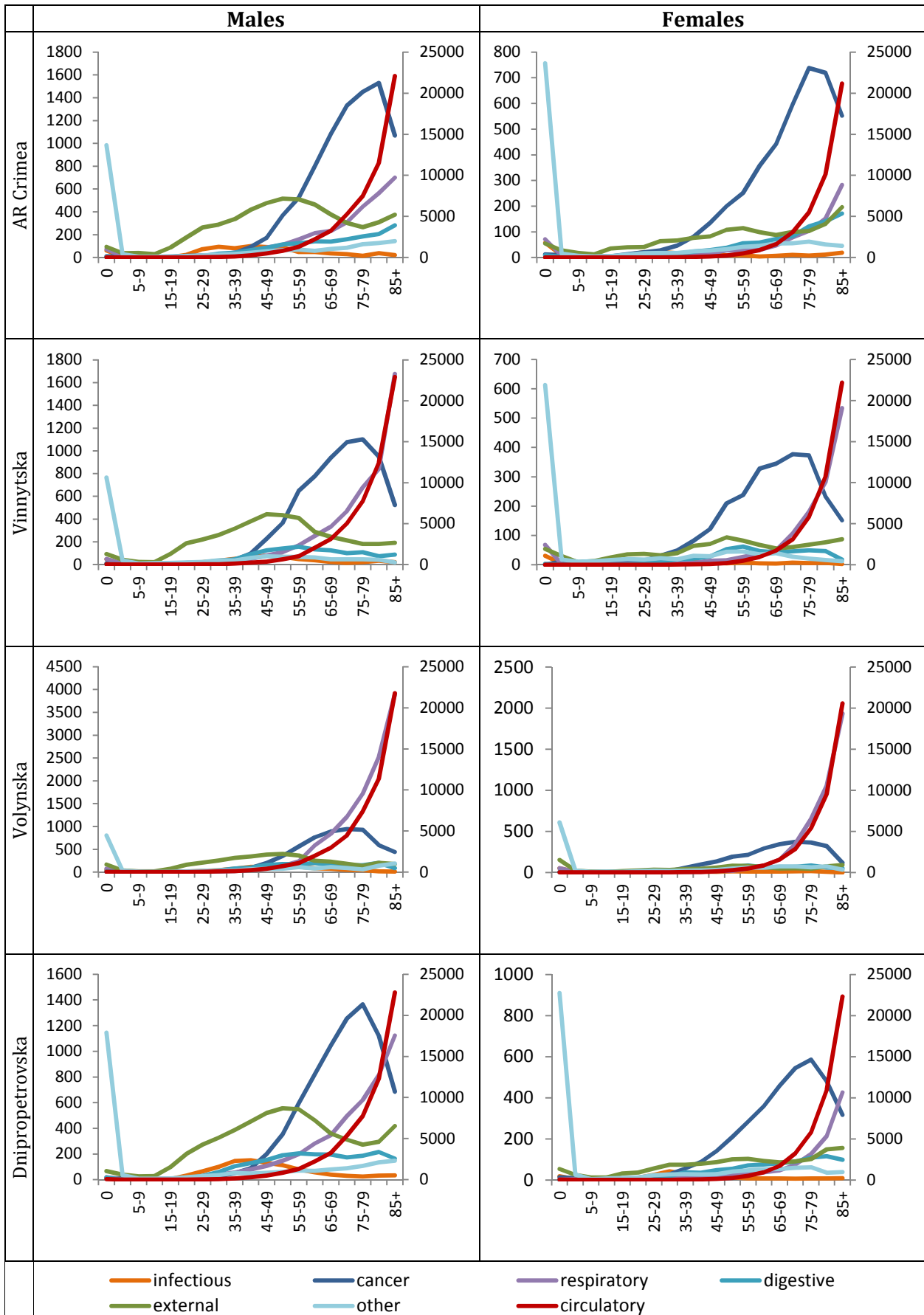


**Figure 8: Life expectancy at birth for rural population by sex and by regions in Ukraine in tree periods**

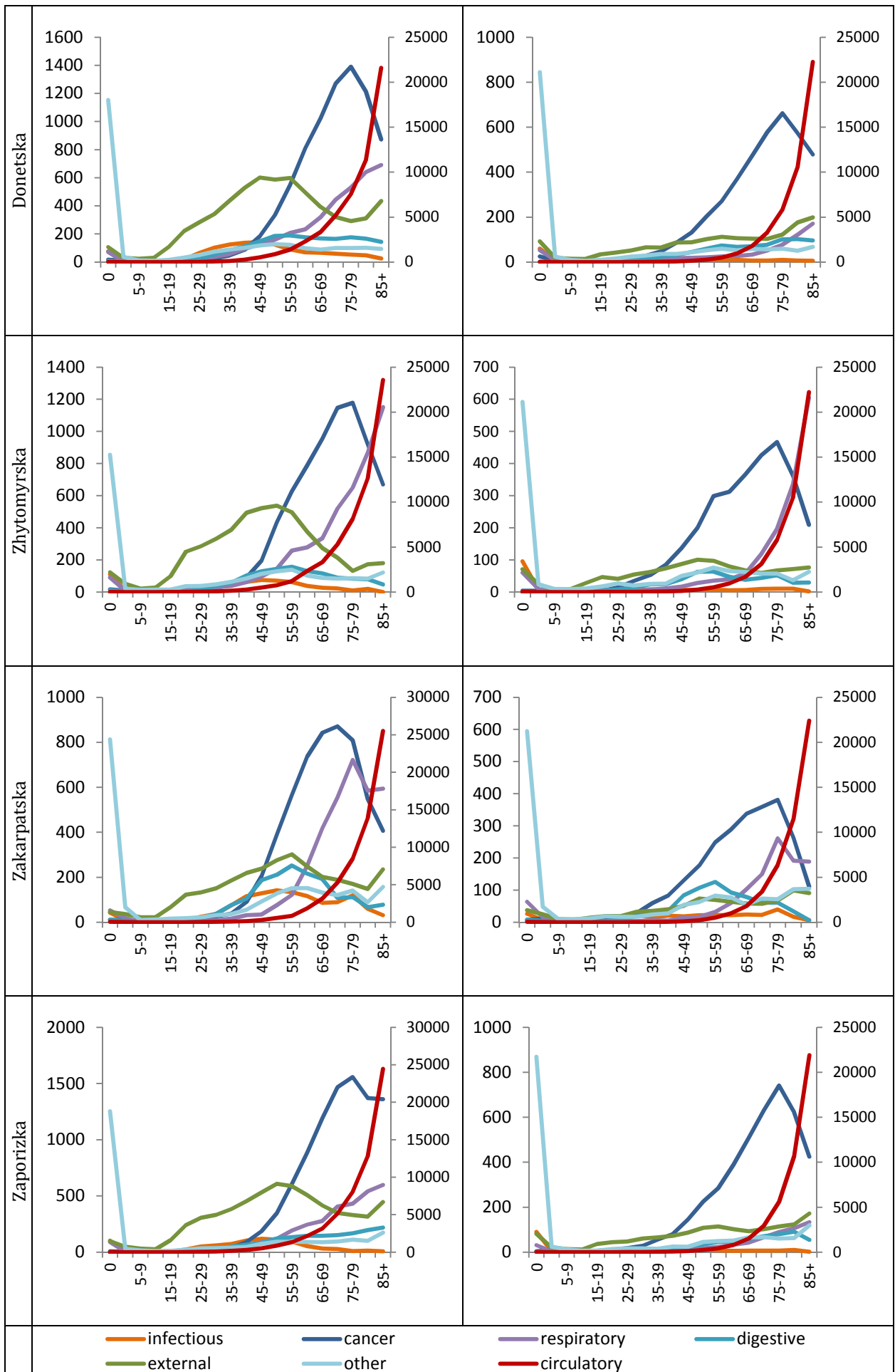


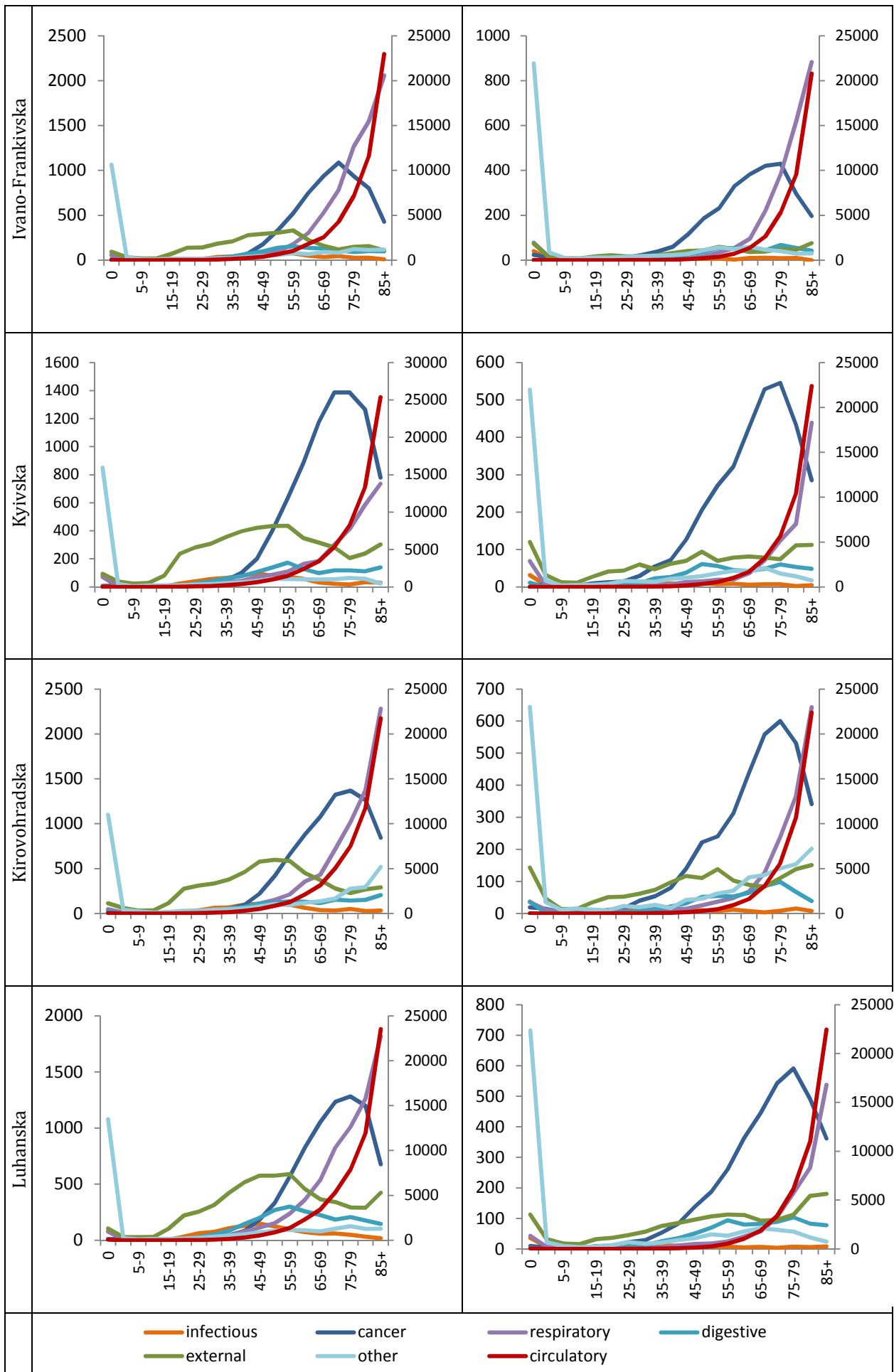
ANNEX O: Age-specific death rates, 2000-2003

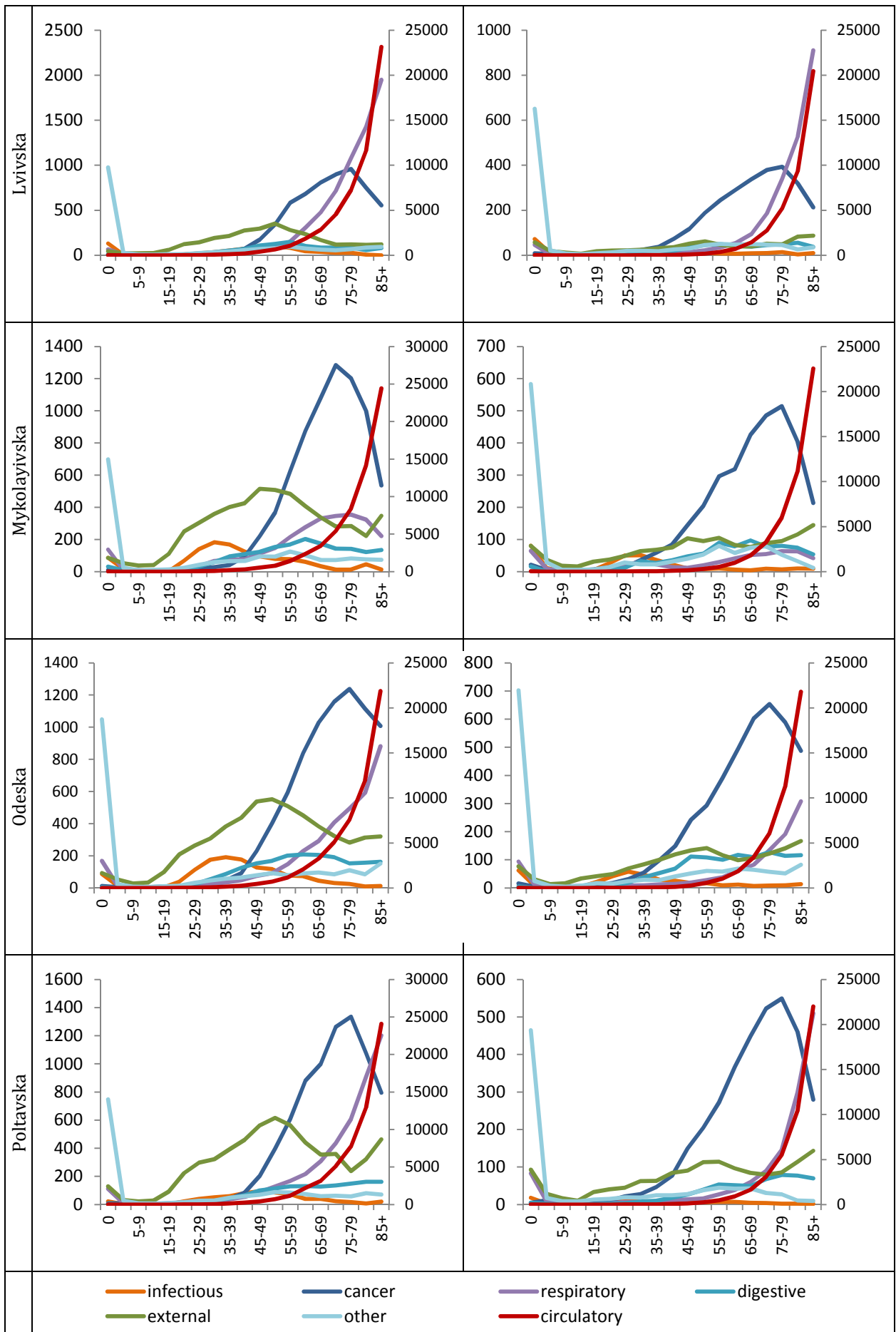
Figure 9: Age-specific death rates from different causes by regions, 2000-2003

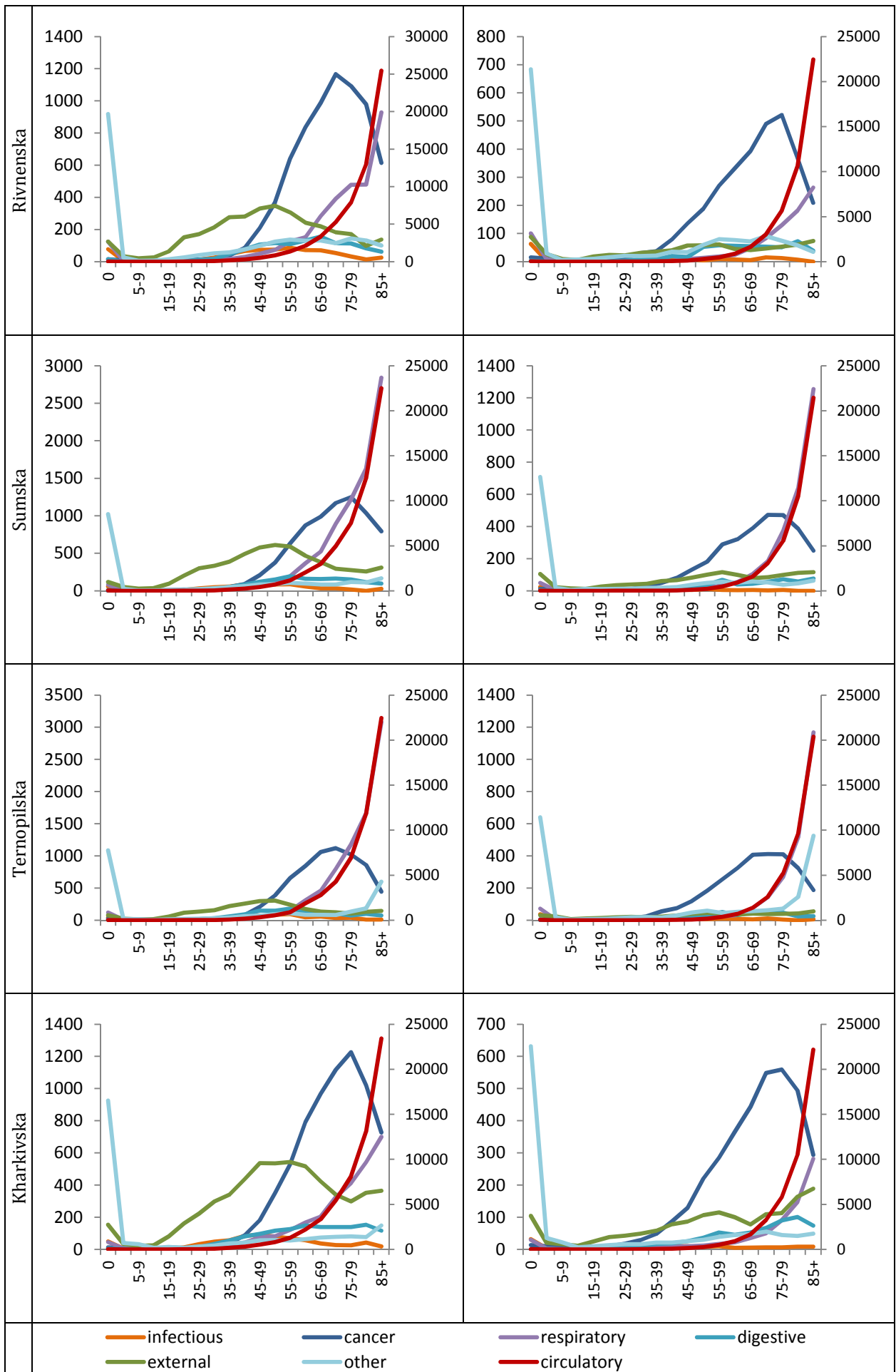


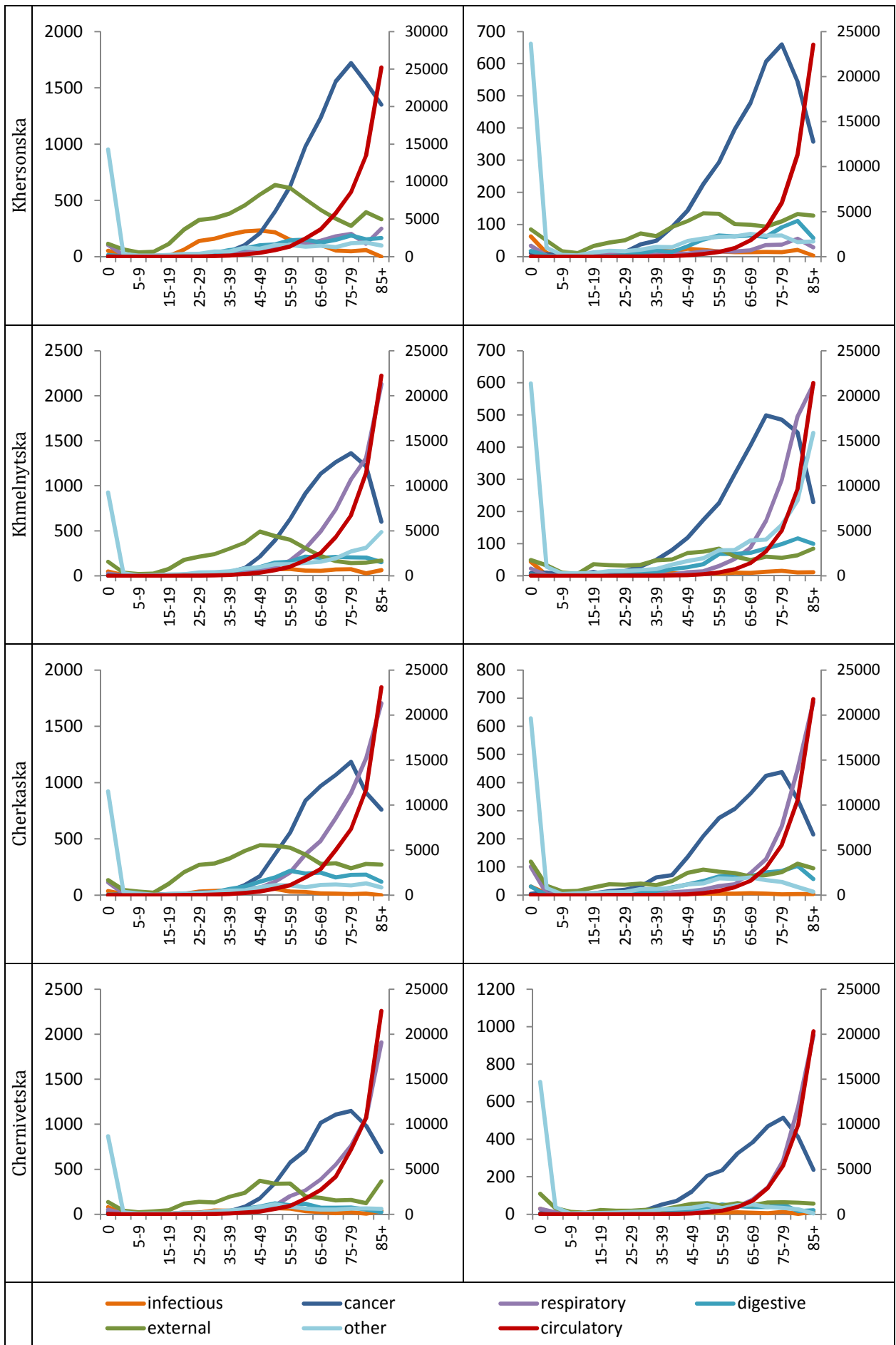














**Table 4: Infant mortality rate by regions, 2000-2003 (with correction for underregistration)**

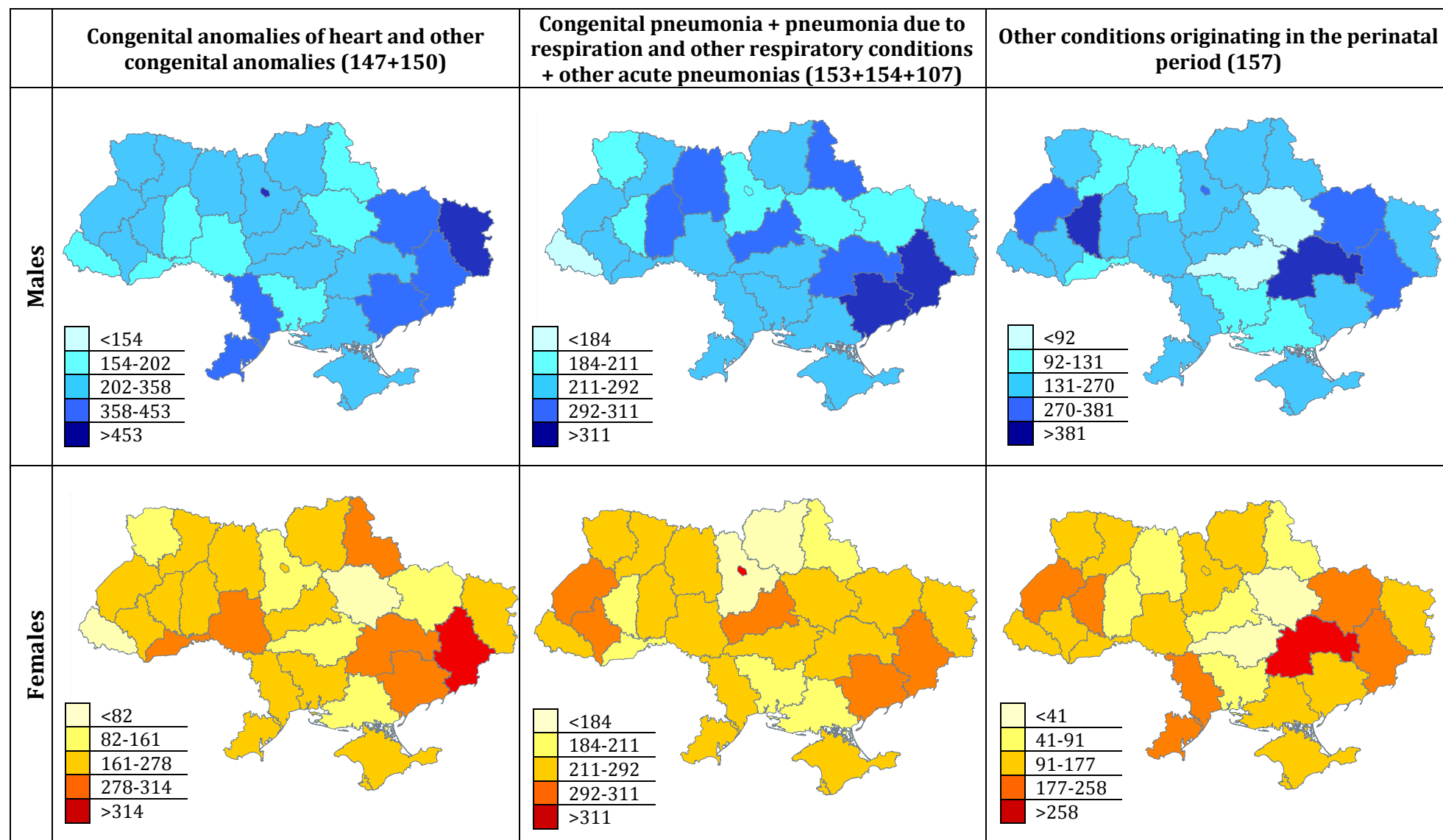
Code	Total	Male	Female	Total urban	Males urban	Female urban	Total rural	Male rural	Female rural
Ukraine	12.7	14.7	10.7	12.3	14.4	10.4	13.4	15.2	11.2
AR Crimea	12.6	14.5	10.8	12.0	13.5	10.8	13.4	15.8	10.7
Vinnyska	9.9	11.0	8.6	11.1	12.2	9.9	8.8	9.9	7.4
Volynska	11.8	13.2	10.2	10.0	11.2	8.7	13.2	14.9	11.5
Dnipropetrovska	15.6	17.4	13.6	15.4	17.4	13.3	16.3	17.4	14.9
Donetska	16.3	18.6	14.0	16.3	18.6	13.9	16.6	17.8	15.2
Zhytomyrska	10.5	12.4	8.4	10.8	13.5	8.0	10.4	11.6	9.1
Zakarpatska	11.2	12.7	9.7	15.8	19.0	12.5	8.7	9.3	8.1
Zaporizka	14.6	17.0	11.9	13.3	15.5	10.9	18.1	21.0	14.5
Ivano-Frankivska	13.4	14.4	12.2	12.8	14.5	11.1	14.7	15.2	14.0
Kyivska	9.5	11.1	7.8	9.2	10.8	7.5	9.9	11.5	8.0
Kirovohradska	15.1	17.8	12.1	15.8	18.8	12.7	14.1	16.6	11.3
Luhanska	13.2	15.8	10.6	13.4	15.9	10.8	12.4	15.0	9.7
Lvivska	15.0	17.8	12.0	11.5	13.6	9.2	19.6	23.2	15.7
Mykolayivska	10.9	12.0	9.8	11.2	12.5	9.9	10.7	11.5	9.9
Odeska	13.3	15.7	10.8	12.4	14.4	10.4	14.5	17.4	11.3
Poltavska	9.7	11.7	7.6	8.2	10.3	6.1	12.7	14.6	10.7
Rivnenska	14.4	16.3	12.4	14.2	16.4	11.9	14.6	16.2	12.7
Sumska	11.4	13.4	9.3	10.5	12.1	8.8	16.2	19.6	12.4
Ternopilska	13.0	16.1	9.6	13.1	16.5	9.6	12.9	15.7	9.6
Kharkivska	12.7	15.0	10.3	11.6	14.0	9.2	16.2	18.2	14.0
Khersonska	12.4	14.6	10.2	13.2	15.9	10.5	11.5	13.0	9.8
Khmelnyska	9.7	11.8	7.4	9.9	11.9	7.7	12.1	14.7	9.0
Cherkaska	13.9	15.7	11.7	12.2	14.2	9.8	16.0	17.4	13.9
Chernivetska	10.9	12.2	9.4	11.9	14.0	9.8	11.3	12.4	10.0
Chernihivska	11.9	14.5	9.1	11.0	12.8	9.1	13.6	17.5	9.2
City of Kyiv	11.3	12.8	9.9	11.3	12.8	9.9			
Sevastopol (aggregation)	12.0	11.9	12.4	12.2	11.5	12.3	15.2	19.5	15.9

**Table 5: Cause-specific IMR for selected etiologic categories, by regions, per 100 000 of standard population, average for 2000-2003**

Code	Congenital anomalies of heart and other congenital anomalies (147+150)		Congenital pneumonia + pneumonia due to respiration and other respiratory conditions + other acute pneumonias (153+154+107)		Other conditions originating in the perinatal period (157)		Intrauterine hypoxia and birth asphyxia (152)		Accidental inhalation and ingestion causing obstruction of respiratory tract, foreign body entering other orifices (169)	
	male	fem	male	fem	male	fem	male	fem	male	fem
Ukraine	327.2	255.2	305.2	209.8	225.0	150.0	69.7	43.7	69.4	48.6
AR Crimea	264.6	232.5	314.6	277.8	269.5	175.9	87.5	65.9	45.7	31.2
Vinnyska	249.9	252.7	353.2	312.7	134.5	97.4	27.0	8.1	92.2	58.9
Volynska	321.7	278.4	163.4	100.4	145.6	108.2	104.4	65.5	137.7	131.9
Dnipropetrovska	361.1	284.9	394.2	289.0	381.2	301.8	28.8	23.5	41.1	23.3
Donetska	385.7	300.2	453.0	343.5	326.4	215.5	52.0	32.7	92.0	50.3
Zhytomyrska	284.8	213.2	370.4	187.6	111.3	73.0	34.3	9.1	54.6	27.2
Zakarpatska	247.5	235.8	132.1	66.5	180.3	147.7	109.8	52.6	35.6	28.7
Zaporizka	394.2	298.7	501.1	289.1	179.3	130.7	97.9	76.3	74.4	45.8
Ivano-Frankivska	349.5	310.9	310.8	239.4	178.5	130.4	94.1	76.2	46.0	19.8
Kyivska	263.9	183.7	200.1	152.0	246.2	120.6	3.5	0.0	18.1	15.7
Kirovohradska	348.5	219.4	262.5	160.8	92.0	14.6	244.4	127.3	131.3	137.3
Luhanska	477.0	291.5	296.2	191.4	248.6	163.1	65.0	34.0	75.0	68.2
Lvivska	321.6	300.2	345.8	175.2	309.2	200.4	60.8	24.6	49.7	39.2
Mykolayivska	229.9	188.1	235.9	161.9	109.0	54.3	88.2	97.3	58.9	69.6
Odeska	378.4	268.3	281.0	176.2	242.8	194.5	45.3	27.4	51.8	42.8
Poltavska	254.7	237.6	177.5	81.9	70.5	41.0	124.6	87.5	77.6	57.2
Rivnenska	358.0	261.8	327.4	204.5	130.7	134.3	52.5	0.0	119.7	73.9
Sumska	231.5	208.8	445.9	313.5	177.2	90.9	45.3	24.2	96.1	91.5
Ternopilska	361.6	191.2	154.3	173.6	497.1	257.8	54.5	18.2	69.4	18.4
Kharkivska	376.1	291.3	184.3	160.2	326.3	199.0	55.3	24.8	93.1	52.0
Khersonska	314.9	210.8	310.2	142.3	103.2	97.2	203.2	176.1	79.1	38.8
Khmelnyska	242.8	223.6	358.0	184.9	160.5	69.1	77.2	32.2	118.8	36.6
Cherkaska	342.5	293.3	435.0	207.7	172.7	79.7	108.4	112.1	102.5	75.5
Chernivetska	220.5	191.5	314.1	292.0	99.6	116.7	59.1	32.3	113.4	103.3
Chernihivska	317.8	168.0	279.2	204.0	181.2	155.3	29.7	6.4	74.8	54.0
City of Kyiv	426.3	327.3	201.6	202.7	302.6	177.0	58.0	37.1	3.0	3.4



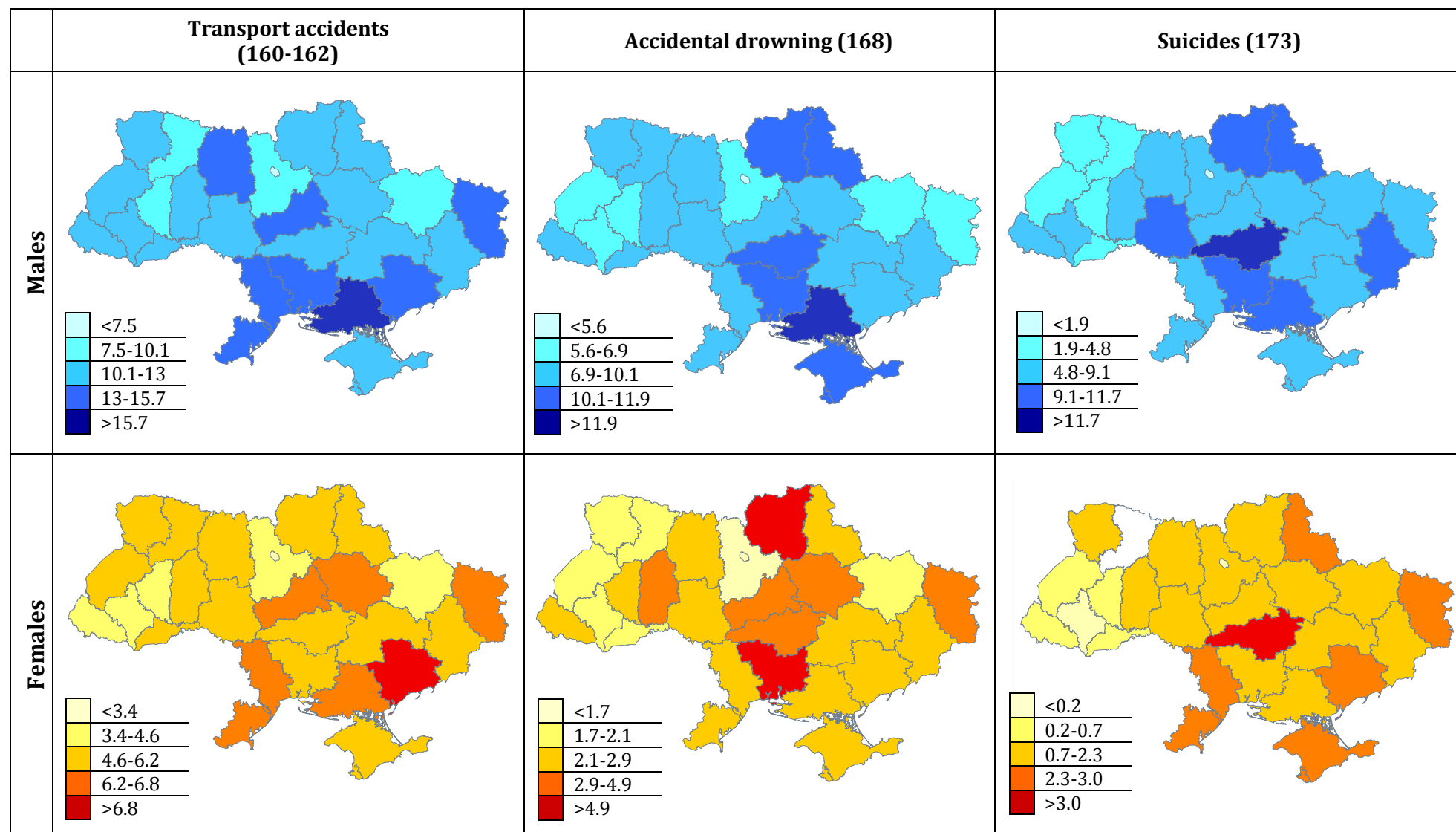
Figure 10: IMR from main three killers per 100 000 live birth, average for 2000-2003



**Table 6: Cause-specific SDR for age group 1-19, for selected etiologic categories, per 100 000 of standard population, average for 2000-2003**

Code	Transport accidents (160-162)		Accidental drowning (168)		Suicides (173)		Injury undetermined (175)		Other diseases of nervous system (83)		Accidents caused by electrical current (171)		Other accidents (172)		Accidental poisoning (163-164)		Homicide (174)		Leukaemia (65)	
	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem
Ukraine	11.1	5.4	8.1	2.6	7.1	1.6	4.6	1.9	4.2	2.6	3.7	0.5	3.7	1.3	3.1	2.3	3.0	2.1	2.0	1.6
AR Crimea	10.5	5.7	10.4	2.8	8.5	2.8	3.3	1.7	2.1	0.8	2.8	0.2	5.0	1.6	3.3	3.1	4.4	3.3	1.4	1.1
Vinnitska	11.0	6.2	7.4	2.7	10.1	1.4	3.8	1.7	7.4	5.0	3.4	0.2	2.6	1.0	2.9	2.8	2.4	1.1	1.9	1.3
Volynska	10.6	5.0	7.7	1.7	4.8	0.7	4.5	0.9	4.8	3.5	2.9	0.2	3.6	1.2	1.8	1.1	1.8	0.9	2.8	2.5
Dnipropetrovska	10.4	5.1	8.9	2.5	8.0	2.2	5.3	2.5	4.4	2.6	4.2	0.5	6.0	1.9	3.4	2.5	3.9	1.9	2.0	1.2
Donetska	12.1	5.9	7.2	2.8	9.5	1.7	3.4	2.0	5.4	2.9	5.6	0.4	3.4	0.8	4.8	3.0	4.8	4.0	2.0	1.3
Zhytomyrska	13.0	6.1	8.5	2.6	8.7	2.3	5.9	0.8	3.7	2.1	2.0		4.4	1.4	3.4	1.2	2.7	1.6	2.2	2.0
Zakarpatska	11.3	3.4	7.1	2.6	4.8	0.6	0.5		3.3	2.0	3.8	0.5	3.3	1.5	1.0	1.2	1.9	1.0	1.9	2.0
Zaporizka	15.7	7.8	9.0	2.4	8.5	2.4	3.5	0.7	6.9	4.8	5.4	0.4	2.9	0.8	4.9	2.9	3.0	3.0	2.2	1.4
Ivano-Frankivska	10.8	3.5	6.3	1.8	5.0	0.2	2.8	1.0	5.2	2.9	3.5	0.3	3.3	0.7	2.9	2.3	2.2	0.9	1.7	2.1
Kyivska	9.4	3.4	5.6	1.6	5.4	1.5	16.2	8.2	4.2	1.3	2.8	0.2	2.6	1.4	1.7	1.3	1.0	1.6	0.8	1.2
Kirovohradska	11.6	5.6	10.6	3.4	11.9	3.3	3.0	1.0	5.8	6.0	7.0	0.4	6.3	3.2	5.9	3.8	3.2	2.2	3.3	2.1
Luhanska	13.3	6.3	6.0	2.9	9.0	2.3	3.0	0.7	3.1	1.6	4.0	0.7	5.9	1.9	3.4	3.6	3.7	3.3	2.3	1.0
Lvivska	10.1	6.1	6.9	2.1	2.3	0.5	2.8	0.7	3.2	2.1	2.5	0.2	3.1	0.6	2.4	1.5	2.2	1.0	1.6	1.3
Mykolayivska	13.6	5.4	11.9	5.0	10.6	2.2	2.8	1.3	3.7	2.7	6.1	1.0	5.0	1.7	4.1	4.5	4.5	1.4	2.8	1.0
Odeska	13.3	6.6	8.6	2.6	7.9	2.4	4.3	1.6	2.7	2.3	4.6	0.9	5.0	1.8	2.7	2.1	4.7	3.0	2.5	1.2
Poltavska	11.4	6.6	9.6	3.9	8.3	1.9	1.0	1.0	4.1	2.4	4.4	1.0	3.0	1.4	4.5	2.3	3.1	1.6	1.9	1.9
Rivnenska	9.4	4.9	10.1	2.0	2.4		1.4	0.3	4.4	2.4	2.7		3.2	1.3	1.8	0.8	1.5	1.7	2.8	2.3
Sumska	11.1	4.6	11.4	2.3	11.7	3.0	3.7	1.4	3.0	2.1	3.3	0.2	3.1	1.1	3.0	2.9	3.2	1.0	1.7	1.3
Ternopilaska	7.8	3.6	6.4	2.4	2.5	0.5	1.0	0.7	4.1	2.1	1.7	0.8	3.5	0.7	2.3	1.3	1.1	0.7	1.4	0.7
Kharkivska	7.5	3.7	5.9	1.7	6.4	1.1	9.4	3.7	9.2	6.4	3.0	0.7	4.2	1.8	2.3	1.4	2.0	1.9	2.3	2.0
Khersonska	15.8	6.8	12.4	2.8	9.1	1.6	2.0	1.8	4.1	1.3	7.5	0.7	4.7	1.1	6.8	4.6	5.7	3.3	3.1	1.4
Khmelnyska	10.2	5.9	8.5	3.1	8.2	1.7	2.2	1.2	4.5	3.0	2.3	0.4	1.9	1.1	3.5	2.0	1.7	2.9	2.1	3.3
Cherkaska	15.3	6.5	9.1	3.1	8.1	2.2	5.4	2.0	3.4	2.2	3.7	0.8	2.3	0.3	3.5	2.5	2.5	2.6	2.0	1.5
Chernivetska	10.1	6.0	8.7	2.1	1.9	0.4	3.6	1.1	1.3	1.6	1.8	1.0	3.1	2.3	1.0	1.2	1.5	0.2	2.5	1.4
Chernihivska	12.0	4.8	11.2	4.9	9.8	1.6	3.3	2.2	2.0	1.0	4.2	0.6	2.8	1.0	2.2	1.6	2.0	1.8	1.8	2.0
City of Kyiv	5.8	3.3	4.0	1.7	0.9	0.1	11.9	4.5	1.4	1.3	0.9	0.3	0.2	0.1	1.0	0.9	1.4	0.9	1.4	1.5

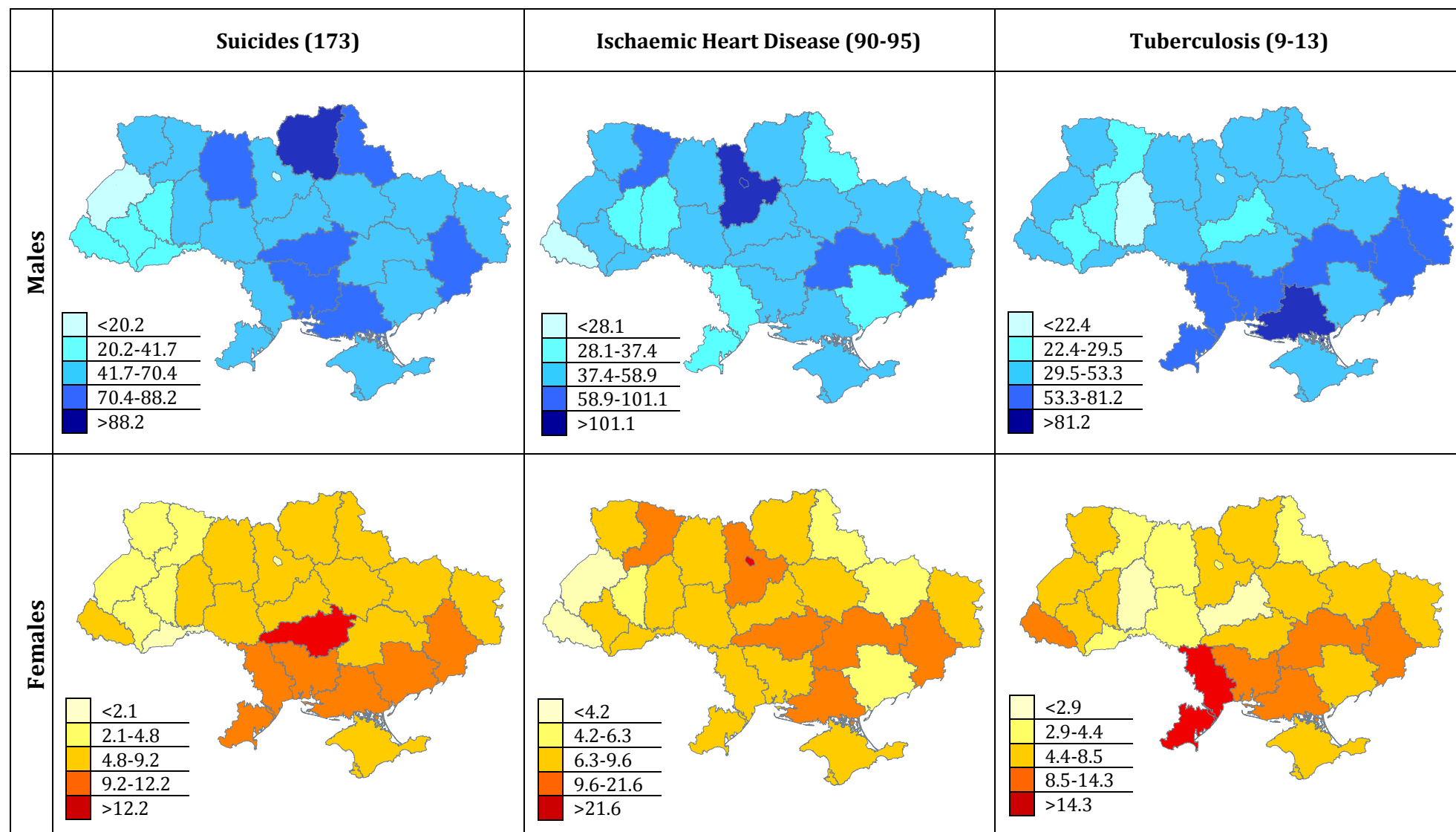
Figure 11: Cause-specific SDR for age group 1-19 years for main three killers, per 100 000 of standard population, average for 2000-2003



**Table 7: Cause-specific SDR for age group 20-44, for selected etiologic categories, per 100 000 of standard population, average for 2000-2003**

Code	Suicides (173)		Ischaemic heart disease (90-95)		Tuberculosis (9-13)		Injury undetermined... (175)		Accidental poisoning by alcohol (163)		Other heart diseases (97)		Homicides (174)		Other accidents (172)		Cirrhosis of liver (122+123)		Pneumonia (105-107)	
	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem
Ukraine	55	7	54	10	52	8	42	8	36	6	30	7	26	7	25	4	28	9	20	5
AR Crimea	61	9	43	8	53	7	25	5	46	9	44	11	33	10	24	3	16	7	22	6
Vinnitska	66	6	48	9	32	4	30	5	32	5	22	5	17	6	14	2	25	7	16	4
Volynska	42	4	50	7	50	7	34	6	22	3	31	7	15	3	19	2	27	8	12	3
Dnipropetrovska	59	9	64	12	79	13	64	14	43	8	23	7	32	10	34	6	47	15	29	8
Donetska	71	10	67	13	73	11	46	8	39	6	11	2	45	12	37	5	33	11	36	9
Zhytomyrska	70	7	43	6	31	4	44	9	43	7	46	11	25	8	31	4	32	11	24	5
Zakarpatska	36	6	22	4	49	13	2	0	7	3	20	8	14	4	17	3	20	10	6	2
Zaporizka	67	9	35	6	53	7	35	6	27	5	68	13	40	9	21	3	18	5	23	5
Ivano-Frankivska	32	3	51	7	29	5	23	3	14	2	33	6	11	2	20	2	21	5	9	3
Kyivska	57	7	123	22	43	6	121	22	6	0	22	4	19	5	19	3	28	11	17	3
Kirovohradska	83	13	50	10	51	8	26	5	47	9	46	9	33	9	38	8	22	6	21	5
Luhanska	67	8	59	8	79	8	29	6	54	10	25	6	39	11	37	6	47	13	20	3
Lvivska	20	2	41	4	36	5	26	4	29	2	23	6	12	3	16	2	26	7	11	2
Mykolayivska	73	10	47	8	81	14	37	6	37	6	69	21	34	8	30	5	40	16	34	13
Odeska	64	10	28	6	77	15	30	10	41	11	51	15	33	10	35	8	43	20	11	4
Poltavska	67	9	45	7	43	5	22	4	64	10	32	7	25	7	29	6	17	6	21	4
Rivnenska	42	5	78	11	29	4	13	1	18	4	25	6	14	5	21	2	20	6	9	1
Sumska	88	9	32	5	42	3	30	5	57	7	38	5	27	8	23	3	22	5	8	1
Ternopil'ska	27	3	36	4	28	5	10	1	33	2	9	2	8	3	14	2	21	6	8	2
Kharkiv'ska	48	7	37	6	43	6	67	15	52	8	51	11	21	7	31	5	22	6	15	3
Kherson'ska	73	12	59	10	142	13	28	5	41	8	34	8	42	12	26	5	19	7	18	4
Khmelnitska	52	7	34	7	22	3	23	3	49	6	25	6	15	5	14	2	19	7	13	2
Cherkaska	64	7	56	9	29	2	34	5	33	3	24	5	27	7	14	2	23	8	16	3
Chernivetska	23	2	56	9	30	4	14	3	31	4	4	1	7	4	12	1	16	5	12	2
Chernihiv'ska	90	8	54	7	44	5	34	6	68	8	36	7	29	7	23	3	24	5	21	5
City of Kyiv	5	1	101	24	21	4	106	17	0	0	8	3	13	3	7	1	19	7	25	5

Figure 12: Cause-specific SDR for age group 20-44 years for main three killers, per 100 000 of standard population, average for 2000-2003



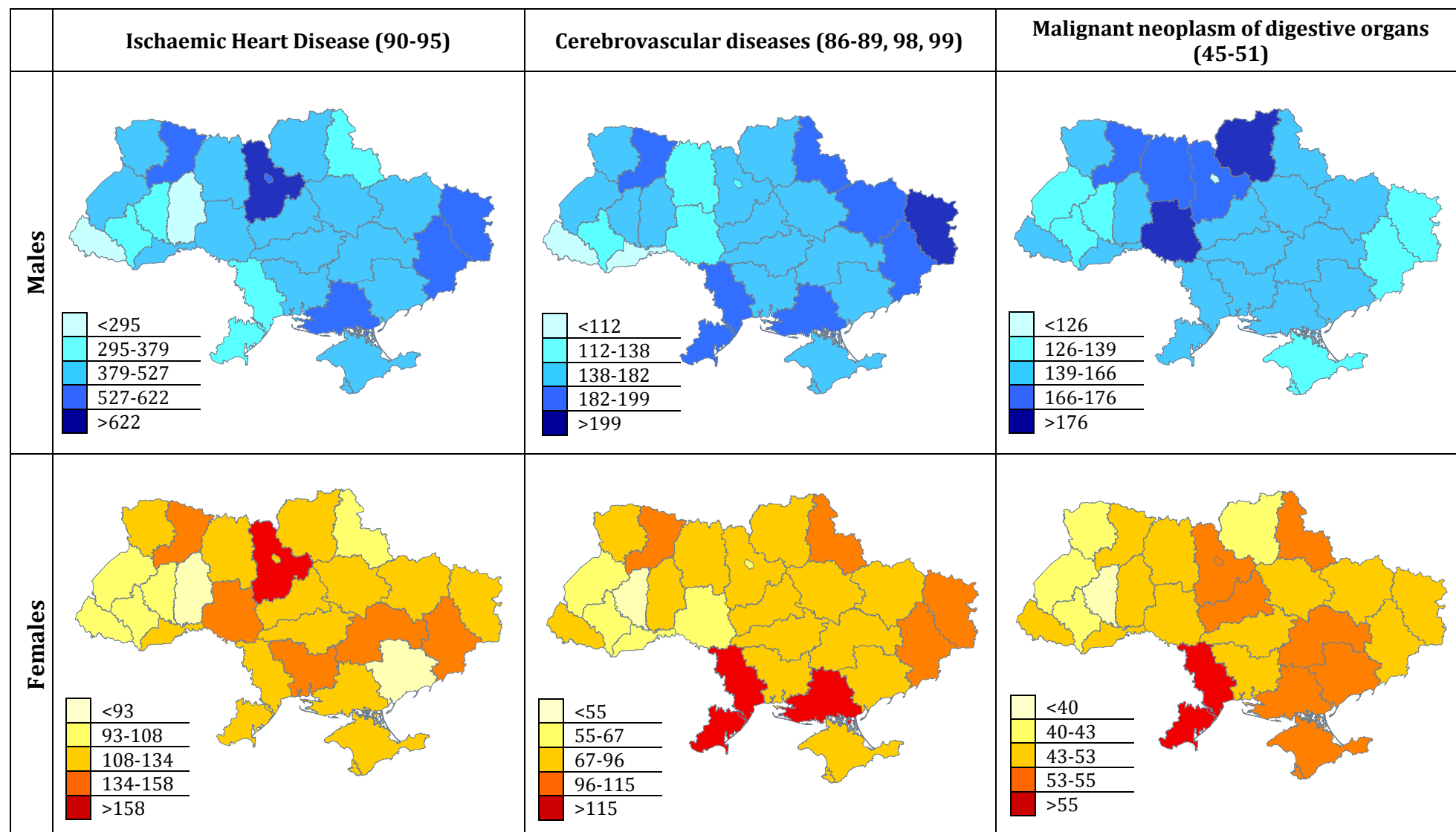
**Table 8: Cause-specific SDR for age group 45-59 for selected etiologic categories, per 100 000 of standard population, average for 2000-2003**

Code	Ischeamic heart disease (90-95)		Cerebrovascular diseases (86-89, 98, 99)		Malignant neoplasm of digestive organs (45-51)		Malignant neoplasm of respiratory organs (52-54)		Other hear diseases (84-85, 96-97)		Cirrhosis of liver (122)		Accidental poisoning by alcohol (163)	
	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem
Ukraine	463	126	165	85	146	50	120	11	110	36	99	37	92	20
AR Crimea	467	119	173	83	139	54	115	12	158	56	63	27	113	29
Vinnytska	388	143	137	66	179	49	114	12	76	25	100	36	92	21
Volynska	418	123	166	95	144	41	119	8	92	37	115	42	56	14
Dnipropetrovska	527	138	174	93	142	54	124	11	83	28	133	40	107	22
Donetska	622	150	187	98	131	50	120	11	37	16	105	39	88	19
Zhytomyrska	382	122	125	76	168	52	123	7	223	73	110	44	84	20
Zakarpatska	237	96	107	72	147	44	128	14	136	57	83	67	21	7
Zaporizka	379	93	172	82	141	54	124	13	261	61	64	20	65	14
Ivano-Frankivska	370	107	122	60	126	40	120	9	134	43	98	27	32	5
Kyivska	722	203	155	78	175	54	125	13	66	29	99	39	7	1
Kirovohradska	472	127	173	96	166	52	153	12	137	43	82	33	145	36
Luhanska	534	134	212	109	133	49	117	9	91	26	195	54	136	27
Lvivska	397	95	141	64	135	41	119	8	89	30	98	33	59	11
Mykolayivska	496	158	138	67	143	51	148	11	184	64	106	45	93	28
Odeska	315	111	199	115	165	59	130	13	189	61	121	76	102	33
Poltavska	410	112	180	93	157	49	122	14	92	32	71	25	165	38
Rivnenska	534	138	182	103	167	43	121	8	100	32	81	31	45	10
Sumska	373	108	191	102	166	55	123	10	109	28	106	29	151	28
Ternopil'ska	327	94	145	54	137	40	142	8	52	24	103	26	65	8
Kharkivska	471	130	184	94	140	51	106	12	139	42	74	22	146	27
Khersonska	529	133	198	121	144	53	150	12	97	33	69	37	127	34
Khmeln'ytska	295	70	151	73	163	45	131	8	141	42	96	32	115	22
Cherkaska	413	124	156	78	159	53	103	13	102	32	120	36	83	18
Chernivetska	395	131	112	55	141	50	116	7	50	23	72	28	93	16
Chernihivska	456	115	175	85	176	41	124	9	135	38	79	28	182	28
City of Kyiv	534	126	128	56	112	54	65	10	28	12	57	26	1	0

**Table 8 (continuation): Cause-specific SDR for age group 45-59 years for selected etiologic categories, per 100 000 of standard population, average for 2000-2003**

Code	Tuberculosis (9-13)		Suicides (173)		Undetermined injury (175)		Pneumonia (105-107)		Transport accidents (160-162)		Homicides (174)	
	male	female	male	fem	male	fem	male	fem	male	fem	male	fem
Ukraine	88	8	81	11	75	13	53	8	37	9	28	9
AR Crimea	70	8	85	14	48	7	58	10	34	8	40	11
Vinnitska	64	5	85	13	43	7	51	8	38	9	15	7
Volynska	109	6	65	9	64	13	32	5	34	8	13	5
Dnipropetrovska	105	9	87	12	106	19	73	11	33	8	35	9
Donetska	118	9	91	12	92	14	97	14	33	7	48	12
Zhytomyrska	68	6	91	10	83	16	61	10	49	10	27	11
Zakarpatska	108	12	52	12	4	0	17	3	38	10	16	7
Zaporizka	101	9	99	13	84	15	78	9	57	13	46	10
Ivano-Frankivska	71	5	51	6	46	8	26	5	36	5	11	3
Kyivska	80	7	73	12	180	32	41	8	35	7	18	7
Kirovohradska	94	7	102	14	45	10	58	9	31	7	38	10
Luhanska	125	9	87	11	59	10	55	6	34	10	43	11
Lvivska	87	9	34	4	51	9	32	6	39	8	8	4
Mykolayivska	75	6	96	13	54	10	48	7	41	7	33	11
Odeska	95	16	104	15	48	12	31	5	48	12	35	12
Poltavska	81	5	106	13	42	7	71	9	42	10	29	9
Rivnenska	69	6	62	10	20	4	20	3	38	8	18	6
Sumska	81	7	132	17	48	8	26	3	35	8	28	9
Ternopil'ska	75	7	49	5	18	2	18	2	39	8	7	3
Kharkivska	79	7	79	12	121	24	40	5	28	8	22	8
Khersonska	203	20	120	16	52	11	42	6	44	12	45	15
Khmelnitska	59	4	82	10	30	5	42	4	46	9	18	6
Cherkaska	45	3	91	15	55	7	36	6	41	10	25	11
Chernivetska	62	7	50	4	41	5	38	3	28	6	14	7
Chernihivska	87	4	128	15	47	9	68	8	41	9	23	13
City of Kyiv	31	3	9	1	200	33	67	10	31	8	12	4

Figure 13: Cause-specific SDR for age group 45-59 years for main three killers, per 100 000 of standard population, average for 2000-2003

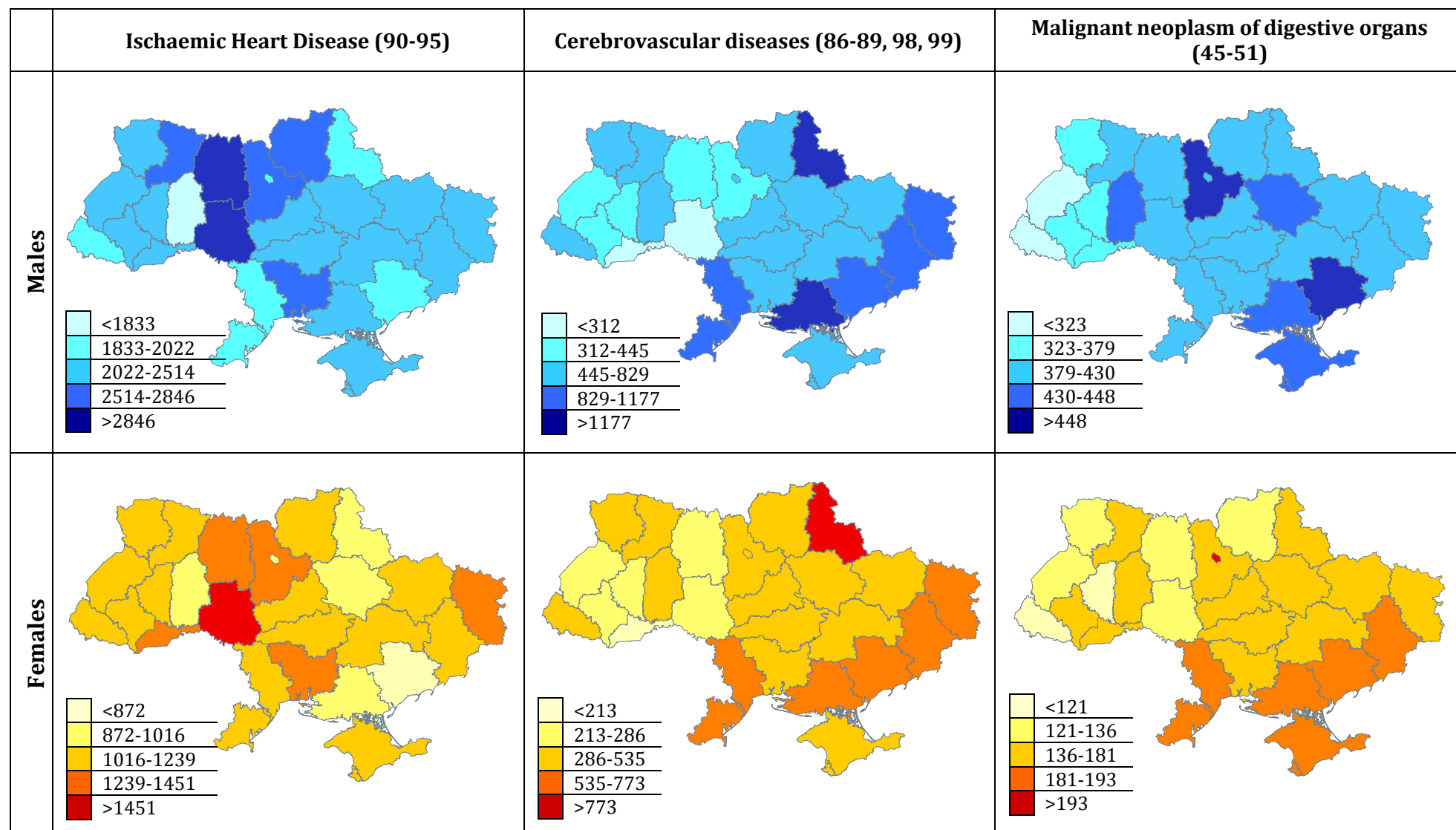




**Table 8: Cause-specific SDR for age group 60-74 for selected etiologic categories, per 100 000 of standard population, average for 2000-2003**

Code	Ischaemic heart disease (90-95)		Cerebrovascular diseases (86-89, 98, 99)		Cancer of digestive organs (45-51)		Cancer of respiratory organs (52-54)		Chronic bronchitis (108)		Diseases of arteries (100)		Other heart diseases (84-85, 96-97)		Cirrhosis of liver (122+123)		Malignant neoplasm of urinary organs (63)		Malignant neoplasm of breast (57)	
	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem	male	fem
Ukraine	2287	1153	730	473	401	162	343	32	284	48	154	73	81	40	91	33	73	14	2	72
AR Crimea	2390	1175	829	501	436	188	357	36	176	36	59	14	110	48	72	33	72	16	3	76
Vinnytska	2848	1545	312	213	398	130	296	35	301	51	19	5	49	28	82	27	64	10	2	57
Volynska	2022	1016	648	433	326	125	288	16	689	148	179	95	134	82	114	40	60	13	1	52
Dnipropetrovska	2406	1202	622	407	417	181	356	31	293	40	348	183	54	31	120	44	73	16	2	80
Donetska	2219	1085	1110	731	403	183	360	37	207	22	77	29	25	22	86	32	77	17	2	77
Zhytomyrska	2846	1451	322	222	380	136	307	21	320	55	90	35	201	85	76	27	72	12	1	59
Zakarpatska	1833	1112	577	364	323	117	285	25	329	83	664	372	96	45	107	48	50	9	4	55
Zaporizka	1910	854	1140	699	448	193	429	42	144	19	81	25	159	42	65	23	86	16	2	89
Ivano-Frankivska	2218	1156	366	257	324	141	348	31	474	104	51	12	98	48	80	31	66	11	1	52
Kyivska	2804	1386	432	286	481	160	349	37	92	17	215	112	88	41	64	22	90	12	2	66
Kirovohradska	2420	1231	664	444	424	167	406	41	380	59	81	27	81	41	82	35	77	11	4	72
Luhanska	2490	1323	872	573	412	176	367	29	441	51	73	26	64	32	152	48	83	15	0	82
Lvivska	2176	1103	445	266	312	126	281	20	435	98	241	111	46	30	57	22	58	11	2	57
Mykolayivska	2604	1305	484	339	400	158	416	32	249	37	330	164	100	44	118	51	67	14	3	75
Odeska	1914	1079	1100	741	430	182	310	37	142	26	151	88	115	50	131	68	73	15	2	95
Poltavska	2089	992	808	535	440	169	348	35	247	49	345	185	64	35	60	19	78	15	3	75
Rivnenska	2605	1235	645	430	392	153	317	26	222	37	48	13	76	37	87	33	72	14	2	62
Sumska	1879	924	1177	775	428	150	333	32	525	97	51	11	53	27	99	22	70	14	1	64
Ternopil'ska	2343	1161	406	252	335	121	396	34	469	70	20	4	43	26	84	26	79	12	2	63
Kharkiv'ska	2514	1239	773	496	379	166	320	31	171	23	54	15	119	46	70	20	67	13	3	78
Kherson'ska	2197	942	1273	773	441	188	489	40	83	13	201	87	70	37	73	29	87	18	2	81
Khmeln'ytska	1662	872	628	432	443	154	366	35	408	79	204	98	188	85	152	47	73	12	2	58
Cherkaska	2116	1104	590	378	418	143	294	30	414	64	340	192	72	36	119	40	74	12	2	59
Chernivetska	2389	1403	279	190	358	142	328	28	272	58	27	5	25	25	49	24	63	10	2	63
Chernihiv'ska	2542	1157	581	380	382	131	345	30	382	56	177	83	69	33	52	17	71	10	2	58
City of Kyiv	1846	911	580	378	399	193	249	36	29	7	80	33	48	36	68	25	74	16	2	92

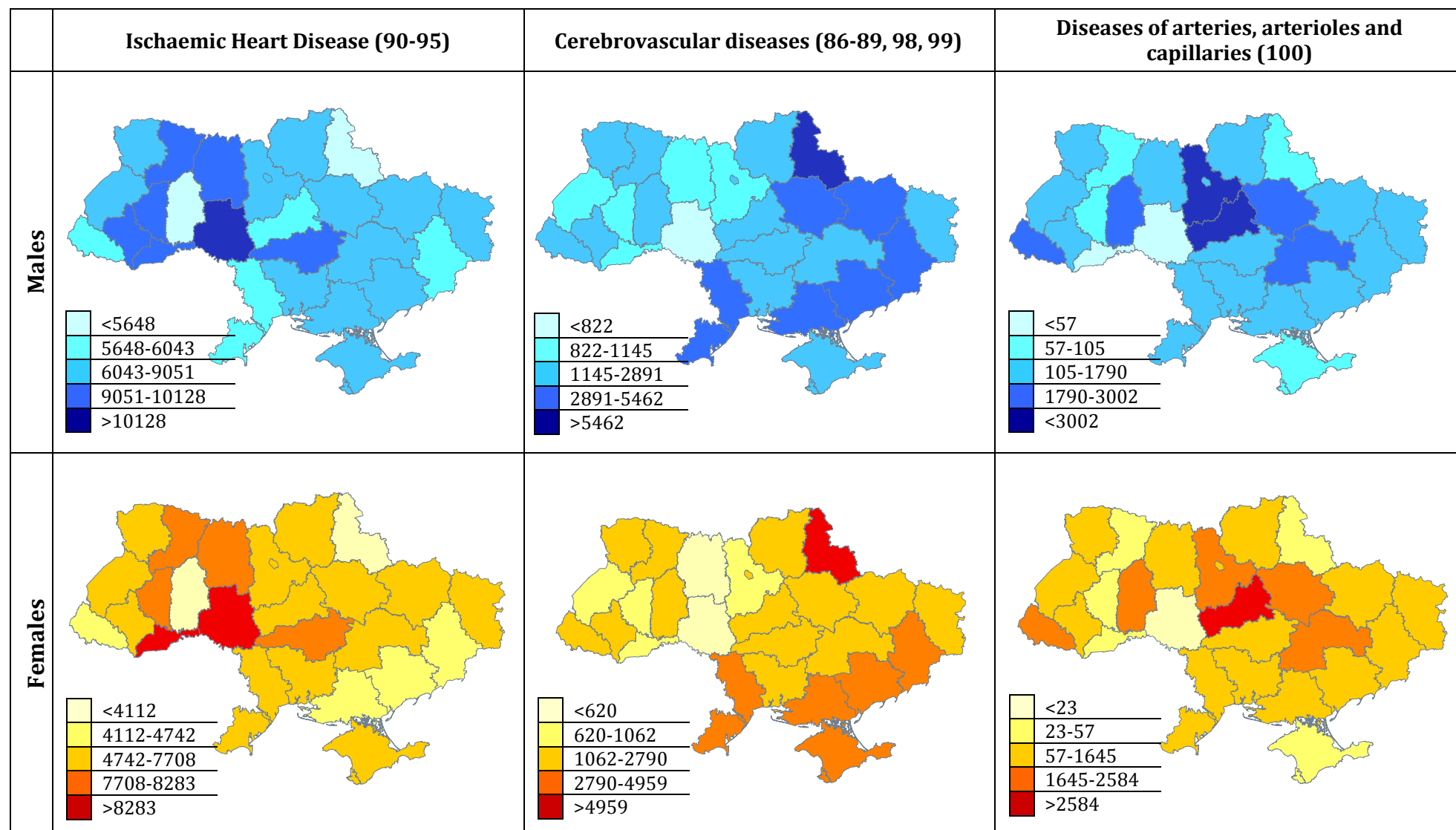
Figure 14: Cause-specific SDR for age group 60-74 years for main three killers, per 100 000 of standard population, average for 2000-2003



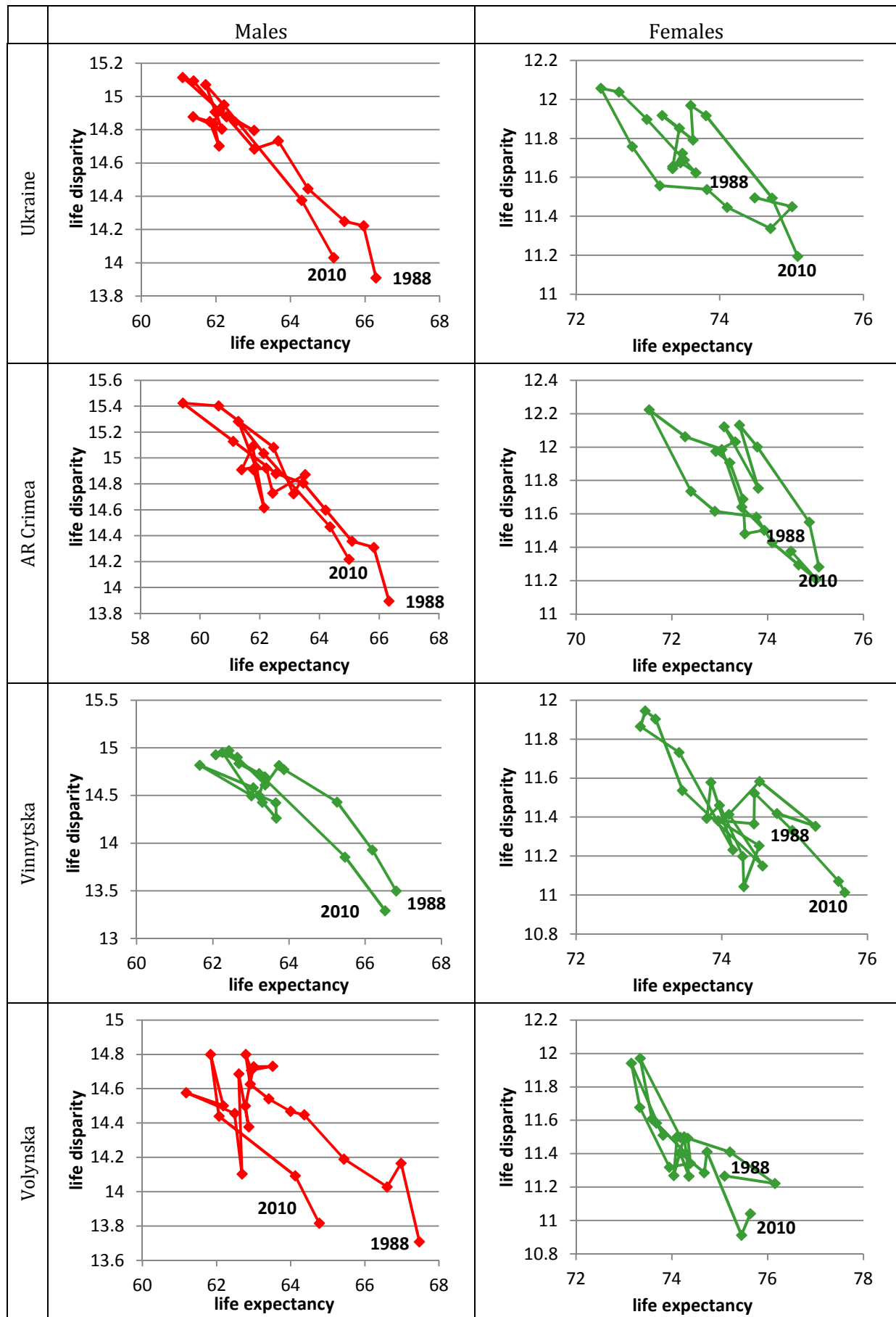
**Table 9: Cause-specific SDR for age group 75+ for selected etiologic categories, per 100 000 of standard population, average for 2000-2003**

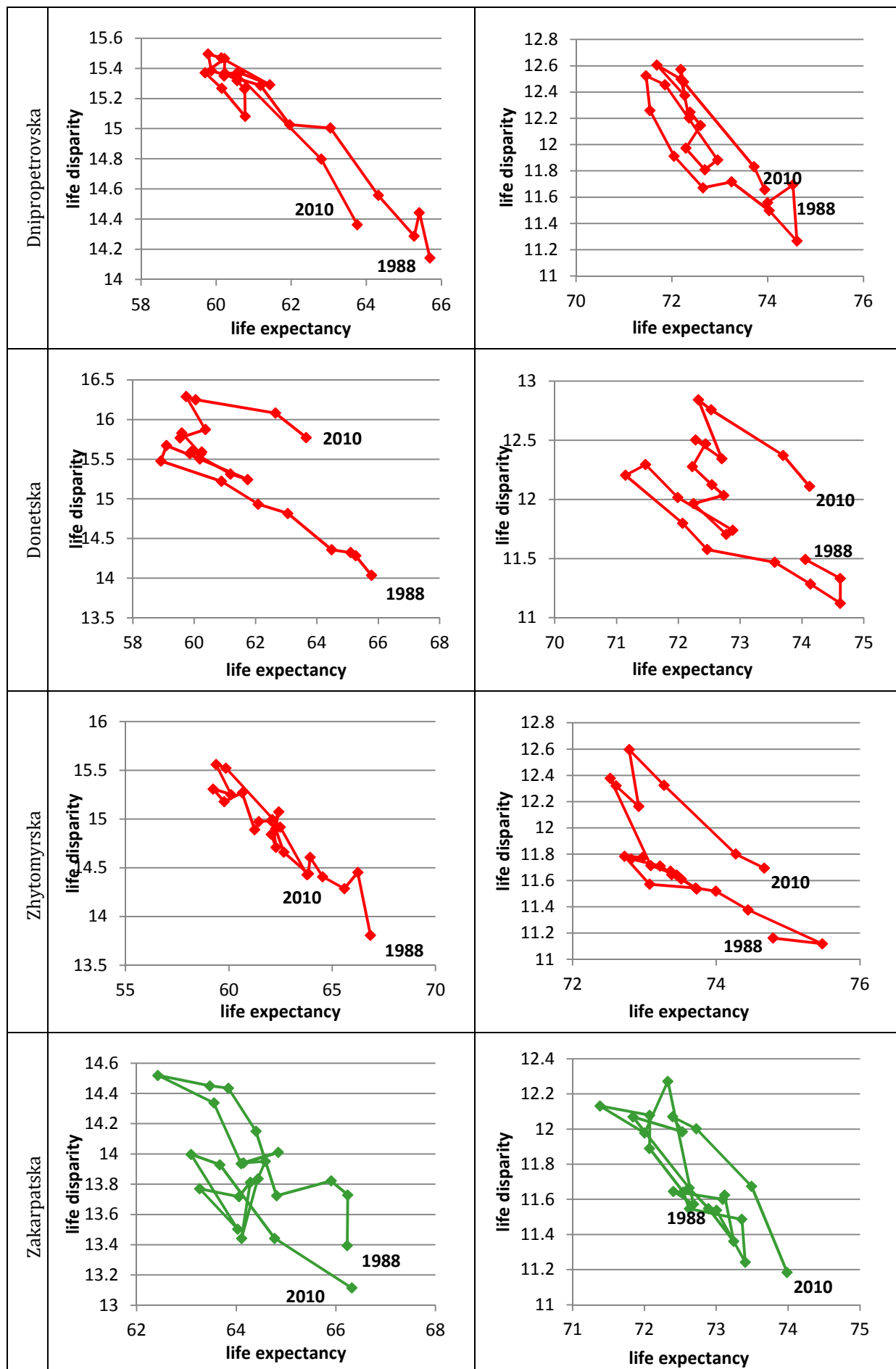
Code	Ischaemic heart disease (90-95)		Cerebrovascular diseases (86-89, 98, 99)		Diseases of arteries, arterioles and capillaries (100)		Chronic bronchitis and emphysema (108)		Cancer of digestive organs (45-51)		Cancer of respiratory organs (52-54)	
	male	female	male	female	male	female	male	female	male	female	male	female
Ukraine	7627	6086	2468	2319	981	903	764	232	485	220	287	41
AR Crimea	7973	6463	2862	2790	95	53	441	120	645	341	348	55
Vinnytska	10863	9365	560	445	57	21	837	241	382	121	231	35
Volynska	6678	5059	2109	2027	1249	1139	2010	858	293	127	164	14
Dnipropetrovska	7478	6078	1593	1432	2348	2346	694	179	514	234	338	40
Donetska	5985	4724	4608	4767	271	270	482	85	520	276	358	51
Zhytomyrska	9897	8127	822	620	830	713	743	285	442	169	220	33
Zakarpatska	5985	4605	2334	2081	2706	2111	600	207	264	118	161	26
Zaporizka	6209	4434	5462	4959	199	133	256	52	643	295	381	54
Ivano-Frankivska	9573	7708	1145	1062	120	102	1406	501	329	151	196	27
Kyivska	8203	6144	991	778	3002	2584	278	99	559	214	313	46
Kirovohradska	9051	7973	1728	1590	149	90	1180	287	493	235	386	69
Luhanska	8360	7199	2527	2278	273	244	1107	248	486	236	312	42
Lvivska	7786	6066	1067	862	1416	1139	1288	473	356	168	201	26
Mykolayivska	8348	5990	1360	1461	1195	907	285	43	462	209	309	39
Odeska	5819	4970	4513	4302	691	705	304	95	526	254	247	50
Poltavska	6534	4742	2891	2638	2118	1827	719	228	500	216	310	45
Rivnenska	10128	7937	1876	1714	105	52	519	147	414	182	233	34
Sumska	5648	4112	5568	5352	81	33	1560	575	501	177	269	37
Ternopil'ska	9672	7879	970	875	67	57	1597	469	349	148	247	31
Kharkiv'ska	8654	6849	2913	2617	221	154	443	118	477	217	256	39
Kherson'ska	6043	4146	4184	3651	1790	1645	145	23	597	257	489	44
Khmeln'ytska	5512	4021	2260	2097	2216	2079	1185	347	505	201	286	46
Cherkaska	6017	4828	1922	1594	3039	2972	1021	329	451	178	249	37
Chernivetska	9793	8283	855	747	39	23	783	371	412	187	251	32
Chernihiv'ska	8371	6639	1523	1397	1515	1357	1050	284	428	168	256	30
City of Kyiv	6977	5960	1788	1784	337	273	64	20	720	406	302	53

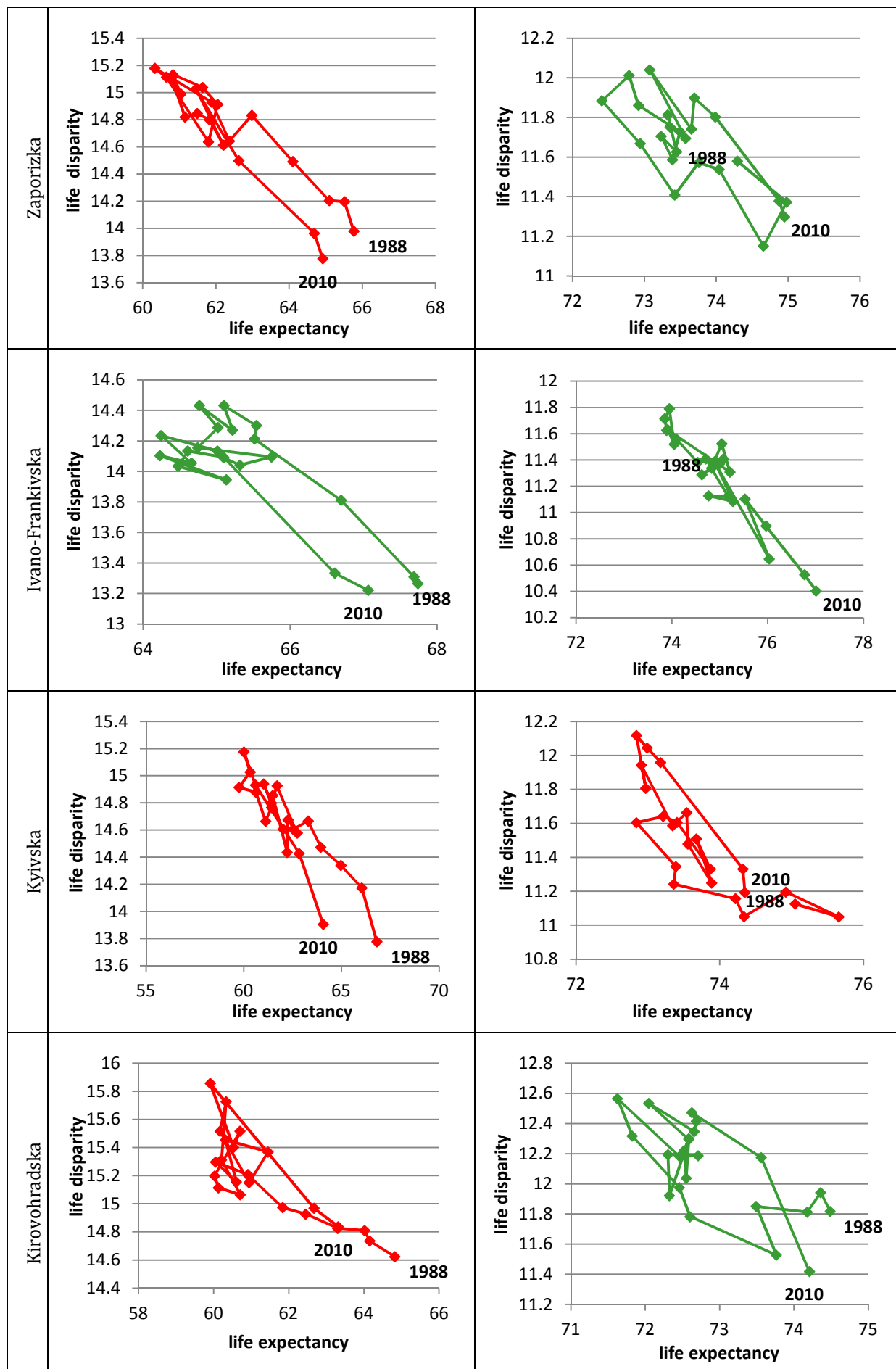
Figure 15: Cause-specific SDR for age group 75 and more for main three killers, per 100 000 of standard population, average for 2000-2003

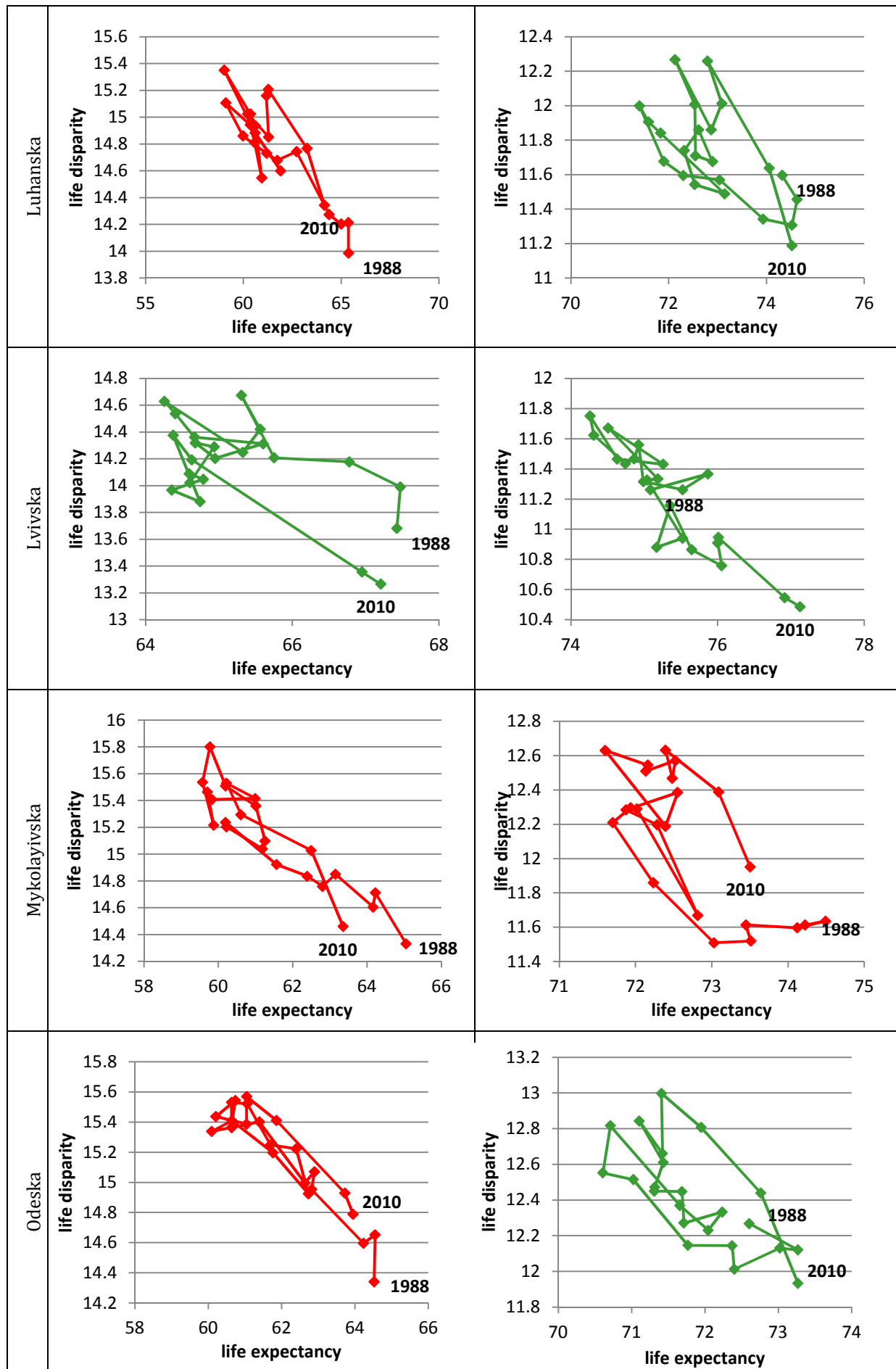


ANNEX P. Lifespan disparity versus life expectancy by oblasts, Ukraine, 1988-2010

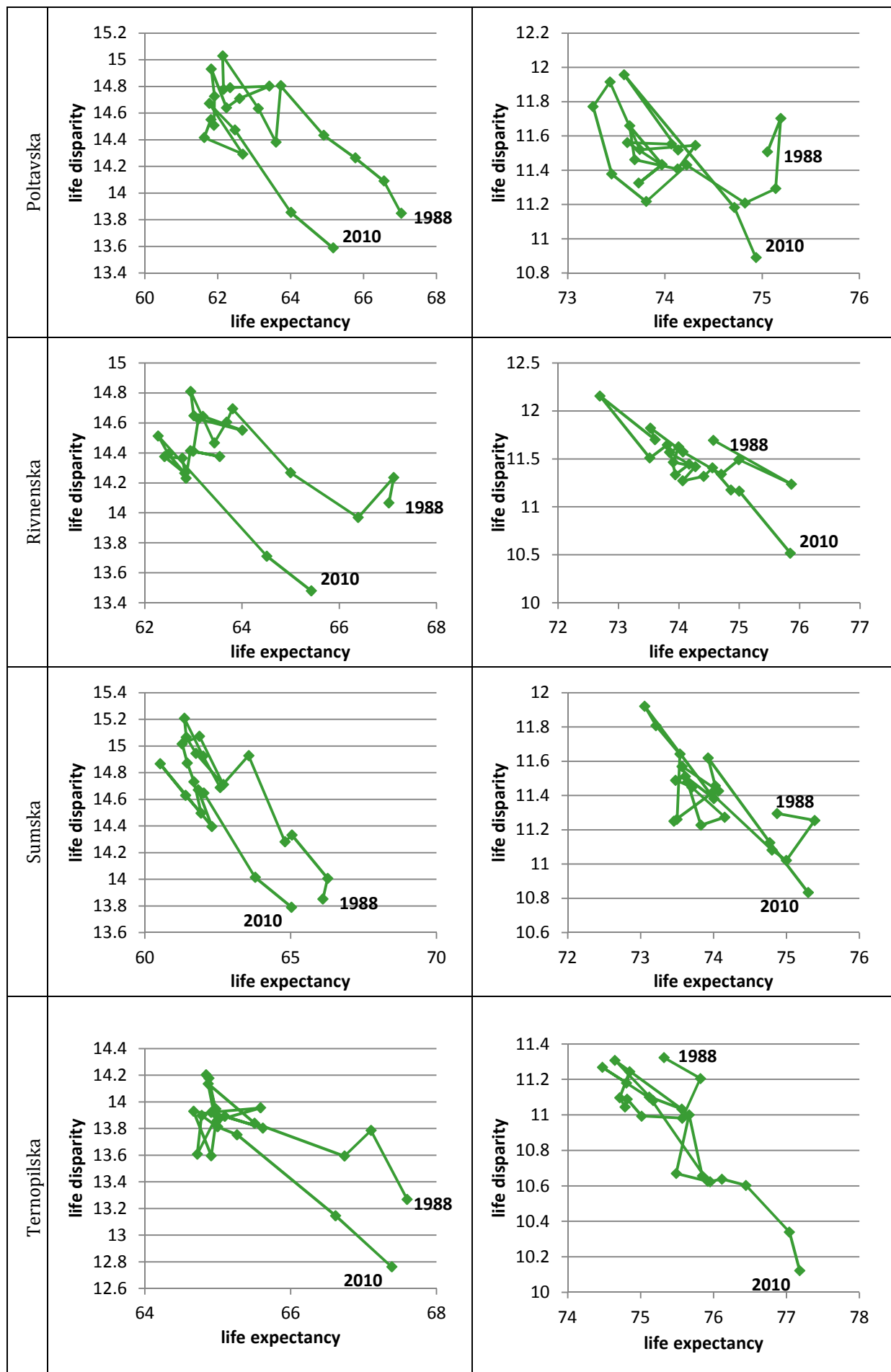


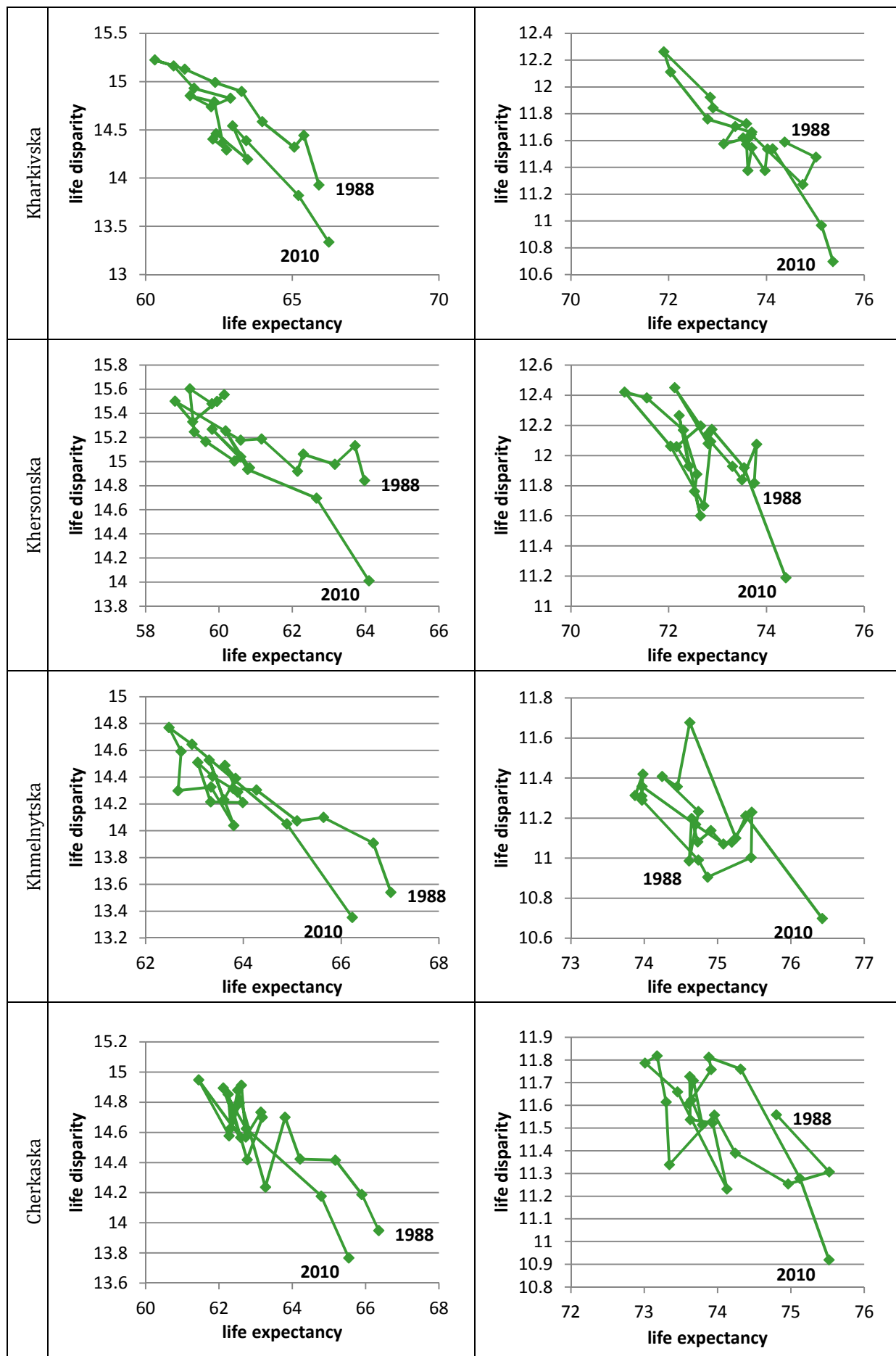


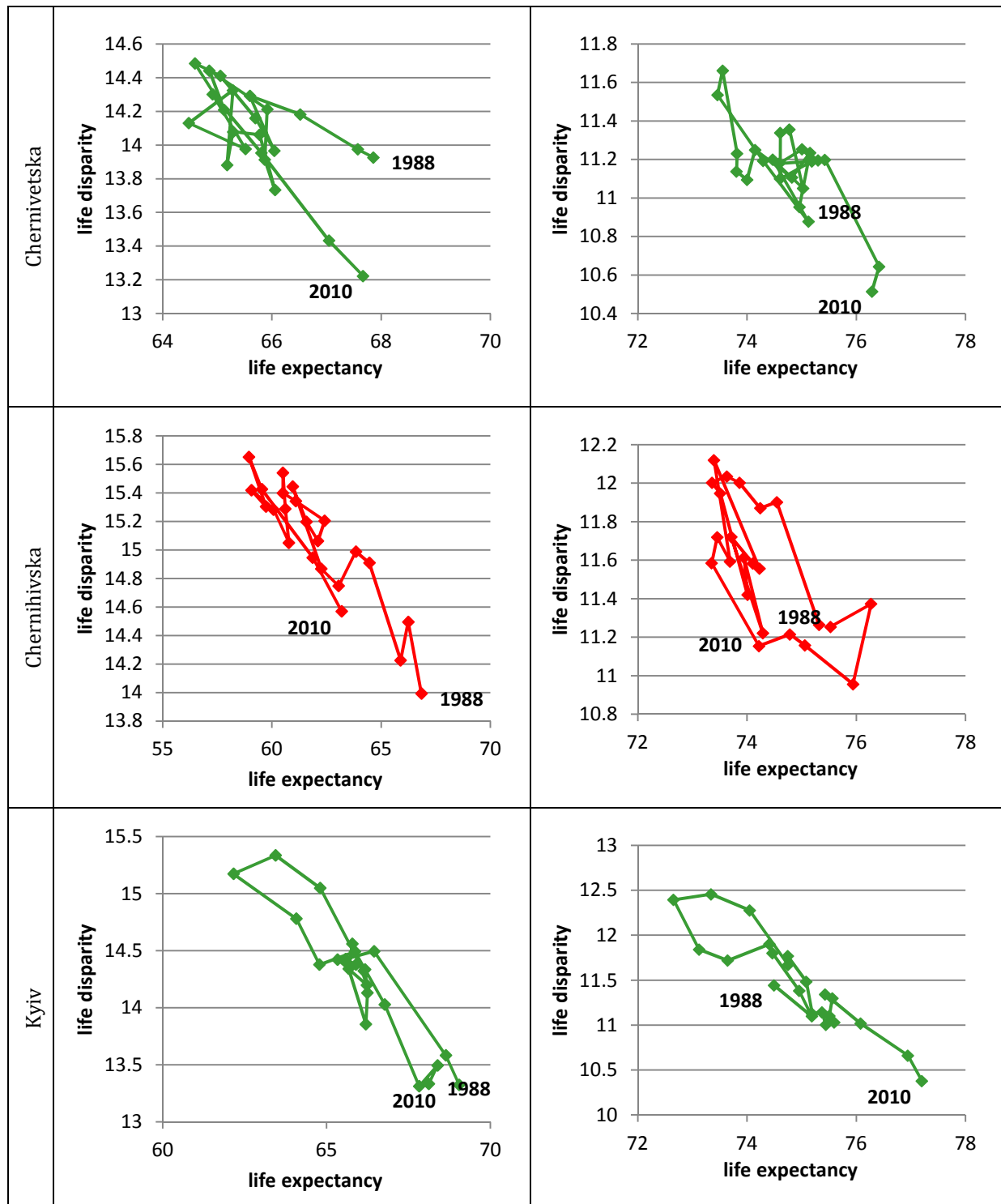














UNIVERSITE PARIS I – PANTHÉON SORBONNE  
École Doctorale de Géographie



## RÉSUMÉ de THÈSE

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## CAUSES ET ÉVOLUTION DES DISPARITÉS RÉGIONALES DE MORTALITÉ EN UKRAINE

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## Introduction

Après la seconde guerre mondiale, la mortalité a diminué partout en Europe notamment grâce à la diffusion massive des antibiotiques et à la généralisation des vaccinations. Au milieu des années 1960, tous les pays européens étaient parvenus à juguler les maladies infectieuses et abordaient une nouvelle étape où la mortalité liée aux maladies de dégénérescence et aux maladies de société (maladies cardio-vasculaires, alcoolisme, accidents de la route) devenait prépondérante (Meslé, 2002). À l'ouest, la plupart des pays ont alors réussi à renverser les tendances de la mortalité pour ces pays, tandis qu'en Europe de l'Est, l'espérance de vie a stagné ou même décliné.

Cette divergence d'espérance de vie était liée à d'importants changements dans la structure de la mortalité par âge et cause. Dans la plupart des pays de la région, la crise sanitaire a conduit à une augmentation des décès évitables et a ébranlé la stabilité sociale. La dégradation de l'état sanitaire a été particulièrement forte dans les pays de l'ex-URSS : Estonie, Lettonie, Lituanie, Russie, et Ukraine (Meslé, 2002).

Des crises de mortalité plus ou moins fortes avaient déjà touché la région. En 1932-1933, l'Ukraine a été frappée par une très grave famine, qui a provoqué la mort de 2,4 à 7,5 millions de personnes, selon différentes estimations. En 1946-1947, l'URSS a subi une autre famine, particulièrement marquée dans les pays producteurs de céréales, comme l'Ukraine. Les pertes de la seconde guerre mondiale pour l'Ukraine sont estimées entre 2,5 et 5,5 millions de morts, soit 40 à 44% du total des pertes de l'Union soviétique.

Deuxième plus grand pays d'Europe par sa surface (603 700 km<sup>2</sup>), l'Ukraine n'occupait que la sixième place en nombre d'habitants (derrière la Russie, l'Allemagne, la France, le Royaume Uni et l'Italie) au tournant du siècle. Depuis 2009, elle est même en septième position, dépassée par l'Espagne dont la population comptait pourtant 13 millions d'habitants de moins deux décennies plus tôt. Alors qu'au moment de l'indépendance en 1991, la population de l'Ukraine atteignait 52 millions, au début de 2014 elle s'élevait seulement à 45,2 millions d'habitants (soit une perte de 13%). La perte annuelle de population correspond à la taille d'une grande ville (environ 300 mille personnes) et est surtout due à un solde naturel négatif plutôt qu'au solde migratoire qui est positif depuis 2004. Ces évolutions démographiques s'accompagnent d'une détérioration de la santé de la population ukrainienne à l'origine de l'augmentation de la mortalité et de tendances défavorables de la plupart des indicateurs de santé.

La détérioration sanitaire s'est accélérée dans les années 1990 à la suite des bouleversements socio-économiques amenant un nouveau recul de l'espérance de vie qui n'a pas encore retrouvé le niveau qui prévalait avant la transition à l'économie de marché. La grave crise économique qui




a frappé l'Ukraine à la fin du XXe siècle a profondément creusé les inégalités sociales. Ces inégalités portent sur les modes de vie, les activités professionnelles, les revenus, l'accès aux institutions sociales et aux soins médicaux selon le milieu urbain ou rural et selon la localisation géographique. En conséquence, les indicateurs démographiques et, en particulier la mortalité, ont également divergé, la crise des années récentes détériorant la situation dans des régions déjà plus vulnérables.

L'Ukraine affiche actuellement la deuxième espérance de vie parmi les plus faibles d'Europe après la Russie, et à égalité avec la Moldavie et la Biélorussie. Le haut niveau national de mortalité masque une grande disparité interrégionale: la différence entre les espérances de vie minimale et maximale est de plus de 5 ans (de 65,7 à 71 ans) : 3,6 ans pour le sexe féminin, et de 7 ans pour le sexe masculin.

L'inégalité croissante de l'espérance de vie entre les différentes régions ukrainiennes fait ressortir le besoin de mener des recherches précises sur la mortalité au niveau local. Cette thèse a pour premier objectif d'analyser la mortalité et son évolution depuis 1988 au niveau des grandes régions de l'Ukraine mais aussi au niveau plus fin de petites sous-divisions administrative, permettant de mettre en lumière des continuums invisibles au niveau des grandes entités régionales. Elle s'attache ensuite à expliquer les différences régionales et leurs évolutions par la prise en compte des causes médicales de décès.

## Objectif et structure

L'objectif de cette étude est d'étudier les différences de mortalité régionales en Ukraine, les structures par causes de décès et les tendances à différentes échelles spatiales. Cette thèse est rédigée en anglais et livrée sous la forme d'un ouvrage de 360 pages. Elle peut être divisée en trois grandes parties. Les quatre premiers chapitres décrivent le cadre et les objectifs du projet et présentent les données et les méthodes utilisées. Les trois chapitres suivants rendent compte des résultats des analyses. Enfin une centaine de page forme un corpus d'annexes comportant notamment de nombreuses représentations cartographiques. La table des matières est organisée comme ci-dessous<sup>33</sup> :

-  Chapitre 1. Justification de la recherche
-  Chapitre 2. Revue de la littérature
-  Chapitre 3. Données disponibles et évaluation de leur qualité

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<sup>33</sup> Pour la table des matières complète, veuillez-vous référer à l'annexe 1.

- 📖 Chapitre 4. Méthodes et techniques
- 📖 Chapitre 5. Géographie de la mortalité au tournant du XXIe siècle
- 📖 Chapitre 6. De l'époque soviétique à l'Indépendance
- 📖 Chapitre 7. Analyse de la mortalité par districts

## **Cadre du projet :**

### **Chapitre 1. Justification de la recherche**

Le chapitre 1 justifie le choix du sujet par l'importance prise en Ukraine par la crise sanitaire qui a frappé l'Europe de l'est à l'époque soviétique d'une part, et par les contrastes culturels importants qui marquent la géographie de l'Ukraine en raison des remaniements territoriaux effectués au cours du XXe siècle.

En superficie, l'Ukraine est le deuxième pays européen. Il est bordé par la mer Noire et la mer d'Azov au sud, la Russie à l'est et au nord, le Belarus au nord, la Pologne, la Slovaquie, la Hongrie et la Roumanie à l'ouest, et la Moldavie au sud-ouest. À différentes époques de son histoire l'Ukraine a été divisée ou prise en tenaille entre ses voisins plus puissants : le grand-duché de Lituanie, le royaume de Pologne, la République des Deux Nations, l'Empire austro-hongrois - au nord et à l'ouest, et l'Empire ottoman, le grand-duché de Moscou ou l'Empire russe, le Khanat de Crimée - à l'est et au sud. Ceci peut expliquer en partie l'importance des différences géographiques qui existent en Ukraine de nos jours. L'Ukraine a accédé à l'indépendance en 1991, après la dissolution de l'URSS.

Historiquement, l'Ukraine était divisée en régions relativement homogènes en termes de densité de population (Pirozgov 2005). Cependant, l'équilibre s'est rompu avec le début de l'industrialisation et le développement rapide des zones voisines de la Russie. Le niveau d'urbanisation est étroitement corrélé à la densité de la population. Au recensement de 2001, il existait un gradient de 5 entre les régions les plus et les moins peuplées avec un maximum à l'est (183 habitants par km<sup>2</sup> dans l'oblast de Donetsk) et un minimum au nord (36 habitants par km<sup>2</sup> dans l'oblast de Chernihiv, vidé d'une partie de sa population après l'évacuation de la zone de Tchernobyl). L'intensification de la production et les mouvements massifs de population vers les centres industriels ont induit des changements dans les structures des populations.

L'Ukraine se caractérise par une forte concentration des capacités politiques, économiques et sociales à Kiev. Ainsi Kiev et Sébastopol sont les seules villes à connaître un accroissement de la population. Même si les régions industrielles et celles riches en matières premières se développent positivement, l'importance de la pollution, la surpopulation, les dangereuses

conditions de travail contrecarrent cet effet et menacent gravement la santé des populations dans les régions orientales (Shevchuk, 2007). L'implication grandissante des femmes dans la société et les obstacles à la formation des familles dans les villes pèsent négativement sur la fécondité, alors que les taux de natalité restent élevés en milieu rural. Le vieillissement de la population est également moins marqué dans l'ouest. D'après le niveau des taux de croissance, on peut diviser l'Ukraine de l'ouest à l'est en grandes régions. À l'ouest, la baisse des moins de 15 ans est plus limitée alors qu'elle est plus forte vers l'est (Ortner, 2009). Enfin, l'offre de travail plus réduite dans les régions rurales occidentales incite à la migration vers les pays européens voisins tandis que les ouvriers de l'est cherchent principalement des salaires plus élevés en Russie.

Toutes ces différences sont à l'origine de comportements différents en matière de dynamique des populations : les régions occidentales ont ainsi été les premières à montrer les premiers signes de sortie de la crise démographique.

Une attention particulière doit être portée aux régions du nord qui ont le plus souffert de l'explosion de la centrale nucléaire de Tchernobyl. La catastrophe survenue en 1986 y a laissé une marque visible (Vlasenko *et al*, 2006 ; Kurilo et Libanova, 2007). Cette région est caractérisée par une faible densité de population (en raison de l'évacuation des habitants) et par une forte proportion de personnes âgées, en particulier des veuves. À l'inverse le sud de l'Ukraine, qui dispose d'une façade maritime, a développé des activités diverses grâce à de nombreux échanges, notamment commerciaux avec d'autres pays.

Les inégalités de mortalité existent à tous les niveaux de division territoriale, et plus le niveau est fin, plus l'amplitude des différences est importante, traduisant une grande hétérogénéité.

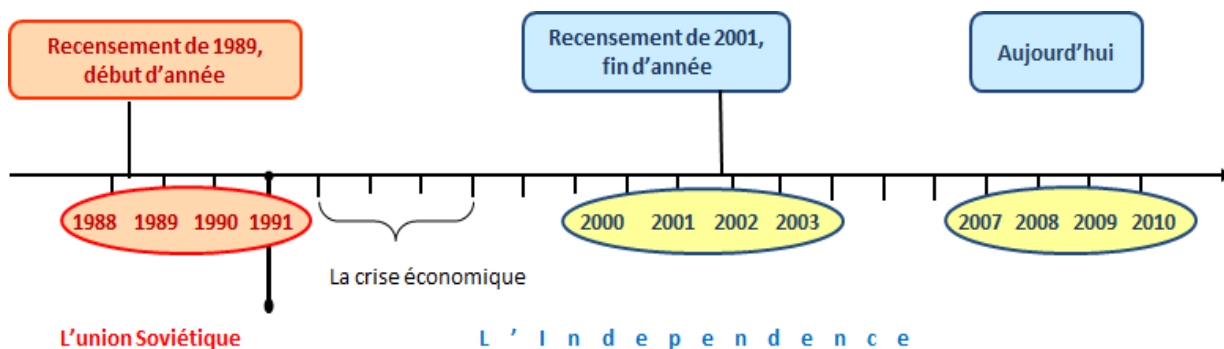
Administrativement l'Ukraine est divisée en 27 unités territoriales : 24 régions ou provinces, la République autonome de Crimée, et deux villes au statut particulier, Kiev, la capitale et l'agglomération de Sébastopol. Les unités de 3e niveau sont les districts, les communautés urbaines (composées d'une ville et de sa banlieue), et les grandes villes dont souvent le chef-lieu de l'oblast. Il y a 490 districts et 174 villes ou communautés urbaines dans les 24 oblasts et la république autonome de Crimée (RAC).

Les variations géographiques de la mortalité sont en partie dues à l'histoire propre à chaque région. La géographie de la mortalité évolue avec le temps, même si certaines caractéristiques restent assez constantes. La période d'étude est centrée sur le recensement, ce qui permet de disposer d'estimations de population régionales plus fiables. Le dernier recensement ukrainien date de 2001. C'était le premier recensement de l'Ukraine indépendante. Après avoir analysé la mortalité par région autour de l'année 2001, la situation observée en 2001 a été comparée à



celle qui prévalait 12 ans plus tôt, en 1989, année du précédent recensement. Enfin, les évolutions les plus récentes ont été étudiées en utilisant des estimations pour 2002-2010.

Figure 1: Visualisation des trois périodes utilisées pour l'analyse



Finalement l'exploration du contexte de la mortalité en Ukraine m'a conduite aux questions de recherche suivantes :

1. Quelle est l'ampleur des différences géographiques de mortalité en Ukraine? (confirmer ces différences à partir de nos propres calculs et estimer leur importance)
2. Quelles sont les principales causes de mortalité?
3. Comment la géographie de la mortalité a-t-elle évolué depuis l'éclatement de l'URSS?

À partir de ces questions de recherche, on peut formuler les hypothèses suivantes :

1. Il existe des différences de mortalité entre régions significatives.
2. La géographie de la mortalité varie selon le sexe, l'âge et la cause du décès
3. Les différences de mortalité par sexe, âge et cause évoluent au cours du temps.

## Chapitre 2. Revue de la littérature

Le chapitre 2 présente brièvement une revue de la littérature, en se concentrant sur les tendances de la mortalité en Europe, la divergence Est-Ouest et les explications données par les principaux auteurs.

L'analyse explicative des importantes différences de mortalité existant entre les régions ukrainiennes a représenté un vrai défi pour les chercheurs. Seulement un petit nombre de travaux portent sur ce sujet, essentiellement en raison de la difficulté d'accès aux données existant seulement sur papier et pouvant paraître incohérentes. De plus ces études n'étaient pas bienvenues dans l'état soviétique qui prônait l'homogénéité sociale. Malgré cela, la revue de la

littérature existante révèle quelques amorces d'études sur les différences géographiques de mortalité en Ukraine.

Bien que les données soient rares pour le début du XXe siècle, la plupart des auteurs s'accordent pour estimer que l'Ukraine, pays agricole avec une forte proportion de population rurale, connaissait alors des niveaux de mortalité considérablement plus élevés que ceux qui prévalaient dans les autres pays européens (Markevich, 1842 ; Bantysh-Kamenskii Dmitrii, 1822 ; Novoselskii, 1916 ; Kurkin, 1938 ; Lorimer, 1946 ; Vishnevskii et Volkov, 1983 etc.).

La situation a considérablement changé au milieu du XXe siècle. La plupart des études (Libanova, 1991; Meslé, 2002; Levchuk et al., 2001, 2007; Pirozhkov, 2004; Libanova et al., 2007; Meslé et Vallin, 2008, 2012;) expliquent la progression de l'espérance de vie par des mesures de prévention appliquées à large échelle. C'est une période de progrès importants avec une convergence entre les régions. Ces progrès ont ensuite laissé la place à une phase de recul de l'espérance de vie qui a trouvé des explications différentes, mais plutôt complémentaires mettant accent sur les difficultés de la période de transitions et des changements structuraux des années 1990 (ex.g. Libanova, 1991; Pirozhkov, 2004 ; Foight, 2002).

En ce qui concerne les différences interrégionales (Libanova 1991, Levchuk 2001 ; Foight, 2005; Rogozhin, 2005; Steshenko, 2005; Pirozhkov, Shevchuk, 2005, 2006, 2007), la situation observée il y a plusieurs décennies n'est pas fondamentalement différente de celle qui prévaut actuellement. Le changement le plus important est l'aggravation de la situation du nord de l'Ukraine. Par ailleurs les différences se sont accusées et la distance entre régions s'est creusée. Les maladies de l'appareil circulatoire restent la cause de décès la plus fréquente dans toutes les régions. La hiérarchie des différentes causes de décès a toutefois légèrement changé dans les années les plus récentes.

Des études sur les variations géographiques de la mortalité existent pour de nombreux autres pays. Les plus intéressantes sont des études portant sur les pays voisins, en particulier la Russie (Vallin et al. 2005), la Biélorussie (Grigoriev, 2011), et les pays baltes (Krumins et al., 2000). Les tendances défavorables de la mortalité sur le long terme en Europe centrale et orientale ont été largement étudiées notamment par des chercheurs français (Bourgeois-Pichat, 1985; Meslé, 1991; Meslé and Hertrich, 1997). Les grandes fluctuations de l'espérance de vie observées depuis 1985 dans les pays de l'ex-URSS ont également fait l'objet de nombreuses analyses d'auteurs russes (Shkolnikov and Nemtsov, 1997; Avdeev et al., 1997 ; Gavrilova et al., 2001).

En résumé, cette revue des travaux existant sur les différences régionales de mortalité en Ukraine montre qu'il existe encore beaucoup de questions inexplorées. Il manque une étude systématique de la mortalité de chaque région permettant d'identifier leurs particularités. Il y a

aussi besoin d'analyses au niveau plus fin des districts, permettant d'ouvrir les "rideaux administratifs". Il faut étudier les derniers développements de la mortalité par cause et les replacer dans l'évolution historique. Les obstacles mentionnés par plusieurs chercheurs peuvent être surmontés en rassemblant toute l'information disponible dans une base de données, en recourant à la standardisation indirecte pour comparer les indicateurs globaux des districts, en reconstruisant des séries de décès par cause cohérentes dans le temps.

### **Chapitre 3. Données disponibles et évaluation de leur qualité**

Le chapitre 3 est consacré aux données disponibles, à leurs sources, à la critique précise de leur qualité et à l'évocation des problèmes qu'elles posent, ainsi qu'à la discussion de solutions possibles et aux corrections effectuées. Une attention particulière a été portée aux problèmes posés par les changements de définition et de modalité d'enregistrement des décès infantiles, en s'appuyant sur des travaux déjà faits au niveau national.

Les chercheurs qui souhaitent travailler sur les variations géographiques de la mortalité en Ukraine se heurtent au manque de disponibilité des données. Depuis peu, des versions électroniques des tableaux statistiques ont été rendues disponibles mais ces données sont encore incomplètes. Depuis le recensement de 2001, de nouveaux tableaux (plus détaillés) ont été produits.

Le Service national de la statistique (SNS) d'Ukraine est en charge de la collecte et de la production des statistiques de population. 25 bureaux régionaux et 495 bureaux de districts effectuent le recensement et les micro-recensements et conduisent différentes enquêtes. Le dernier recensement ukrainien a eu lieu en 2001 et ses résultats ont été publiés en 2002-2004. Des estimations de population intercensitaires ont été recalculées pour la période 1989-2001

Les bureaux d'état civil enregistrent les événements vitaux (naissances, mariages, divorces et décès). Ils sont rattachés au Ministère de la justice et ne dépendent pas directement des institutions statistiques. Les données individuelles sur les décès enregistrés dans les bureaux d'état civil sont agrégées au niveau des subdivisions régionales qui produisent des tableaux par sexe, âge, milieu de résidence (urbain ou rural) et cause de décès. Le SNS dresse les tableaux au niveau national, analyse les données et produit un rapport annuel. Depuis 1993, les données d'état civil sont publiées tous les ans dans "Population of Ukraine". Sous le même titre, depuis 2003, le SNS, en collaboration avec l'institut de démographie et d'études sociales, publie un rapport annuel complet.

Les statistiques de décès sont également disponibles pour 26 régions de 1989 jusqu'en 1995, puis pour 27 lorsque la ville de Sébastopol a été traitée séparément du reste de la république de

Crimée. De 1989 à 1995, les tableaux de décès par causes ne contiennent que quelques grands groupes de causes et ne fournissent pas une information détaillée par maladie. À partir de 1996, les causes sont détaillées pour chaque région. Enfin, l'Ukraine a adopté la 10e révision de la Classification statistique internationale des maladies et des problèmes de santé connexes (CIM-10) en 2005. De 1989 à 2004 les décès étaient codés dans la version soviétique de la CIM-9. Ce changement introduit donc une rupture dans les séries statistiques.

Il existe aussi des tableaux disponibles au niveau des districts. Il s'agit des données du recensement pour 490 unités locales, et des données d'état civil sur le mouvement naturel pour chaque unité administrative et chaque commune. De plus, à partir de 2005, année de passage à la 10e révision de la CIM, des données par cause de décès sont disponibles au niveau des districts: les décès sont distribués dans 19 grands groupes, avec quelques subdivisions pour certains groupes (maladies infectieuses, troubles mentaux, maladies de l'appareil circulatoire, maladies du système digestif, et morts violentes). Il s'agit d'un nombre total de décès, sans mention d'âges mais ces données pourront être utilisées pour le calcul du SMR (Standardised Mortality Ratio) permettant de comparer les niveaux de mortalité par cause entre districts.

Enfin, tous les tableaux mentionnés ci-dessus pour les districts distinguent les villes. Cela permet d'estimer les différences entre urbain et rural à un niveau très fin.

Avant d'utiliser ces données, il est important de juger de leur qualité. La division administrative actuelle compliquée la prise en compte des villes qui ont un statut spécial et sont considérées comme des unités indépendantes, sans rattachement à un district. Le problème est que le nombre de ces villes n'est pas constant et augmente en permanence : il est ainsi passé de 145 en 1990 à 179 en 2010. De plus l'existence de divisions territoriales (les districts) et de formations autonomes ayant le statut d'oblast ou de république « d'importance » conduit à un mélange de deux structures de base, territoriale et administrative.

Pour résoudre ce problème, dans nos analyses, les unités administratives à statut spécial ont été rattachées aux districts dans lesquels elles se situent géographiquement. Ainsi, au lieu de 490 districts ruraux et 174 agglomérations à statut spécial, j'ai finalement travaillé sur 496 entités territoriales au 3<sup>e</sup> niveau (y compris 6 agglomérations qui sont encore traitées séparément). Chacune de ces entités comporte une population rurale et une population urbaine et inclut une ou plusieurs grandes villes.

En ce qui concerne la qualité des données, jusqu'en 1990, l'enregistrement des décès en Ukraine était fiable. Depuis 1990, en raison de la libéralisation de toutes les sphères de la vie, le contrôle sur le recueil des données de mortalité s'est relâché et la qualité des statistiques de décès a diminué. Ainsi la part des décès d'âge inconnu a augmenté. Par ailleurs, il est apparu un sous-

enregistrement non négligeable des décès en zones rurales qui a détérioré la qualité des statistiques (Pyrozgkov et al., 2006).

Il y a des raisons sérieuses de croire que la mortalité infantile est sous-estimée, du fait d'une définition de la naissance vivante différente de celle préconisée par l'OMS. En 2005, l'Ukraine a progressivement appliqué cette dernière. La définition antérieure excluait des statistiques de mortalité infantile les enfants les plus vulnérables. Selon différentes évaluations (Anderson et Silver, 1986; Verkoff et Miller, 1995; Kingkade et Sawyer, 2001 ; Aleshina et Redmond, 2003 ; Pirozhkov et al., 2006; Meslé et Vallin, 2008) le sous-enregistrement de décès de nouveau-nés est estimé à environ 20%, ces décès étant enregistrés comme des avortements spontanés. L'application de notre propre méthode de correction du taux de mortalité infantile (TMI), s'appuyant sur les données régionales, a résulté en une augmentation de 17% pour l'Ukraine dans son ensemble, ce qui est proche des estimations publiées par les autres auteurs, bien qu'un peu moins élevé. Le coefficient de correction varie de 1.01 à 1.42 selon les régions avec les corrections les plus fortes dans les régions du centre et de l'ouest. La correction est plus importante en milieu rural (20,8%) qu'en milieu urbain (15.0%), ce qui renforce l'hypothèse que les événements vitaux sont davantage sous-estimés dans les campagnes que dans les villes.

Les données de mortalité aux grands âges posent également problème, car elles sont anormalement fluctuantes. Les courbes peuvent être lissées en appliquant des modèles paramétriques (Gompertz, Makeham, Siler, Helligman-Pollard). Plus récemment le modèle de Kannisto permet d'estimer les risques de décès aux très grands âges (Wilmoth et al, 2007).

Même s'il persiste des doutes sur la qualité des données existantes, il est possible de remédier à certaines imperfections. Les taux de mortalité par district ou région ont été calculés pour des périodes de 4 ans, ce qui minimise les fluctuations aléatoires et résout le problème des "zéro" décès dans les petits agrégats statistiques. Le choix de la période a permis aussi de travailler sur des séries cohérentes de décès par cause classés selon la même révision de la classification (CIM-9) de 1989 à 2004. Les groupes de causes analysés étant suffisamment larges, l'adoption de la 10<sup>e</sup> révision, en 2005, n'a pas provoqué de ruptures notables dans les séries. Au total, l'information statistique disponible fournit un matériau suffisant pour l'analyse géographique de la mortalité.

#### **Chapitre 4. Méthodes et techniques**

Le chapitre 4 est dévolu à l'exposé des méthodes statistiques utilisé pour analyser des disparités en mortalité. Les méthodes utilisées varient selon les étapes du projet de recherche, des indicateurs classiques de la démographie aux approches statistiques plus spécifiques.

Une fois assuré de la qualité des données, il était possible de calculer des taux de mortalité par âge et des tables de mortalité. À côté des indicateurs classiques d'espérance de vie (durée moyenne de vie), certains chercheurs ont proposé de calculer la disparité de la durée de vie – une mesure de dispersion qui donne le nombre moyen d'années de vies perdues (Shkolnikov et al., 2011; Kibele, 2013).

Au niveau des districts, en l'absence de distribution par âge des décès, la standardisation indirecte permet de calculer le rapport de mortalité standardisé (SMR). Ce dernier peut aussi être établi par cause de décès si l'on connaît le nombre total de décès dus à une cause (Krumins et al., 2000) comme c'était le cas pour l'Ukraine.

La dispersion des observations peut être estimée par des indicateurs classiques : écart-type, coefficient de variation, coefficient de dissymétrie etc., on peut aussi calculer des indicateurs spécifiques – comme la mesure de la dispersion de la mortalité (MDM) – qui peuvent être utilisés dans les études régionales. Le MDM prend en compte les différences de mortalité entre toutes les paires d'unités géographiques, pondérées par la taille de la population (Kibele, 2012; Moser et al., 2005).

L'analyse de la mortalité par cause est la partie la plus importante et la plus originale du projet. Le rôle de chaque cause de décès peut être quantifié en calculant à partir des tables de mortalité l'âge moyen au décès de cette seule cause ; ou la contribution de cette cause aux différences d'espérance de vie (Andreev, 1982; Pollard, 1982, 1988; Arriaga, 1984; Pressat, 1985; Andreev, Shkolnikov, Begun, 2002). Toutes ces mesures sont importantes en niveau absolu mais aussi en niveau relatif entre les régions pour comprendre comment chaque cause pèse dans les inégalités régionales.

Pour étudier la relation existant entre le niveau de la mortalité et certaines caractéristiques on peut calculer un coefficient de corrélation. En cas de relations multiples, on utilise des méthodes telles que l'Analyse en Composantes Principales (ACP) ou l'Analyse Factorielle des Correspondances (AFC). Ces techniques permettent d'identifier des composantes qui influent significativement sur la mortalité. Les index de Moran et Lisa ont été utilisés pour mesurer les corrélations spatiales entre districts.

Les logiciels statistiques standard (STATA) et différents programmes (R, Excel) ont servi à calculer les indicateurs, examiner les tableaux croisés, identifier des associations ou groupements significatifs. Des outils graphiques, tels que MapInfo, PhilCarto et GeoDa, ont permis de visualiser les résultats.

## Principaux résultats

### Chapitre 5. Géographie de la mortalité au tournant du XXI<sup>e</sup> siècle

Le chapitre 5 traite du relief de la géographie de la mortalité ukrainienne à l'aube du XXI<sup>e</sup> siècle, sur la base de ses 27 régions.

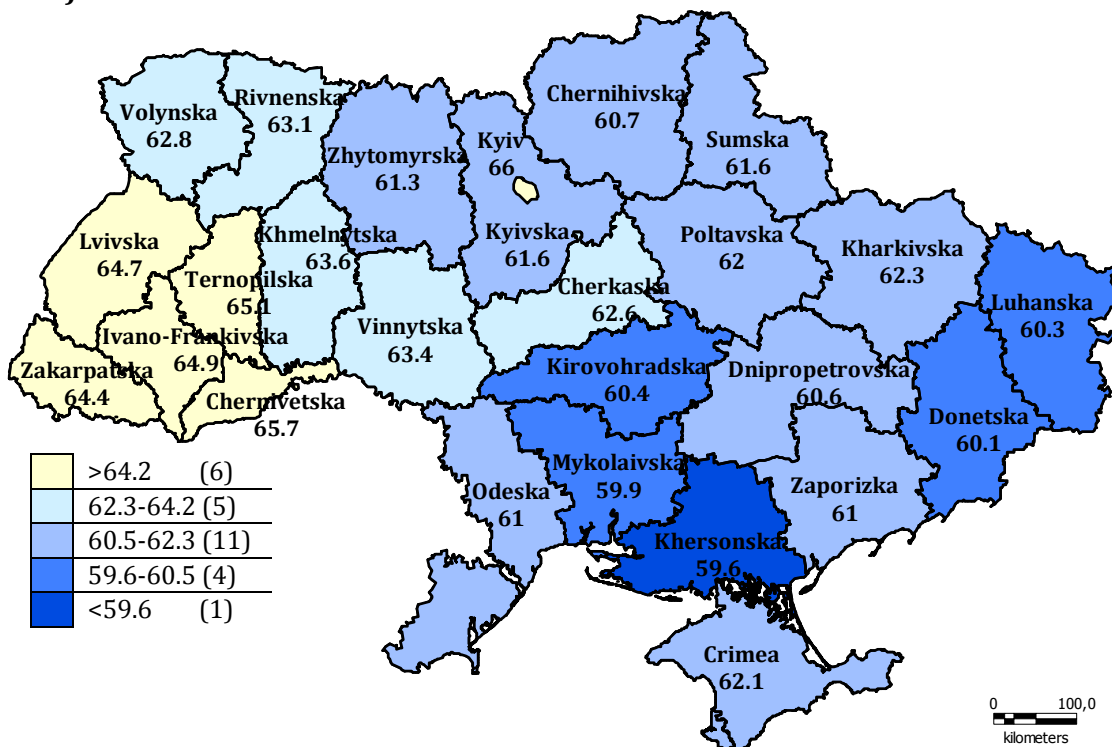
La Figure 1 illustre cette diversité, montrant une espérance de vie plus élevée à l'ouest qu'au sud et à l'est. Les régions les plus défavorisées forment une ceinture qui part de l'oblast d'Odessa (Odes'ka oblast), traverse toutes les régions du sud et se termine dans le Donbass. Les régions à faible mortalité sont à l'ouest, à proximité des Carpates. Il s'agit de régions anciennement polonaises annexées au lendemain de la Seconde Guerre mondiale. Enfin, les deux régions entourant Kiev ont une faible espérance de vie masculine qui contraste vivement avec le niveau élevé de l'espérance de vie dans la capitale. Dans son ensemble, la géographie est tout aussi nette si l'on considère l'espérance de vie à 25 ans et même encore plus pour l'espérance de vie à 65 ans.

L'analyse de la structure par âge de la mortalité montre qu'il existe de très fortes corrélations entre les groupes d'âges, quelle que soit la région. Ainsi, si la mortalité dans une région est très élevée pour un groupe d'âges, il est très probable qu'elle le sera pour tous les autres. La mortalité infantile joue toutefois un rôle particulier dans la géographie de la mortalité. Dans l'analyse en composantes principales, elle s'oppose sur le deuxième axe à la mortalité aux grands âges, alors que c'est le niveau de l'espérance de vie qui structure le premier axe.

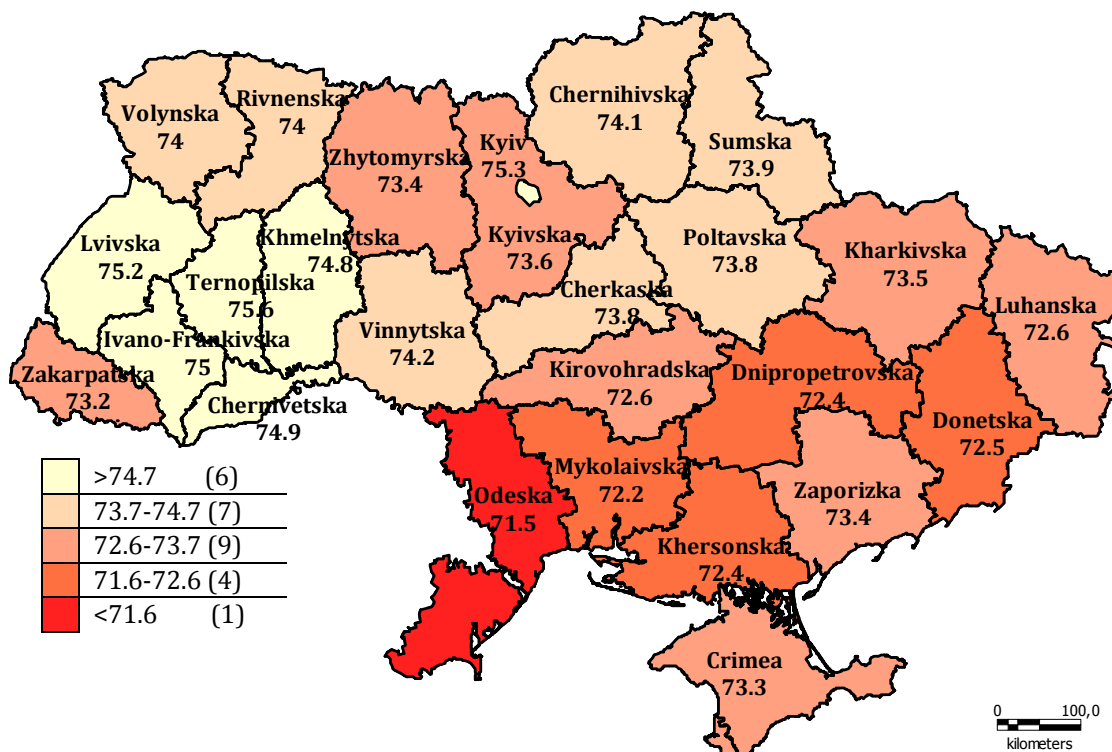
Finalement, les régions peuvent être regroupées en trois grandes catégories : le groupe à mortalité basse pour tous les groupes d'âges s'oppose à un groupe à mortalité élevée pour tous les groupes d'âges, tandis qu'un groupe intermédiaire rassemble des régions où la mortalité infantile est assez basse alors qu'elle est forte aux autres âges. Ces catégories dessinent une géographie claire : le premier groupe à l'ouest, le second au sud-est, alors que le groupe intermédiaire rassemble des régions du centre et du nord. Cette géographie n'est pas exactement la même pour les hommes et les femmes : le gradient va de l'ouest à l'est pour les premiers et de l'ouest au sud-est pour les secondes.

Figure 1: Espérance de vie à la naissance en Ukraine, 2000-2003

a) Hommes



b) Femmes



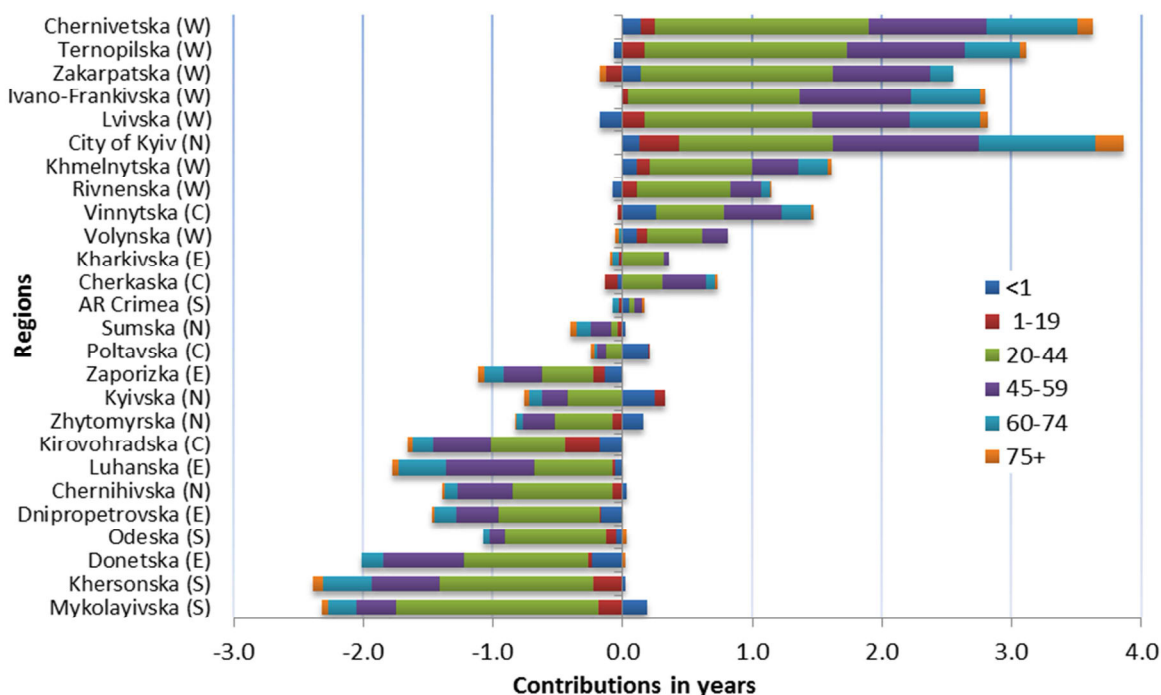
Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine après correction de la mortalité infantile



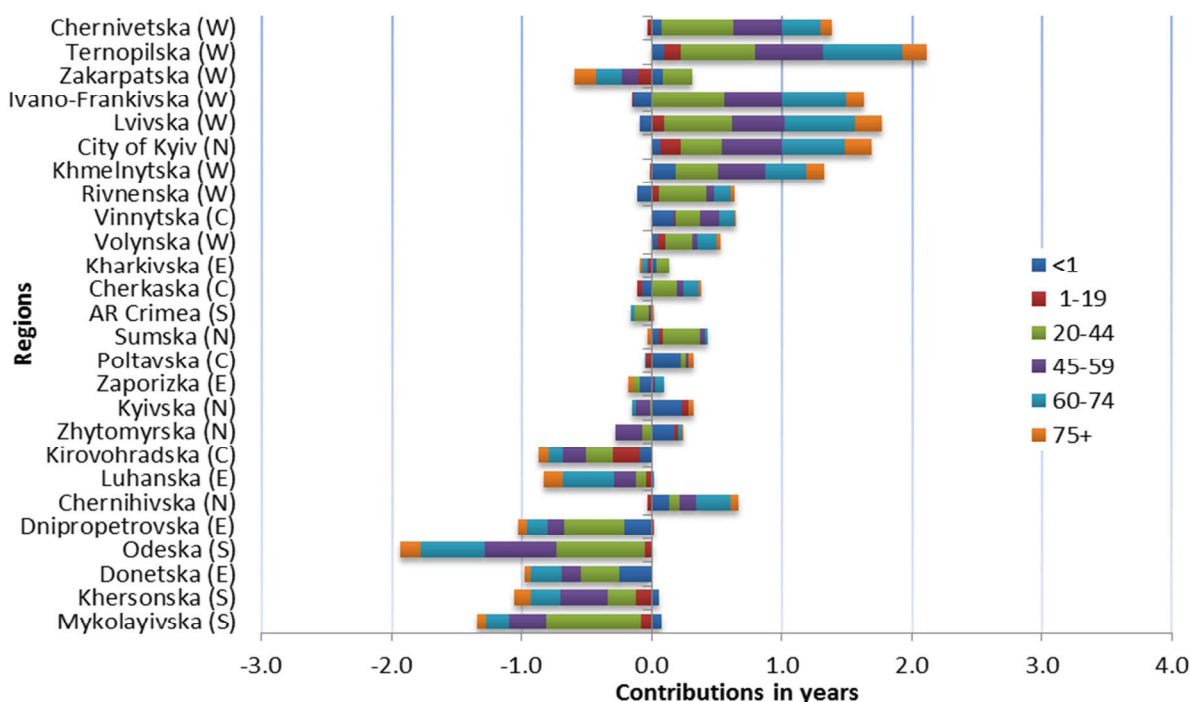
La figure 2 explicite les contributions de chaque groupe d'âge à l'écart d'espérance de vie entre chaque région et la moyenne nationale.

Figure 2: Contributions des groupes d'âges à la différence d'espérance de vie entre chaque région et la moyenne nationale, 2000-2003

**Hommes**



**Femmes**



Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine

Les régions peuvent être grossièrement réparties en deux groupes selon le signe de la différence. Si celle-ci est positive, tous les groupes d'âges jouent dans le même sens et contribuent à cet écart favorable à la maison. Si cette différence est négative, ce sont également tous les groupes d'âges qui y participent. L'avantage des régions les plus performantes est plus accentué que le désavantage des régions les plus défavorisées. Ceci est vrai pour tous les groupes d'âges mais particulièrement aux âges les plus élevés. On note aussi que les régions où l'espérance de vie est élevée ont une mortalité aux grands âges particulièrement faible.

Les profils de mortalité sont modelés par trois grands groupes de causes de décès : les maladies cardio-vasculaires, les cancers et les morts violentes. Chacune de ces grands groupes de causes de décès a sa propre géographie mais aucune n'offre une géographie identique à celle de l'espérance de vie. Les régions de l'ouest et la ville de Kiev sont systématiquement en meilleure position que le reste du pays, mais la surmortalité des régions du sud et de l'est est moins nette et souvent plus marquée chez les femmes que chez les hommes. Les causes moins importantes présentent des géographies encore plus éloignées. Pour les maladies respiratoires la géographie est même presque inversée, avec un désavantage de l'ouest.

Les profils de mortalité par cause varient aussi en fonction de l'âge. Les morts violentes jouent un rôle particulièrement important aux jeunes âges (accidents de la route, suicides, et noyades accidentelles) et aux âges actifs (suicides, empoisonnements alcooliques accidentels et homicides). Les suicides sont la cause de décès la plus importante à 20-44 ans et pèsent encore lourd dans la mortalité jusqu'à 60 ans. En général, les morts violentes réduisent l'espérance de vie d'environ un an dans les régions orientales (comparé à la moyenne nationale) et elles donnent un avantage d'environ 1,5 an aux régions occidentales.

Les maladies infectieuses, dominées par la tuberculose, sont importantes aux âges actifs (surtout chez les hommes). Dans quelques régions du sud (les oblasts d'Odessa et de Mykolaïv), elles frappent mêmes de plus jeunes âges (25-30 ans).

La mortalité par âges à cause des tumeurs et des maladies de l'appareil respiratoire sont similaires: les taux de mortalité augmentent exponentiellement avec l'âge. La bronchite chronique est la principale maladie respiratoire tandis que le cancer des bronches et du poumon domine les tumeurs. Dans certaines régions, dès l'âge 8 ans, la mortalité par maladies respiratoires est plus élevée que la mortalité cancéreuse alors que dans d'autres moins nombreuses (RA de Crimée, oblasts Donetska, Zaporiska, Kyivska, Mykolaïvska, Khersonska et ville de Kiev) les cancers restent prépondérants.

Toutefois à des grands âges, ce sont les maladies de l'appareil circulatoire qui dominent massivement la mortalité. Cette classe de causes de décès (Chapitre IX de la CIM-10) inclut

plusieurs importantes sous-catégories (cardiopathies ischémiques, maladies hypertensives et cérébro-vasculaires, maladies des veines, des artères et des autres vaisseaux) qui ont cependant des profils de mortalité très proches. Cela nous a permis de les agréger dans l'analyse de la mortalité par âge afin d'éviter le risque des conclusions biaisées fort probable en raison de l'incertitude de la diagnostique détaillée d'une cause principale de décès aux grands âges.

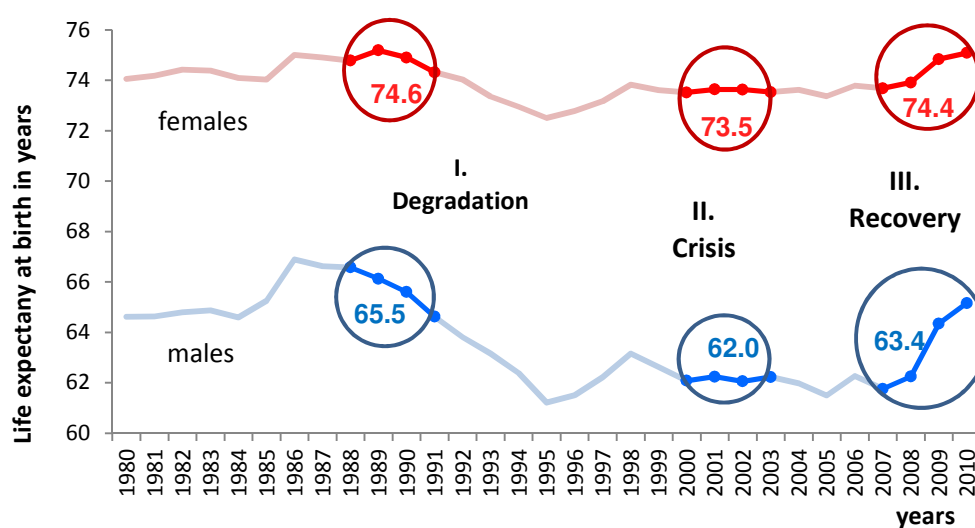
En résumé, on peut dire que les régions orientales sont à un stade moins avancé de développement sanitaire que les régions occidentales, ces dernières bénéficiant d'une plus faible mortalité par maladies de l'appareil circulatoire et par morts violentes et donc d'une espérance de vie plus élevée. Ceci tient aux progrès réalisés aux âges élevés et à un profil épidémiologique plus favorable dans la partie occidentale de l'Ukraine.

## Chapitre 6. De l'époque soviétique à l'Indépendance

Au chapitre 6, les observations ainsi faites pour la période 2000-2003 sont replacées dans l'évolution chaotique de l'espérance de vie ukrainienne depuis l'indépendance. La géographie ukrainienne observée en 2000-2003 est comparée d'une part à celle qui existait en 1988-1991 (appuyée sur le dernier recensement soviétique de 1989) et, d'autre part, à la géographie la plus récente, observée sur la période 2007-2010 en s'appuyant sur de nouvelles estimations de population.

Pendant deux décennies, l'espérance de vie Ukraine a fortement diminué, avant de stagner puis de repartir à la hausse dans les années les plus récentes (Figure 3).

Figure 3: Espérance de vie par sexe, Ukraine 1988-2010

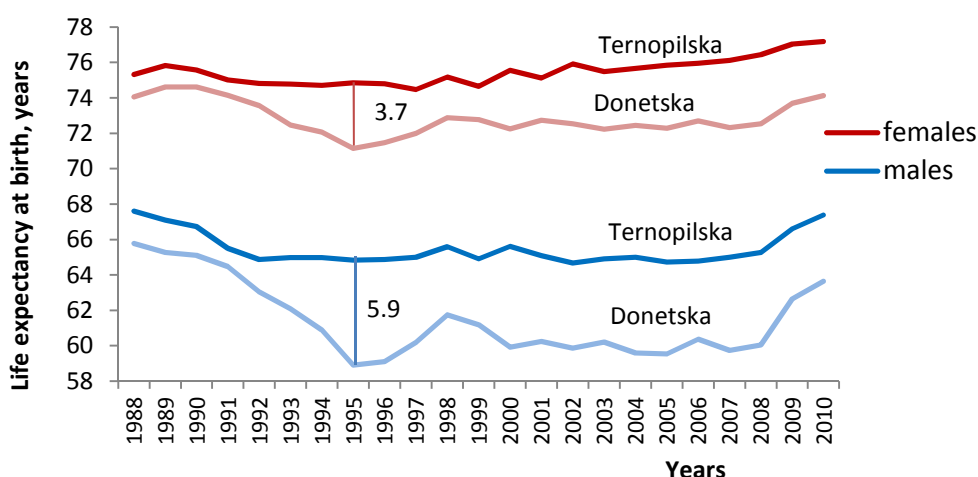


Source: 1988-2010 - calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine après correction de la mortalité infantile; 1980-1987 - Human Mortality Database

Les progrès récents n'ont pas ramené le pays à la situation qui prévalait avant la crise. Alors qu'au premier coup d'œil, il pourrait sembler que l'Ukraine a regagné les années d'espérance de vie perdues pendant la période de crise, un examen plus attentif révèle que ce n'est pas tout à fait le cas. En 1989, la différence d'espérance de vie entre hommes et femmes était à un niveau minimum comparé aux deux autres périodes. Par ailleurs, le coefficient de variation a quasiment doublé entre cette première période et les deux suivantes.

La baisse de la l'espérance de vie s'est faite à des rythmes différents d'une région à l'autre si bien que l'écart s'est creusé entre les régions extrêmes. L'écart a culminé en 1995 (5,9 ans chez les hommes et 3,7 chez les femmes) au moment même où la crise socio-économique frappait le pays suite au passage brutal à l'économie de marché. L'écart était nettement inférieur à la fin des années 1980 et il s'est à nouveau réduit depuis 2008 avec la remontée de l'espérance de vie.

Figure 4: Évolution de l'espérance de vie à la naissance dans les oblasts de Donetsk et Ternopil'ska, 1988-2010



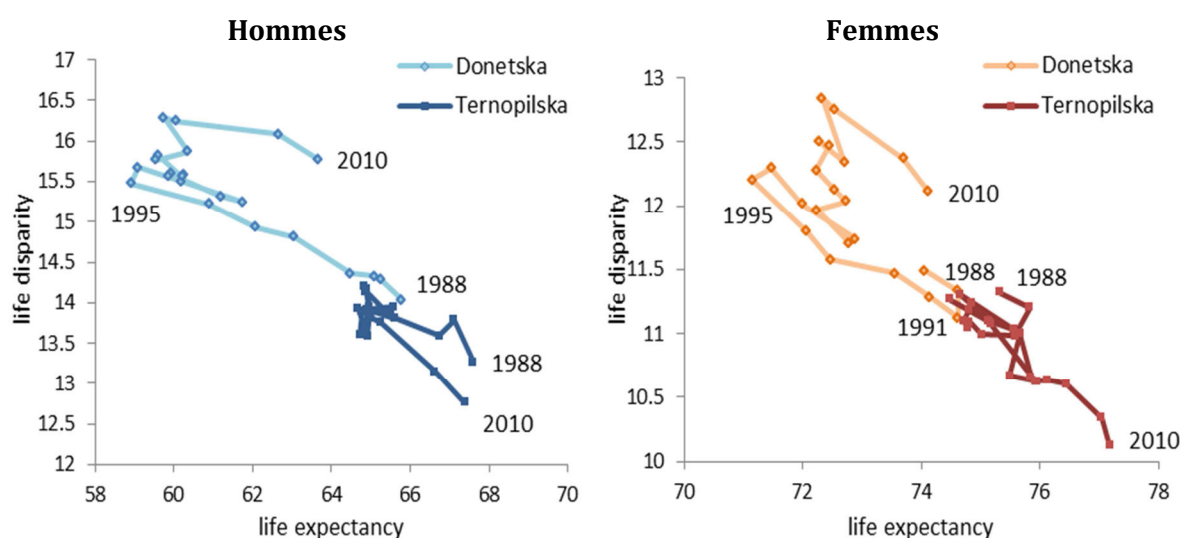
Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine après correction de la mortalité infantile

En plus de la vie moyenne, on peut également analyser la santé de la population sous l'angle de l'inégalité d'espérance de vie. L'agenda pour l'égalité face à la santé prévoit à la fois une espérance de vie élevée et une faible disparité. La figure 5 reprend les deux régions extrêmes déjà prises en exemple, les oblasts Donetsk et Ternopil'ska. En 1988, dans le Donetsk oblast, l'espérance de vie masculine à la naissance était de 65,6 ans et la disparité de 14 ans. Avec la baisse de l'espérance de vie, la disparité s'est accrue et la ligne bleue se déplace vers le haut à gauche de la figure. En théorie, c'est effectivement ce que l'on devrait observer : une corrélation négative entre l'espérance de vie et la disparité, puisqu'une augmentation de l'espérance de vie

s'accompagne généralement d'une compression de la mortalité et à la rectangularisation de la courbe de survie, et donc à une réduction de la disparité de l'espérance de vie (Kibele, 2012).

En pratique, les situations sont diverses. Par exemple, l'espérance de vie féminine dans le Donetsk oblast a atteint 74 ans à trois reprises (en 1988, 1991 et 2010) mais chaque fois la disparité d'espérance de vie correspondante est différente. Elle est ainsi passée de 11 à 12 ans entre 1991 et 2010. Ainsi la récupération observée en 2010 n'a pas permis de retrouver exactement la même situation que celle qui prévalait en 1991, puisque la disparité a augmenté.

Figure 5: Relation entre la disparité d'espérance de vie et l'espérance de vie dans deux oblasts, 1988-2010



Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine

L'annexe P présente des graphiques pour toutes les régions ce qui permet de différencier les régions dont le chemin de retour est très proche de celui de l'aller et celles où il en est au contraire très éloigné. Parmi ces dernières, il faut noter que l'éloignement peut être dû à deux phénomènes opposés : une période où l'espérance de vie a stagné alors que la disparité augmentait (les oblasts Donetsk, Volynska, Zakapartska) ou une période de croissance de l'espérance de vie alors que la disparité stagnait (les oblast Lvivska, Rivnenska). Finalement, même dans les régions qui ont bien progressé, le bilan n'est pas aussi positif qu'il pourrait apparaître au premier abord du fait de l'augmentation des disparités.

Les profils nosologiques ont changé au cours des trois périodes. Pour la plupart des causes de décès, les tendances sont restées les mêmes sur la plus grande partie de la période étudiée. Ainsi, les maladies de l'appareil circulatoire demeurent très largement prépondérantes. Elles comptent pour 60 à 70 % des décès et la tendance est à l'augmentation sur l'ensemble de la

période, à l'exception des toutes dernières années, où une petite amélioration semble se dessiner mais il est trop tôt pour savoir si celle-ci sera durable.

La mortalité cancéreuse, pour sa part, est en diminution constante. Cette tendance est visible dans toutes les régions, sans qu'il soit possible de la relier à des facteurs politiques, sociaux ou économiques. Après avoir explosé dans les années 1990, les morts violentes ont retrouvé leur niveau initial, qui reste toutefois très élevé. Pour les autres causes de décès, les évolutions se sont poursuivies dans le même sens tout au long de la période : à la baisse pour les maladies de l'appareil respiratoire, à la hausse pour les maladies infectieuses et les maladies du système digestif.

Les maladies de l'appareil circulatoire qui sont le principal déterminant de la géographie de la générale mortalité ont particulièrement marqué les parties nord et sud de l'Ukraine. La dégradation de la situation dans le nord du pays est impressionnante. Dans les années récentes l'oblast de Tchernihiv apparaît particulièrement désavantagé. Il est possible que cette détérioration soit en partie due aux conséquences du désastre de Tchernobyl.

La réduction de la mortalité par cancer s'est distribuée de façon assez homogène dans toutes les régions. Il est possible qu'une plus forte mortalité cancéreuse se retrouve dans des régions mieux organisées, où les diagnostics médicaux sont de meilleure qualité et qui disposent de centres de traitement spécifiques pour les malades du cancer.

Enfin, ce sont les morts violentes qui dessinent le contraste le plus accusé entre l'ouest et l'est de l'Ukraine. La situation s'est énormément dégradée dans les années 1990, sous l'effet de la crise économique. Les morts violentes sont en effet très sensibles aux changements sociaux. Après cette impressionnante montée, la mortalité violente a retrouvé le niveau qui prévalait avant la crise.

Les maladies de l'appareil respiratoire sont les seules causes de décès pour lesquelles la mortalité est plus élevée à l'ouest qu'à l'est de l'Ukraine. Toutefois les différences se sont réduites au cours du temps. La géographie des maladies digestives et celle des maladies infectieuses, très proches l'une de l'autre, n'a pas changé au cours de la période : ces causes de décès sont particulièrement importantes dans le sud et l'est de l'Ukraine, ainsi que dans l'oblast de Transcarpatie (Zakarpatska oblast).

## **Chapitre 7. Analyse de la mortalité par districts**

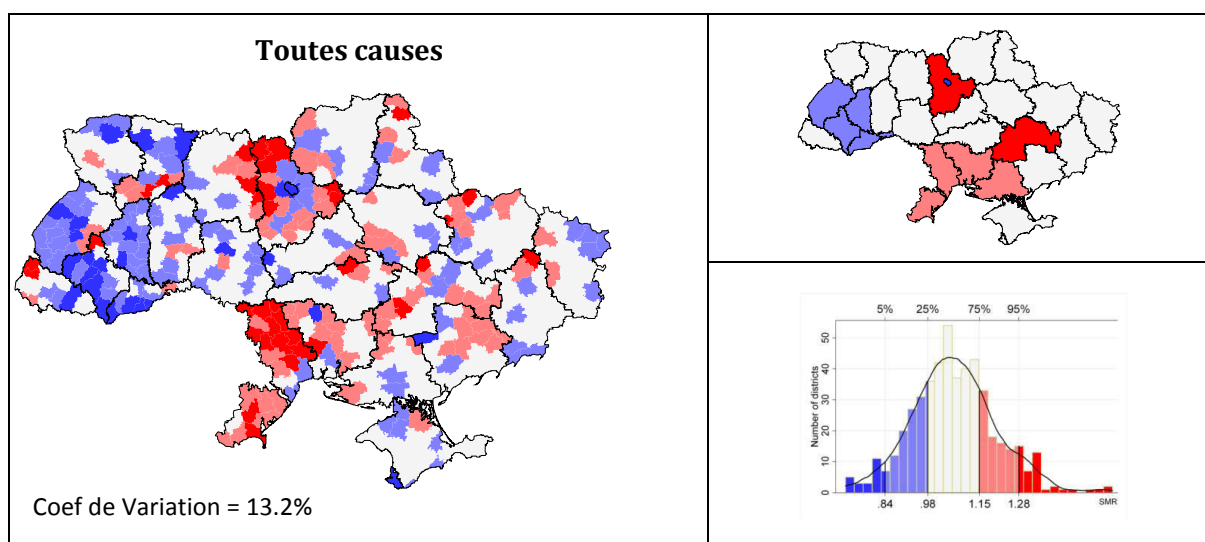
Pour finir, le chapitre 7 reprend l'analyse au niveau très fin des districts tout en simplifiant, puisque les données par cause y sont nécessairement plus concentrées et ne distinguent ni l'âge

ni le sexe. En effaçant les frontières régionales, il est possible de dessiner des zones géographiques plus homogènes par rapport à telle ou telle cause. On voit ainsi apparaître des continuités transrégionales, allant de l'ouest au sud-est de l'Ukraine et passant d'une mortalité plus faible à une mortalité forte.

La première partie du chapitre est consacrée à la mortalité infantile. Comme on pouvait s'y attendre, celle-ci est plus basse en milieu urbain qu'en milieu rural. Toutefois cet avantage des villes sur les campagnes ne suffit pas à effacer les différences est-ouest et la mortalité infantile des régions de l'est, pourtant fortement urbanisées, est supérieure à celle de l'ouest rural. De plus les villes de l'est et de l'ouest sont différentes. Les métropoles orientales bénéficient de bonnes infrastructures sanitaires tandis que les habitants des campagnes qui les entourent sont particulièrement défavorisés de ce point de vue. Si l'on considère seulement les régions rurales, le contraste entre l'ouest et l'est du pays s'accroît. Par ailleurs, il est notoire que l'écart entre la mortalité infantile dans les zones rurales et dans de petites et moyennes agglomérations urbaines est moins important.

La représentation graphique des SMR permet de distinguer quatre grands types de zones en Ukraine pour la mortalité totale : les régions de l'ouest à faible mortalité, une zone défavorisée autour de la capitale, les régions du sud-est à forte mortalité, et des zones qui réunissent des districts à forte et faible mortalité, donnant une impression d'éparpillement. L'analyse des résultats au niveau très fin du district confirme ainsi en la précisant la géographie décrite au niveau des oblasts (Figure 6).

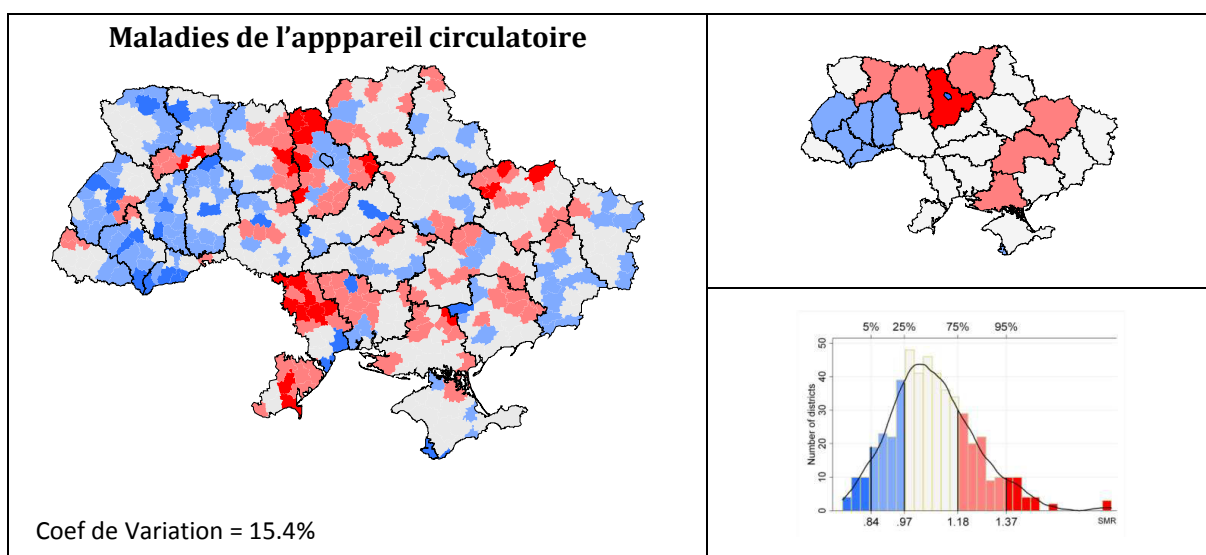
Figure 6: SMR toutes causes, moyenne 2005-2010, Ukraine



Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine

La distribution des SMR par maladies cardio-vasculaires qui rassemblent la majorité des décès est très comparable à celle des SMR toutes causes (Figure 7). Les oblasts de Kiev et Odessa présentent des zones continues de forte mortalité, alors que des zones continues de faible mortalité regroupant des districts adjacents sont clairement visibles à l'ouest. Le coefficient de variation est de 15.4%, ce qui n'est pas très élevé.

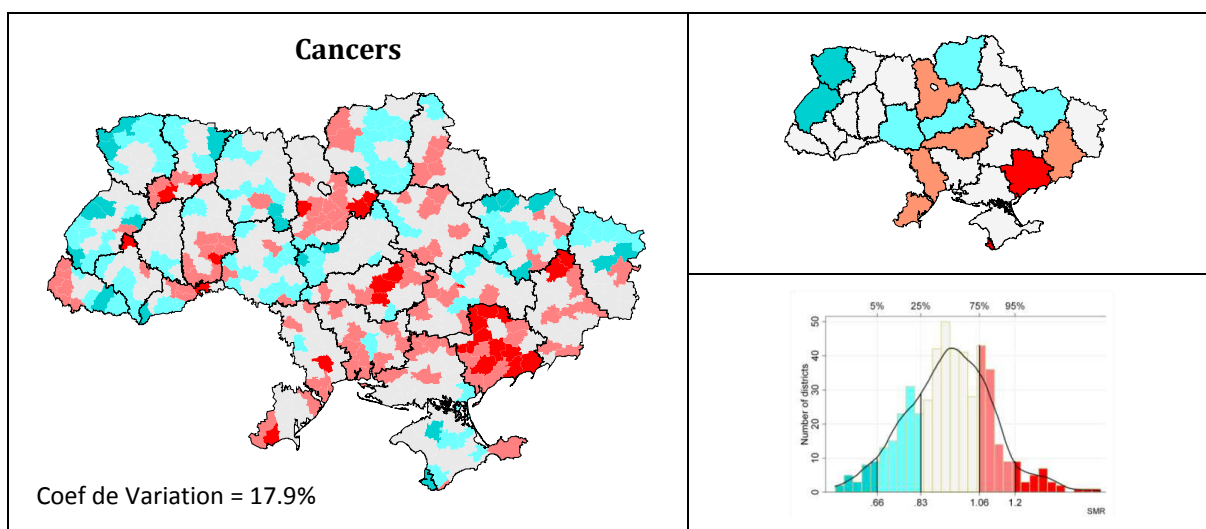
Figure 7: SMR par maladies de l'appareil circulatoire, moyenne 2005-2010, Ukraine



Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine

Il n'est pas possible d'identifier une géographie précise de la mortalité cancéreuse (Figure 8), des districts à faible mortalité jouxtant d'autres districts où le SMR est très élevé. Seul l'oblast de Zaporizka ne regroupe que des districts à forte mortalité. Le coefficient de variation du SMR s'élève à 17.4%, plus haut que pour les maladies circulatoires.

Figure 8: SMR par cancers, moyenne 2005-2010, Ukraine

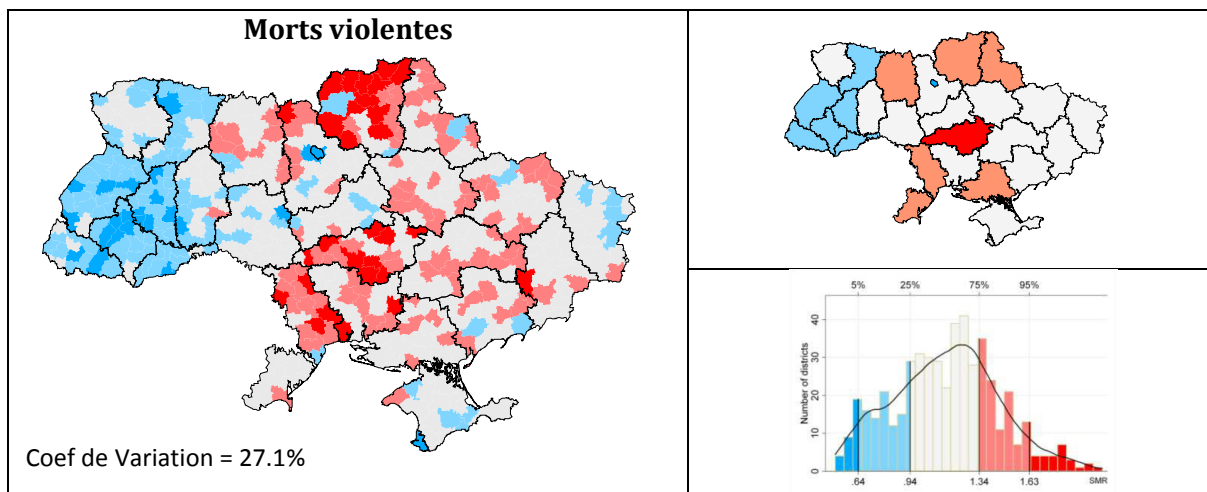


Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine



La distribution spatiale des morts violentes (Figure 9) diffère notablement du profil géographique de la mortalité toutes causes. Il existe ici un très fort contraste entre l'ouest de l'Ukraine et le reste du pays. Ce contraste est encore plus marqué si l'on considère uniquement les homicides et les suicides. La limite de la zone de faible mortalité coïncide exactement avec la frontière historique de l'Union soviétique avant la seconde guerre mondiale. Le coefficient de variation pour ce groupe de causes est très élevé à 27%.

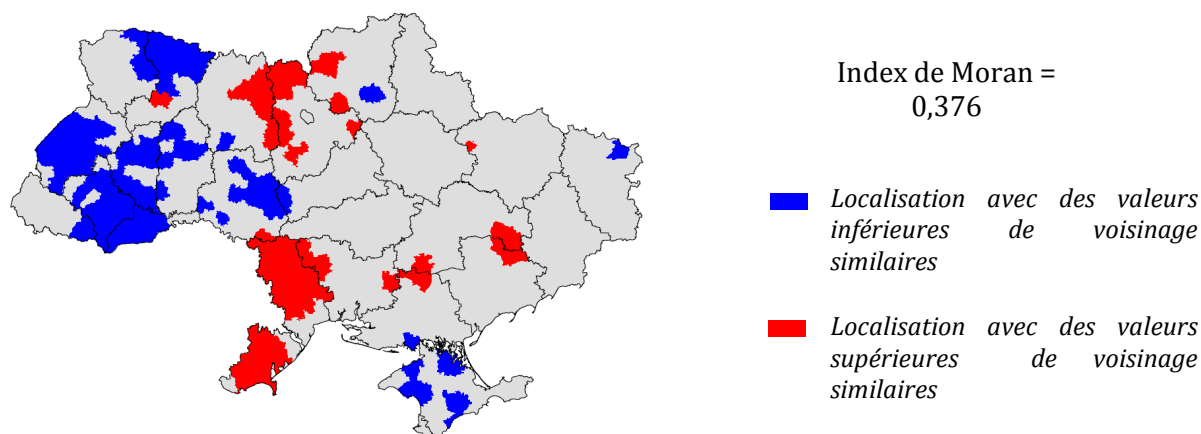
Figure 9: SMR par morts violentes, moyenne 2005-2010, Ukraine



Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine

L'analyse spatiale (indices de Moran et LISA) permet ensuite de donner plus de contraste aux résultats en majorant la visibilité des districts environnés de districts similaires. On obtient alors des cartes extrêmement lisibles mais qui font disparaître certaines réalités qu'on avait cru fortes. Certes, l'avantage massif de l'ouest demeure. Le désavantage du sud-est est beaucoup plus nuancé. Il disparaît presque complètement pour les maladies cardiovasculaires, il laisse complètement à l'écart la Crimée et les régions voisines pour les maladies digestives, les morts violentes et les maladies infectieuses.

Figure 10: Index LISA par districts ukrainiens, 2005-2010, toutes causes

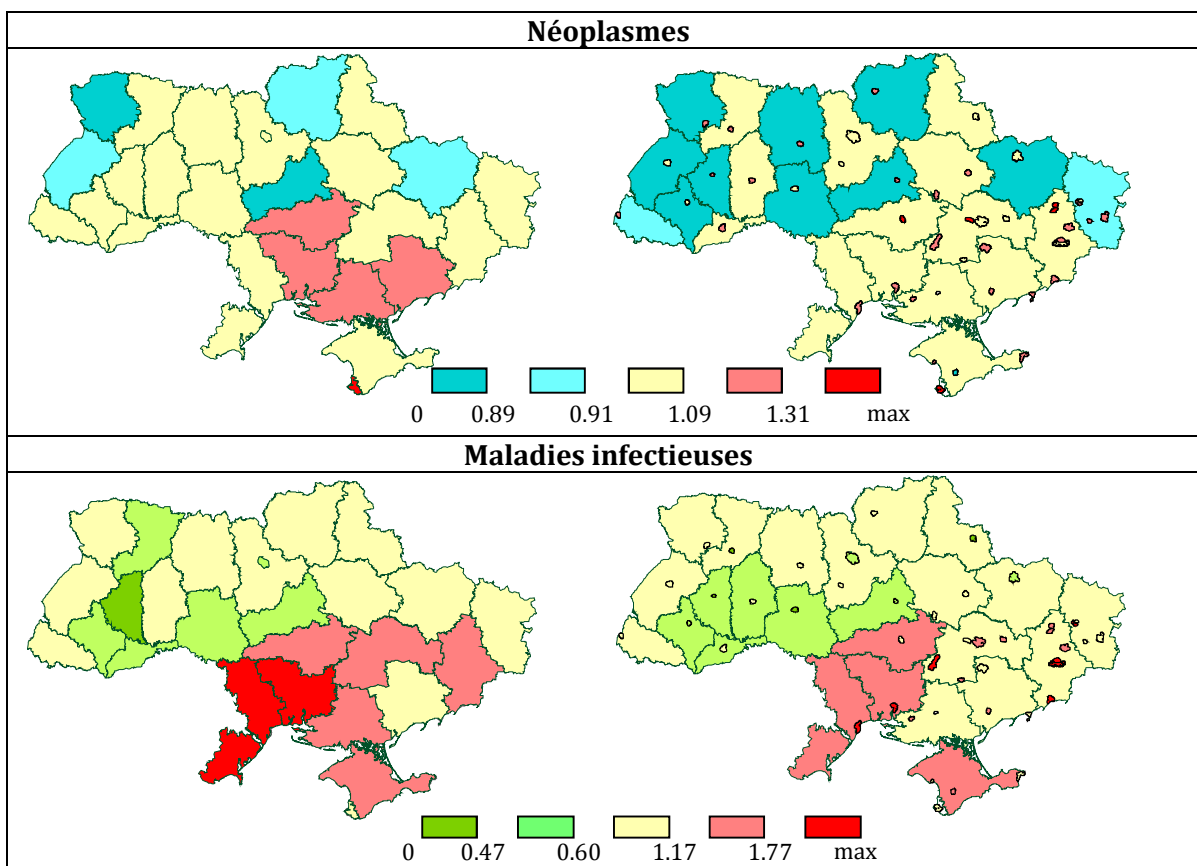


Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine

Il était aussi important de prendre en compte les différences de densité de population dans les différents districts car la présence d'une grande ville peut biaiser les résultats. En effet, l'exclusion des grands centres urbains modifie les profils régionaux, avec une amélioration ou une détérioration de la situation selon la cause de décès considérée.

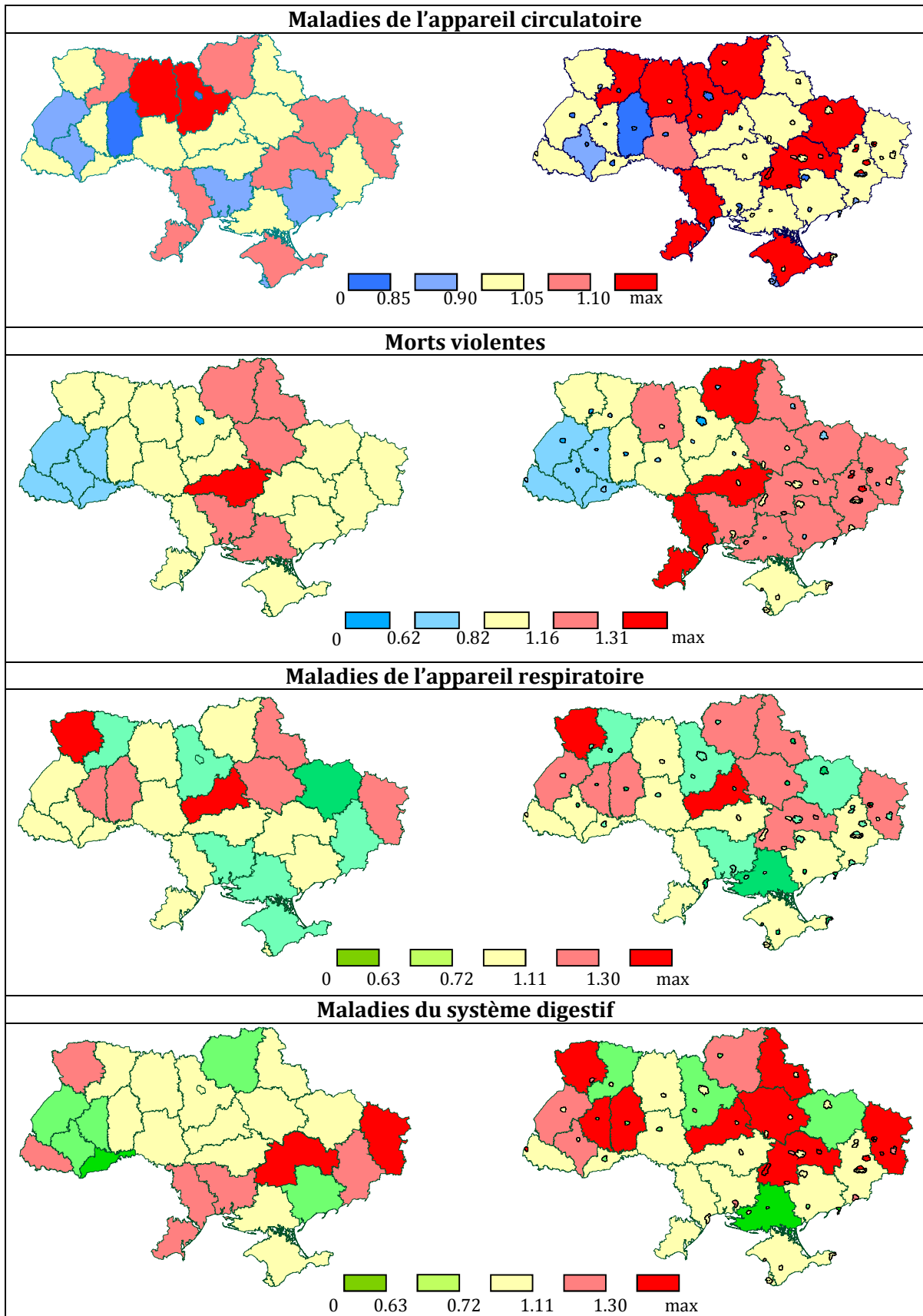
Pour les cancers et les maladies infectieuses, l'exclusion des grandes villes améliore la situation (Figure 11). Ceci peut s'expliquer par le fait que les grands centres de traitement anti-cancéreux sont généralement installés dans les grands centres urbains. Les malades viennent s'y faire soigner et s'ils décèdent, leur décès est enregistré à l'endroit où il se produit même s'il ne s'agit pas de la résidence habituelle. Le même type d'explication peut s'appliquer aux maladies infectieuses au sein desquelles la tuberculose occupe la première place. Là encore les centres antituberculeux se retrouvent pour la plupart au sein des agglomérations urbaines. D'un autre côté, les épidémies s'étendent dans des places densément peuplées et, dans les années récentes, les risques infectieux ont été amplifiés par le développement du sida. Il faut toutefois noter que, pour certaines régions occidentales, l'exclusion des villes n'améliore pas la situation, mais au contraire la dégrade. Ceci signifie sans doute que les maladies infectieuses ne sont pas de la même nature dans les villes de l'ouest et de l'est du pays.

Figure 11: SMR par cancer et maladies infectieuses avant et après exclusion des grandes villes, Ukraine 2005-2010



Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine

Figure 12: SMR pour différentes causes de décès avant et après exclusion des grandes villes, Ukraine 2005-2010



Source: calculs de l'auteur à partir de données du Service national de la statistique d'Ukraine

Pour les autres causes l'exclusion des grandes villes aggrave le tableau (Figure 12). Généralement vivre en ville procure un avantage sanitaire par rapport à la vie en milieu rural. Pour les maladies de l'appareil circulatoire et du système digestif, cette exclusion ne modifie cependant pas considérablement le tableau mais pour les morts violentes, la différence est saisissante.

De même, pour les maladies de l'appareil respiratoire, la situation du nord de l'Ukraine est profondément modifiée selon que l'on inclut ou non les villes. L'exclusion de la seule ville de Tchernihiv fait chuter l'oblast de deux niveaux, ce qui montre que la population rurale de cet oblast est extrêmement défavorisée pour cette cause de décès par rapport à la population urbaine.

Enfin, le chapitre 7 se termine par une analyse particulière de la mortalité dans la ville de Slavutysh, qui a été créée après l'accident de la centrale nucléaire de Tchernobyl pour accueillir la population de Pripiat, la ville la plus sévèrement touchée par la catastrophe. Slavutysh présente des taux de mortalité relativement élevés pour les cancers et les maladies endocriniennes, compte tenu d'un niveau de mortalité total particulièrement bas dans cette ville. Le désavantage pour ces causes apparaît également si l'on compare aux régions voisines ou à des villes similaires dans d'autres régions d'Ukraine.

## **Conclusion**

L'objectif de cette étude était d'étudier les différences de mortalité régionales en Ukraine, les structures par causes de décès et les tendances à différentes échelles spatiales. À l'issue des différentes analyses effectuées, il est possible d'apporter des éléments de réponse aux différentes questions de recherche posées en introduction.

### *1) Quelle est l'ampleur des différences géographiques de mortalité en Ukraine?*

Cette question a été traitée en utilisant nos propres estimations effectuées à partir des données brutes fournies par le Service de statistiques d'Ukraine (et non les résultats diffusés par ce service). Quelques corrections ont dû être apportées aux données, pour tenir compte des problèmes posés par les particularités des divisions administratives, l'imperfection de l'enregistrement des événements vitaux et la ré-estimation des populations entre recensements. Alors qu'il a été possible de réarranger les unités administratives et de corriger la mortalité infantile, la ré-estimation des populations régionales n'a pu être effectuée dans le cadre de cette thèse. Les estimations du Service national de la statistique ont donc été utilisées en l'état,

considérant que les possibles imprécisions concernaient surtout les âges actifs jeunes, pour lesquels la mortalité peu élevée ne pèse pas beaucoup sur le calcul de l'espérance de vie.

En général, la disponibilité des données (par causes, par districts etc.) s'accroît avec le temps. En 2005, l'Ukraine a adopté la 10<sup>e</sup> révision de la Classification internationale des maladies, et de nouvelles règles sont entrées en vigueur: publication de nouveaux formulaires statistiques et nouvelles instructions pour le codage des causes de décès.

Différents indicateurs de mortalité ont pu être calculés à partir de ces données pour identifier les différents profils régionaux de mortalité et pour mesurer l'ampleur des écarts. Des contrastes géographiques nets ont ainsi été mis en évidence : pour les hommes, entre l'ouest et l'est de l'Ukraine, et pour les femmes - entre l'ouest et le sud-est. Le schéma général reste le même quel que soit le groupe d'âges, car comme l'a montré l'analyse des corrélations, il y a des liens très forts d'un groupe d'âge à l'autre. Les régions à faible espérance de vie ont une mortalité forte à tous les âges alors que pour celles où l'espérance de vie est élevée, la mortalité est basse à tous les âges. La décomposition par âge des écarts d'espérance de vie entre chaque région et la moyenne nationale a révélé que l'avantage des régions les plus performantes était plus important que le désavantage des régions les plus défavorisées. Ceci est vrai à tous les âges mais est davantage marqué aux âges les plus élevés. Les régions les plus favorisées ont une mortalité aux âges élevés particulièrement basse. Ceci montre l'importance de réorganiser le système de santé de façon à ce qu'il réponde aux besoins de la population âgée, ce qui pourrait favoriser la hausse de l'espérance de vie.

La disponibilité de données à un niveau géographique fin a permis de mettre en évidence certaines caractéristiques invisibles au niveau régional. Les districts de l'ouest forment ainsi une zone continue homogène de basse mortalité. Grâce aux index de corrélation spatiale, on voit que ces districts s'influencent positivement entre eux. De la même manière l'Odes'ka oblast est très homogène avec des districts étroitement corrélés, mais ici avec une influence réciproque négative.

Pour la plupart des causes de décès (à l'exception du cancer et des maladies infectieuses) vivre dans une grande métropole est un avantage. Le cas de la ville de Slavoutytch qui a particulièrement souffert de l'accident de Tchernobyl a fait l'objet d'une analyse spécifique.

## 2) *Quelles sont les causes de décès qui dessinent la géographie de la mortalité?*

Trois causes principales déterminent les profils géographiques de mortalité : les maladies cardio-vasculaires, les cancers et les morts violentes. Cependant, aucune cause de décès n'offre une géographie identique à celle de l'espérance de vie. Les maladies de l'appareil circulatoire

prédominant dans tous les régions, mais elles sont particulièrement élevées dans le nord et dans quelques régions du sud. Les cancers ne montrent aucune continuité géographique, tandis que les morts violentes différencient très nettement l'ouest, moins touché par ces causes, du reste de l'Ukraine.

Les régions de l'ouest et la ville de Kiev sont systématiquement en meilleure position que le reste du pays, mais la surmortalité des régions du sud et de l'est est moins nette chez les femmes que chez les hommes. Les causes moins importantes présentent des géographies encore plus éloignées de celle de la mortalité toutes causes. Pour les maladies respiratoires la géographie est même presque inversée, avec un désavantage de l'ouest.

À la vue des schémas régionaux de mortalité par causes médicales de décès, il apparaît que les régions ukrainiennes se trouvent à différents stades de la lutte contre les maladies dégénératives. Les régions occidentales ont réussi à progresser, grâce à des changements de comportement et une prise en charge individuelle de leur santé par les habitants. Les régions du nord, où la mortalité par maladies cardio-vasculaires est largement dominante, semblent juste entrer dans une nouvelle étape mais elles manquent encore des moyens efficaces de lutte contre ces maladies. Enfin, les régions de l'est et du sud se caractérisent par une structure de mortalité archaïque avec un risque élevé de mortalité par maladies digestives et infectieuses, ainsi qu'une importante mortalité violente. Pour la plupart ces pathologies sont liées à la consommation d'alcool et peuvent être qualifiées de maladies de société.

### 3) *Comment la géographie de la mortalité a-t-elle évolué depuis l'éclatement de l'URSS "*

Enfin, la dynamique des deux dernières décennies a fait l'objet d'une attention particulière. Pendant cette période l'espérance de vie a connu une forte baisse, suivie d'une stagnation, puis d'un début de reprise. Le rythme des changements n'a pas été le même partout. Dans certaines régions, le recul de l'espérance de vie a été plus rapide que dans d'autres et, en conséquence, l'écart s'est creusé. La disparité des durées de vie s'est aussi accrue dans la plupart des régions. Le coefficient de variation a quasiment doublé en 20 ans.

Ces évolutions se sont accompagnées d'une transformation des schémas régionaux de mortalité par cause.

Sur l'ensemble de la période, les maladies de l'appareil circulatoire sont restées la cause de décès majeure, sans que l'on puisse noter de quelconques progrès dans leur prévention ou leur traitement. Ce groupe de maladies compte pour 60 à 70% de l'ensemble des décès et son évolution est globalement à la hausse, si l'on fait abstraction des fluctuations des années 1990. La mortalité violente a elle aussi subi des fluctuations très accusées liées aux bouleversements

socio-économiques de ces années-là. Les autres causes ont eu des évolutions assez régulières : à baisse pour le cancer et les maladies respiratoires et à la hausse pour les maladies digestives et infectieuses.

Finalement, le gradient de mortalité de l'ouest à l'est de l'Ukraine n'a pas fondamentalement changé au cours de la période. Les régions occidentales sont nettement influencées par le contexte polonais auquel elles sont historiquement liées alors que les régions de l'est sont restées très proches de la Russie. L'idéologie soviétique qui n'encourageait pas l'initiative individuelle en termes de santé était probablement moins prégnante dans les régions occidentales que dans les régions orientales qui ont eu plus de mal à s'adapter aux réalités post-soviétiques.

En résumé, si l'on fait abstraction des fluctuations des années 1990, sur le long terme aucun progrès décisif n'a été réalisé dans l'ensemble de l'Ukraine. En l'absence de stratégies efficaces et de réformes de fond du système de santé, la révolution cardio-vasculaire n'a pu avoir lieu et le système a même échoué à réduire la mortalité évitable. Le système de santé n'a pas été modernisé et souffre d'un manque de moyens financiers, même si l'intention de créer une assurance médicale obligatoire figure à l'agenda politique depuis de nombreuses années.

Faute de données disponibles, les analyses présentées dans cette thèse ne couvrent pas les années les plus récentes. Depuis 2008, une reprise de la hausse de l'espérance de vie a pu être observée. L'année 2014 a été marquée par plusieurs événements tragiques : la perte d'une partie du territoire et les opérations terroristes menées dans l'est de l'Ukraine qui ont provoqué un changement important de la composition de la population dans ces régions. Dans ces circonstances, le besoin d'un nouveau recensement, déjà retardé de quatre ans, est devenu d'autant plus urgent. Les données de ce recensement permettraient de mieux évaluer les évolutions récentes de mortalité au niveau régional en fournissant de nouvelles estimations de populations qui prennent en compte les migrations et en permettant de ré-estimer les populations des différents districts dans la période intercensitaire.

Il serait aussi utile d'examiner dans quelle mesure les événements socio-économiques et politiques récents ont pesé sur les évolutions récentes de mortalité selon les régions. Des données socio-économiques régionales, et idéalement au niveau plus fin des districts, aideraient à mieux comprendre les différences de mortalité observées. Les recherches sur la mortalité en Ukraine devraient à l'avenir chercher à quantifier plus précisément l'impact sur la mortalité de certains facteurs de risque comme l'alcool, le tabac, le régime alimentaire, les conditions de travail, la pollution le stress, etc. Les différences de mortalité selon le milieu de résidence, le niveau d'instruction ou le groupe social pourraient aussi être explorées.

Nul besoin de dire qu'une étude fouillée des évolutions historiques sur le long terme permettrait de remettre les évolutions récentes en perspective. De ce point de vue, la numérisation des données régionales antérieures à 1988 fournirait aux chercheurs un matériau inestimable.

Les résultats d'une telle étude pourront servir de base à la construction de projections de population par région. Une meilleure compréhension des différences de mortalité aide à anticiper les évolutions à venir et à relever les futurs défis démographiques. Les décideurs pourront prendre en compte les spécificités des profils régionaux de mortalité ainsi mis à jour pour développer des politiques socio-sanitaires adaptées dans le cadre de l'actuelle restructuration politique. Chaque région doit développer ses propres stratégies et instruments pour garantir le plein fonctionnement des systèmes locaux pour la population concernée mais aussi pour les futures générations. La plupart des programmes nationaux visant à réduire les inégalités entre les régions ukrainiennes préconisent une redistribution des ressources de l'est vers l'ouest et concentrent l'attention du gouvernement sur les zones les moins attractives en termes d'investissement. Ces politiques laissent de côté des régions vulnérables d'un point de vue démographique. Pour réduire les inégalités et renverser les tendances négatives, il faut que les forces politiques et de planification interviennent dans la vie sociale et appliquent des mesures adaptées à chaque région.

Enfin, les processus démographiques ukrainiens présentent aussi un intérêt particulier pour la recherche internationale du fait de la situation particulière de l'Ukraine, calée entre la Russie et le reste de l'Europe d'un point de vue géographique, politique, idéologique et démographique.



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Annexes

## Annexe 2. Validation des résultats

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