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REGIONAL MORTALITY DIFFERENTIATION IN KAZAKHSTAN (1999-2008)

Doctoral Thesis

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In Prague, Shynar Tuleshova

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Regional mortality differentiation in Kazakhstan (1999-2008)

Abstract

The objective of the submitted doctoral thesis is to examine the mortality variation across regions of Kazakhstan and to investigate the explanatory factors of regional mortality differences in the period 1999-2008. Population and mortality data for the period 1999-2008 and the explanatory variables for the periods 1999, 2000, 2007, 2008 were obtained from Agency of Statistics of the Republic of Kazakhstan.

The work analyzed the development of regional differentiation in overall mortality level and mortality level by age group, and examined the regional mortality trends by sex, age groups, and selected leading causes of death in the observed period. The intention was to show the regional mortality differences in the periods 1999-2000 and 2007-2008 and the changes between observed periods.

The special attention is paid to assessing the contribution of age groups and selected main causes of death to the change in overall mortality level in the regions between examined periods.

The observation of association of regional differences in life expectancy and measures of inequality in age at death in the beginning and the end of the period and its change between the periods were one of the ways of examination the regional mortality inequalities.

The multiple regression model was used to investigate the variables explaining the regional variation in overall mortality level while canonical correlation method was applied to examine the variables explaining the regional variation in mortality level by age groups in the periods 1999-2000 and 2007-2008.

The results of the work suggested the increase of regional mortality differentiation which was explained by substantial mortality decline in municipal cities and the comparative stagnation in mortality improvement in other regions. Mortality differences across regions were determined by regional socio-economic and demographic inequalities in the observed period.

Key words: Kazakhstan, Regional differences, Mortality, Factors of mortality, Regression, Correlation

Региональная дифференциация смертности в Казахстане (1999-2008)

Абстракт

Цель работы: исследовать варьирование смертности в регионах Казахстана, а также изучить факторы, влияющие на различие в показателях смертности с 1999 по 2008гг. Представленные в работе данные за период 1999-2008 и показатели за 1999, 2000, 2007 и 2008 гг. были получены в Агенстве Республики Казахстан по статистике.

В работе проводится комлексный анализ регионального дифференцирования общего уровня смертности и уровня смертности по возрастным группам, исследованы региональные особенности смертности по возрастным группам, половой принадлежности и по отдельным основным причинам смерти в исследуемый период. Задачей автора было показать региональные различия в уровнях смертности в 1999-2000 гг.и 2007-2008 гг., а также переменах, произошедших между исследуемыми периодами.

Особое внимние уделено оценке влияния возрастних групп и отдельных основных причин смерти на изменения в общем уровне смертности в регионах между исследуемыми периодами.

Одним из способов изучения разницы в смертности по регионам было наблюдение за связью между региональными различиями по ожидаемой продолжительности жизни и по показателям разницы возраста наступления смерти в начале и конце исследуемых периодов, а также за изменениями, проходящими между ними.

Метод многоуровнего регрессионного анализа был применен для исследования переменных, которые объясняют варьиравание общего уровня смертности по регионам. Для изучения переменных показателей, отражающих региональное варьирование в общем уровне смертности по возрастным группам в периоды 1999-2000 гг. и 2007-2008 гг. был использован метод канонической корреляции.

Полученные результаты показывают, что дифференциация смертности по регионам возросла, что явилось следствием существенного снижения смертности в городах муниципального назначения, и сравнительной стагнации в показателях смертности в других регионах. Различия в смертности по регионам объясняются присутствующими социально-экономическими и демографическими различиями в исследуемый период.

Ключевые слова: Казахстан, региональные различия, смертность, факторы смертности, регрессия, корреляция

CONTENTS

LIST OF ABBREVIATIONS

USSR – Union of Soviet Socialist Republics

WHO – World Health Organization

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

LIST OF APPENDICES

Chapter 1

Introduction

1.1 Problem definition

In contemporary demography the study of regional mortality differentiation within country is a matter of growing concern. The main reason of this evidence is that the observation of regional mortality variation affords to perform better mortality pattern in the country. Kazakhstan is one of the post-soviet Central Asian countries whose territory is considered to be one of the biggest in the world. 14 regions (oblasts) and 2 municipal cities of the country are differentiated not only by natural resources and economic status but also by ethnical composition and ecological features. These differences definitely would have the possible effect on regional mortality inequalities in the country. This topic was briefly issued before by researchers C. Becker and D. Urzhumova (2005) for the period 1995-2001. Authors concluded that there were the stark regional differences − mortality decline was underway in many areas with substantial economic recovery, while elsewhere there had been no discernable improvement. Our study period 1999-2008 coincides with the time of economic growth in the country. In this period mortality level slightly improved in the country. Life expectancy at birth for males increased for 1.0 year (from 60.2 in the period 1999-2000 to 61.2 in the period 2007-2008) while female life expectancy at birth increased for 1.3 years (from 70.7 years in the period 1999-2000 to 72.0 in the period 2007-2008). In this sense it would be important to examine if all regions demonstrated the improvement or the stark regional differences existed as it was noted before. Hence, it would be reasonable to observe what factors were responsible for regional mortality differences.This examination is fundamentally important to fill the wide knowledge gap in research of regional mortality differentiation within Kazakhstan. Moreover, the observation would identify the fact that mortality is higher in one region than in another emphasizes the urgency of solving the underlying problems in those regions where mortality is highest and it suggests that improvements can indeed be made.

1.2 Goal and objectives of the research

The main *goal* of the thesis is to analyze the regional mortality differentiation in the period 1999-2008 focusing on the changes in regional mortality differences between the periods 1999-2000 and 2007-2008 and identifying the socio-economic and demographic factors of regional differences in both periods. From the main goal we define the following *research objectives* of the thesis:

- to observe the development of regional mortality variation in the period 1999-2008
- to examine the regional mortality trends by sex, age and causes of death in the period 1999-2008;
- to assess the contribution of age groups and causes of death to the change in life expectancy at birth in the regions between the periods 1999-2000 and 2007-2008;
- to analyze the changes in association of regional differences in expectation of life and measures of inequality in age at death between the periods 1999-2000 and 2007-2008;
- to investigate the socio-economic and demographic factors of regional differentiation in overall mortality level and mortality by age groups in the periods 1999-2000 and
- 2007-2008;

1.3 Structure of thesis

According to the topic of research and the problem definition the thesis is divided into two main parts: theoretical and analytical.

Theoretical part includes the first seven chapters of the thesis. The topic of thesis, the goal and objectives of research and the structure of thesis are specified in introductory chapter. The introduction is followed by the second chapter providing an overview of literatures which are relevant to the topic. The next chapter describes the theoretical framework of research. The definitions of basic theories and their relevance to the studied problem by basic facts are presented in the chapter. The forth chapter identifies the main research questions and hypotheses according to the questions. In the following chapter author describes the main data sources of thesis, mortality data collection and its processing. The quality of obtained data, the choice process of explanatory variables and their description are also specified in the given chapter. The next chapter addresses the research methods which are divided according to their level of complexity, and demographic/statistical characteristics. The last chapter of the given part makes an overview of regional development during the study period focusing on socio-economic changes between the periods 1999-2000 and 2007-2008. Regional differences in socio-cultural and educational structures of population, ecological problems of regions are also described in the chapter.

The next six chapters focused on principal results of research are presented in analytical part. The analysis of regional variation development in overall mortality level and mortality by age groups in the period 1999-2008 through the statistical indicators is specified in the eighth chapter. The next chapter examines the regional trends of mortality according to sex, age groups and selected leading causes of death in the period 1999-2008. The contributions of age groups and selected main causes of death to the change in life expectancy at birth between the periods 1999-2000 and 2007-2008 in each region are presented in tenth and eleventh chapters. The following chapter analyses the change in association of regional differences in expectation of life and measures of inequality in age at death between abovementioned periods. The last chapter of analytical part identifies the relation of selected socio-economic and demographic variables to regional differences in overall mortality level and mortality level by age groups in the periods 1999-2000 and 2007-2008.

In the final chapter of the thesis the main findings are recapitulated and conclusions are drawn. Lists of tables, figures, and appendices represent an unseparable part of the submitted thesis.

Chapter 2

Literature overview

The examination of regional mortality differentiation within country turned into the main topic of researchers in many countries. They tried to answer two principal questions. What regions have the higher and lower risks of mortality within country? What factors would explain the regional mortality differences?

The observation of mortality level across European Union countries and 272 European regions determined the difference between higher mortality of the new Central and Eastern European Member States and lower mortality of the old European Union countries in the period 1994-1996 (Eurostat, 2009). Moreover, the issue identified the regions with highest and lowest mortality levels within the European countries. The socio-economic factors of regional mortality differentiation in Europe were determined in research work of J.Spijker (2004). Author identified the greater role of socio-economic indicators as absolute income and divorce rate in Eastern Europe compared to Western one. This evidence was explained by the higher effect of absolute income where absolute standard of wealth was lower and the higher role of divorce rate as an indicator of psychosocial stress.

Among western European countries the regional mortality differentiation in Netherlands was partly explained by average income (Mackenbach et al., 1991) while in Germany the dominant factor was regional unemployment (Grozinger, 2009). Answering the question if regional mortality differences in Belgium can be explained by individual socio-economic characteristics researchers P. Deboosere and S. Gadeyne (2002) identified additional four groups of factors: environmental factors, contextual socio-economical factors, effects of different public health policies and amenities, and behavioural or cultural factors. Despite the fact that cultural factors were less considered in Western Europe higher mortality in the southern part of Netherlands was explained by higher percentage of Roman Catholics there due to a higher prevalence of smoking among them (Mackenbach et al., 1991). Regional variation of ischaemic heart disease and cerebrovascular disease mortality as the leading causes of death in these countries was examined separately in several researches (Fulton et al., 1978, Muller-Nordhorn et al., 2004, Andersohn et al., 2010).

In southern Europe Italy where south-north gradient of mortality was well established male mortality was higher in industrialized northern part while female one was higher in underdeveloped southern part. Moreover, better environmental and health conditions, higher educational status and greater safety at the workplace were considered to be the factors of adult mortality decline from cancer in the North (Caselli et al., 2003). In Greece regional mortality variation was explained by the level of living standard and healthcare access indicators which identified Thrace as the region with the highest risk of mortality and underdeveloped among ten regions (Papastergiou et al., 2008).

In European countries regional variation of traffic accident mortality was considered independently as it was an important cause of premature death (Eksler et al., 2008). In Switzerland population density, in Italy the unemployment rate were considered to be its strong predictors (Torre et al., 2007, Spoerri et al., 2011).

Among the post socialist central and eastern European countries the regional mortality differentiation was examined mostly in Czech and Slovak Republics. However, the small issue was devoted to Poland which identified the sharp regional inequalities by the incidence of tuberculosis correlated with poorer housing and atmospheric pollution (Dawson, 2000). In Czech Republic mortality level for both sexes was considered to be higher in industrial border zones with specific population structure (Burcin and Kucera, 2000, Rychtarikova, 2002) while in Slovakia the districts of the southern part had higher mortality level for both sexes (Rosicova et al., 2009). In these countries the frequently determined factors were the educational attainment of population, the proportion of Gypsy population, unemployment rate, and average income (Spijker, 2009, Rosicova et al., 2009, 2011a, Michalek and Podolak, 2007). J. Spijker (2009) considering the effect of smoking proxy on regional differences of mortality from respiratory and circulatory system diseases in Czech Republic suggested that highly educated people are better informed about smoking and are also less likely to smoke due to other psychosocial and material factors associated with education. The examination of regional infant mortality differences in Slovakia identified the proportion of Gypsy population as the important predictor because of their socio-economic disadvantages (Rosicova et al., 2011b).

Among the post soviet countries regional mortality variation was investigated mostly in Russia. The examination of regional mortality differentiation was considered mainly from the period of mortality crisis (1989-1994) in the country. From that period the stark contrast was defined between south-west and north-east, both in terms of total mortality and cause-of-death patterns. Mortality risks were higher in Siberian and Far Eastern European regions while they were lower in southern regions (Men et al., 2003, Vallin et al., 2005). This differentiation was partly explained by mortality variation from external causes (Antonova, 2007). In the period of mortality crisis the regions with the biggest increase of mortality level were predominantly urban, with high rates of labor turnover, large increases in recorded crime, higher average but unequal distribution of household income, and higher divorce rate (Popov, 2009, Walberg, 1998). Researchers examined regional male mortality differentiation independently taking into account excess male mortality in productive ages in the country (Ivanova, 2010). The regional differentiation of male mortality was explained by inequalities in socio-economic development expressed by gross regional product, unemployment rate, divorce rate, migration growth. The intensive immigration of males to capital city Moscow was considered to promote their life potential.

In post soviet Baltic countries regional mortality variation was considered to be significant despite their small territories (Krumins et al., 2006). In Lithuania in the period 1988-1996 among 55 administrative regions the favourable ones were the major towns. The inequalities were explained by the level of urbanisation, education, and marital status (Kalediene and Petrauskiene, 2000).

Regional mortality variation in developing countries was not greatly considered. The main reason of this evidence would be the unavailability of accurate data in most of them. Therefore, in Iran regional mortality variation was examined using the death registration system (Khosravi, 2007). In developing countries Gini coefficient and poverty were the important determinants of variation (Saikia et al., 2009, Jain, 1985).

Regional mortality variation in post soviet Kazakhstan was briefly issued by researchers C.Becker and D.Urzhumova (2005). The authors identified mortality variation between thriving municipal cities and industrial regions, poor, predominately Kazakh western, southern regions and northern regions with predominantly Russian population in the period of economic recovery (1996-2001). This variation was explained by service-oriented character of municipal cities relative to petrochemical and industrial regions as well as “Slavic male mortality disadvantage in prime adult age” in predominantly Russian regions relative to Kazakh populated regions. Adversely to regional adult male mortality differences infant mortality appeared highest in the regions where titular nationalities comprise the majority of the population, and the least economically developed regions with lowest level in North Kazakhstan region and highest in Mangystau region (Buckley, 1998).

The evidences observed in the countries indicated the important role of socio-economic indicators in explanation of regional mortality differences. The ethnicity was also considered as the main factor in the countries where their regional variation was high.

Chapter 3

Theoretical framework and basic facts

Demographic and Epidemiologic transition theories, theory of spatial diffusion of innovation were selected to make the framework for representing the regional mortality differences and their change in the observed period. The chapter tries to connect mortality differences across regions and their change with the stages of mortality development defined in the first two theories. One of mechanisms in the last theory explains the hierarchical diffusion of innovation. The chapter attempts to explain the regional mortality differences through the expansion of healthcare innovation across regions.

3.1 Demographic transition theory

Demographic transition is a model used to explain the process of transition from high birth rates and high death rates to low birth rates and low death rates as the part of the economic development of a country from a pre-industrial to an industrialized economy. Usually it is described through the "Demographic Transition Model" (DTM) that performs the population changes over time. It is based on an interpretation begun in 1929 by the American demographer Warren Thompson of prior observed changes, or transitions, in birth and death rates in industrialized societies over the past two hundred years (Montgomery, 2000).

The model can be divided into four stages. Each stage was defined by the level of crude death rate, crude birth rate, and the population growth. In the first stage (pre-modern) crude death rate was strongly fluctuated at the level 40 per 1,000. In the second stage (urbanizing/industrializing) death rate was rapidly declining from 40 to 15 per 1,000. The third stage (mature industrial) was characterized by slow decline of death rate from 15 to 10 per 1,000. In the forth stage (post industrial) death rate was constant at the level 10 per 1,000 (Barcelona Field Studies Centre, 2011).

Crude death rate in Kazakhstan changed from 19.9 per 1,000 in the period 1999-2000 to 20.0 per 1,000 in 2007-2008. The evidence demonstrated that the country was in the second stage according to the level of crude death rate in the examined period. The observation of crude death rate across regions indicated that in the period 1999-2000 it varied between 13.7 in South

Kazakhstan region and 24.7 in North Kazakhstan region. In the period 2007-2008 it oscillated between 11.4 in Astana city and 27.3 in North Kazakhstan region (see Appendix 1). This evidence demonstrated that in the observed periods North Kazakhstan region was in the second stage while South Kazakhstan region and Astana city were in the third stage according to the level of crude death rate. However, crude death rate does not take into account the changes in age structure of population. In this sense Abdel Omran's 1971 theory "Epidemiologic transition" explained the changes of mortality pattern due to overall mortality level, infant mortality rate and cause of death patterns in the framework of demographic transition.

3.2 Epidemiologic transition theory

Abdel Omran's theory "Epidemiologic transition" focused on the complex change in patterns of health and disease and on the interactions between these patterns and their demographic, economic and sociologic determinants and consequences (Omran, 2005). According to theory all societies experience three "ages" in the process of modernization: the "age of pestilence and famine", during which mortality is high and fluctuating, with an average life expectancy under 30 years; the "age of receding pandemics", during which life expectancy rises considerably, from under 30 to over 50; and the "age of degenerative and man-made diseases", during which the pace of the mortality decrease slackens, while the disappearance of infectious diseases increases the visibility of degenerative diseases, and man-made diseases become more and more frequent.

The countries and regions had the differences in passing through abovementioned ages due to timing, pace, and underlying mechanisms. Therefore, A. Omran proposed several basic models of transition. The accelerated variant of the classical model described the transition observed in Japan and Eastern Europe. In these countries mortality decline started later (in the end of 19 century) but reached the low level in a shorter period of time. The changes were based on social improvements as well as medical advancements. At that time Kazakhstan as one of subordinate countries of Russian empire was not considered separately. Researchers assumed that Russia had the improvement even later than other countries in Eastern Europe (Vallin and Mesle, 2004). It was documented that since the 1960s an "epidemiologic transition" has occurred in varying degrees in the different republics of the Soviet Union. And this transition was characterized by declining mortality from infectious diseases and rising death rates from non-infectious diseases which specified the third stage of epidemiological transition (Tulchinsky and Varavikova, 1996).

A. Omran specified only abovementioned three ages of transition. However, since the middle of 1960-s the developed countries had the further increase of male life expectancy at birth due to mortality improvement from cardiovascular diseases. S. Olshansky and A. Ault (1986) considered this improvement as the forth stage of epidemiological transition and this stage was called as the "age of delayed degenerative diseases". The age of delayed degenerative diseases was characterised by "rapid mortality declines in advanced ages that are caused by a postponement of the ages at which degenerative diseases tend to kill". This age, in fact, began with a dramatic divergence between the two main parts of the industrialized world divided by their social and political systems: East and West. The Soviet Union countries along with socialist countries of Eastern Europe had life expectancy decline due to mortality increase from cardiovascular diseases for males contrary to the western countries (Vallin and Mesle, 2004). This divergence continues today in post soviet countries which could not improve male mortality from cardiovascular diseases. In the period 1999-2008 Kazakhstan had the increase of life expectancy at birth for males as well as females (from 60.2 to 61.2 for males, from 70.7 to 72.0 for females). Despite the fact that improvement from circulatory system diseases could contribute to female life expectancy increase in age groups 45+ improvement of male mortality from this cause occurred only in age 75+ in the country (see Chapter 11).

It is well established that not only do differences emerge over time in the nature of diseases in countries but that, at any point in time, their internal distributions can be quite variable. This can reflect variations between regions or districts, or between town and country (Philips, 1994). According to this assumption the improvement of mortality and cause of death pattern were not even across regions of Kazakhstan. Northern, central, and eastern regions had the increase of male mortality from circulatory system diseases continuing the divergence of the forth stage of epidemiological transition (see Chapter 11). The quiet exception among regions was Astana city which could increase male life expectancy at birth for 6.0 years mostly due to mortality improvement from circulatory system diseases in age groups above 30 when these diseases tend to kill.

According to epidemiologic transition IMR (infant mortality rate) falls from 200-300 deaths per 1,000 live births in the first stage to 150 per 1,000 live births at the end of second stage. By the end of the third stage, infant mortality reaches a level of less than 25 deaths per 1,000 live births. The declines were considered to be the results of better sanitary conditions, improvements in social and economic circumstances and advances in medicine and health services (Omran, 2005). Between the periods 1999-2000 and 2007-2008 in Kazakhstan infant male mortality rate decreased from 23.0 to 20.0 while female one decreased from 17.0 to 15.0. These levels demonstrated that the country was in the end of third stage according to infant mortality level for both sexes. However, the regional differences of infant mortality rate indicated that in the beginning of the period infant male mortality rate in Mangystau, Pavlodar, Zhambyl, and Kyzylorda regions was above than 25 per 1,000 live births. For female infants the rate was 25.6 per 1,000 only in Mangystau region. In the end of the period in the result of further decrease of infant mortality rate for both sexes in most of regions, South Kazakhstan was the one region which had IMR for males at the level 25.4 per 1,000. For females there was no region which had IMR above than 25 deaths per 1,000 live births (see Appendices 2a and 2b).

3.3 Theory of spatial diffusion of innovation

T. Hagerstrand's (1953) "Innovation Diffusion as a Spatial Process" paved the way for a branch of spatial process, which aims at examining the mechanism producing spatial patterns. Thus spatial diffusion research was established as a subfield of spatial process. Spatial diffusion is a phenomenon in which an event spreads from one or a few points of origin within a given area through time. Spatial diffusion is classified into two types: relocation-type diffusion and expansion-type diffusion. Expansion diffusion can be divided into two more types of diffusion: contagious diffusion is smooth and continuous across space and takes place via social networks, whereas hierarchical diffusion occurs when an innovation passes down some hierarchical structure (Yoshio, 1985).

T. Hagerstrand suggested that innovation and information were likely to spread from larger to smaller cities through hierarchical communication network. It was established that health care innovations were likely to spread from major urban areas to rural ones (Williams, 2000). This process would have effect on spatial disparities of health and mortality.

Among the sixteen regions of Kazakhstan Astana and Almaty are municipal cities without any rural areas while other regions include both urban and rural areas. Definitely, these cities are considered to be the centres of new innovation and information. The spread of innovation to other cities in regional scales move from these two cities. In Kazakhstan the health seeking behaviour variation across rural and urban areas was due to differences in real costs, quality of healthcare, and the perceptions of health and health care (Thompson et al., 2003).

The second aspect of diffusion process is adoption of innovation. The realisation of innovation adoption is time-lagged according to the adopter's economic, social, and psychological characteristics. Therefore, the use of healthcare innovations would vary across regions according to socio-economic characteristic of population.

Chapter 4

Research questions and hypotheses

The chapter determines the main research questions and hypotheses according to questions defined to achieve the goal of the thesis.

4.1 Research questions

To achieve the goal of thesis the following research questions were defined:

1. What changes took place in development of regional mortality variation (overall mortality level, mortality level by age groups) in the period 1999-2008?
2. What changes took place in regional mortality trends (overall mortality level, mortality level by age groups and selected leading causes of death) for males and females in the period 1999-2008?
3. What age groups contributed the most to the change in life expectancy at birth of males and females in the regions between the periods 1999-2000 and 2007-2008?
4. What selected main causes of death contributed the most to the change in life expectancy at birth of males and females in the regions between the periods 1999-2000 and 2007-2008?
5. What changes took place in the association of regional differences in expectation of life and measures of inequality in age at death for males and females between the periods 1999-2000 and 2007-2008?
6. In what way the selected socio-economic and demographic indicators were related to regional mortality (overall mortality level, mortality by age groups) differences of males and females in the periods 1999-2000 and 2007-2008?

4.2 Research hypotheses

According to research questions the following main hypotheses were determined:

1. *Regional mortality variation increased for both sexes with the bigger increase for males.* It is considered about less reaction of females to socio-economic conditions compared to

males (Grözinger, 2009). The situation observed in other countries indicated more increase of regional variation for males because of socio-economic mortality differences in males compared to females (Kalediene and Petrauskiene, 2000).

2. *Mortality level improved for both sexes in all regions with the bigger improvement in the regions with the most favourable socio-economic conditions.* It is well established that the decline of mortality level occurs mainly in the countries with socio-economic improvement (Spijker and Wissen, 2009). In the period of economic recovery (1995-2001) in the country mortality level declined in the regions with substantial economic recovery (Becker and Urzhumova, 2005).

3. *A. Mortality improvement in productive age groups (20-64) for both sexes contributed the most to the change in life expectancy at birth in the regions with the most favourable socio-economic conditions.* The improvement of mortality level in adult ages in western European countries was related to socio-economic development as well as changes in individual behaviour and being actively responsible for one’s own health (Vallin and Mesle, 2004). Highly educated persons tend to be more responsible for their health than lower educated ones (Groot and van den Brink, 2006) and their higher concentration in the region determines its favourable environment (Bulled and Sosis, 2010).

   B. Mortality increase in productive age groups (20-64) for both sexes contributed the most to the change in life expectancy at birth in other regions. Chronic conditions kill people at economically and socially productive ages: 80% of chronic disease deaths occur in low and middle-income countries (World Health Organization, 2005). Regional differentiation of mortality level increases mainly in productive age groups related to socio-economic conditions of regions (Ivanova, 2010).

4 *A. Mortality improvement from circulatory system diseases in productive age groups (20-64) contributed the most to the change in life expectancy at birth in the regions with the most favourable socio-economic conditions.* The improvement of mortality from cardiovascular diseases depends on the development of a new strategy based on advanced medical technology and changes in individual behaviour (Vallin and Mesle, 2004). The adoption and use of healthcare advances, and the changes in individual behaviour is related to socio-economic status of population (Hagerstand, 1953, Groot and van den Brink, 2006) which determines the favourable socio-economic conditions of region.

   B. Mortality increase from circulatory system diseases in productive age groups (20-64) contributed the most to the change in life expectancy at birth in other regions. The World Bank groups low and middle income countries into six geographic regions. One of them is Europe and Central Asia (ECA). The ECA region has a rate of 690 cardiovascular deaths per 100,000, more than double the rate of high-income countries. However, the heterogeneity is apparent even within countries related to socio-economic conditions (Gaziano, 2007).

5. *Between the periods 1999-2000 and 2007-2008 inequality in age at death decreased in the regions where expectation of life increased while it increased in the regions where expectation of life decreased*. In most cases, temporal increases in life expectancy correspond to decreases in this diversity; and life expectancy is, in most cases, higher in countries where the diversity is lower (Shkolnikov et al., 2011). One of possible reasons of this evidence would be the higher premature death in the countries with lower life expectancy at birth.

6. *A. Fertility level is positively associated with infant and child mortality.* It is well known that high fertility is one of determinants of high infant mortality. This relation is explained by variables as birth order, mother's age, or the length of previous birth interval linked to fertility levels (Taucher, 1989). Total fertility rate was determined as one of the most determinants of infant mortality rate differentiation across 117 low, middle, and high income countries (Zakir and Wunnava, 1999). The examination of the effect of birth interval on neonatal, infant, under-five mortality across developing countries demonstrated that the longer the birth interval, the lower the risk of dying (Rutstein, 2005).

   B. Divorce level is positively associated with mortality. House et al. (1988) reported that the magnitude of the social-integration effect for predicting early death was roughly equivalent to the magnitude of the effect of smoking and medical technology. In this sense it is well established that divorced people tend to die earlier from different diseases (Sbarra and Nietert, 2009) and are at higher risk of suicide than the married (Kposowa, 2003). In explanation of regional mortality differences from cancer and circulatory system diseases divorce rate was significant in Czech Republic (Spijker, 2009) while in Taiwan regional mortality differences from suicide were partially explained by divorce rate (Chuang and Huang, 2007).

   C. The highest educational attainment is negatively associated with mortality. It is well considered that lower educated people experience more health problems and have a shorted life expectancy than higher educated. Lower educated people are more likely to smoke, engage in excessive alcohol consumption and to be overweight and obese (Groot and van den Brink, 2006). Better educated people are more likely to earn higher incomes, they have more opportunities to make healthier choices in life, for example in terms of diet or smoking. Their occupations are less likely to entail risks to their safety and they are less likely to live in areas where they are exposed to danger. They are likely to have more control over their lives (Ross and Mirowsky, 1999).

   D. The proportion of Russian population is positively associated with male mortality in productive age groups. The evidences from other countries indicated about positive relation of mortality level with ethnic minority mainly according to their socio-economic disadvantages or lifestyle peculiarities (Mackenbach et al., 1991, Rosicova et al., 2009). In Central Asian countries including Kazakhstan there were assumed about male mortality disadvantage among Russians in productive ages (Guillot et al., 2010, Becker and Urzhumova, 2005).

E. The poverty incidence is positively associated with mortality. Poverty is often identified as a major barrier to human development. It is well documented that poverty is one of contributors of high mortality (Wang et al., 1997, Lanre-Abbas, 2008, Gortmaker, 1979). Because poverty creates barriers in access to healthy food, proper sanitation in some rural areas, access to health care and education about proper nutrition (Eudy, 2009).

F. The gross regional product is negatively associated with mortality. The most common indicator of living standards of a region Gross Regional Product per capita as a measurement of the average income of a person in a population is considered to have the positive relationship with health (Papastergiou et al., 2008). Because high-income regions are likely to consume more commodities that have a direct impact on the quality of life, such as housing, dietary and health care factors.

G. Unemployment rate is positively associated with mortality. Unemployment affects mortality directly or through intervening social factors. The social factors are described as the most common being fall in income and socio-economic state, increased stress, disruption of social networks, and unstable lifestyle (Martikainen, 1990).

H. The volume of industrial production is positively associated with mortality. It is established the mortality increasing effects of urbanisation and industrialization have obscured the mortality lowering effects of high living standards (Mackenbach and Looman, 1994). Russian researcher B.Revych (2005) describing the role of environment in mortality of population in Russia determined some peculiarities in health status of population in industrial regions. Becker and Urzhumova (2005) using the volume of industrial production measured by its price per capita as an indicator of economic prosperity found the positive relation of the volume of industrial production to regional mortality differences in Kazakhstan. The evidence explained the higher mortality level in industrial and oil-extracting regions.

Chapter 5

Data availability and quality

To examine the regional mortality differentiation in the period 1999-2008 data on deaths and population were collected for 16 regions (oblasts) including 2 municipal cities of Kazakhstan in calendar years between 1999 and 2008. To explain the regional mortality differentiation in the periods 1999-2000 and 2007-2008 the demographic and socio-economic indicators were compiled for all regions in calendar years 1999, 2000, 2007, 2008. The detailed data description and indicator definitions are presented in the next sub-chapters.

5.1 Main data sources

Data for the thesis was compiled from the Agency of Statistics of the Republic of Kazakhstan. These are population and mortality data in single and five year age intervals for males and females for all regions for the years between 1999 and 2008. Population data was available for the beginning and the middle of each year. Cause of death data for 19 broad groups of causes by sex and age for all regions and years was also obtained from the Agency (see Appendix 3). To determine the factors of regional mortality differentiation the socio-economic and demographic indicators were obtained for the years 1999, 2000, 2007, and 2008 from the Agency by means of application of the author and the electronic statistical publications of the Agency. The sources of these indicators are specified in detail in subchapter 5.4.

5.2 Mortality data collection and processing

Mortality data in Kazakhstan are compiled on the basis of two death registration documents (Medical death certificate and Legal death certificate). The medical death certificate is issued by the doctor, who treated the deceased, or by a forensic doctor or a pathologist. They write down the cause of death. The medical death certificate records whether it was issued by a doctor (which means that an autopsy was not performed), a pathologist or a forensic doctor. Next, at the regional departments of Statistics the cause of death in medical death certificates is coded manually by the coders.

The second document is a legal death certificate. It is completed for all deaths which occur on the territory of Kazakhstan. It is filled up at the Civil Registration Office in the place of residence of deceased or on the place of his death.

According to Law of Marriage and Family the death must be reported not later than seven days, for violent death, suicide, accidental death as well as the body discovery – not later than five days from the date of death or discovery of body (Kazakhstan, 1998). The report of death should be given by the persons who lived with deceased, in case of their absence by neighbors, the workers of housing-maintenance organizations or the administration of the institution where the death occurred or the bodies of internal affair who discovered the dead body (ibid.). The legal death certificate includes such information as the first, middle, last names, birth date, the last place of residence of deceased and his marital status, date and cause of death (ibid.). For infant deaths along with the first, middle, last names, sex, nationality, date, place and cause of death, date and place of birth, age of deceased infant the death certificate includes the information related to mother (the order of birth, age, place of residence, marital status, occupation, educational attainment) (see Appendix 4).

The statistical data processing of death in The Republic of Kazakhstan is conducted by the order of the administrative division of the country: Republic consists of regions (oblasts). Each region is divided into districts (there is a different number of districts (rayons) in each oblast). Each district is divided into villages (aul). The data processing begins from districts. The Statistical bureau in the district compiles the death certificates from the local Bureau of Civil Registration Office and reports them to the Regional Department of Statistics. The Department counts the number of deaths and deaths by cause in each district on the basis of these certificates and in turn reports this data on the regional level to the Agency of Statistics of the Republic of Kazakhstan. The statistical departments of Astana and Almaty cities also report the data to the Agency of Statistics of the country. The Agency compiles the data from each region and counts the numbers at the national level.

5.3 Mortality data quality

The problems of data quality in the country mostly concern infant, old-age deaths, and causes of death (Wuhib et al., 2003, Boleslawsky and Tabeau, 2001, Mathers et al., 2005). Issuing the infant mortality rate in Zhambyl region of the country European researchers came to the conclusion that the FSU (Former Soviet Union) definition of live birth underestimated the infant mortality rate rather than the WHO one (Wuhib et al., 2003). The WHO defined a live birth as the complete expulsion or extraction from its mother of an infant, irrespective of the duration of the pregnancy, which after such separation shows any other evidence of life such as breathing, beating of the heart, pulsation of the umbilical cord or definite movement of the voluntary muscles while FSU one did not consider as live birth infants who were born alive and were less than 28 weeks' gestation, of weight less than 1000 g, or of length less than 35 cm and died within

7 days of birth (Goubin and Masuy-Stroobant, 1995). Table 1 presents detailed differences of Soviet and WHO definitions of live births and stillbirths. Certainly, these differences led to substantial underestimation of infant mortality rates in Soviet statistical sources in comparison with the rates of countries which follow the WHO definition. In 2008 Kazakhstan moved from the FSU definition of live birth to the WHO one which sharply raised infant mortality rate values in the country (Shokamanov, 2009). In this case the author had to take into account the changes in definition in the process of description the trends and changes of regional infant mortality differentiation.

Mortality data quality was also low especially in old ages as it was considered to be low in many other countries except few developed ones (Boleslawsky and Tabeau, 2001). The low quality of data in old ages was taken into account by the author and smoothed using the Kannisto model, specified in the chapter 6.1.

Table 1 − Soviet and WHO definitions of live birth and stillbirth

	Infant born after the end of the 28th week of pregnancy			
	No signs of life	No breath but other signs of life	Died during the first 7 days	Survived the first 7 days
USSR	Stillbirth		Live birth	
WHO	Stillbirth	Live birth		
	Infant born before the end of the 28th week of pregnancy; or with weight under 1000 gr. or length under 35 cm.			
	No signs of life	No breath but other signs of life	Died during the first 7 days	Survived the first 7 days
USSR	Miscarriage			Live birth
WHO	Stillbirth	Live birth		

***Source**: Anderson and Silver (1986)*

In Mangystau region in the year 2007 the number of deaths from circulatory system diseases sharply decreased for both sexes in ages 40+ while from respiratory system diseases it sharply increased for both sexes in the same ages. This case would be the problem of data quality as Kazakhstan was considered to be the country with medium quality of data according to the Bulletin of World Health Organisation for the year 2005 (Mathers et al., 2005). This evaluation was based on two main criteria: completeness of reporting and proportion of deaths assigned to ICD codes that the authors consider ill-defined. Medium quality was defined according to 100% completeness and 11% ill-defined causes. The proportion of deaths assigned to ill-defined causes is used as a measure of the quality of coding. Error of coding may occur in several cases: 1.The information supplied on the certificate and the decedent’s medical diagnosis would be incomplete and not accurate (Sirken et al., 1987).The completion of medical death certificate after autopsy is considered to be more accurate compared to before (Schottenfeld et al., 1982). 2. Deaths that occur away from a medical setting—as for an unobserved sudden death—the medical certifier may not have sufficient information about the decedent’s medical history in order to report the underlying cause of death correctly. 3. The cause of death would be classified to a related, but incorrect, disorder or to a nonspecific disease category. This type of error can be addressed by grouping the related causes that are often confused or by not subsetting the broadly specified disease for analysis (National Center for Health Statistics, 1996).

5.4 Explanatory variables

To explain the regional mortality differentiation in the periods 1999-2000 and 2007-2008 the number of socio-economic and demographic indicators were selected (see Appendix 5). Their selection has been based on a preliminary study of their correlation in 1999-2000 and 2007-2008 separately (see Appendices 6a and 6b). It goes without saying that each significant variable in the model also represents all the other closely related variables. To explain this further:

1. The volume of industrial production is positively correlated with secondary sector employment, a feature of industrial regions.
2. The gross regional product per capita, the nominal wage and nominal income are highly positively correlated because they are indicators of living standard.
3. The proportion of population with high and incomplete high education is highly positively correlated with the number of physicians. The physicians as the persons with highest educational attainment are highest in the regions where the proportion of population with highest educational attainment is highest.

From the first correlated two indicators, the volume of industrial production was chosen because this variable explains not only the higher proportion of secondary sector employees, but also could explain the economic prosperity of industrial regions. From the second complex of indicators the GRP was chosen because the size of this variable responds also to the size of nominal wage and income. From the third complex, the proportion of population with high and incomplete high education was chosen because the physicians as the persons with highest educational attainment are highest in the regions where the highest proportion of population with high and incomplete educational attainment is observed. The proportion of urban population was not taken as the explanatory variable because of changes included in The Law of administrative-territorial organization of the Republic of Kazakhstan from the 4 of November in 2006. The changes were implemented from the 1 of January in 2007. According to these changes the term «rural type of settlement» expanded by including to them “poselok” in the territory of rural administrative subordination (Kazakhstan, 2006). Hence, the proportion of urban population in the period 1999-2000 did not coincide with the proportion of urban population in 2007-2008.

Chosen explanatory variables are divided into three groups: demographic, social, and economic.

1. Demographic variables: Total fertility rate, Crude divorce rate.
2. Social variables: The proportion of population with high and incomplete high education, the proportion of Russian population, the proportion of population with income below subsistence minimum, unemployment rate.
3. Economic variables: Gross regional product, the volume of industrial production.

The total fertility rate (labelled TFR) is the demographic indicator. Age-specific number of live births and the number of women population by age were obtained from Agency of Statistics and the total fertility rate was calculated by author for the years 1999, 2000, 2007, 2008 for 16 regions. The selection of the indicator was based on the possible relation of high fertility with high infant mortality. Researchers explain this relation according to influence of variables as birth order, mother's age, or the length of previous birth interval linked to fertility levels (Taucher, 1989).

Crude divorce rate (labelled DIV) is the demographic indicator which indicates the number of divorces per 1,000 mid-year population. The disadvantage of the indicator is it does not take into account the age structure of population. The data was obtained from Agency of Statistics by means of application of the author for the years 1999, 2000, 2007, 2008. The selection of the indicator was based on the possible positive relationship of divorce rate with mortality from external causes, the comparatively weaker health and earlier death of divorced persons than married ones, the affect of parental divorce on mental health and mortality of children and young adults (Sbarra and Nietert, 2009, Kposowa, 2003, Gove, 1972, Hansagi et al., 2000).

The highest educational attainment (labelled HIGHEDU) is here defined as the proportion of population aged 15+ with high and incomplete high education, per 1,000 persons. High education coincides with the first stage of tertiary education specified in ISCED (International Standard Classification of Education) (ISCED, 1997). People with high education are those who successfully passed final attestation, gains qualification and (or) academic degree "bachelor" (Kazakhstan, 2007). As the number of population with high education was not available separately from incomplete high education for the year 2007, for the year 1999 we added together population with high education and incomplete high education. According to the system of education in the Republic of Kazakhstan people with incomplete high education are those citizens who have not completed tertiary education or not passed the final attestation and they got only the certificate of fixed standard about completed examinations (Kazakhstan, 2007).

The data were available only for two years 1999 and 2007. The number of population with high and incomplete high education for the year 1999 was obtained from the site publication "Naselenie Respubliki Kazakhstan po urovnyu obrazovaniya" which was published in 2000 according to the result of Population Census in 1999 (Agentstvo Respubliki Kazakhstan po Statistike, 2000). The number of population with high and incomplete high education for the year 2007 was taken from the statistical collection "Ekonomicheskaya aktivnost naseleniya po regionam Kazakhstana 1998-2007" (Agentstvo Respubliki Kazakhstan po Statistike, 2008). The selection of the indicator was based on the consideration that lower educated people experience more health problems and have a shorted life expectancy than higher educated mainly because of their different life and working conditions (Groot and Van den Brink, 2006), infant and child mortality of higher educated women is less than that of lower educated ones (Academy of Preventive Medicine, 2000).

The proportion of Russian population (labelled RUSSIAN) is the proportion of Russian population in total population, in percentage. The data were obtained from Agency of Statistics by means of application of the author for the years 1999, 2000, 2007, 2008. The importance of use this indicator was related to several reasons. Firstly, Russian population takes the second place by its proportion in the country. Secondly, the regional differences in proportion of Russian population are also high. Thirdly, it was taken into account the statement about "prime-age adult Slavian male mortality disadvantage" in the country assumed by C.Becker and D.Urzhumova (2005).

The proportion of poor population (labelled POVERTY) is the proportion of population with income below subsistence minimum, in percentage. Subsistence minimum is necessary minimal financial income per one person equal by cost to minimal consume basket. Minimal consume basket consists of food basket and expenditures for non-foods and services. The proportion of population with income below subsistence minimum is a quantitative indicator which measures the scale of poverty. It indicates the proportion of household members with income below fixed criteria in percentage to observed population (Agentstvo Respubliki Kazakhstan po Statistike, 2002a:72). The data were obtained for the years 2000, 2007, and 2008 from the site statistical publications of the Agency of Statistics of the Republic of Kazakhstan. The proportion of population with income below subsistence minimum for the year 2000 was obtained from the site publication "Uroven zhizni naseleniya v Kazakhstane" (Agentstvo Respubliki Kazakhstan po Statistike, 2002a). The proportion of population with income below subsistence minimum for the years 2007 and 2008 were compiled from the site statistical publication "Uroven zhizni naseleniya v Kazakhstane 2004-2008" (Agentstvo Respubliki Kazakhstan po Statistike, 2009a). Poverty is considered to be one of the negative factors of health as the barrier for better nutrition, access to healthcare, etc (Eudy, 2009). Therefore, it is reasonable to examine the relation of poverty incidence and mortality across regions.

The Gross regional product (labelled GRP) is the economic indicator measured by US dollar per capita. According to its economic content GRP indicator is close to GDP indicator which is calculated by productive method in national level. The main difference of GRP from GDP some elements of GDP can not be calculated in regional level or distributed by regions. Therefore, they are included in calculation only for whole Kazakhstan (Agentstvo Respubliki Kazakhstan po Statistike, 2004:245). It was obtained for the years 1999, 2000, 2007, and 2008. The data for the year 1999 were obtained from the site statistical publication "Regionalnyiy statisticheskiy ezhegodnik Kazakhstana 1996-1999" (Agentstvo Respubliki Kazakhstan po Statistike, 2000:159), for the year 2000 it was taken from the site statistical publication “Regionyi Kazakhstana 2004” (Agentstvo Respubliki Kazakhstan po Statistike, 2004a). For the years 2007 and 2008 the data were compiled from the site statistical publication “Regionyi Kazakhstana v 2008 godu” (Agentstvo Respubliki Kazakhstan po Statistike, 2009b). Gross regional product can be measured by absolute price as well as the price per capita. Therefore, it is not only the economic indicator but also the indicator which is used for analysis of social condition of the region (Agentstvo Respubliki Kazakhstan, 2004a:245). GRP as an indicator of living standard level of the region was considered to have the effect on regional mortality inequalities (Papastergiou et al., 2008).

The unemployment rate (labelled UNEMP) in percentage is the social indicator. The indicator was calculated by author using the number of economically active and unemployed population. This data were obtained from the Statistical Agency by means of application of the author for the years 1999, 2000, 2007, and 2008. Regional inequalities in labor market explained regional mortality differences in other countries even in developed ones with relatively high living standard (Grözinger, 2009). Unemployment is supposed to result in fall in income, socio-economic state, increased stress, disruption of social networks, and unstable lifestyle which would have effect on health and mortality (Martikainen, 1990). Therefore, the indicator was chosen as an explanatory variable.

The volume of industrial production (US dollar per capita) (labelled INDPROD) is the economic indicator. The data were obtained from the Agency of Statistics by means of application of the author for the years 1999, 2000, 2007, 2008. The indicator was applied as the explanatory variable by C.Becker and D.Urzhumova (2005) before in the issue of regional mortality inequalities in the country. According to the assumption of authors the volume of industrial production which is measured by the price of industrial production, service in this sphere indicates the economic prosperity of the region. On the other hand, the region with high volume of industrial production would have the environmental degradation.

Chapter 6

Methods

The chapter describes the methods applied in the analyses. As the applied methods are in different character they were divided into main groups: basic demographic, advanced demographic, statistical, and cartographic.

6.1 Basic demographic methods

Life table construction and the standardization method are described as the basic demographic methods.

6.1.1 Life table construction

As regional mortality (life) tables published in the statistical publications of the Agency of Statistics of the Republic of Kazakhstan were not available for all years of the period 1999-2008, complete life table (by single age) was constructed by the author for both sexes, for each region, for the periods 1999-2000, 2000-2001, 2001-2002, 2002-2003, 2003-2004, 2004-2005, 2005-2006, 2006-2007, 2007-2008 in order to study the regional mortality differences in the country. Life table was constructed using the software application DeRaS (Burcin, Hulíková Tesárková, Komanek, 2011). For this aim the number of deaths by units of age for all observed years, the corresponding numbers of mid-year population, the number of live births for all observed years for each region were served as input data.

The software along with the life table construction smoothed and extrapolated mortality rate in old ages (applying Kannisto model for age interval 60-84). There are several models of smoothing age specific death rates (or probabilities of dying) as Gompertz-Makeham, Weibull, Heligman & Pollard, Coale & Kisker, Thatcher, and Kannisto. The main advantages of Kannisto model are the assumption that the relative increase in the force of mortality decreases in old ages which ignores the assumption to be the constant proposed by Gompertz Law and easier estimation of model by the least squares estimator than other logistic type models estimated by maximum likelihood method (Roli, 2008). Kannisto model was applied taking into account these advantages. The model has two parameters α and ß. To estimate the parameters of Kannisto model we applied the nonlinear regression through method of the weighted least squares using the abovementioned software DeRaS. The estimation of parameters makes it easy to calculate the force of mortality μ_x (or instantaneous death rate or hazard rate) which is the main indicator by Kannisto model. We calculated it till the age 100+:

$$m_{x+0.5} = \frac{a * \exp[b * (x + 0.5)]}{1 + a * \exp[b * (x + 0.5)]}$$

$$m_{x+0.5} = m_x$$

where m_x is the age-specific death rate. Other life table indicators derived using the software DeRaS are following:

q_x − probability of dying between exact ages x and x+n;
l_x − number of persons alive at exact age x;
${}_nd_x$ − number of persons dying between exact ages x and x+n;
${}_nL_x$ – number of person-years lived between exact ages x and x+n;
T_x – total number of person-years lived after ages x;
e_x – expectation of life at exact age x;

6.1.2 Standardization

To examine the regional mortality differentiation by cause of death 6 main causes were selected from 19 ones according to their proportion in total number of deaths in all ages (see Appendices 7a and 7b).

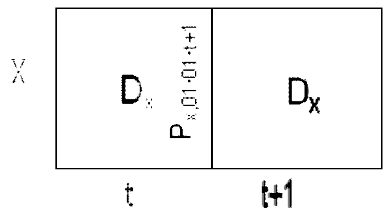
Table 2 – Selected main causes of death (ICD-10)

Chapters	Blocks	Title
I	A00-B99	Certain infectious and parasitic diseases
II	C00-D48	Neoplasms
IX	I00-I99	Diseases of the circulatory system
X	J00-J99	Diseases of the respiratory system
XI	K00-K93	Diseases of the digestive system
XX	V01-Y98	External causes of morbidity and mortality
		Other causes

***Source**: WHO (2007)*

In our analysis we used the direct method of standardization to study the regional mortality differences by cause of death (Wunsch, 2006). European “old” standard population (WHO, 1976) was taken as the standard population. The steps of the direct standardization used in the analysis:

1. The age-specific mortality rate for both sexes, for each cause and region for the periods 1999-2000, 2000-2001, 2001-2002, 2002-2003, 2003-2004, 2004-2005, 2005-2006, 2006-2007, 2007-2008 was calculated. For this reason the number of deaths in five year age interval (from age 0 to 85+) from seven selected causes for each region for the years between 1999-2008, the number of population for the beginning of the years 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, and 2008 were used:



$$M_{x,n} = (D_{x,n,t} + D_{x,n,t+1})/(P_{x,01.01.t+1}*2)$$

$M_{x,n}$ – age-specific death rate for age x, from cause n, for two year period;
$D_{x,n,t}$ – the number of deaths for age x, from cause n, for the year t;
$D_{x,n,t+1}$ – the number of deaths for age x, from cause n, for the year t+1;
$P_{x,01.01.t+1}$ – the number of population for age x, for the beginning of the year t+1;

2. The Age-standardised death rate (ASDR) from cause n per 100,000 persons was computed:

$$ASDR = \sum (M_{x,n} * P_x^{std}) / (\sum P_x^{std}) * 100{,}000$$

$M_{x,n}$ – age-specific death rate for age x, from cause n, for two year period;
P_x^{std} – European standard “old” population;

3. To describe the trend of regional mortality differences by cause of death age standardised death rate was calculated for seven main causes for age groups *0-4, 5-19, 20-64, 65-84* in the following way (these age groups were defined in the result of factor analysis):

$$ASDR = \sum_{0}^{4} (m_x * P_x^{std}) / \sum_{0}^{4} P_x^{std}) * 100{,}000$$

$$ASDR = \sum_{5}^{19} (m_x * P_x^{std}) / \sum_{5}^{19} P_x^{std}) * 100{,}000$$

$$ASDR = \sum_{20}^{64} (m_x * P_x^{std}) / \sum_{20}^{64} P_x^{std}) * 100{,}000$$

$$ASDR = \sum_{64}^{85} (m_x * P_x^{std}) / \sum_{64}^{85} P_x^{std}) * 100{,}000$$

The number of European "old" standard population is not equally distributed across age groups. Therefore, mortality level measured by age-standardised death rate in one age group is not comparable with the other.

6.2 Advanced demographic methods

The methods of decomposition, the calculation of losses of expected lifetime and Gini coefficient as a life table function are described as the advanced demographic methods.

6.2.1 Decomposition

To assess the contributions of age groups and the selected main causes of death to the change in life expectancy at birth between the periods 1999-2000 and 2007-2008 the methods proposed by R. Pressat and J. Pollard were applied.

6.2.1.1 Pressat method

To assess the contribution of age groups to the change in life expectancy at birth between the periods 1999-2000 and 2007-2008 the method proposed by R. Pressat was used (Vallin and Caselli, 2006).

The contribution of age groups (five year age groups) to the change in life expectancy at birth Δ_x between the periods 1999-2000 and 2007-2008 was computed in the following way:

$$\Delta_x = (e_x^{2007-2008} - e_x^{1999-2000}) * \frac{l_x^{2007-2008} + l_x^{1999-2000}}{200{,}000} - (e_{x+n}^{2007-2008} - e_{x+n}^{1999-2000}) * \frac{l_{x+n}^{2007-2008} + l_{x+n}^{1999-2000}}{200{,}000}$$

e_x and e_{x+n} are the expectation of life at exact ages x and x+n;
l_x and l_{x+n} are the number of persons alive at exact ages x and x+n.
n is the length of age group.

As fourteen year age interval is more substantial than five year age interval in regional level calculated life expectancy differences for five year age interval was summed for fourteen year age interval in the following way:

$$\Delta_{1-14} = \sum_{1-4}^{10-14} \Delta$$

$$\Delta_{75+} = \sum_{75-79}^{85+} \Delta$$

According to Shkolnikov et al. (2003) the method for the decomposition of a difference between two life expectancies by age was independently developed in the 1980s by three researchers E.Andreev (1982), E.Arriaga (1984), and R. Pressat (1985). The formula of decomposition by E.Andreev is exactly equivalent to that by R.Pressat. The formula by E.Arriaga is written in a slightly different form, but is actually equivalent to the formula by Andreev and Pressat.

6.2.1.2 Pollard method

To assess the contribution of death causes in fifteen year age groups to the change in life expectancy at birth between the periods 1999-2000 and 2007-2008 the method proposed by Pollard was used (Vallin and Caselli, 2006). Each indicator was calculated for the periods 1999-2000 and 2007-2008, for males and females, for each region separately in the following way:

1. Table death rate Q_x was calculated for fifteen year age interval:

$$Q_x = -LN\,(l_{x+n}/l_x)$$

where l_x and l_{x+n} are the number of persons alive at exact ages x and x+n.

2. The number of person-years lived between exact ages x and x+n (p_x) was calculated: For age 0 $p_0=L_0$, for age group 1-14: $p_1=l_7$; for age group 15-29: $p_{15}=L_{22.}$ In such a way the middle age of each age group was chosen.

3. Expectation of life was calculated: For age 0: $e_0= (e_0+e_1)/2$; for age group 1-14 e_1=e7; for age group 15-29 $e_{15}= (e_{22}+e_{23})/2$. In such a way the middle age of each age group was chosen.

4. The weight w_x of periods 1999-2000 and 2007-2008 was calculated for each age group in the following way:

$$w_x^{1999-2000\backslash 2007-2008} = \left(\frac{p_x^{1999-2000}}{100{,}000} * e_x^{2007-2008}\right) + \left(\frac{p_x^{2007-2008}}{100{,}000} * e_x^{1999-2000}\right)$$

5. The contribution of age groups to the change in life expectancy at birth between two year periods by Pollard method was calculated in the following way:

$$\Delta_x^{1999-2000\backslash 2007-2008} = ((Q_x^{1999-2000} - Q_x^{2007-2008}) / w_x^{1999-2000\backslash 2007-2008}$$

6. In order to correspond the contribution values calculated by Pollard with the contribution calculated by Pressat the new weight w_x^* was calculated:

$$w_x^* = (w_x^{1999-2000\backslash 2007-2008} * \Delta_{x,\Pr essat}^{1999-2000\backslash 2007-2008}) / \Delta_{x,Pollard}^{1999-2000\backslash 2007-2008}$$

7. Pollard change was calculated according to Pressat values:

$$\Delta_x^{1999-2000\backslash 2007-2008} = (Q_x^{1999-2000} - Q_x^{2007-2008}) * w_x^*$$

8. The proportion of number of deaths from cause ***n*** in total number of deaths was calculated:

$$p_x^n = D_x^n / D_x^{total}$$

9. The contribution of each cause of death to the change in life expectancy at birth between the periods 1999-2000 and 2007-2008 was calculated:

$$\Delta_x^{n,1999-2000\backslash 2007-2008} = (Q_x^{1999-2000} * p_x^{n,1999-2000} - Q_x^{2007-2008} * p_x^{n,2007-2008}) * w_x^n$$

$$\Delta_x^{n,1999-2000\backslash 2007-2008} = (\Delta_x^{n,1999-2000\backslash 2007-2008} * \Delta_{x,\Pr essat}^{n,1999-2000\backslash 2007-2008}) / \Delta_{x,Pollard}^{1999-2000\backslash 2007-2008}$$

For regions where the contribution of age groups by Pollard method did not correspond to contribution of age groups calculated by Pressat method by sign in fifteen year age interval each indicator was calculated for five year age interval. Then the contribution of each cause of death in five year age interval to life expectancy at birth changes was summed for fifteen year age interval.

6.2.2 Losses of expected lifetime

Patterns of diversity in age at death are examined using e^{ψ} dispersion measure that equals the average expected lifetime lost at death (Shkolnikov et al., 2011). The countries or regions would be characterized by high diversity in age at death compared with the average life span because of relatively high proportions of deaths at ages that are much younger and much older than the average life span (ibid.).

To assess the changes in association of regional differences in average expected lifetime lost at death and life expectancy at birth between the periods 1999-2000 and 2007-2008 average life expectancy losses were calculated in single age interval in the following way for the periods 1999-2000 and 2007-2008, males and females separately:

1. The number of person years lost between exact age x and x+1 was calculated.

$$L_x = d_x * (\frac{e_x + e_{x+1}}{2})$$

2. The total number of person-years lost after ages x was calculated in the following way:

$$T_{100+} = L_{100+}$$

$$T_x = L_x + T_{x+1}$$

3. The average life expectancy losses attributable to death e_x^y was calculated for each age in the following way:

$$e_x^g = T_x / l_x$$

6.2.3 Gini coefficient as a life table function

Gini coefficient is used as a measure of inequality in distribution of length of life between individuals. At present, researchers are interested in studying to what extent the average length of life is equally accessible to all people. That is why the measures of variability in respect to length of life attract growing attention (Shkolnikov, 2003).

In order to assess the changes of association in regional differences of inequality in distribution of length of life between individuals and expectation of life between the periods 1999-2000 and 2007-2008 Gini coefficient was calculated for whole age interval and age interval 40-80:

1. The average share of the interval lived by individuals, who die within the interval A_x was calculated in the following way:

$$A_x = (L_x - l_{x+1}) / (l_x - l_{x+1})$$

2. The average share of the interval lived by individuals, who die within the interval taking into account the profile of mortality A_x^* was calculated:

$$A_0^* = A_0 * (1 - (q_0 * (0 + 0.83087 * q_0) / (2 + q_0)$$

$$A_x^* = (1 - \frac{2}{3} * q_x + C_x * (2 - q_x - \frac{6}{5} * C_x) / (2 - q_x)$$

where $C_x = A_x - 0.5$;

q_x is the probability of dying between exact ages x and x+n.

3. Gini coefficient for each age was calculated:

$$G_0 = l_{x+n} * l_{x+n} + A_x^* * (l_x * l_x - l_{x+n} * l_{x+n}$$

where l_x and l_{x+n} are the number of persons alive at exact ages x and x+n.

4. From this Gini coefficient for whole age interval was calculated:

$$Gini = 1 - \frac{\sum G_0}{e_0 * 100{,}000 * 100{,}000}$$

where e_0 is life expectancy at birth.

5. For age interval 40-80 expectation of life was calculated in the following way:

$$e^{40-80} = (T_{40} - T_{80}) / l_{40}$$

where T_{40} and $T_{80}$are total number of person-years lived after ages 40 and 80;

l_{40} is the number of persons alive at exact age 40.

6. For age interval 40-80 Gini coefficient was calculated:

$$Gini^{40-80} = 1 - (\sum_{40}^{80} G_0) / (e_{40-80} * l_{40} * l_{40})$$

The main reason of Gini coefficient estimation for age range 40-80 is that in this range the inter-individual inequality is higher in comparison with the whole range.

6.3 Statistical methods

Factor analysis was selected to group the probability of dying for five year age groups into broader ones. Multiple regression and canonical correlation analyses were selected to investigate the determinants of regional differentiation in overall mortality level and mortality by age groups. The subchapter describes the application of selected methods.

6.3.1 Factor analysis

To analyze the regional mortality differentiation by age groups probability of dying for five year age groups was grouped into broader ones using the factor analysis. For this reason the probability of dying in five year age groups was derived from complete life table for males and females, for the periods 1999-2000 and 2007-2008, for each region in the following way:

$$_nq_x = 1-(l_{x+n}/l_x);$$

where l_x and l_{x+n} are the number of persons alive at exact ages x and x+n;
n is the length of age group; It is worth to mention that ages 85+ were not taken for analysis.

To have the same age groups for both sexes we composed the input data from the average of male and female probabilities of dying for each region for the periods 1999-2000 and 2007-2008:

$$_nq_x = ({_nq_{x,\ males}} + {_nq_{x,\ females}})/2;$$

The regions doubled according to periods (1999-2000 and 2007-2008) were in rows. The values of the average of male and female probabilities of dying for each region for the period 1999-2000 and for the period 2007-2008 were in columns. We used the statistical software SAS to run the analysis. Principal component analysis was used as the extraction method of factor analysis. The used ROTATE keyword represented the rotated factor solution which is statistically appropriate than the initial one. The used keyword VARIMAX SCORE specified orthogonal varimax rotation.

In the result of factor analysis three independent factors were defined (see Appendix 8). Taking into account the correlation coefficient values for five year age interval probability of dying in each factor, the probability of dying between exact ages 20 and 65 ($_{45}q_{20}$) was defined in factor 1, the probability of dying between exact ages 0 and 5 ($_5q_0$) and the probability of dying between exact ages 65 and 85 ($_{20}q_{65}$) were in factor 2, the probability of dying between exact ages 5 and 20 ($_{15}q_5$) was in factor 3. As the Factor 2 includes the child and old ages together the direction of their relationship was assigned. The figure indicates that the probability of dying between exact ages 0 and 5 had the direct relationship with the probability of dying between exact ages 65 and 85 (see Appendix 9).According to the result of factor analysis the age groups 0-4, 5-19, 20-64, and 65-84 were defined to examine the regional mortality differentiation by age groups. During the description of analyses they will be characterized as child (0-4), young (5-19), adult (20-64), and old (65-84) age groups. The age group 20-64 is also defined as productive age group.

6.3.2 Multiple regression and Canonical correlation

To explain the regional differentiation in life expectancy at birth in the periods 1999-2000 and 2007-2008 two selection methods of multiple regression analysis were used. The stepwise automated variable selection method of the analysis was applied which at each stage after entering the new variable drops from the model the variable which no longer contributes significantly. The method demands one dependent and several independent variables. Life expectancy at birth for the periods 1999-2000 and 2007-2008 which was derived in the result of life table construction for two year period specified in the chapter 6.1 was served as dependent variable. Independent (explanatory) variables were the selected socio-economic and demographic variables specified in the chapter 5.4.

To explain the regional differentiation in life expectancy at birth input data which consist from regions in rows and life expectancy at birth, the socio-economic, ecological, demographic indicators in columns was organized for the periods 1999-2000 and 2007-2008 separately, for males and females separately.

The used second model selection was maximum r-square improvement which tries to find the best-one, the best two variable models and so on. For this selection method the same input data was used. Stepwise selection method leaves in the model only variables which are significant at the level 0.1500 while maximum r-square improvement model considers all variables adding one variable in each step. At each step of maximum r-square improvement model selection R square (R^2) increases and C (p) (named for Colin L.Mallows) decreases. R^2 is the coefficient of determination whose value can be between 0 and 1. When the R^2 equals to 1, it means the strong determination of the model. C (p) is used to assess the fit of a regression model. Smaller value of C (p) indicated the better fit of a regression model. Therefore, with adding the new variable the C (p) decreases. Despite the fact that maximum r-square improvement model considers all variables adding one variable in each step in one certain step the value of C (p) begins to increase. The included variables till the last step when the C (p) indicated its smallest value coincides with the number of variables included in the result of stepwise selection.

After the predictor variables were defined in the result of stepwise and maximum r-square improvement model selection methods we ran the model procedure using the keywords b and stb. Here, in input data we keep the dependent variable (life expectancy at birth), among independent (socio-economic and demographic indicators) variables the selected variables in the result of stepwise selection. B is used to compute the estimated regression coefficients for predictor variables while stb represents the standardised regression coefficients. The negative value of regression coefficient demonstrates the indirect relationship between predictor and dependent variables while the positive one indicates the direct effect. A standardised regression coefficient indicates how strongly each predictor variable affects the dependent variable. The higher is the value of standardised regression the stronger is the effect of predictor variable.

To explain the regional mortality differentiation by age groups in the periods 1999-2000 and 2007-2008 canonical correlation analysis was used. Canonical correlation analysis is typically used to examine the potential relationships between two multivariate data sets. The main difference of canonical correlation from multiple regression analysis is that in canonical correlation several variables are served as dependent ones. Probabilities of dying between exact ages derived in the result of factor analysis specified in chapter 6.2 were served as dependent variables while the socio-economic and demographic variables were the independent ones. Input data consisted from regions in rows and probabilities of dying between exact ages (${}_{5}q_{0}$, ${}_{5}q_{15}$, ${}_{45}q_{20}$, and ${}_{20}q_{65}$), the socio-economic and demographic indicators in columns. They were organized for the periods 1999-2000 and 2007-2008, for males and females separately.

6.4 Cartographic method

6.4.1 Spatial mapping

The cartographic method is used to study the rules of spatial arrangement of phenomena and their interrelationships, dependence, and development. Modern cartography is closely integrated with geographic information science (GIS science) and constitutes many theoretical and practical foundations of geographic information systems. GIS (Geographical Information System) is a tool for linking and visualizing geographically referenced data from different sources, in which a geographical data element is used to provide a reference for the statistical or non-locational data element (By, 2001). In our work we created maps to show the regional differentiation of selected socio-economic and demographic indicators with the help of geographical tool ArcGIS 9. The definition of cut-point is the most important step in the process of mapping. Each series of cut-points is based on a particular mathematical and statistical formula. We chose ***equal interval*** classification method for the cutting map into 5 graduated colors, which was determined in ArcGIS by number of classes. Classification by equal interval breaks down the distributions of rates or values into two or more categories. Each category has the same data range or interval which can be appropriate for rectangular distribution of values.

Chapter 7

An overview of recent regional development in Kazakhstan

The chapter makes an overview of regional socio-economic, ecological, and demographic differences in the period 1999-2008 accentuating on the changes between the periods 1999-2000 (the beginning of the period) and 2007-2008 (the end of the period) in order to identify the possible factors of regional mortality differentiation in the observed periods.

7.1 The regional structures of production and rural/urban character of regions

Kazakhstan is a large and diverse country in terms of natural resources, climate, and population. Administratively, the country is divided into 14 regions (oblasts) and 2 municipal cities (Almaty and Astana).

Map 1 – Map of Kazakhstan

The term “region” or “zone” may be used in a number of different senses and the areas referred to may be of different sizes (Demographic Dictionary Committee, 1958:16). Region is a part of the territory of the republics which includes several settlements founded and controlled for the convenience of the republics (Kazakhstan, 1993). In our work oblasts are considered as regions.

There are the groups of regions by structure of production:

Oil extracting regions:

- Aktobe
- Atyrau
- West Kazakhstan
- Kyzylorda
- Mangystau

In 2004 these regions produced 99.97 percent of oil in the country. Their individual proportion in total oil production ranges from 12.2 to 28.9 percent (United States Agency, 2006).

Agricultural regions:

- Akmola
- Almaty
- Zhambyl
- Kostanai
- North Kazakhstan
- South Kazakhstan

Agriculture accounted for at least 20 percent of value added in these regions. In other regions agriculture was much less important (ibid.).

Industrial, non-oil regions:

- East Kazakhstan
- Karagandy
- Pavlodar

These are regions with relatively low agricultural production and strong industrial sectors, including coal, copper, aluminum, steel, and electricity (ibid.).

Municipal cities:

- Astana is the new capital
- Almaty is the old capital

The groups of regions are geographically compact (see Figure 1). Specifically, oil regions are in the west (except Kyzylorda region). Industrial non oil regions are in the north-east and centre of the country. Agricultural regions can be divided geographically into two subgroups, northern and southern; three regions are in each part. Among the oil-extracting regions the biggest ones are Atyrau and Mangystau regions by size of production.

Figure 1 − Groups of regions by structure of production

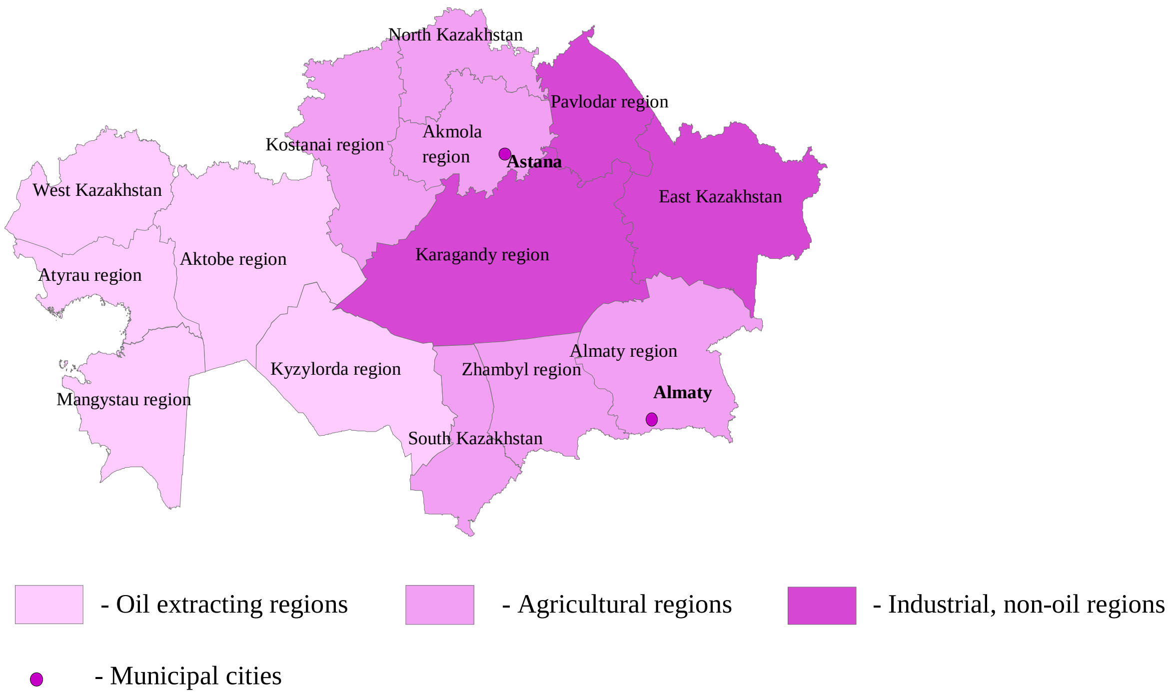
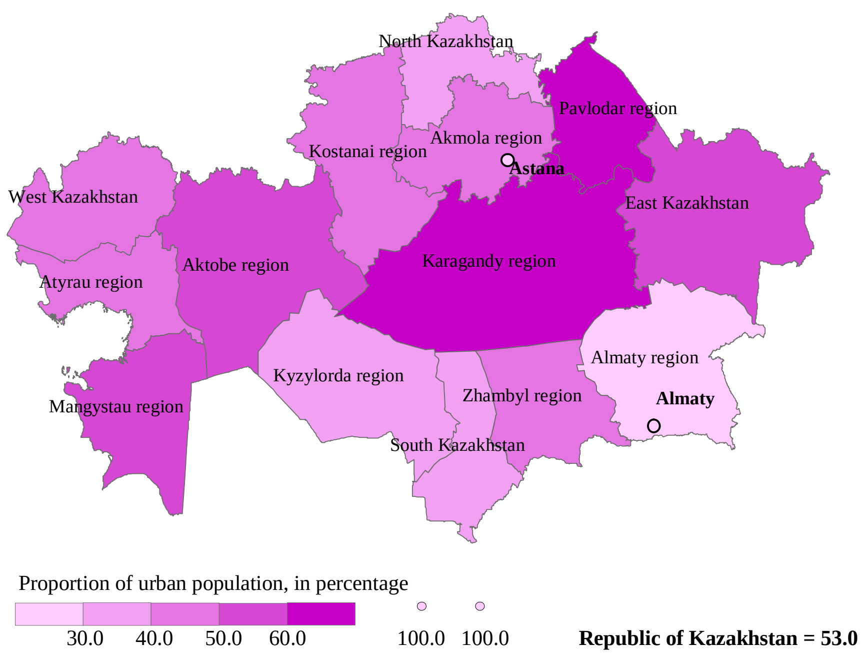


Figure 2 −The proportion of urban population, 2007-2008 (in percentage)



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

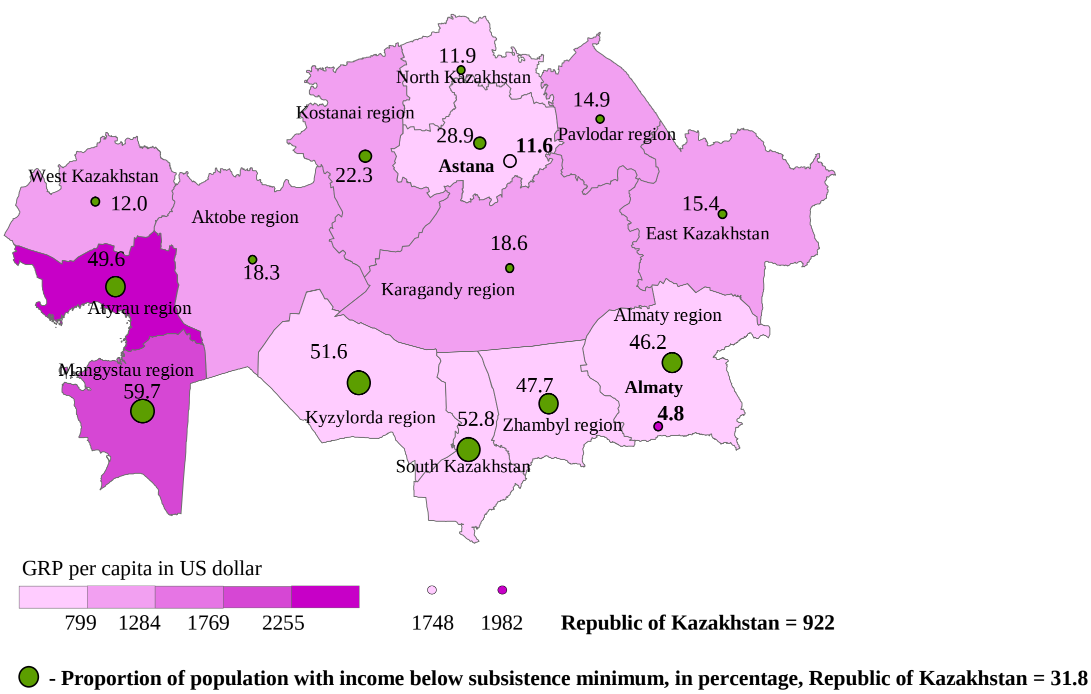
All regions except Astana and Almaty cities include urban and rural areas. However, it is not possible to compare the change in the proportion of urban and rural population in the regions between the periods 1999-2000 and 2007-2008 because of administrative changes included in The Law which were described in chapter 5.4. As a result, the industrial non oil regions (Karagandy, Pavlodar, and East Kazakhstan) and Mangystau, Aktobe regions among oil extracting regions had more than half of urban population in the period 2007-2008 (see Figure 2). Author defined these regions as urbanized ones.

7.2 Economic growth and poverty reduction

Kazakhstan's economy passed through stages of decline, stagnation, and high economic growth after independence in 1991. Since, the several stages of economic development of Kazakhstan were defined: 1. The first stage covers the years 1991-1994. This period was the crash of old command-administrative system and the beginning of complex transformation. 2. The second stage includes the years 1995-1999. In this period the strategic priorities of the country development were assigned. 3. The third stage is covered by the years 2000-2008. The economic growth of the country begins from this period (Kurganbayeva, 2009).

Our study period of regional mortality differentiation (1999-2008) coincides with the end of second stage and the third stage of economic development.

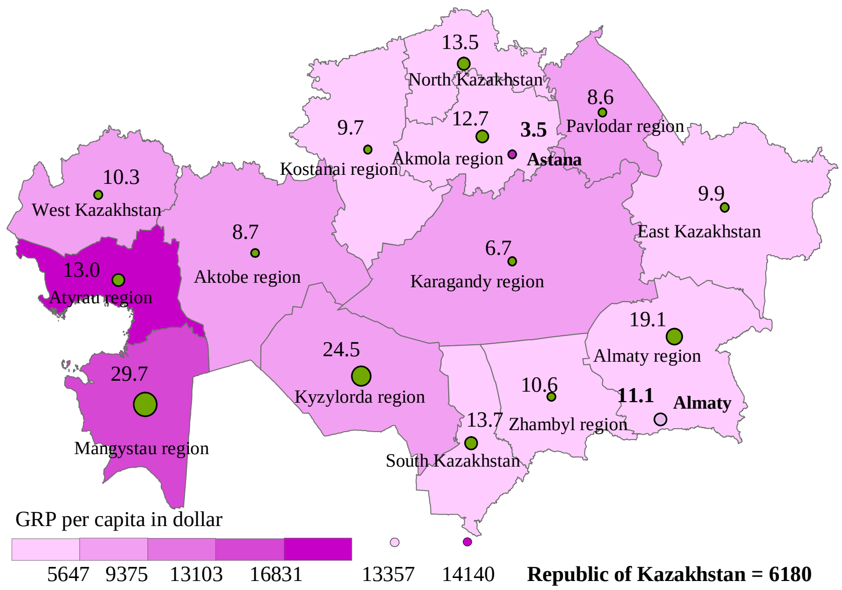
Figure 3a − Gross regional product per capita (in US dollar) and the proportion of population with income below subsistence minimum (in percentage), 1999-2000



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 GDP in Kazakhstan was 922 $ per capita. The regional differentiation of GRP size was related to the structure of production of the region. Agricultural regions except Kostanai and Kyzylorda among oil-extracting regions had the lowest size (below 799$) of gross regional product per capita (see Figure 3a). Industrial and oil extracting regions except Atyrau and Mangystau had the gross regional product between 799$ and 1,284.2$ per capita. The highest size of gross regional product was observed in main oil extracting regions Atyrau and Mangystau, and municipal cites Almaty and Astana.

Figure 3b − Gross regional product per capita (in dollar) and the proportion of population with income below subsistence minimum (in percentage), 2007-2008



- Proportion of population with income below subsistence minimum, in percentage, Republic of Kazakhstan = 12.4%

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The size of gross regional product measured per capita is the indicator of living standard and determines the size of average absolute income in the region. However, the regional differentiation of poverty incidence demonstrated that not in all regions the social well-being of population coincided with the level of economic development. In the country the proportion of poor population was 31.8% in the observed period. Along with the southern agricultural regions oil-extracting Atyrau, Mangystau, and Kyzylorda regions had the above national poverty scale (see Figure 3a). For Atyrau and Mangystau regions with highest size of gross regional product this situation was paradoxical. Poverty scale is mainly related to unemployment level. In this period the unemployment rate in the country was 12.8%. It varied across regions between 7.8% in West Kazakhstan and 16.0% in Atyrau (see Appendix 10a).

Despite the fact that main oil-extracting Atyrau and Mangystau regions ranked ahead from the rest of Kazakhstan by size of GRP they were far behind by social indicators as poverty scale and unemployment level in the observed period. It is well established that poverty creates barriers in access to healthy food, proper sanitation in some rural areas, access to health care and education (Eudy, 2009).

In the period 2007-2008 the size of gross national product increased (for 5,258 $) in the country compared to 1999-2000 which testified about economic growth. Regions also observed the growth of GRP in the examined period (see Figure 3b). The role of oil-extracting regions increased in the economy which would be explained by the fact that the economic growth in the country in the observed period was mainly related to upturn in oil production (Pomfret, 2005). Oil-extracting Kyzylorda region which had the lowest size of gross regional product in the period 1999-2000, substantially increased it, and was among other oil-extracting and industrial regions by its size in the period 2007-2008 (see Figure 3b).

Unemployment rate have gone down over the observed period in the country as well as its regions because the economic growth stimulated economic activities, and, therefore, employment (see Appendix 10b). The regional variation of unemployment was not as big as it was observed in the period 1999-2000. It varied between 6.4% in Karagandy and 7.7% in Mangystau (see Appendix 10c). Economic growth resulted in employment growth which in its turn affected to enormous decrease of poverty in the regions. However, 29.7% and 24.5% of poverty scale in oil extracting Mangystau and Kyzylorda regions respectively were considered to be the highest among all regions (see Figure 3b). The evidence would be explained by the fact that in the regions economic activity is heavily focused on oil-extraction – a highly capital-intensive industry that offers limited employment opportunity (United States Agency, 2006).

The regions which were the most favorable in terms of economic development as well as poverty incidence were Astana and Almaty cities. In the period 1999-2000 the cities had the lowest incidence of poverty among all regions (see Figure 3a). However, in 2007-2008 in Almaty city the proportion of poor population increased and moved aside the city to the lower place while Astana city decreased the poverty incidence even more (see Figure 3b). This evidence would be explained by the capital status of Astana city which was gained in 1997. The movement of affluent people from Almaty city (former capital) as well as other regions to the new capital, and the rapid construction of new capital in the observed period would change the situation in two cities adversely.

7.3 Ecological problems of regions

Kazakhstan is blessed with energy resources including oil, gas, coal, and uranium. But attached to this blessing is also a curse, since the extraction of these resources causes numerous ecological problems. Karagandy, Pavlodar, Mangystau, Atyrau, East Kazakhstan regions defined their role as the main industrial and oil producing (Atyrau, Mangystau) centres from the Soviet period or even earlier. The high level of coal, oil, ferrous and non-ferrous metal provision led to the formation of heavy industry and the highest degree of air pollution in the regions. Karagandy region includes several industrial centres such as Balkhash with the index of air pollution - 3.3

(non-ferrous metallurgy, power generation), Zhezkazgan – 7.5 (non-ferrous metallurgy, power generation), Karagandy – 4.6 (power generation, coal-mining, vehicle transport) and Temirtau – 6.9 (ferrous metallurgy, chemical industry) according to data of 2000 (Agentstvo Respubliki Kazakhstan po Statistike, 2004b:55). Therefore, Karagandy region is considered to be the most ecologically unfavourable one where Balkhash mining-metallurgic and Temirtau metallurgic enterprises which give more than a third of all pollution in the country are regarded as the biggest air pollutants (Agentstvo Respubliki Kazakhstan po Statistike, 2004b:14). Moreover, Karagandy region was affected by three military test sites: the Semipalatinsk nuclear site, the military rocket Sary-Shagan site, and the space-vehicle launching site Baykonur (Dahl and Kuralbayeva, 2001). In the region not only population health but also occupational diseases was the research topic even in the Soviet period (Abzhanov, 1977, Tchaikovsky and Sosonkin, 1968). Therefore, one of main possible factors of highest mortality for both sexes in the region compared to other ones in the observed period would be its environmental damage.

The oil producing regions Atyrau and Mangystau are also considered to be the ecologically polluted. According to the report of Ministry of Environmental Protection of the Republic of Kazakhstan in Atyrau region the main part (80-85%) of air pollution comes from oil producing enterprises (Ministerstvo okhrany okruzhaushei sredy Respubliki Kazakhstan, 2006) while in Mangystau region along with the air pollution by oil production the nuclear tests conducted in the territory have their negative effect on ecological and medical-demographic situation of the region (Ministerstvo okhrany okruzhaushei sredy Respubliki Kazakhstan, 2005).

Most of enterprises in the country have backward technology, worn-out productive assets which increase the amount of harmful emissions. In oil-producing western regions the neutralization of air pollutants was very low according to the data of 2003. Only 0.1% of air pollutants emitted from stationary sources in Atyrau region and 0.6% in Mangystau region were neutralized in the given year (Agentstvo Respubliki Kazakhstan po Statistike, 2004b:66). Furthermore, the industrial and oil producing regions had higher proportion of employees employed in unhealthy and unfavourable working conditions compared to other ones. In 1999 their proportion was highest in Mangystau (36.3%), Karagandy (34.3%), and Atyrau (29.3%) regions (Agentstvo Respubliki Kazakhstan po Statistike, 2001:167). The unhealthy working conditions, external accidents in work places could be the reason of higher mortality in the regions.

Along with the ecological problems linked with industrial and oil extracting position of the regions serious ecological problems are a heritage left to Kazakhstan from the policy of former Soviet command system. Intensive and irrational development of irrigated agriculture has led to shortages of water in the basins of small and large rivers of the southern region, such as Ile, Syrdarya and others. The drying of Aral Sea which caused by the use of its water enormously for agriculture in the end of 1950-s (the period of implementation of virgin lands) is the world ecological catastrophe. It turned into the object with dead water which leaves the chemicals, natural salts on its coast. The chemicals with the influence of wind turn into harmful dusty storm.

The situation of Aral Sea in Kyzylorda region could affect the health of population in the region. In the region researchers were attracted by poor health of women and children (Dangour et al., 2001, 2002, Jensen et al., 1997). High level of female and child mortality was documented in the research of O.Ataniyazova as following: “Average life expectancy in the Kyzylorda region of Kazakhstan has declined from 64 to 51 years. Women and children are the most vulnerable. Maternal and infant morbidity and mortality are significantly higher in Karakalpakstan and Kyzylorda than in other parts of Uzbekistan and Kazakhstan” (Ataniyazova, 2003:3).

East Kazakhstan region is also considered to be the ecological zone. Along with the environmental degradation related to its industrial position in its territory, in the border of East Kazakhstan (former Semipalatinsk), Pavlodar and Karagandy regions the Soviet government tested nuclear weapons in the period of Cold War (1949). The polygon was closed only in 1991. In the region as a zone of nuclear tests in Soviet period the incidence of oncological diseases, especially breast cancer and thyroid diseases was found to be much higher compared to other regions (Teleuov, 2007, Grosche et al., 2002).

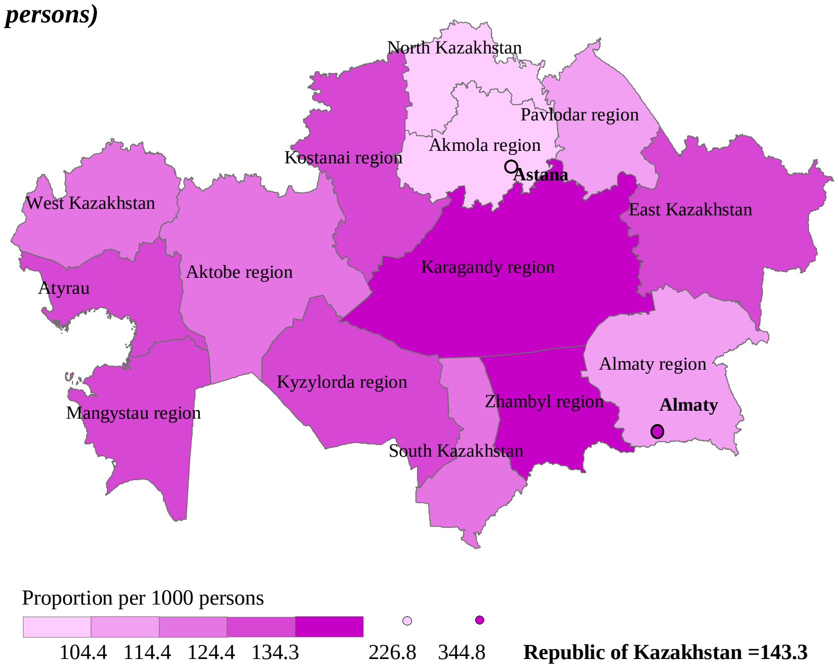
Hence, Kyzylorda and East Kazakhstan regions were declared environmental disaster zones, where there has been the destruction of natural ecological systems, degradation of flora and fauna, and the poor heath and high mortality of population.

7.4 Educational structure of population

According to the census of 1999, population with high and incomplete high educational attainment was significantly higher in Almaty and Astana cities (344.8 and 226.8 per 1,000 respectively) in comparison with other regions. There was no the big difference in the proportion of population with highest educational attainment among other regions of the country varying between 94.4 in North Kazakhstan region and 140.7 in Zhambyl region per 1,000 (see Figure 4a).

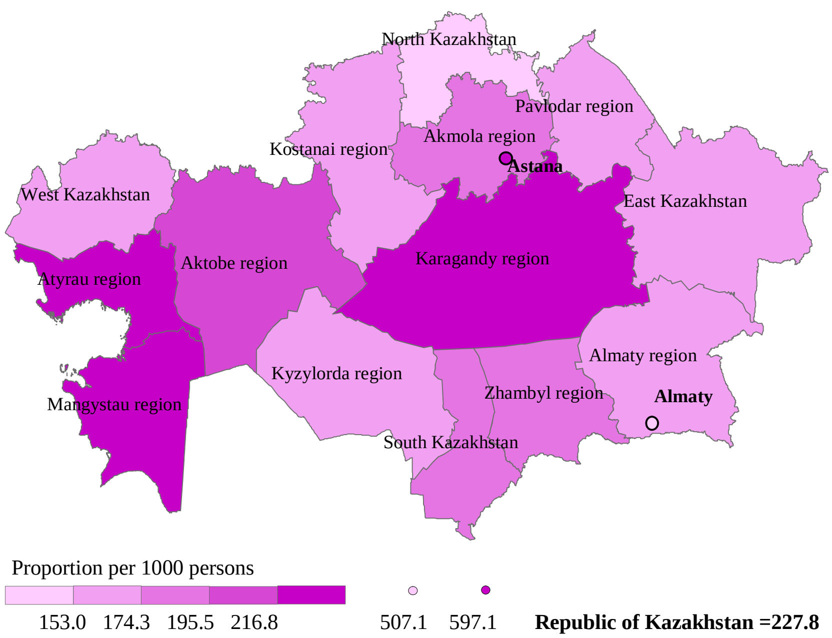
The concentration of population with highest educational attainment in two municipal cities was related to several factors. Firstly, the government/public administration bodies, the national and private sector organisations are located mainly in these two cities. Secondly, the universities which prepare the specialists in different spheres mainly are located in two municipalities. In 2004 66 high schools from 181 in the country were in Almaty city. If the number of high schools in Astana city was 10 in 2004, in 2008 they were 12. In Almaty city the proportion of students in high schools (from high school students in the country) increased from 25.4 % in 2004 to 30.8% in 2008 whereas in Astana city it increased from 4.7% to 6.6% respectively (Agentstvo Respubliki Kazakhstan po Statistike, 2009c:13). The graduates of these high schools in the cities try to work and establish there. Thirdly, population with different educational attainment including the highest one tends to migrate from other regions to the cities. The main reasons of such migration are considered to be the high mobility of population and the role of cities as the concentration of authority, money, wealth and prestige (Zabyrova, 2009).

Figure 4a – The proportion of population with high and incomplete high education, 1999 (per 1,000 persons)



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 4b − The proportion of population with high and incomplete high education, 2007 (per 1,000 persons)



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The proportion of population with highest educational attainment increased in the country from 143.3 per 1,000 in the year 1999 to 227.8 per 1,000 in the year 2007. However, the increase across regions was not even. The most increase occurred in Astana, Almaty cities, and Atyrau Mangystau, West Kazakhstan, Akmola regions (see Appendix 11). The evidence indicated that the importance of oil extracting regions increased in the observed period because of their highly qualified labor requirements and higher wage which attracted more highly educated persons. The proportion of highly educated population in Astana city was higher in comparison with Almaty city in 2007 while in 1999 the situation was adverse (see Figure 4b). The main reason of this evidence is the rapid development of the city with the acquisition of capital status and related to it the migration of young, mobile population with highest educational attainment to Astana city.

The differences in the educational attainment cause the socio-economic differentiation of population. People with higher education tend to have occupied more qualified jobs and to earn higher wages (Burcin and Kucera, 2000). In the country the size of average income per capita by educational attainment data for the year 2001 indicated that the person with secondary education had average income at the rate of 34.6$ per month while the person with high education had average income at the rate of 58.2$ in the country (Agentstvo Respubliki Kazakhstan po Statistike, 2002b:36). Moreover, Astana and Almaty cities which had highly educated persons as the half of their population had the highest proportion of employed population occupied in the sphere of service (75.3% in Astana, 74.2% in Almaty in 2007-2008) among all regions (Agentstvo Respubliki Kazakhstan po Statistike, 2009d). Hence, the people with highest educational attainment tend to be occupied in healthy working conditions. The role of educational attainment as the factor influencing on the people's values and behaviour would be also typical for Kazakhstan as it was observed for many other countries.

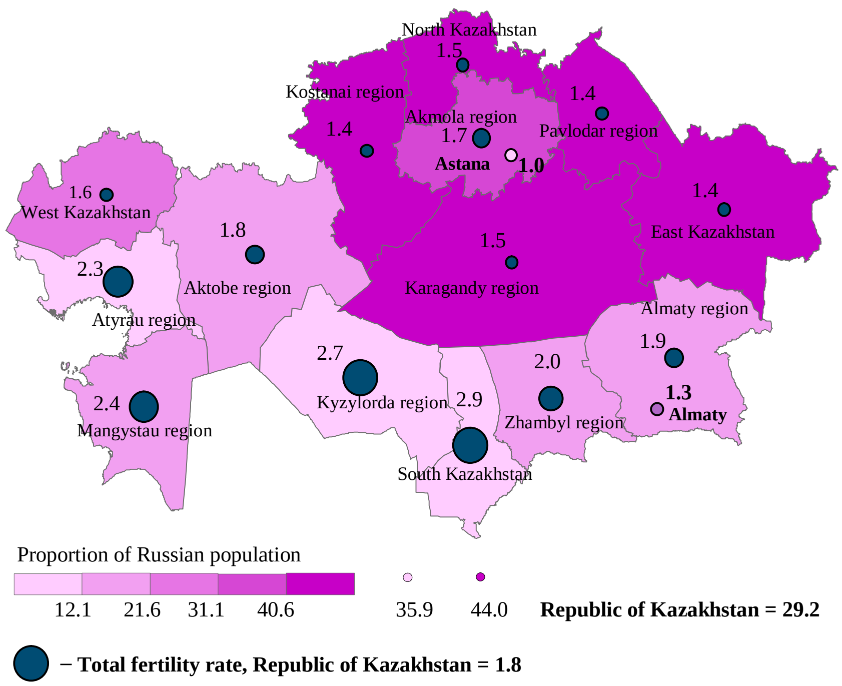
7.5 Socio-cultural structure of population

Kazakhstan is the multiethnic country which is the native land for more than 130 ethnicities. Numerically, the proportion of Slavian population (Russians, Ukrainians, and Belaruses) is the most dominant in the country. Historically, the immigration of Slavian population to the country began from XIX century, but their prevalent number immigrated in the Soviet Period. The preconditions of their migration were the industrialization and the implementation of virgin regions. And mainly, who came in this period to Kazakhstan, were the specialists in technical and agricultural spheres. The implementation of virgin lands (1954-1962) was conducted mainly in Kostanai, Akmola, North Kazakhstan, Pavlodar regions. Industrialization was developed in Karagandy, Balkhash, Zhezkazgan (Karagandy region), Shymkent (South Kazakhstan region), Aktobe, Embi (Aktobe region), Pavlodar, Ekibastuz (Pavlodar region) and Uskemen (East Kazakhstan) cities. From 1940-s to 1950-s all population of the country increased to 6.1%. This increase was mainly for account of immigrants (Alekseenko, 1999:67).

As the main regions of industrialization and implementation of virgin lands were located in northern, central, and eastern parts in 1999-2000 the proportion of Slavian population (North Kazakhstan – 58.0%, Kostanai – 57.3%, Karagandy – 50.2%, Pavlodar – 50.1%, Akmola – 48.7%, East Kazakhstan – 46.2%) was extensive there. Among these ethnicities the proportion of Russian population was highest in these regions (see Figure 5a). Their proportion was more than

40% in North Kazakhstan, Kostanai, Pavlodar, Karagandy, and East Kazakhstan regions (Akmola region − 39.8%).

Figure 5a − The proportion of Russian population (in percentage) and total fertility rate, 1999-2000



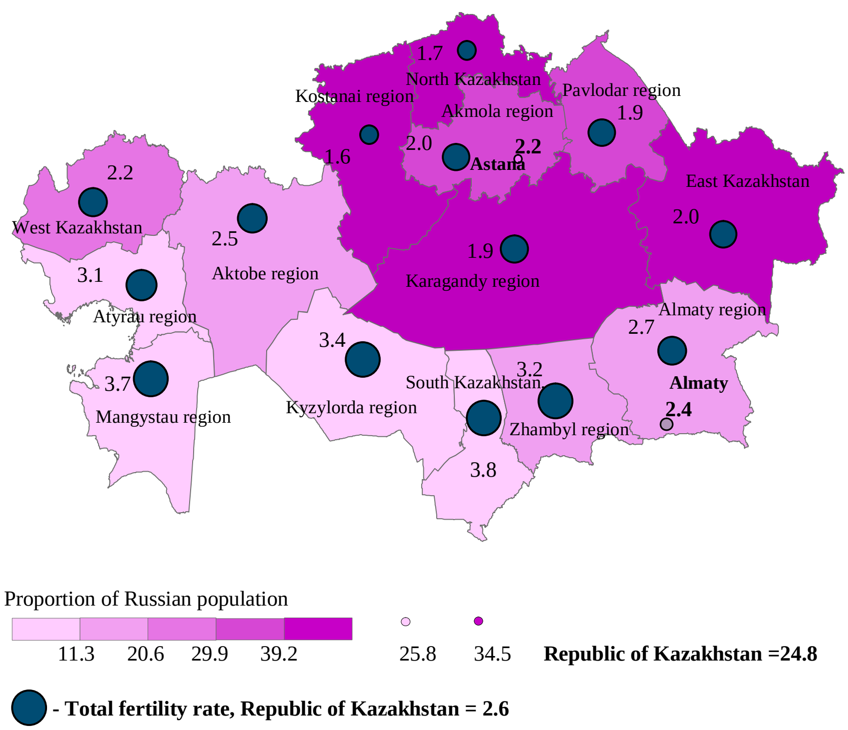
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Despite the fact that over observed time the proportion of Russian population decreased further in the regions because of their emigration their proportion remained highest in the same regions in the period 2007-2008 (see Figure 5b). The regions with less than 21.6% of Russian population were Atyrau, Mangystau, Aktobe, South Kazakhstan, Kyzylorda, Zhambyl, and Almaty regions with the lowest proportion in Atyrau, South Kazakhstan, and Kyzylorda. In the period 2007-2008 their proportion was less than 11.3% in Atyrau, Mangystau, South Kazakhstan, and Kyzylorda regions.

The evidence demonstrated that southern and western regions are mainly inhabited by titular nationality whereas almost half of population in northern, central, and eastern regions consisted of Russians. Despite the unavailability of data it was documented that comparatively big proportion of Russians lived in urban areas and worked in industry. However, their proportion employed in agriculture (18% -Russians, 57% - Kazakhs) was considered to be also higher compared to other Central Asian countries (Andreev, 2007).

According to E.Hammel (1990) culture identifies a social grouping whose values and norms may explain why communities or persons living under apparently identical conditions, but differing in language or tradition, often behave very differently demographically. In this sense the ethnical differentiation of regions had impact on variation of fertility level across regions which identified the higher fertility level in southern and western regions and lower one in northern, central, and eastern regions (see Figures 5a and 5b). An interesting point is that predominantly Kazakh regions with higher fertility rate (South Kazakhstan, Kyzylorda, Zhambyl, Atyrau, and Mangystau) had higher scale of poverty compared to other ones in the period 1999-2000 (see Chapter 7.2). Namely these regions had higher level of infant and child mortality.

Figure 5b − The proportion of Russian population (in percentage) and total fertility rate, 2007-2008



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

J. Falkingham (2005) determined that in the period of economic crisis (1989-1995) in more "russified" Kazakhstan male life expectancy at birth declined more compared to other Central Asian countries. Therefore, Kazakhstan was considered as the country who has been subjected to highly stressful and extensive social change associated with the transition out of communism along with other post soviet Eastern European countries (Cockerham et al., 2006). In this sense C.Becker and D.Urzhumova (2005) investigating the positive influence of proportion of Russian population on regional male mortality differentiation assumed about "Slavic male mortality disadvantage in prime adult age". They related the evidence to three possible reasons: Firstly, Kazakhs tend to live in less environmentally damaged areas and work in less dangerous occupations; Secondly, Ethnic Kazakhs are commonly believed to consume less alcohol than their European counterparts because of their Muslim identity; Thirdly, Kazakhs have stronger social network than their European counterparts which save them more from external causes (suicide, homicide and other self-destructive behaviour) (ibid., 116-117).

7.6 General performance of regional differentiation

Our study period of regional mortality differentiation coincided with the period of economic growth in the country. The economic growth led not only to poverty reduction but also the decline of unemployment rate and the increase of population with highest educational attainment and fertility level in the country. However, the differentiation of socio-economic indicators and their change were not even across regions:

1. In the process of economic reforms the government considered oil as the key of economic growth in the country. Therefore, the importance of oil-extracting regions (Atyrau, Mangystau, West Kazakhstan, Aktobe, and Kyzylorda) increased in the observed period with the enormous growth of average income per capita. Moreover, Atyrau and Mangystau regions were in the second place by the proportion of highly educated population after municipal cities in the period 2007-2008. The main disadvantage of Atyrau, Mangystau, Kyzylorda regions was the above national of poverty scale there.
2. Agricultural regions (Akmola, Almaty, Zhambyl, Kostanai, North Kazakhstan, and South Kazakhstan) were considered as the low income regions. Southern agricultural regions (Almaty, Zhambyl, South Kazakhstan) had the above national scale of poverty, the highest proportion of titulatar nationality and accordingly the above national level of fertility apart from northern regions (Akmola, Kostanai, North Kazakhstan).
3. Industrial regions (East Kazakhstan, Karagandy, and Pavlodar) were favourable in socio-economic conditions with the above national gross regional product and the below national scale of poverty. The regions were urbanized with the higher proportion of Russian population. The important disadvantages of regions were their ecologically unfavourable situation and the higher proportion of employees employed in unhealthy and unfavourable working conditions.
4. Among all regions Astana and Almaty cities are considered to be the most favorable in many aspects:
    1. The cities were in the second place after Atyrau and Mangystau regions according to size of Gross regional product per capita.
    2. The poverty incidence was below national.
    3. The proportion of population with high and incomplete high education, accordingly the number of doctors were highest among all regions;
    4. The cities were service oriented with the highest proportion of employees employed in service sector.

Chapter 8

Regional differentiation in the development of mortality in 1999-2008

The chapter examines the development of regional mortality variation in the period 1999-2008. The examination was made for overall mortality level and mortality by age groups. The observed age groups were 0-4, 5-19, 20-64, and 65-84 derived in the result of factor analysis (see Chapter 6.3.1).

8.1 Overall mortality level

In the period 1999-2008 mortality indicators observed the change in the Republic of Kazakhstan. The average number of deaths was gradually increasing from 297,194 in the period 1999-2000 to 311,003 in the period 2007-2008. In the period 1999-2000 there were 19.9 deaths per 1,000 people alive, in the period 2007-2008 it changed to 20.0 per 1,000 people alive fluctuating over time (see Table 3). However, these indicators do not take into account the change in age structure of population.

Table 3 − Mortality in 1999-2008, Republic of Kazakhstan

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
Number of deaths	297,194	297,257	307,527	314,331	311,003
Crude mortality rate (in ‰)	19.9	20.0	20.6	20.7	20.0
Age-standardised death rate (per 100,000)[1]					
males	2,038	2,019	2,052	2,000	1,897
females	1,108	1,090	1,092	1,072	1,020
Life expectancy at birth (in years)					
males	60.2	60.4	60.4	60.4	61.2
females	70.7	71.0	71.3	71.4	72.0
difference (females – males)	10.5	10.5	10.9	11.1	10.8
Infant mortality rate (in ‰) males	22.5	20.9	17.0	16.2	19.9
females	16.6	15.2	12.7	12.7	15.4

Note: *1. Standard – European 'old' standard population*

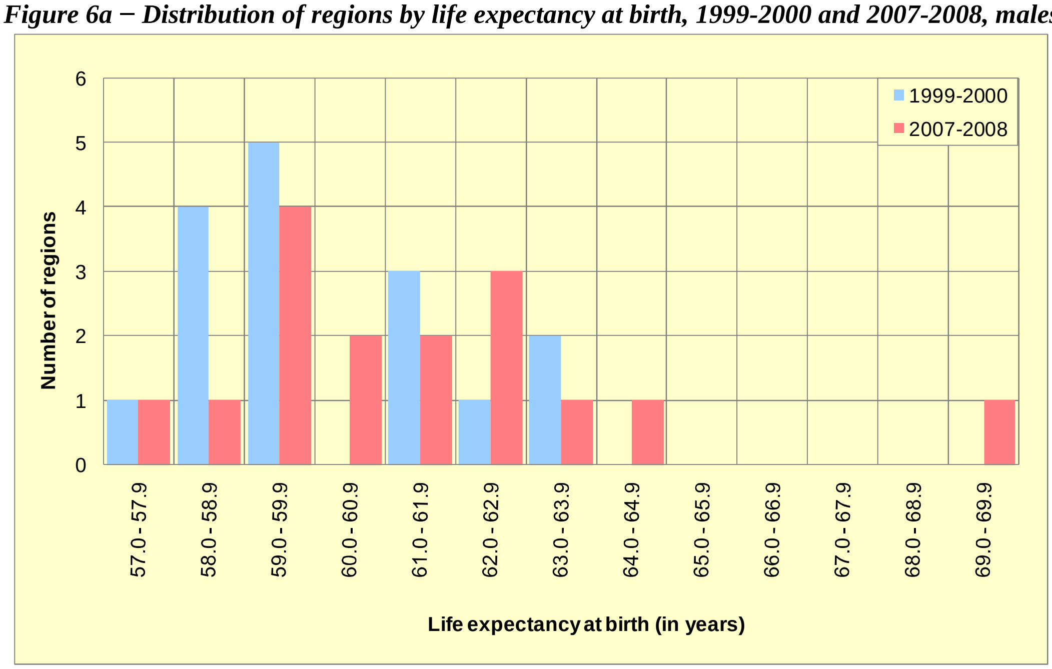
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Therefore, it is worth to examine the change in age-standardised death rate and life expectancy at birth for both sexes. Age-standardised death rate for males decreased from 2,038 to 1,897 deaths per 100,000 males alive between the periods 1999-2000 and 2007-2008 while for females the deaths decreased from 1,108 to 1,020 between the observed periods.

Male life expectancy at birth increased from 60.2 years in the period 1999-2000 to 61.2 years in the period 2007-2008. The substantial increase was noted in the period 2007-2008 compared to previous periods. Female life expectancy at birth increased from 70.7 to 72.0 years between abovementioned periods. Apart from male life expectancy at birth female one was increasing gradually over time. The increase of female life expectancy at birth was higher for 0.3 years compared to the increase of male one.

Infant male mortality rate decreased from 22.5 deaths per 1,000 live births in the period 1999-2000 to 19.9 deaths per 1,000 live births in the period 2007-2008 in the country. Infant female mortality decreased from 16.6 deaths to 15.4 respectively. However, the value would be even lower in the period 2007-2008 if one observes the trend of decrease over time. The increase of infant mortality rate for both sexes in the period 2007-2008 compared to previous ones was related to movement of the country from Soviet definition of live birth to WHO one. The decrease of infant mortality rate for both sexes testified about socio-economic improvement in the country.

Figure 6a − Distribution of regions by life expectancy at birth, 1999-2000 and 2007-2008, males

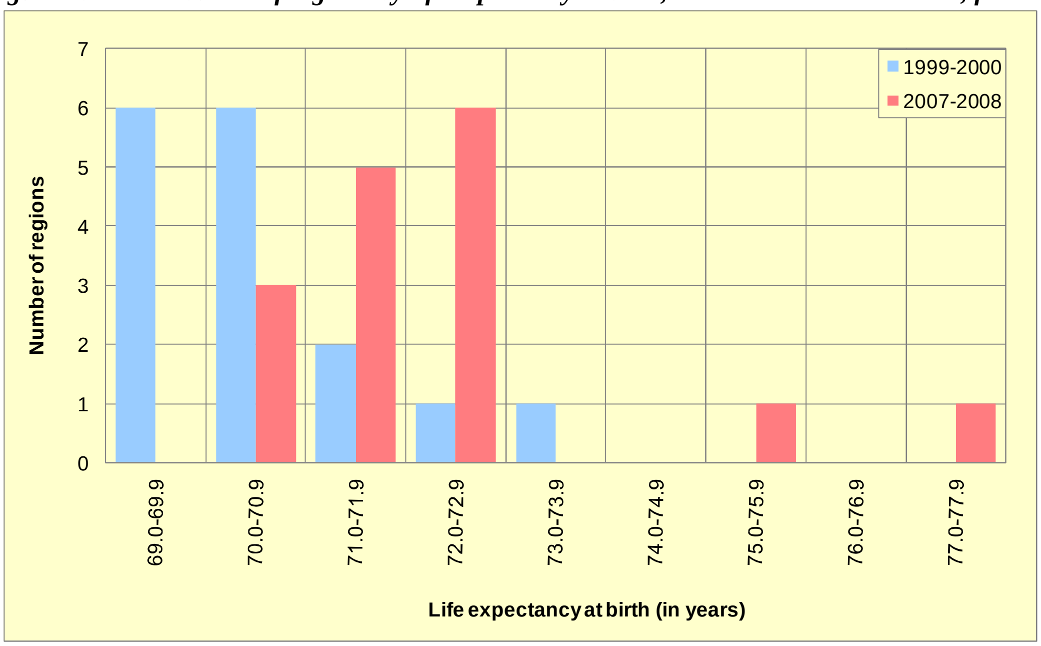


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Male life expectancy at birth varied between 57.0 and 64.0 years in the period 1999-2000, between 57.0 and 70.0 years in the period 2007-2008 across regions of the country (see Figure 6a). In both of periods the most number of regions examined male life expectancy at birth in the range 59.0-59.9. However, in the period 2007-2008 two regions had male life expectancy at birth in the range 64.0-64.9 and 69.0-69.9 apart from 1999-2000. The increase of variation between two periods occurred because of enormous increase of male life expectancy at birth in one region.

Female life expectancy at birth oscillated between 69.0 and 73.0 in 1999-2000, 70.0 and 78.0 years in 2007-2008 across regions (see Figure 6b). The most of regions demonstrated female life expectancy at birth in ranges 69.0-69.9 and 70.0-79.9 in the period 1999-2000. In the period 2007-2008 the major number of regions indicated the values between 71.0-71.9 and 72.0-72.9. The evidence demonstrated that the variation of female life expectancy at birth was not as great as it was observed for males. However, the increase of regional variation of female life expectancy at birth also occurred because of substantial improvement of mortality level in one region as it was examined for males. The minimal value of female life expectancy at birth changed from 69.0 to 70.0 years in the end of the period differently from male one which expresses the improvement of life expectancy at birth for females in all regions. This evidence indicated that regional variation of male as well as female life expectancy at birth increased in the end of the period (2007-2008) compared to the beginning (1999-2000).

Figure 6b − Distribution of regions by life expectancy at birth, 1999-2000 and 2007-2008, females



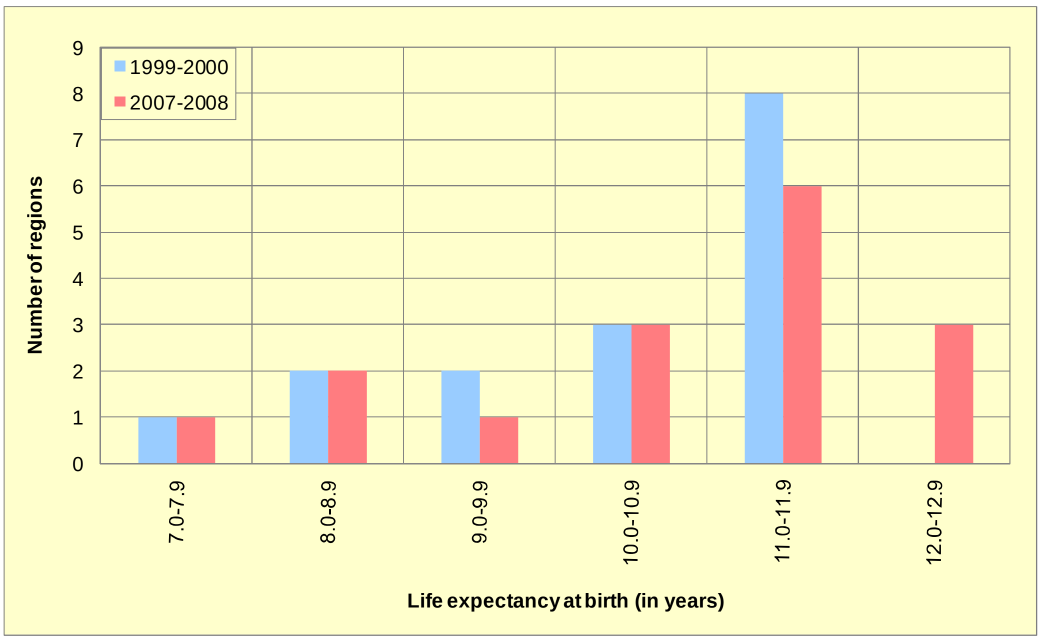
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The difference between female and male life expectancy at birth varied between 7.0 and 12.0 in 1999-2000, 7.0 and 13.0 in 2007-2008 across regions of the country (see Figure 6c). The most number of regions indicated the difference in the range 11.0-11.9 in both of periods. However, in the period 2007-2008 the difference was in the range 12.0-12.9 in three regions apart from the period 1999-2000 which indicated the increase of regional variation in excess male mortality.

The changing values of regional mortality variation indicators demonstrated that male as female life expectancy at birth variation across regions was increasing over observed period (see Table 4a). The value of regional variation coefficient for males was 2.7% in the period

1999-2000, in the following three year periods it was stable in the level 3.4%. However, in the period 2007-2008 it achieved to 4.4%. The increase of regional variation coefficient over time indicated the increase of regional variation of male life expectancy at birth in the observed period with the big increase in the period 2007-2008. The value of standard deviation was also increasing from 1.6 in the period 1999-2000 to 2.7 in the period 2007-2008. The low values of coefficient variation and standard deviation would make the regional variation of life expectancy at birth hidden from the view. The higher value of range demonstrated the evidence more precisely. The range between maximal and minimal values of male life expectancy at birth was increasing gradually over observed period. The increase of range occurred not only because of increase in maximal values but also the decrease of minimal values.

Figure 6c − Distribution of regions by difference between female and male life expectancy at birth, 1999-2000 and 2007-2008



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The values of regional variation indicators for female life expectancy at birth were lower than those of male life expectancy at birth in the observed period which demonstrated the smaller regional variation of female mortality level compared to male one (see Table 4a). The value of regional variation coefficient for female life expectancy at birth was increasing from 1.5% in the period 1999-2000 to 2.3% in 2007-2008. Despite the gradual increase of its values over time the change was not as severe as it was observed for males. The value of standard deviation was also increasing constantly over examined period. The increase of range occurred only because of increase in maximal value of female life expectancy at birth apart from male one.

Apart from male and female life expectancy at birth the value of regional variation coefficient for difference between female and male life expectancy at birth was increasing with fluctuation over time (see Table 4b). In the periods 2003-2004 and 2005-2006 the coefficient value lowered, however, in the period 2007-2008 it increased sharply. The value of standard deviation was also observing such change over observed period. However, the range between maximal and minimal values was increasing gradually over time and its increase occurred because of changes in maximal and minimal values. The observation of regional variation indicators demonstrated that regional variation in excess male mortality also increased in the period 2007-2008 compared to 1999-2000 fluctuating over time.

The observation of changes in regional mortality variation indicators for male and female overall mortality level in 1999-2008 demonstrated the increase of regional variation of mortality level for both sexes with the bigger one for males.

Table 4a − Cross-regional variation in life expectancy at birth, 1999-2008, males and females

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
	Males				
Minimal value	58.0	58.0	57.7	57.5	57.9
Maximal value	63.2	64.5	66.1	66.0	69.2
Range	5.2	6.5	8.4	8.5	11.3
Standard deviation	1.6	2.0	2.0	2.1	2.7
Coefficient of variation (in %)	2.7	3.4	3.4	3.4	4.4
Republic of Kazakhstan	60.2	60.4	60.4	60.4	61.2
	Females				
Minimal value	69.4	69.4	69.4	69.9	70.4
Maximal value	73.2	73.7	75.0	75.4	77.1
Range	3.8	4.3	5.7	5.5	6.8
Standard deviation	1.0	1.2	1.3	1.3	1.7
Coefficient of variation (in %)	1.5	1.6	1.9	1.9	2.3
Republic of Kazakhstan	70.7	71.0	71.3	71.4	72.0

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 4b − Cross-regional variation in difference between female and male life expectancies at birth, 1999-2008

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
Minimal value	7.9	8.1	8.1	8.7	7.9
Maximal value	11.9	12.2	12.2	12.8	12.5
Range	3.9	4.1	4.1	4.2	4.6
Standard deviation	1.3	1.4	1.2	1.3	1.4
Coefficient of variation (in %)	12.2	12.8	11.5	11.2	13.4
Republic of Kazakhstan	10.5	10.5	10.9	11.1	10.8

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

8.2 Mortality level by age groups

The probability of dying for the age group 0-4 decreased from 29.1 in the period 1999-2000 to 24.0 per 1,000 in 2007-2008 in the country (see Table 5a). The value of regional male mortality variation coefficient in this age group decreased from 19.7% in the period 1999-2000 to 17.7% in 2007-2008 indicating the higher value (21.1%) in the period 2005-2006. The value of standard deviation also decreased fluctuating over observed period. However, very small value of standard deviation was hidden from the view. The range between maximal and minimal values also decreased in the end of the period compared to the beginning. However, after gradual decrease in the beginning periods it increased again in the periods 2005-2006 and 2007-2008. This change was related to the decrease of minimal value as well as the increase of maximal value.

The value of regional variation coefficient for female mortality level in age group 0-4 decreased from 18.1% in the period 1999-2000 to 17.0% in the period 2007-2008 fluctuating over observed period (see Table 5a). The decrease was not as big as it was observed for males. The value of standard deviation did not indicate such a big change because of its very small size. Apart from males the range between maximal and minimal values of female mortality level was decreasing without fluctuation over observed period. Their size was not as big as it was observed for males. The change in regional variation indicator values for male and female mortality level in the given age group demonstrated that regional variation of mortality level for both sexes decreased in the period 2007-2008 compared to 1999-2000. The decrease was observed because of the decrease in maximal value of mortality level for both sexes.

Table 5a − Cross-regional variation of the probability of dying for the age group 0-4, 1999-2008, males and females

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
Minimal value (per 1,000)	19.0	18.7	16.5	15.9	16.8
Maximal value (per 1,000)	40.6	37.1	28.6	34.1	31.3
Range (per 1,000)	21.6	18.4	12.1	18.1	14.5
Standard deviation	0.006	0.005	0.003	0.004	0.004
Coefficient of variation (in %)	19.7	19.5	14.3	21.1	17.7
Republic of Kazakhstan (per 1,000)	29.1	26.4	21.7	21.0	24.0
	Females				
Minimal value (per 1,000)	14.4	12.5	12.0	12.5	13.1
Maximal value (per 1,000)	31.7	28.2	23.1	23.2	24.2
Range (per 1,000)	17.3	15.7	11.1	10.7	11.1
Standard deviation	0.004	0.004	0.003	0.003	0.003
Coefficient of variation (in %)	18.1	19.6	16.0	18.8	17.0
Republic of Kazakhstan (per 1,000)	22.4	19.8	16.6	16.5	18.8

Source: *Author’s calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Among all age groups the level of mortality in age group 5-19 was the lowest in the country with the lower level for females compared to males (see Table 5b). The value of regional variation coefficient for male mortality level decreased from 17.8% in the period 1999-2000 to 15.2% in the period 2007-2008. The range between maximal and minimal values indicated the decrease from 8.0 in the beginning of the period to 7.5 in the end of the period.

The value of regional variation coefficient for female mortality level decreased from 18.8% in the period 1999-2000 to 18.5% in the period 2007-2008. If one observes its change over observed time after the gradual decrease till the period 2005-2006, the value substantially increased in the period 2007-2008. The range between maximal and minimal values was also decreasing over time with the increase in the period 2007-2008. However, its value was lower in the period 2007-2008 compared to 1999-2000. The change in regional mortality variation in the observed age group was seen only from the value of regional variation coefficient because of the very small size of standard deviation as well as range. The value of regional variation coefficient demonstrated the decrease of regional variation of mortality level for both sexes in the period 2007-2008 compared to 1999-2000 despite its substantial increase for females in the last period compared to previous ones.

The level of male mortality in age group 20-64 decreased in the period 2007-2008 compared to 1999-2000 with the gradual increase over time and sharp decrease in the period 2007-2008 in the country (see Table 5c). The value of regional variation coefficient for male mortality level changed from 7.7% in the period 1999-2000 to 12.9% in the period 2007-2008 gradually increasing over time. The value of standard deviation was also gradually increasing over observed period from 0.039 to 0.062. The next indicator is range between maximal and minimal values. The range was constantly increasing over observed period from 119.5 to 245.0 per 1,000. The increase occurred not only from the decrease of minimal value as well as increase of maximal value.

Table 5b − Cross-regional variation of the probability of dying for the age group 5-19, 1999-2008, males and females

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
	Males				
Minimal value	9.9	9.1	8.2	7.7	8.5
Maximal value	18.0	17.8	15.7	16.4	16.0
Range	8.0	8.7	7.5	8.7	7.5
Standard deviation	0.003	0.003	0.002	0.002	0.002
Coefficient of variation (in %)	17.8	18.3	16.8	16.2	15.2
Republic of Kazakhstan (per)	14.5	13.3	12.8	12.9	12.7
	Females				
Minimal value	4.0	4.6	5.0	4.3	4.0
Maximal value	10.5	9.5	8.6	8.5	9.0
Range	6.5	5.0	3.6	4.2	4.9
Standard deviation	0.001	0.001	0.001	0.001	0.001
Coefficient of variation (in %)	18.8	16.4	14.0	13.5	18.5
Republic of Kazakhstan	7.6	7.4	7.0	7.0	7.1

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The level of female mortality in this age group was twice lower than that of male mortality. The level of female mortality in the country decreased from 236.4 in the period 1999-2000 to 217.7 per 1,000 in 2007-2008. The coefficient of regional female mortality variation also increased gradually from 6.6% to 14.6% which demonstrated the bigger increase compared to males. The range as well as the value of standard deviation indicated the rapid increase for females over observed period. The increase of regional variation coefficient was even bigger than that of male mortality level while the range increased more for males compared to females. This adverse situation would be the statistical artefact in demonstration regional variation coefficient values.

The increase of regional variation indicator values demonstrated the increase of regional mortality variation for both sexes in the observed age group. The evidence indicated that the increase of regional variation of life expectancy at birth for both sexes was partly explained by regional mortality variation increase in age group 20-64.

The level of male mortality in age group 65-84 decreased from 886.3 in the period 1999-2000 to 860.8 per 1,000 in the period 2007-2008 in the country (see Table 5d). The increase of regional variation coefficient value from 2.6% to 6.9% demonstrated the increase of regional male mortality variation over observed period. The values of standard deviation and range were also increasing gradually over time. The increase of range was observed because of the increase of maximal value as well as the decrease of minimal value.

Table 5c − Cross-regional variation of the probability of dying for the age group 20-64, 1999-2008, males and females

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
	Males				
Minimal value	431.8	434.4	413.8	407.4	333.4
Maximal value	551.3	567.5	593.5	593.8	578.4
Range	119.5	133.0	179.6	186.4	245.0
Standard deviation	0.039	0.048	0.049	0.049	0.062
Coefficient of variation (in %)	7.7	9.4	9.5	9.5	12.9
Republic of Kazakhstan	505.5	509.0	520.1	518.0	489.4
	Females				
Minimal value	200.1	193.1	180.4	165.3	144.7
Maximal value	258.9	263.9	287.9	286.2	262.8
Range	58.8	70.8	107.5	120.9	118.1
Standard deviation	0.016	0.020	0.025	0.030	0.031
Coefficient of variation (in %)	6.6	8.3	10.7	13.1	14.6
Republic of Kazakhstan	236.4	236.2	237.2	235.8	217.7

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality level was slightly lower than that of males in examined age group which identified about the decrease of difference between female and male mortality level in this age group compared to 20-64. The level of female mortality changed from 777.4 in the period 1999-2000 to 739.1 per 1,000 in the period 2007-2008 gradually decreasing over time in the country. In the period 1999-2000 the regional differentiation of female mortality was bigger than that of male one. However, in the following periods their level was closer. In the period 2007-2008 the regional variation coefficient value was equal for both sexes. The change of values of regional variation indicators for female mortality level also indicated the increase of regional female mortality variation as it was observed for males.

The examination of changes in regional mortality variation by age groups in the period

1999-2008 demonstrated that in age groups 0-4 and 5-19 variation decreased for both sexes in the period 2007-2008 compared to 1999-2000 while in age groups 20-64 and 65-84 it increased. The increase of regional mortality variation in older age groups compared to younger ones would indicate the increasing role of universal factors of mortality (Burcin and Kucera, 2000).

The bigger regional mortality differentiation in age groups 0-4 and 5-19 measured by values of regional variation coefficient compared to older age groups would be again the statistical artefact resulted from a relatively small number of deaths in these age groups.

Table 5d − Cross-regional variation of the probability of dying for the age group 65-84, 1999-2008, males and females

	Males				
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
Minimal value	822.8	774.6	727.7	712.4	654.6
Maximal value	914.4	911.5	929.0	930.2	938.3
Range	91.6	136.9	201.3	217.8	283.6
Standard deviation	0.023	0.031	0.042	0.046	0.060
Coefficient of variation (in %)	2.6	3.6	4.8	5.4	6.9
Republic of Kazakhstan	886.3	877.7	879.9	865.3	860.8
	Females				
Minimal value	729.3	702.7	652.3	647.1	581.2
Maximal value	833.4	840.3	825.0	833.2	825.0
Range	104.1	137.6	172.7	186.1	243.9
Standard deviation	0.025	0.030	0.036	0.039	0.051
Coefficient of variation (in %)	3.3	3.9	4.7	5.1	6.9
Republic of Kazakhstan	777.4	767.6	766.9	753.9	739.1

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

8.3 Main finding

The finding of the analyses described in the chapter answers the first research question.

1. *What changes took place in development of regional mortality variation (overall mortality level, mortality level by age groups) in the period 1999-2008?*

1. The examination of regional mortality variation development in the period 1999-2008 demonstrated that male as well as female life expectancy at birth variation across regions increased in the period 2007-2008 compared to 1999-2000 with the bigger increase for males.

   This change was explained by regional mortality variation increase in age groups 20-64 and 65-84 for both sexes. In age groups 0-4 and 5-19 regional variation of mortality for both sexes observed the decrease in the period 2007-2008 compared to 1999-2000.

Chapter 9

Regional mortality trends in Kazakhstan in 1999-2008

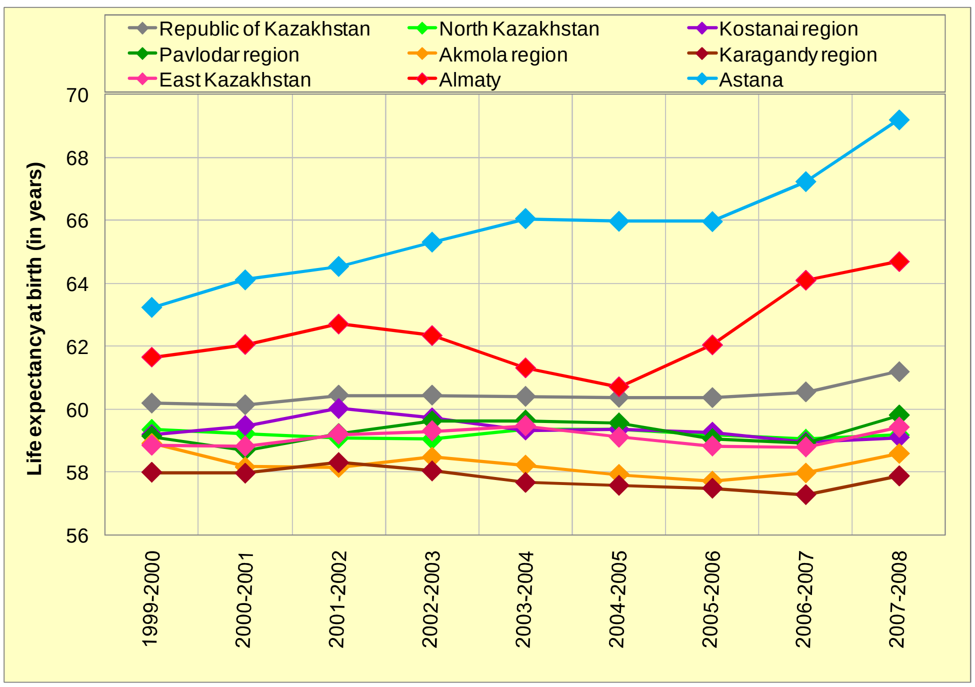
The chapter describes the regional trends of overall mortality level, mortality by age groups and selected leading causes of death in the period 1999-2008. As sixteen regions in one graph are not readable we divided them into two groups according to geographical position and their equal distribution across graphs. The first group of regions include northern (North Kazakhstan, Kostanai, Pavlodar), central (Akmola, Karagandy), eastern (East Kazakhstan) regions, and municipal cities (Almaty, Astana). The second group includes western (West Kazakhstan, Aktobe, Atyrau, Mangystau) and southern (South Kazakhstan, Kyzylorda, Zhambyl, Almaty) regions.

9.1 Trends of overall mortality level

In the period 1999-2000 male life expectancy at birth was 60.2 years in the country. Among the first group of regions northern, central, and eastern regions had below national male life expectancy at birth. The lowest level was observed in Karagandy (58.0 years) among the regions. Astana and Almaty cities had above national male life expectancy at birth (63.2 and 61.6 years respectively). In the following periods only Astana and Almaty cities increased the level rapidly with the fluctuated and slower trend for Almaty city (see Figure 7a). Other regions along with the country had somehow stable trend with the slight increase in the period 2007-2008. Between the periods 1999-2000 and 2007-2008 in the country male life expectancy at birth increased for 1.0 year (from 60.2 to 61.2). The increase was observed in Pavlodar, East Kazakhstan regions, and Astana, Almaty cities with the biggest one in Almaty and Astana cities (3.0 and 6.0 years respectively). The slight decrease was noted in North Kazakhstan, Kostanai, Akmola, Karagandy regions. As a result of such trend in the period 2007-2008 Astana and Almaty cities (69.2 and 64.7 years respectively) had above national male life expectancy at birth. Other regions had below national level with the lowest one in Karagandy (57.9 years) as it was observed in the period 1999-2000.

In the period 1999-2000 among the second group of regions the southern regions South Kazakhstan, Kyzylorda, Zhambyl, and Almaty had above national male life expectancy at birth with the highest one in South Kazakhstan (63.2 years) while western regions West Kazakhstan, Aktobe, Atyrau, and Mangystau had below national level with the lowest one in Atyrau (58.6 years) (see Figure 7b). However, the favourable southern regions could not improve the level as substantial as Astana and Almaty cities in the following periods. Almaty region even was decreasing the level from the period 2001-2002 with the slight increase in the period 2007-2008. Western regions could improve the level apart from southern ones. Atyrau and West Kazakhstan regions achieved the national level in the period 2004-2005. Mangystau and Aktobe regions also were gradually increasing the level over time. Between the periods 1999-2000 and 2007-2008 all regions of the second group except Almaty increased the level with the biggest increase in Atyrau and Mangystau (2.6 and 2.3 years respectively). Almaty region decreased the level for 0.1 years. In the period 2007-2008 Atyrau and Mangystau regions had the level equal with the country (61.2 years) while Aktobe and West Kazakhstan regions had the slight lower level (60.9 years). Southern regions indicated the above national level as it was observed in the period 1999-2000.

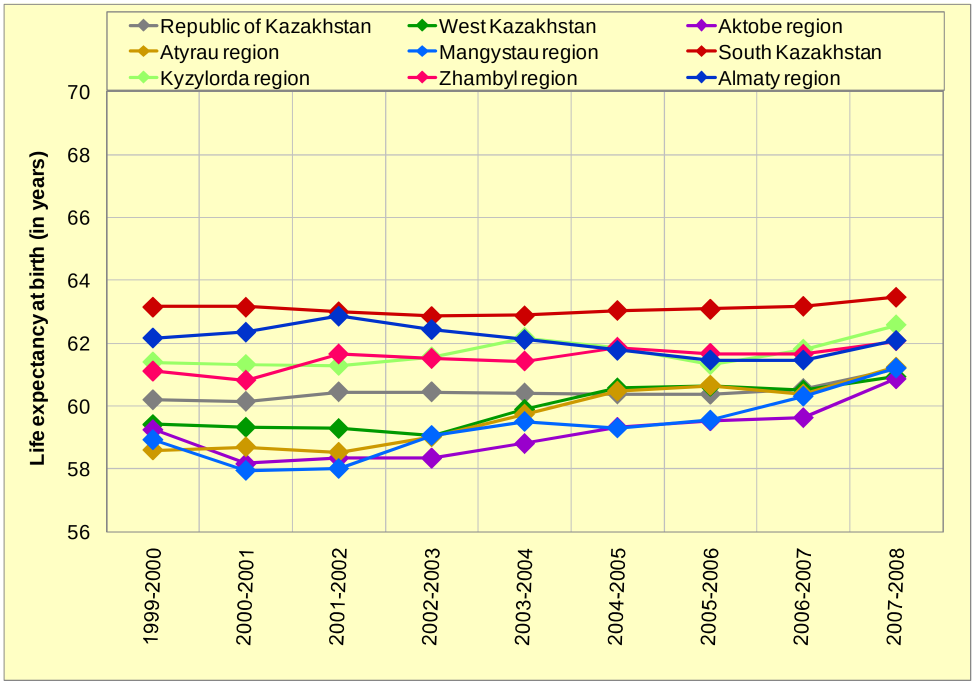
Figure 7a − Life expectancy at birth, the first group of regions, 1999-2008, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 male life expectancy at birth was above national in southern regions, and Astana, Almaty cities while it was below national in western, eastern, northern, central regions. Between the periods 1999-2000 and 2007-2008 the level increased in western, eastern regions, northern region Pavlodar, southern regions South Kazakhstan, Zhambyl, Kyzylorda, and Astana, Almaty cities with the bigger increase in western regions Atyrau and Mangystau, and Astana, Almaty cities. The level slightly decreased in central regions, northern regions North Kazakhstan, Kostanai, and southern region Almaty. In the period 2007-2008 male life expectancy at birth was above national in the same regions. However, western regions Atyrau and Mangystau observed the equal value with national one. Below national level was kept in central, northern, eastern regions, and western regions West Kazakhstan and Aktobe.

Figure 7b − Life expectancy at birth, 1999-2008, the second group of regions, males



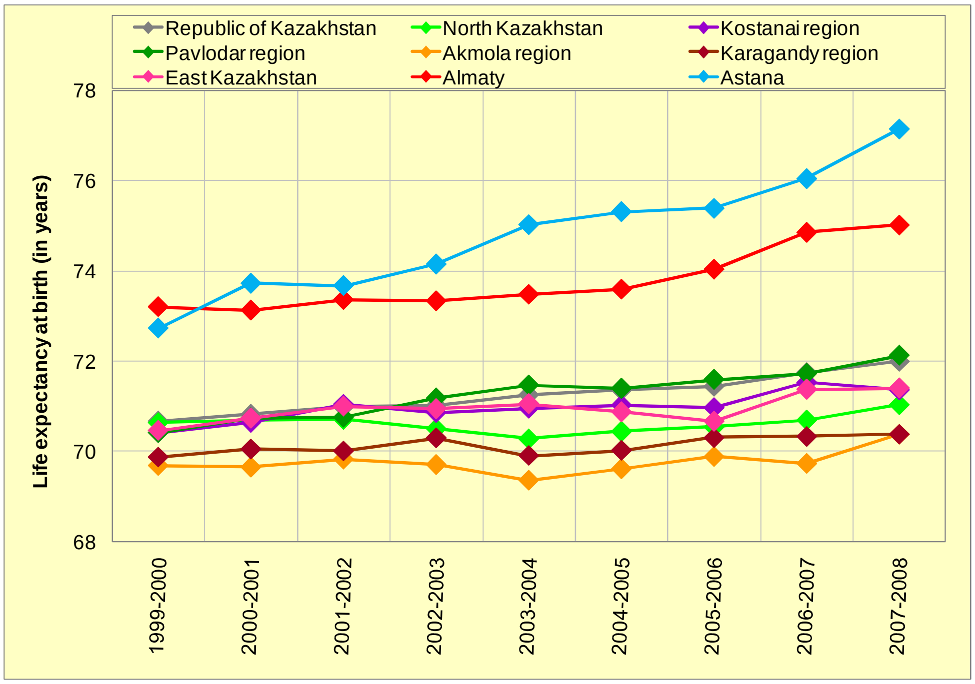
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 female life expectancy at birth was 70.7 years in the country. Among the first group regions female life expectancy at birth was above national in Astana and Almaty cities. North Kazakhstan, Kostanai, Pavlodar, and East Kazakhstan regions had the slight lower level than national one (see Figure 7c). The lowest female life expectancy at birth was observed in Akmola and Karagandy regions (69.7 and 69.9 years respectively). All regions including country and excluding Astana and Almaty cities had the slow increase of level over time. Municipal cities with the highest values for female life expectancy at birth had the greatest increases over the period considered. Between the periods 1999-2000 and 2007-2008 female life expectancy at birth increased in the country (1.3 years) as well as all regions. In the period 2007-2008 above national female life expectancy at birth was noted in Astana, Almaty cities, and Pavlodar region while North Kazakhstan, Kostanai, East Kazakhstan, Akmola, Karagandy regions indicated the below national level. The highest value for female life expectancy at birth was observed in Astana city (77.1 years) whereas the lowest value was noted in Akmola and Karagandy regions (70.4 years).

In the period 1999-2000 among the second group of regions female life expectancy at birth was above national in Almaty, South Kazakhstan, and West Kazakhstan regions. Kyzylorda, Atyrau, Mangystau, Aktobe regions had below national female life expectancy at birth in the observed period. Compared to the first group of regions (except Astana and Almaty cities) the second group regions had more rapid increase of the level over time. Particularly, it concerned

Atyrau, Mangystau, and Aktobe regions (see Figure 7d). The slowest increase was noted in Almaty region. Between the periods 1999-2000 and 2007-2008 the level increased in all observed regions with the biggest increase in Aktobe and Atyrau regions (2.8 and 2.7 years respectively). In the period 2007-2008 above national female life expectancy at birth was observed in West Kazakhstan, Aktobe, Atyrau, and Zhambyl regions. Kyzylorda, Almaty, and Mangystau regions had below national female life expectancy at birth with the lowest value for Kyzylorda (70.8 years).

Figure 7c − Life expectancy at birth, 1999-2008, the first group of regions, females

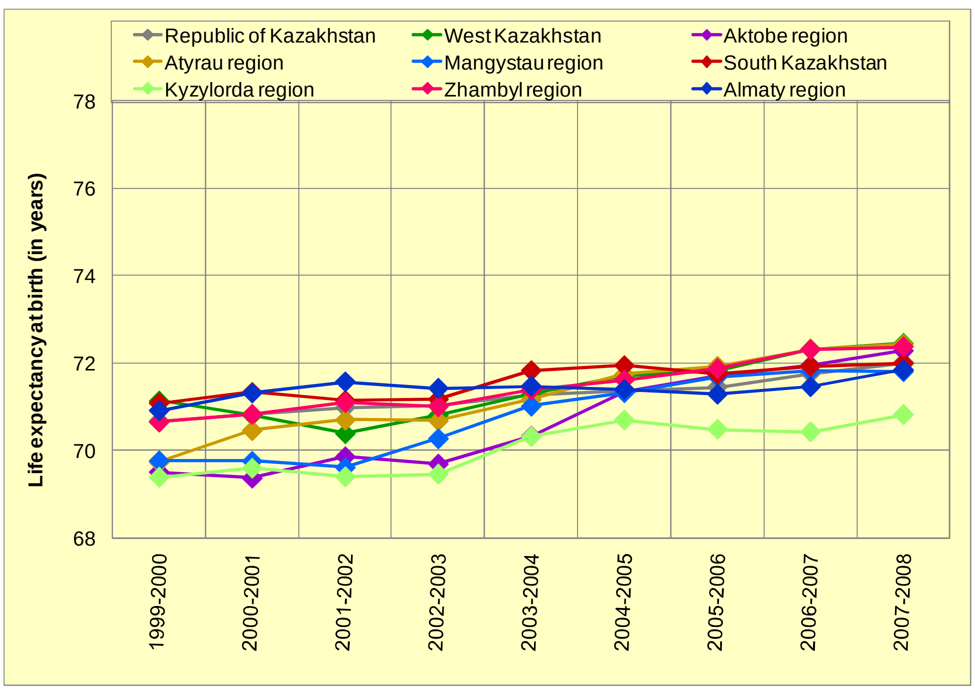


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 below national female life expectancy at birth was noted in all northern, central, eastern regions, western regions Atyrau, Aktobe, Mangystau, and southern region Kyzylorda. West Kazakhstan, South Kazakhstan, Zhambyl, Almaty regions, Astana, Almaty cities indicated the above national level. Between the periods 1999-2000 and 2007-2008 the level in the country as well as all regions increased with the biggest increase in Astana city. In the period 2007-2008 above national female life expectancy at birth was found in Astana, Almaty cities, and northern region Pavlodar, southern region Zhambyl, western regions Atyrau, Aktobe, West Kazakhstan with the highest level in Astana city. Central, eastern regions, northern regions North Kazakhstan, Kostanai, western region Mangystau, southern regions Kyzylorda, Almaty demonstrated below national level with the lowest values in Akmola and Karagandy regions in the observed period. South Kazakhstan region had the value equal to national one. Aktobe, Atyrau, and Pavlodar regions indicated the above national level while Almaty region demonstrated the below national one in the period 2007-2008 apart from 1999-2000 which was related to their level of increase.

The rapid increase of life expectancy at birth for both sexes was noted in Astana, Almaty cities, and western oil-extracting regions which would be explained by their comparatively rapid socio-economic development. The observed period was considered as the period of economic growth in the country which was mainly related to oil boom (see chapter 7.2). This boom promoted mainly the development of western regions. Astana and Almaty are considered to be favourable even from the earlier periods (Becker and Urzhumova, 2005). The favourable environment, high-paid and perspective work places in oil extracting regions and municipal cities could involve highly educated persons more than other regions. Therefore, their proportion increased mainly in these regions in the observed period. Along with the fact that the increase of highly educated population is the indicator of economic development, highly educated persons promote the improvement of mortality level through acquisition of knowledge regarding health damaging behaviour (Spijker, 2004). It is worth to note that Astana as the new capital overcame Almaty city with the more rapid increase of life expectancy at birth for both sexes over observed time.

Figure 7d − Life expectancy at birth, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

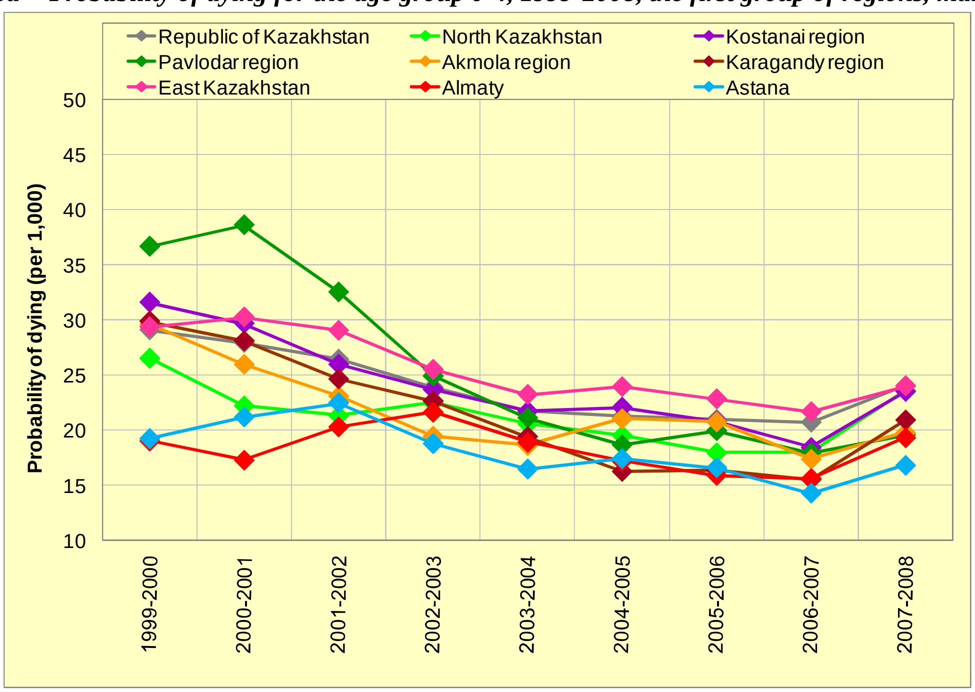
9.2 Trends of mortality level by age groups

Mortality level by age groups will be analyzed through probability of dying for the definite age group. Examined age groups were defined in the result of factor analysis (see Chapter 6.3.1).

9.2.1 Age group 0-4

In the period 1999-2000 male mortality level in age group 0-4 was 29.1 deaths per 1,000 in the country. Among the first group of regions male mortality level in age group 0-4 was above national in Pavlodar, Kostanai, Karagandy, and Akmola regions with highest level in Pavlodar (36.7 per 1,000). The below national male mortality level was observed in Astana, Almaty cities, and North Kazakhstan region with the lowest value in Almaty (19.0 per 1,000). All regions as well as the country had the decrease of level over time with the rapid decrease in Pavlodar region (see Figure 8a). The increase of the level in the country as well as the regions was noted in the period 2007-2008. Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 29.1 to 24.0 deaths per 1,000. The regions except Almaty city also decreased the level with the above national decrease in Kostanai, Pavlodar, Akmola, Karagandy, East Kazakhstan regions. The below national decrease was noted in North Kazakhstan region and Astana city. Almaty city increased the level slightly from 19.0 to 19.3 deaths per 1,000 between two periods. In the period 2007-2008 all regions demonstrated the below national male mortality level with the lowest value in Astana city (16.8 per 1,000). East Kazakhstan region had the equal level with national one in the observed period (24.0 per 1,000).

Figure 8a − Probability of dying for the age group 0-4, 1999-2008, the first group of regions, males

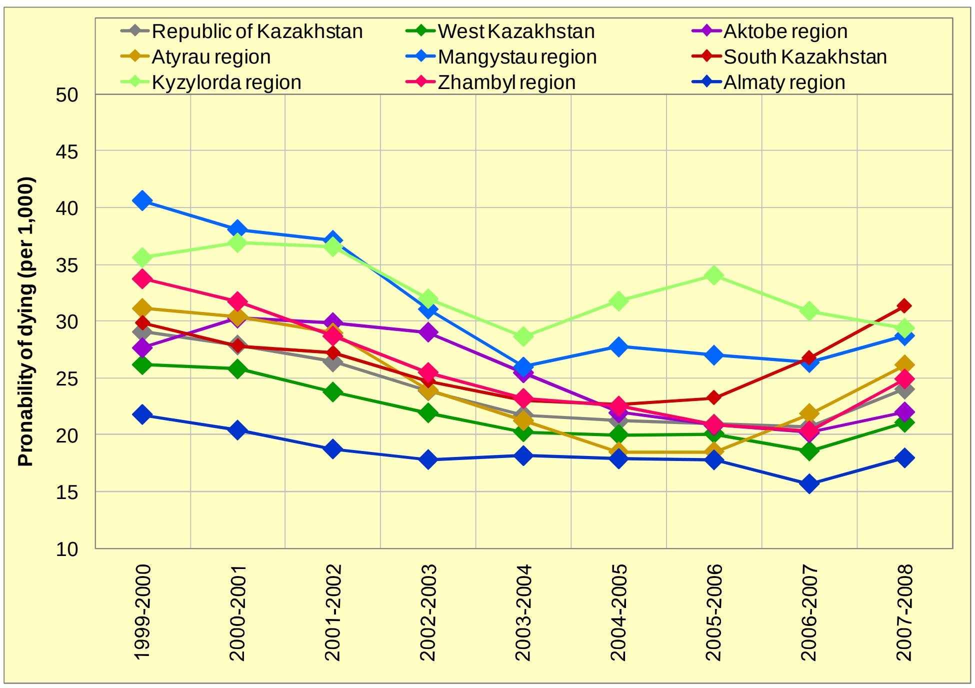


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Among the second group of regions male mortality level was above national in Mangystau, Atyrau, Kyzylorda, Zhambyl and South Kazakhstan regions with the highest value in Mangystau (40.6 per 1,000) while Almaty, Aktobe, West Kazakhstan regions had the below national level with the lowest value in Almaty (21.8 per 1,000) in the period 1999-2000. All regions were decreasing the level over time with the slight increase in the period 2007-2008 as it was observed for the first group of regions (see Figure 8b). It is worth to note that South Kazakhstan region was increasing the level from the period 2004-2005 apart from other regions. Between the periods 1999-2000 and 2007-2008 the level decreased in all regions of the second group except South Kazakhstan. South Kazakhstan region increased the level from 29.8 to 31.3 deaths per 1,000. The above national decrease was noted in Aktobe, Mangystau, Kyzylorda, Zhambyl, Almaty regions.

West Kazakhstan region indicated the decrease equal to national one (5.1 per 1,000) while the decrease in Atyrau region was slightly lower (5.0 per 1,000). In the period 2007-2008 male mortality level in the observed age group was above national in South Kazakhstan, Zhambyl, Kyzylorda, Atyrau, Mangystau regions as it was observed in the period 1999-2000. However, the highest level in Mangystau region in the period 1999-2000 was replaced by South Kazakhstan (31.3 per 1,000) in the period 2007-2008 which was related to level increase in South Kazakhstan and the biggest decrease of level in Mangystau. The below national level was observed in West Kazakhstan, Aktobe, and Almaty regions with the lowest value in Almaty (18.0 per 1,000) as it was observed in the period 1999-2000.

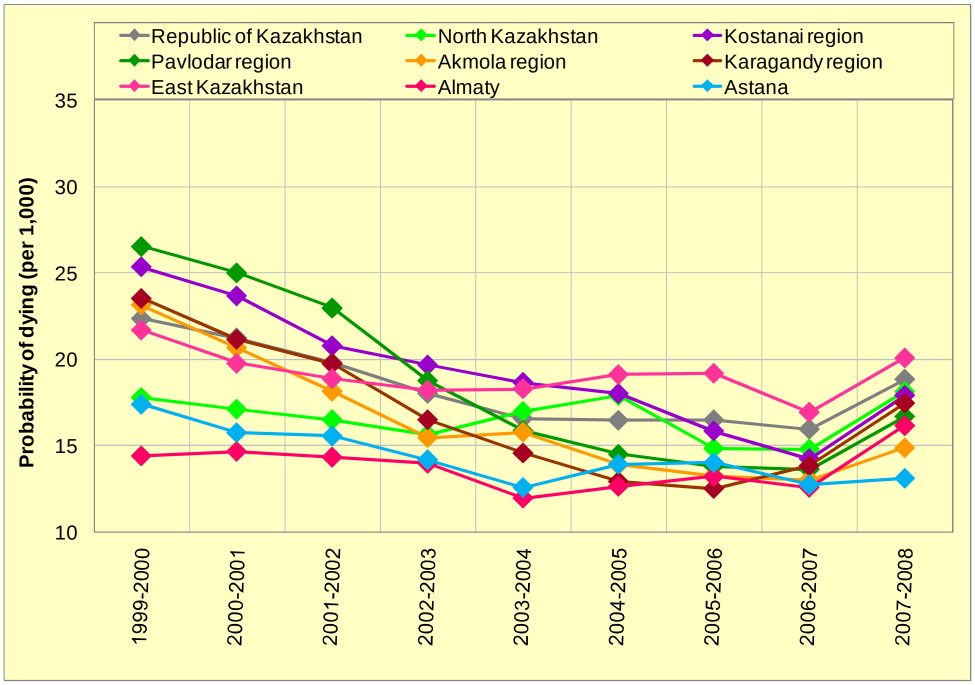
Figure 8b − Probability of dying for the age group 0-4, 1999-2008, the second group of regions, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 male mortality level was above national in central, eastern regions, northern regions Kostanai, Pavlodar, western regions Atyrau, Mangystau, southern regions South Kazakhstan, Kyzylorda, Zhambyl regions with the highest level in Mangystau region. The below national male mortality level was observed in Astana, Almaty cities, northern region North Kazakhstan, western regions West Kazakhstan, Aktobe, and southern region Almaty with the lowest level in Astana and Almaty cities. The country as well as the regions except South Kazakhstan region and Almaty city observed the decrease of the level between the periods 1999-2000 and 2007-2008 with the greatest decreases in the regions with the highest values. South Kazakhstan region and Almaty city increased the level with the slight increase in Almaty city. In the period 2007-2008 the above national male mortality level was found in western regions Atyrau, Mangystau, and southern regions South Kazakhstan Zhambyl, Kyzylorda.

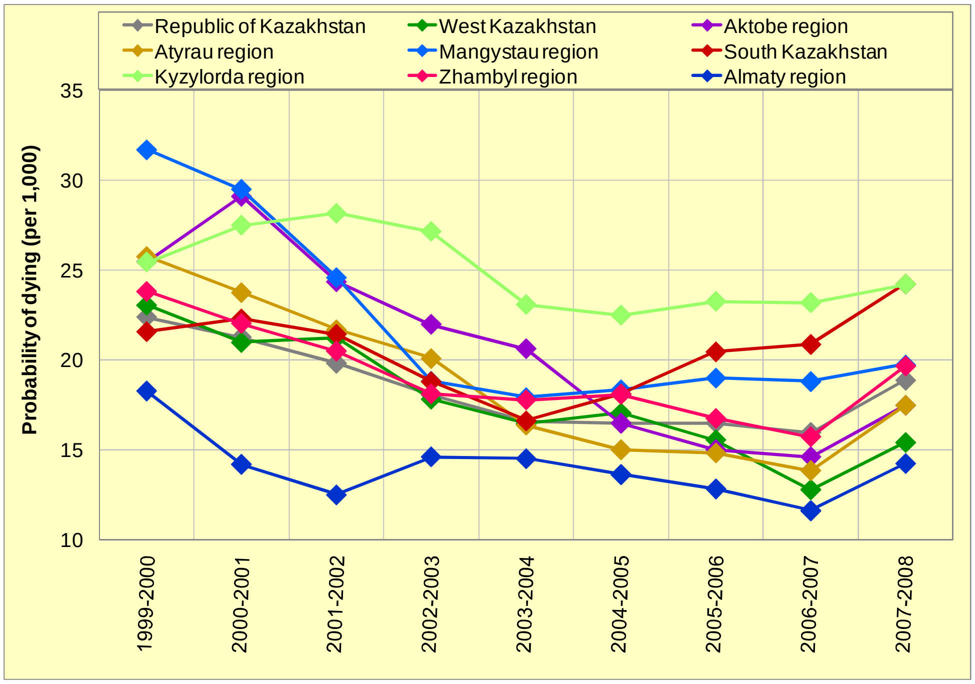
Figure 8c − Probability of dying for the age group 0-4, 1999-2008, the first group of regions, females



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality level in age group 0-4 was lower than that of males in the country (22.4 per 1,000) in the period 1999-2000. Among the first group of regions female mortality level was above national in Kostanai, Pavlodar, Akmola, Karagandy regions with the highest value in Pavlodar (26.5 per 1,000) while it was below national in North Kazakhstan, East Kazakhstan regions, and Almaty, Astana cities with the lowest value in Almaty city (14.4 per 1,000). All observed regions had the decrease of level over time with more rapid decrease in the regions with the higher values (see Figure 8c). However, East Kazakhstan region slowly increasing the level from the period 2002-2003 indicated the highest level from the period 2004-2005 among the regions. In the period 2007-2008 the slight increase was observed in the regions as well as the country. Between the periods 1999-2000 and 2007-2008 the level in the country decreased from 22.4 to 18.8 deaths per 1,000. The regions except North Kazakhstan region and Almaty city had the decrease of level. North Kazakhstan region and Almaty city slightly increased the level between two periods (0.3 and 1.7 per 1,000 respectively). The above national improvement was noted in Kostanai, Pavlodar, Akmola, Karagandy regions, and Astana city with the biggest decrease in Pavlodar (9.8 per 1,000) while East Kazakhstan region indicated the below national decrease (1.6 per 1,000). In the period 2007-2008 female mortality level was above national only in East Kazakhstan region (20.1 per 1,000). Other regions indicated the below national level with the lowest value in Astana city (13.1 per 1,000). It is worth to note that the regions with above national level in the period 1999-2000 indicated the below national level in the period 2007-2008 thanks to above national improvement of level in the regions. Almaty city with the lowest level in the period 1999-2000 was replaced by Astana city in the period 2007-2008 because of level increase in Almaty city between two periods.

Figure 8d − Probability of dying for the age group 0-4, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Among the second group of regions in the period 1999-2000 female mortality level was above national in all western regions, and southern regions Kyzylorda, Zhambyl with the highest value in Mangystau (31.7 per 1,000). South Kazakhstan (21.6 per 1,000) and Almaty (18.2 per 1,000) regions had the below national level in the observed period. In the following periods the regions had the trend of decrease over time with the rapid decrease in Mangystau (see Figure 8d).

South Kazakhstan region indicated the gradual increase from the period 2003-2004 apart from other regions. Between the periods 1999-2000 and 2007-2008 the level increased only in South Kazakhstan region (2.6 per 1,000). The below national decrease was noted in Kyzylorda region (1.2 per 1,000) among the regions. In the period 2007-2008 female mortality level was above national in South Kazakhstan, Kyzylorda, Zhambyl, and Mangystau regions with the highest value in South Kazakhstan and Kyzylorda (24.2 per 1,000) while West Kazakhstan, Aktobe, Atyrau, Almaty regions demonstrated the below national level with the lowest value in Almaty (14.2 per 1,000). It is worth to note that West Kazakhstan, Aktobe, Atyrau regions with the above national level in the period 1999-2000 demonstrated the below national level in the period 2007-2008 thanks to above national improvement of level in the regions.

As a result, in the period 1999-2000 female mortality level in age group 0-4 was above national in northern regions Kostanai, Pavlodar, southern regions Kyzylorda, Zhambyl, and all central, western regions with the highest value in Mangystau while it was below national in North Kazakhstan, East Kazakhstan, South Kazakhstan, and Almaty regions with the lowest value in Almaty city. Between the periods 1999-2000 and 2007-2008 the country as well as the most of regions decreased the level with the biggest decrease in Mangystau. The level increased in North Kazakhstan, South Kazakhstan regions, and Almaty city between two periods. In the period 2007-2008 the above national level was observed in eastern region East Kazakhstan, western region Mangystau, and southern regions South Kazakhstan, Kyzylorda, Zhambyl. Kostanai, Pavlodar, Akmola, Karagandy, West Kazakhstan, Aktobe, Atyrau regions with the above national level in the period 1999-2000 indicated the below national level in the period 2007-2008 thanks to above national improvement of level in the regions. South Kazakhstan and East Kazakhstan regions with below national level in the period 1999-2000 demonstrated the above national level in the period 2007-2008 which was related to below national improvement in East Kazakhstan and the increase of level in South Kazakhstan.

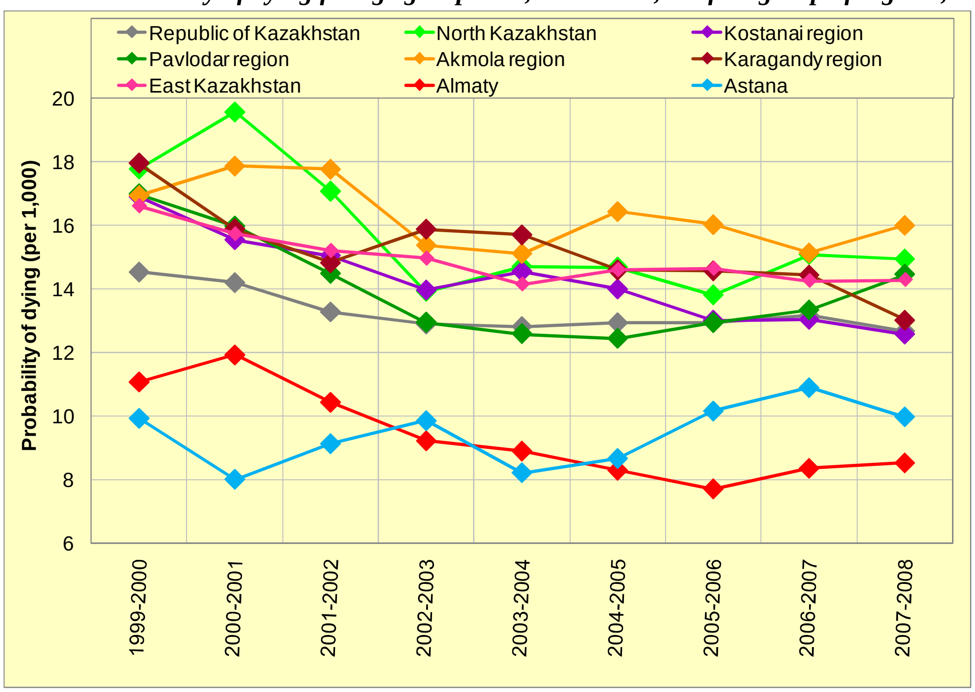
Mortality level in age group 0-4 improved for both sexes in the country as well as the most of regions between the periods 1999-2000 and 2007-2008. This improvement would be related to socio-economic improvement in the regions linked with the economic growth as mainly this age group is considered to be sensitive to socio-economic conditions. However, South Kazakhstan region and Almaty city increased the level for both sexes. The increase was slight for Almaty city and its level was lowest among all regions in the period 1999-2000. South Kazakhstan region indicated the above national level for both sexes in the period 2007-2008. It was documented that in agricultural Central Asian countries including Kazakhstan (South Kazakhstan is the agricultural region with the higher proportion of rural population) poverty, reduced healthcare combined with environmental degradation were the main explanatory indicators of high child mortality (Franz and FitzRoy, 2006). The above national mortality level in age group 0-4 for both sexes and its further increase over time in South Kazakhstan region would be related to abovementioned factors.

Western regions especially Mangystau with the highest level in the period 1999-2000 had the biggest improvement of mortality level for both sexes which would be related to comparatively rapid socio-economic development in the region.

9.2.2 Age group 5-19

Mortality level in age group 5-19 was the lowest for both sexes compared to other observed age groups in the country as well as its regions. The evidence is related to the fact that this age group is the least risky compared to other ones. In the period 1999-2000 male mortality level was 14.5 deaths per 1,000 in the country. Among the first group of regions male mortality level was below national in Almaty and Astana cities while northern, central and eastern regions observed the above national level with the highest value in Karagandy (18.0 per 1,000). In this age group male mortality level was not significantly decreasing in the regions as it was observed for age group 0-4 (see Figure 9a). However, the country as well as the regions except Astana city observed somehow decrease with the fluctuation over time in North Kazakhstan, Kostanai, Akmola, Karagandy regions. Pavlodar region observing the slow decrease over time indicated the slow increase from the period 2004-2005. Between the periods 1999-2000 and 2007-2008 Astana city observed the slight increase (from 10.0 to 9.9 per 1,000) of level while the country (from 14.5 to 12.7 per 1,000) as well as other regions indicated the improvement. The below national decrease was noted only in Akmola region (0.9 per 1,000) while the biggest decrease was noted in Kostanai and Karagandy (4.3 and 4.9 per 1,000 respectively). In the period 2007-2008 the level in country was 12.7 per 1,000. The highest value was noted in Akmola (16.0 per 1,000) among the regions with above national level in the observed period. Almaty city had the lowest level of male mortality among the regions (8.5 per 1,000) in the observed period gradually decreasing it over time.

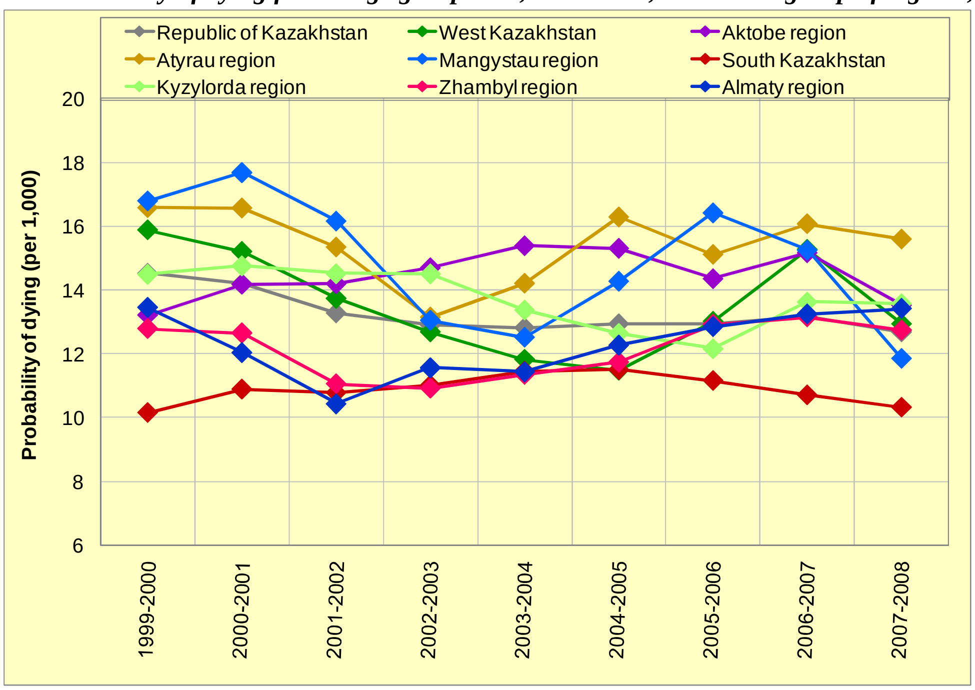
Figure 9a − Probability of dying for age group 5-19, 1999-2008, the first group of regions, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 among the second group of regions male mortality level was above national in West Kazakhstan, Atyrau, Mangystau regions while other regions observed the below national level with the lowest value in South Kazakhstan (10.1 per 1,000). The trend of level did not observe the visible decrease in the regions indicating in Atyrau and Mangystau regions the strong fluctuation over time (see Figure 9b). Almaty and Zhambyl regions decreased the level between the periods 1999-2000 and 2001-2002 with the following slow increase over time. Kyzylorda region indicated the gradual decrease between the periods 1999-2000 and 2005-2006 with the following slow increase. In the period 2007-2008 male mortality level was above national in Aktobe, Atyrau, Zhambyl, Almaty regions while other regions demonstrated the below national level. Among the regions Aktobe (from 13.2 to 13.5 per 1,000) and South Kazakhstan (from 10.1 to 10.3 per 1,000) regions indicated the slight increase of the level in the period 2007-2008 compared to 1999-2000. West Kazakhstan, Atyrau, Mangystau, and Kyzylorda regions had the decrease of level. Zhambyl and Almaty regions did not observe any change between two periods. In the period 2007-2008 West Kazakhstan, Aktobe, Atyrau, Kyzylorda, Almaty regions demonstrated the above national level with the highest value in Atyrau (15.6 per 1,000). Mangystau, South Kazakhstan, and Zhambyl regions indicated the below national level with the lowest value in South Kazakhstan (10.3 per 1,000).

Figure 9b − Probability of dying for the age group 5-19, 1999-2008, the second group of regions, males



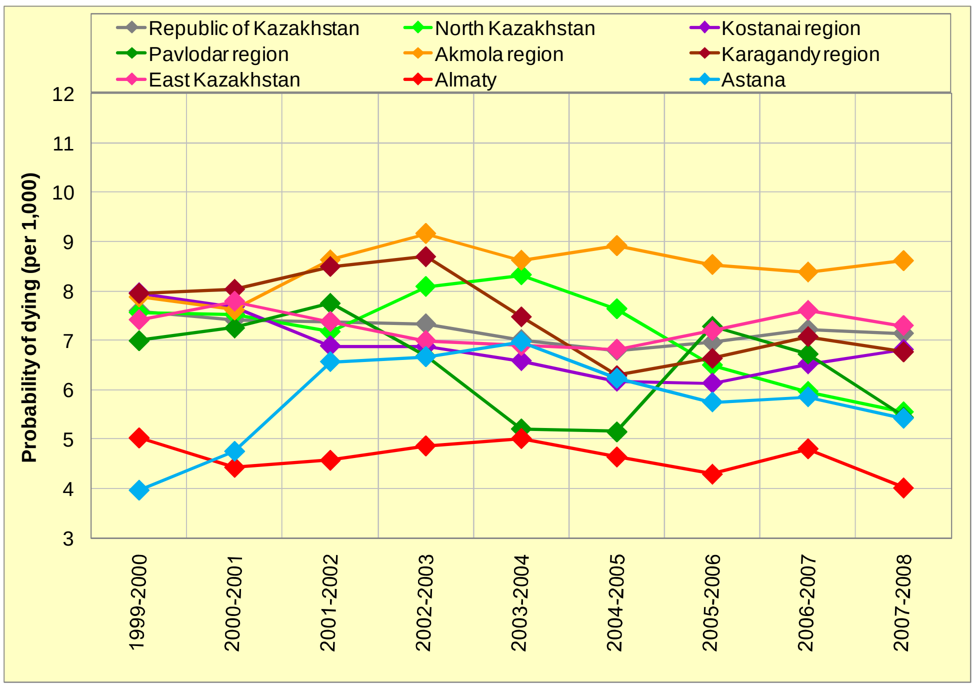
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 male mortality level was above national in all northern, central, eastern regions, and western regions West Kazakhstan, Atyrau, Mangystau with the highest level in central region Karagandy. The below national level was observed in all southern regions, western region Aktobe and Astana, Almaty cities with the lowest level in Astana city. Between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as the regions except Aktobe, South Kazakhstan regions, and Astana city. The biggest decrease was noted in Karagandy and Mangystau regions. In the period 2007-2008 the level of mortality was above national in central, eastern regions, northern regions Pavlodar, North Kazakhstan, western regions West Kazakhstan, Aktobe, Atyrau, and southern regions Kyzylorda and Almaty. The lowest level was noted in Almaty city among the regions with below national level.

In the period 1999-2000 female mortality level in age group 5-19 was even lower than that of males in the country (7.6 per 1,000). Among the regions of first group Kostanai, Akmola, Karagandy indicated the above national level while other regions demonstrated the below national one. The country was slowly decreasing the level between the periods 1999-2000 and 2004-2005 with the following slow increase (see Figure 9c). Among the regions Pavlodar observed more strong fluctuating trend and decreased the level in the period 2007-2008 compared to 1999-2000 (from 7.0 to 5.4 per 1,000). Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 7.6 to 7.1 per 1,000.The above national decrease was noted in North Kazakhstan, Kostanai, Pavlodar, Karagandy regions, and Almaty city. The below national decrease was observed only in East Kazakhstan region (for 0.1 deaths). The increase of level was found in Akmola region and Astana city (0.7 and 1.5 deaths per 1,000 respectively).

In the period 2007-2008 the above national level was noted in Akmola and East Kazakhstan regions while other regions indicated the below national level with the lowest one in Almaty city (4.0 per 1,000). It is worth to note that Kostanai, Karagandy regions with the above national level in the period 1999-2000 indicated the below national level in the period 2007-2008 thanks to above national decrease of level in the regions.

Figure 9c − Probability of dying for the age group 5-19, 1999-2008, the first group of regions, females

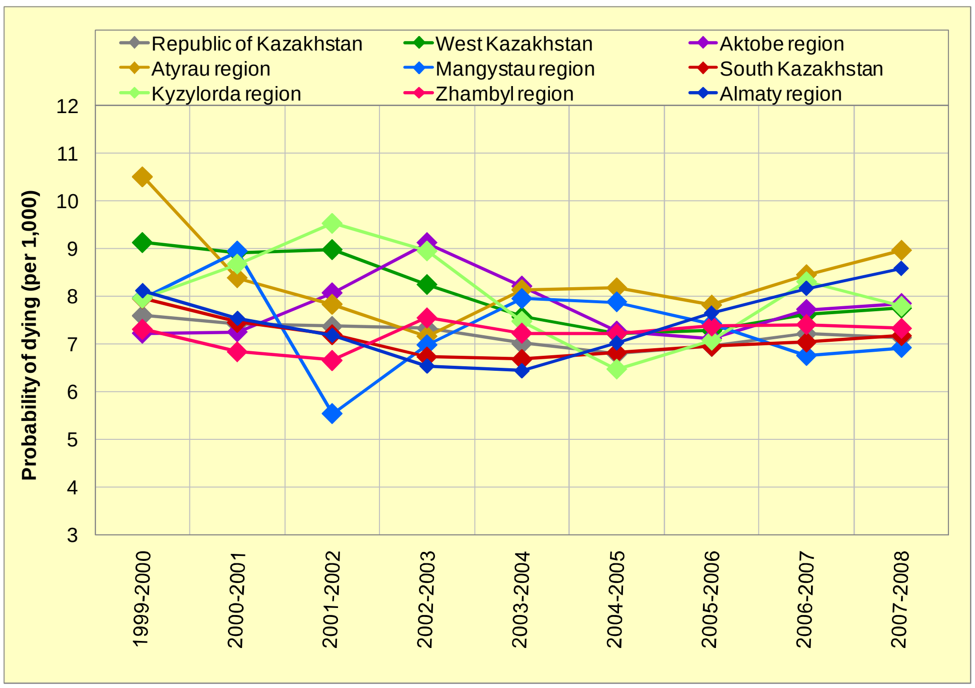


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Among the second group of regions the level was above national in West Kazakhstan, Atyrau, Mangystau, South Kazakhstan, Kyzylorda, and Almaty regions with the highest value in Atyrau region (10.5 per 1,000) while Aktobe and Zhambyl regions indicated the below national level. In the following periods Atyrau region with the highest level was rapidly decreasing it between the periods 1999-2000 and 2002-2003 with the following fluctuating slow increase (see Figure 9d). Mangystau region demonstrated the strong fluctuation sharply decreasing the trend in the period 2000-2001 with the gradual increase in the following periods. The sharp fluctuation would be related to very low level of mortality in observed age group which makes the little change more fluctuated. Almaty region was slowly decreasing the level between the periods 1999-2000 and 2003-2004 with the following more rapid increase while West Kazakhstan indicated the rapid decrease between the periods 1999-2000 and 2004-2005 with the following very slow increase.

Between the periods 1999-2000 and 2007-2008 the level increased in Aktobe and Almaty (06 and 0.5 per 1,000) regions while Zhambyl did not change the level. Other regions indicated the decrease of level with the below national decrease in Kyzylorda (0.2 per 1,000). West Kazakhstan and Atyrau (1.4 and 1.5 per 1,000) regions indicated the biggest decrease among the regions with above national improvement. In the period 2007-2008 the level was below national only in Mangystau region (6.9 per 1,000) while other regions indicated the above national level with the highest value in Atyrau (9.0 per 1,000).

Figure 9d − Probability of dying for the age group 5-19, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 female mortality level in age group 5-19 was above national in central regions, northern region Kostanai, western regions Atyrau, Mangystau, West Kazakhstan, southern regions South Kazakhstan, Kyzylorda, Almaty. Other regions indicated the below national level with the lowest values in Astana and Almaty cities. Between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as in most of regions with the biggest decrease in North Kazakhstan. The level increased in Akmola, Aktobe, Almaty regions, and Astana city while Zhambyl region did not change the level. In the period 2007-2008 the above national level was observed in southern, eastern regions, western regions Atyrau, West

Kazakhstan, Aktobe, central region Akmola with the highest value Atyrau. Other regions demonstrated the below national level with the lowest value in Almaty city.

As it was mentioned above the level of mortality for both sexes was lowest in the observed age group with quite lower level for females. The explanation of regional mortality trend would be possible through examination of mortality from external causes as this cause was considered to be leading for this age group.

9.2.3 Age group 20-64

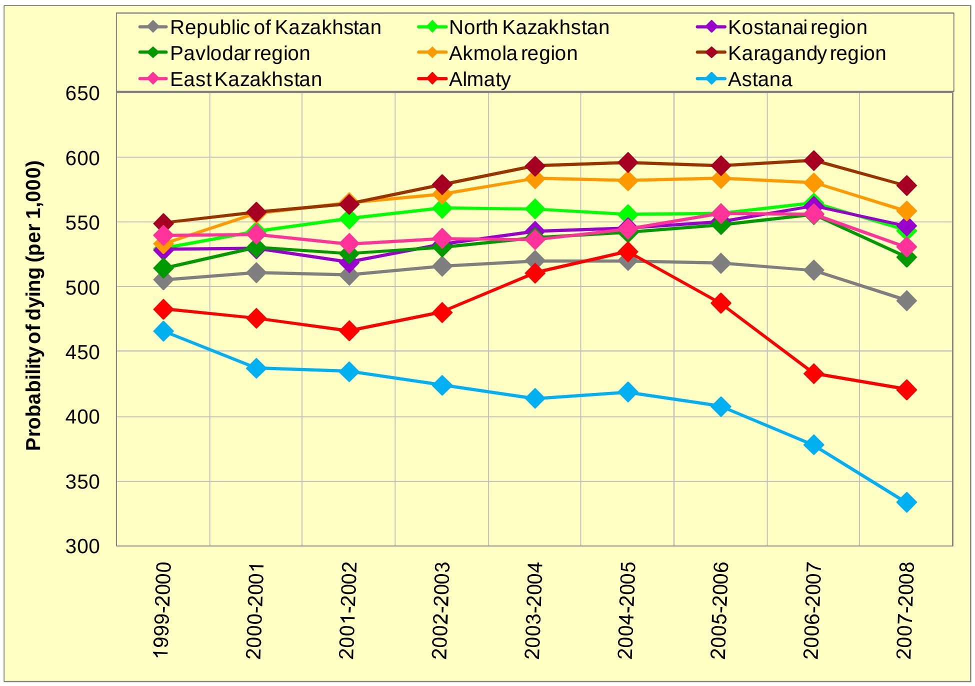
In the period 1999-2000 male mortality level in age group 20-64 was 505.5 per 1,000 in the country. Among the first group of regions male mortality level was below national in Astana and Almaty cities while northern, central, eastern regions demonstrated the above national level (see Figure 10a). In the following periods the level was slowly increasing with the slight decrease in the period 2007-2008 in the regions except Astana and Almaty cities. The municipal cities demonstrated the decrease over time with the fluctuation in Almaty city. The evidence indicated that the trend of male life expectancy at birth was partly influenced by the trend of male mortality level in observed age group. Between the periods 1999-2000 and 2007-2008 the level increased in central, northern regions with the biggest increase in Karagandy region (from 549.1 to 578.4 per 1,000). It is worth to note that this region had the highest level among all regions over observed time. The improvement of level was noted in Astana, Almaty cities, and East Kazakhstan region with the biggest decrease in Astana city (from 466.0 to 333.4 per 1,000). In the period 2007-2008 male mortality level was above and below national in the same regions as it was observed in the period 1999-2000 with the highest value in Karagandy region (578.4 per 1,000) and the lowest value in Astana city (333.4 per 1,000).

In the period 1999-2000 among the second group of regions western regions had the above national level with the highest value in Atyrau (551.3 per 1,000) while southern regions demonstrated the below national level with the lowest value in South Kazakhstan (431.8 per 1,000) (see Figure 10b). However, the following periods were more successful for western regions compared to favourable southern ones. Southern regions indicated the somehow stable trend with the slight decrease in the period 2007-2008. However, Almaty region had the trend of level increase between the periods 2001-2002 and 2006-2007 with the slight decrease in the period 2007-2008.Western regions demonstrated the trend of decrease over observed period.

Between the periods 1999-2000 and 2007-2008 Almaty region indicated the increase of level (from 464.0 to 474.3 per 1,000) while other regions observed the decrease with the biggest one in Atyrau (from 551.3 to 478.7 per 1,000) and Mangystau (from 508.8 to 448.4 per 1,000). In the period 2007-2008 West Kazakhstan and Aktobe regions demonstrated the above national level (498.8 and 496.4 per 1,000 respectively) while other regions indicated the below national level with the lowest value in South Kazakhstan (418.7 per 1,000). It is worth to underline that Atyrau and Mangystau regions with the above national level in the period 1999-2000 indicated the below national level in the period 2007-2008 thanks to rapid decrease of level in the regions.

As a result, in the period 1999-2000 male mortality level in age group 20-64 was above national in northern, central, eastern, and western regions while it was below national in southern regions, and Astana, Almaty cities. Between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as western, eastern regions, southern regions South Kazakhstan, Zhambyl, Kyzylorda, and Astana, Almaty cities with the biggest decrease in Astana. The level increased in northern, central regions, and southern Almaty region. In the period 2007-2008 the above national level was kept in northern, central, eastern regions, and western regions West Kazakhstan, Aktobe. The below national level was observed in the same regions including western regions Atyrau and Mangystau.

Figure 10a − Probability of dying for the age group 20-64, 1999-2008, the first group of regions, males



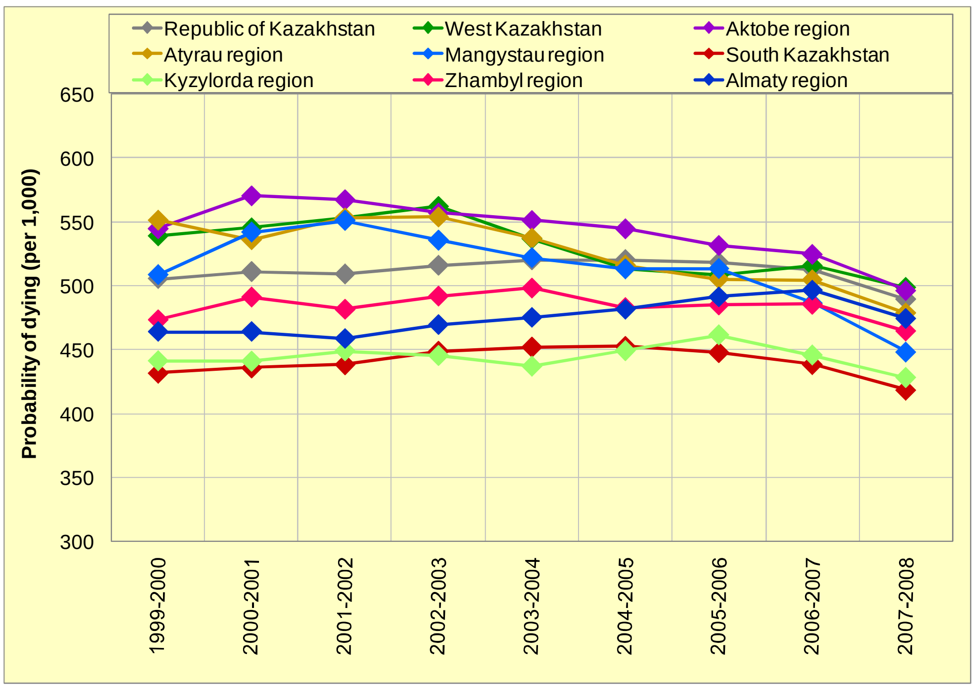
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The evidence indicated that among all regions Astana, Almaty cities, and western regions could substantially improve the level over observed period. The evidence and explanation is very similar to male life expectancy at birth development across regions. Oil extracting western regions along with the most favourable Astana and Almaty cities could improve the level which would be related to their more rapid socio-economic development. Regions of other parts had somehow stable trend even with increasing the level in northern, central regions, and southern region Almaty. The highest level was kept in industrial Karagandy region among all regions which was considered to be the ecologically unfavorable industrial center from the Soviet period (see Chapter 7.3).

Female mortality level in observed age group was twice lower than that of males in the country (236.4 per 1,000) in the period 1999-2000. Among the first group of regions female mortality level was quite lower than national one in Astana and Almaty cities (208.0 and 200.1

per 1,000 respectively) (see Figure 10c). The above national level was observed in Karagandy, Akmola, North Kazakhstan, and East Kazakhstan regions. Kostanai and Pavlodar regions indicated the slightly lower level than national one (234.3 and 232.7 per 1,000 respectively). In the following periods the country had the stable trend with the slow decrease of level from the period 2003-2004. Akmola, Karagandy, and North Kazakhstan regions with the highest values had the slow increases over time with the slight decrease in the period 2007-2008. Kostanai, East Kazakhstan, and Pavlodar regions with the very close level to national one indicated the slow increase from the period 2003-2004 in East Kazakhstan and Pavlodar, from the period 2002-2003 in Kostanai. From the period 2005-2006 the level was slowly decreasing in the regions. The gradual decrease of the level was noted in Astana (from 208.0 to 144.7 per 1,000) and Almaty (from 200.1 to 160.4 per 1,000) cities with more rapid decrease in Astana city.

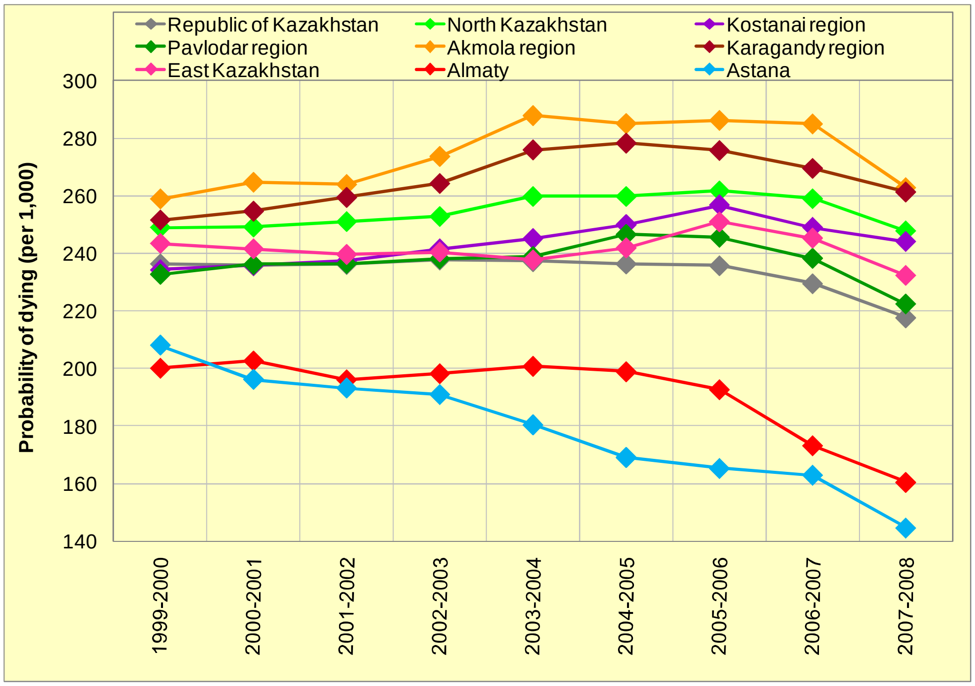
Figure 10b − Probability of dying for the age group 20-64, 1999-2008, the second group of regions, males



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Between the periods 1999-2000 and 2007-2008 female mortality level decreased in the country from 236.4 to 217.7 deaths per 1,000. The above national decrease was noted in Astana, Almaty cities while North Kazakhstan, Pavlodar, and East Kazakhstan regions indicated the below national decrease. The level increased in Kostanai, Akmola, and Karagandy regions with the biggest increase in Kostanai (from 234.3 to 244.1 per 1,000) and Karagandy (from 251.6 to 261.3 per 1,000). In the period 2007-2008 female mortality level was below national in Astana and Almaty cities while other observed regions demonstrated the above national level with the highest one in Akmola and Karagandy (262.8 and 261.3 per 1,000 respectively). It is worth to note that Kostanai and Pavlodar regions with the below national level in the period 1999-2000 demonstrated the above national level in the period 2007-2008 because of level increase in Kostanai and below national decrease of level in Pavlodar.

Figure 10c − Probability of dying for the age group 20-64, 1999-2008, the first group of regions, females



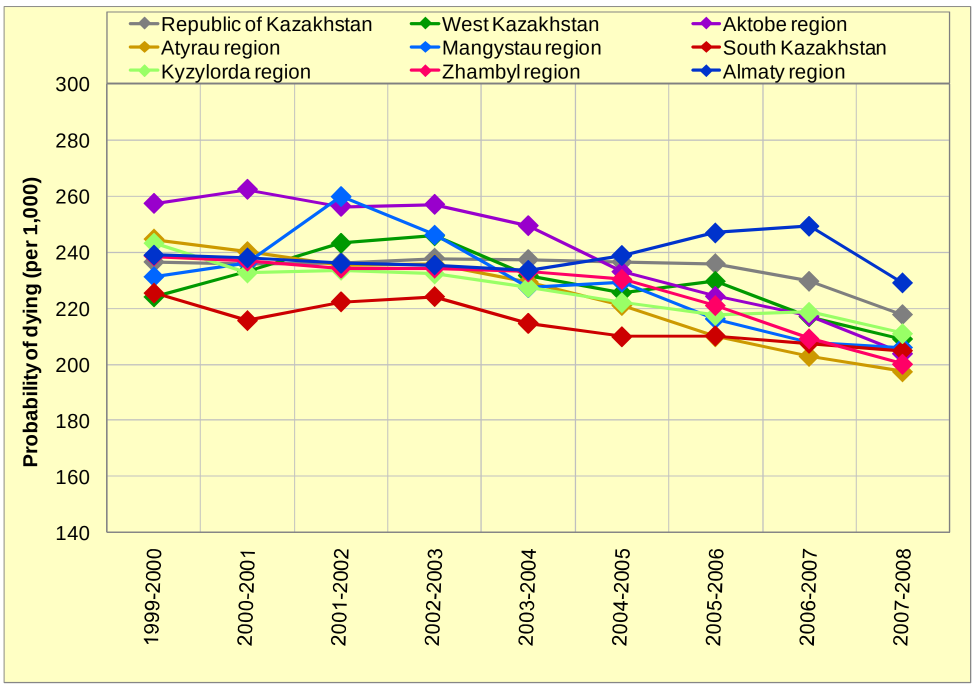
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Among the second group of regions in the period 1999-2000 female mortality level was above national in Aktobe, Atyrau, Kyzylorda, Zhambyl, and Almaty regions while West Kazakhstan, Mangystau, and South Kazakhstan regions indicated the below national level with the lowest value in West Kazakhstan (224.0 per 1,000). Apart from the first group of regions the regions of the second group observed the decrease of the level over time with fluctuation in Mangystau region (see Figure 10d). The region had the increase of level between the periods 2000-2001 and 2001-2002 with the following rapid decrease over time. Among the regions Almaty had the increase of level from the period 2003-2004 with the decrease in the period 2007-2008. Between the periods 1999-2000 and 2007-2008 the level decreased in all observed regions with the below national decrease in West Kazakhstan and Almaty. Other regions indicated the above national decrease. Aktobe region with the highest value for level indicated the biggest decrease (53.4 per 1,000). In the period 2007-2008 the level was above national in Almaty region whereas other regions demonstrated the below national level with the lowest value in Atyrau (197.4 per 1,000).

As a result, in the period 1999-2000 female mortality level was above national in central, eastern regions, northern region North Kazakhstan, western regions Aktobe, Atyrau, and southern regions Kyzylorda, Zhambyl, Almaty with the highest values in Akmola and Aktobe regions. Other regions indicated the below national level with the lowest value in Astana and Almaty cities. Between the periods 1999-2000 and 2007-2008 the increase of level was observed in central regions and northern region Kostanai. The biggest decrease was noted in Astana city and Atyrau region among the regions with the level improvement. In the period 2007-2008 the above national level was observed in central, northern, eastern regions, and southern region Almaty. Western regions, southern regions South Kazakhstan, Zhambyl, Kyzylorda, and municipal cities Astana and Almaty indicated the below national level with the lowest value in Astana city.

The evidence demonstrated that western and southern regions, Astana and Almaty cities could improve the level substantially and some of them indicated the below national level in the period 2007-2008 apart from 1999-2000. The rapid improvement of female mortality level in Astana, Almaty cities, and western regions would be the result of rapid socio-economic development in the regions as it was explained for males. Northern, central, and eastern regions indicated the higher mortality level in both periods. Between two periods some regions of these parts even indicated the increase of level.

Figure 10d − Probability of dying for the age group 20-64, 1999-2008, the second group of regions, females

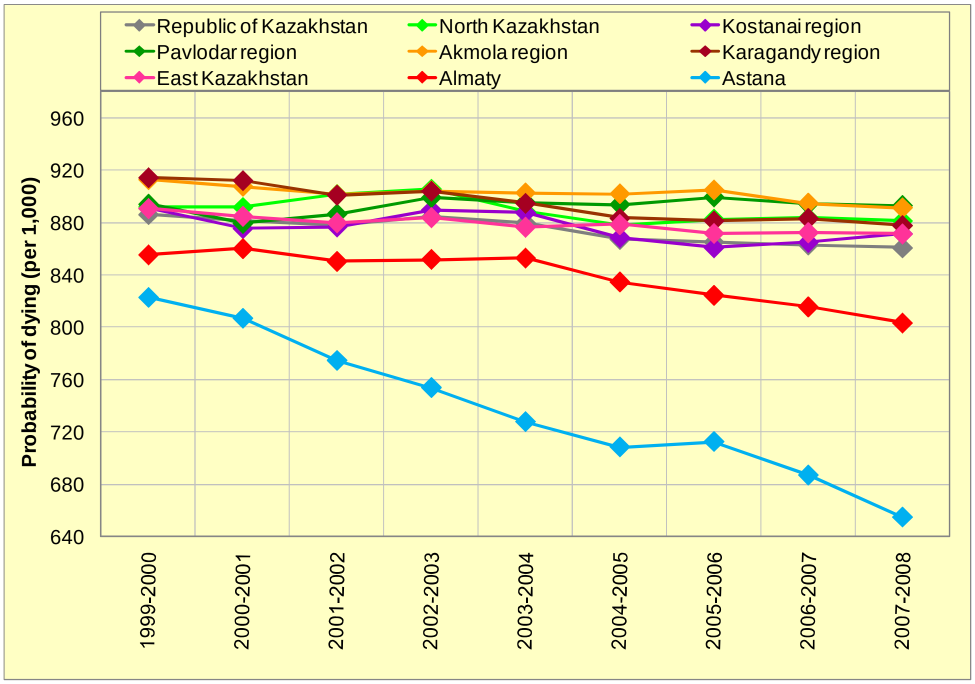


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstam*

9.2.4 Age group 65-84

In the period 1999-2000 male mortality level in age group 65-84 was 886.3 per 1,000 in the country. The level of the first group of regions was very close to national one except Astana and Almaty cities. Even it is not possible to notice the national level among the regions (see Figure 11a). In the period 1999-2000 these northern, central, eastern regions had above national level with the highest values in Karagandy (914.4 per 1,000) and Akmola (912.6 per 1,000) regions while Astana and Almaty cities indicated the below national level (822.8 and 855.2 per 1,000 respectively). The trend was somehow stable with the invisible decrease of level in the regions except municipal cities. Astana city rapidly decreased the level over time while Almaty city indicated much slower decrease.

Figure 11a − Probability of dying for the age group 65-84, 1999-2008, the first group of regions, males



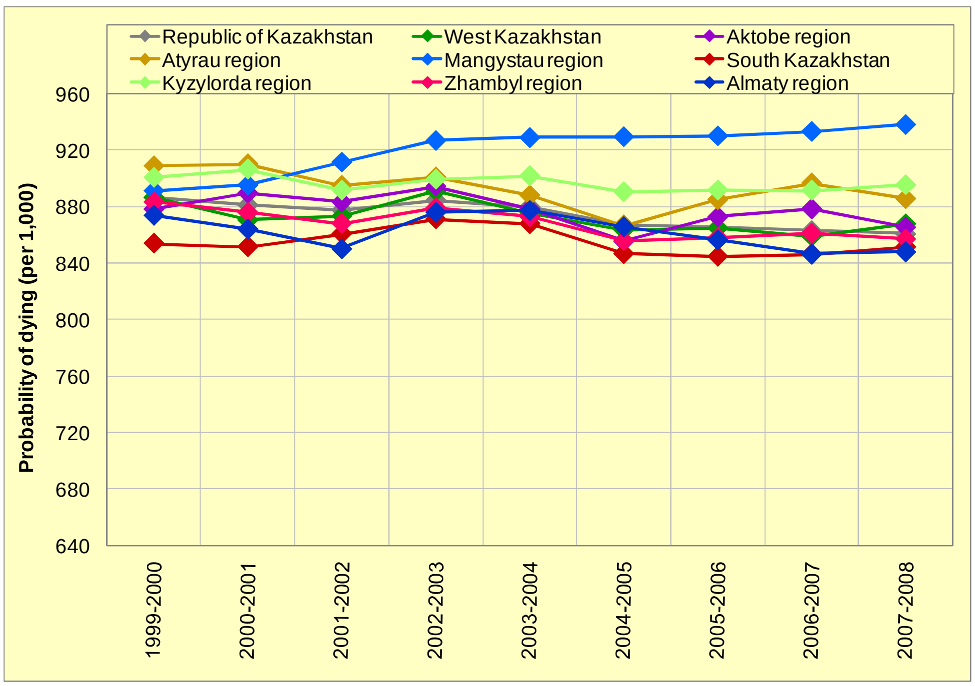
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 886.3 to 860.8 per 1,000. All regions indicated the decrease of level with above national decrease in Karagandy region, and Almaty, Astana cities. North Kazakhstan, Kostanai, Pavlodar, Akmola, and East Kazakhstan regions demonstrated the below national decrease. In the period 2007-2008 the level was above national (860.8 per 1,000) in the same regions as it was observed for the period 1999-2000. The lowest level was noted in Astana city (654.6 per 1,000) with substantial difference from other regions.

In the period 1999-2000 among the second group of regions the above national male mortality level was noted in all regions except South Kazakhstan, Zhambyl, and Almaty regions (see Figure 11b). These regions had the below national level with the lowest value in South Kazakhstan (853.9 per 1,000). In the following periods the regions except Mangystau and Kyzylorda had the similar trend with the fluctuation over time. The national trend was invisible because of close regional trends. Kyzylorda region had somehow stable trend of level with weak fluctuation over time. Mangystau region was slowly increasing the level over time.

Between the periods 1999-2000 and 2007-2008 the level increased only in Mangystau region (from 891.1 to 938.3 per 1,000) while other regions indicated the decrease of level with above national decrease in Zhambyl and Almaty regions (26.3 and 25.8 per 1,000 respectively). In the period 2007-2008 male mortality level in the observed age group was below national in the same regions as it was observed in the period 1999-2000. Despite the fact that the regions except Mangystau decreased the level between two periods, none of the regions with above national level could overcome the national level. As a result, in the period 1999-2000 male mortality level in age group 65-84 was below national only in southern regions South Kazakhstan, Zhambyl, Almaty, and municipal cities Astana and Almaty. In the period 2007-2008 the same regions had the below national level. Between two periods the level decreased in all regions except Mangystau with the biggest decrease in Astana city. However, it is worth to note that the level difference between regions excluding Astana city was not big in the observed periods.

Figure 11b* − *Probability of dying for the age group 65-84, 1999-2008, the second group of regions, males

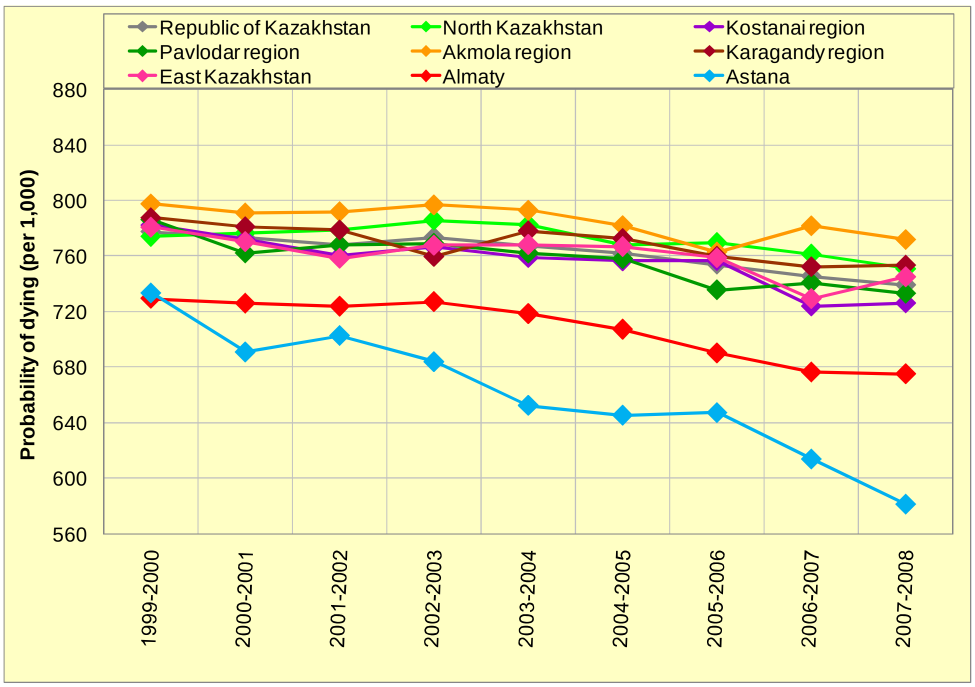


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality level was lower than that of males in the country in the period 1999-2000 (777.4 per 1,000). However, the difference was not as substantial as it was observed for age group 20-64 which was explained by the decrease of mortality difference between sexes in older ages. The national level was not visible among the regional ones because the levels are very close to each other (see Figure 11c). In the period 1999-2000 the below national female mortality level was observed in Astana, Almaty cities, and North Kazakhstan region with the lowest values in Astana and Almaty cities (733.4 and 729.3 per 1,000 respectively). Other regions indicated the above national level with the highest value in Akmola (797.6 per 1,000). The regions except Astana and Almaty cities had the very slowly decreasing trend without visible fluctuation over time. Astana and Almaty cities observed the rapid decrease with more rapid one in Astana. Between the periods 1999-2000 and 2007-2008 the regions observed the decrease along with the country (from 777.4 to 739.1 per 1,000). The above national decrease of level was noted in

Kostanai, Pavlodar regions, and Astana, Almaty cities with the biggest decrease in Astana city (152.2 per 1,000). North Kazakhstan, Akmola, Karagandy, and East Kazakhstan regions demonstrated the below national decrease. In the period 2007-2008 female mortality level was above national in Akmola, Karagandy, East Kazakhstan, and North Kazakhstan regions with the highest value in Akmola (771.7 per 1,000) while Kostanai, Pavlodar regions, and Astana, Almaty cities indicated the below national level with the lowest value in Astana city (581.2 per 1,000). It is worth to note that North Kazakhstan region with the below national level in the period 1999-2000 indicated the above national level in the period 2007-2008 because of smallest decrease of level while Kostanai and Pavlodar regions indicated the adverse evidence thanks to their above national decrease of level.

Figure 11c − Probability of dying for the age group 65-84, 1999-2008, the first group of regions, females

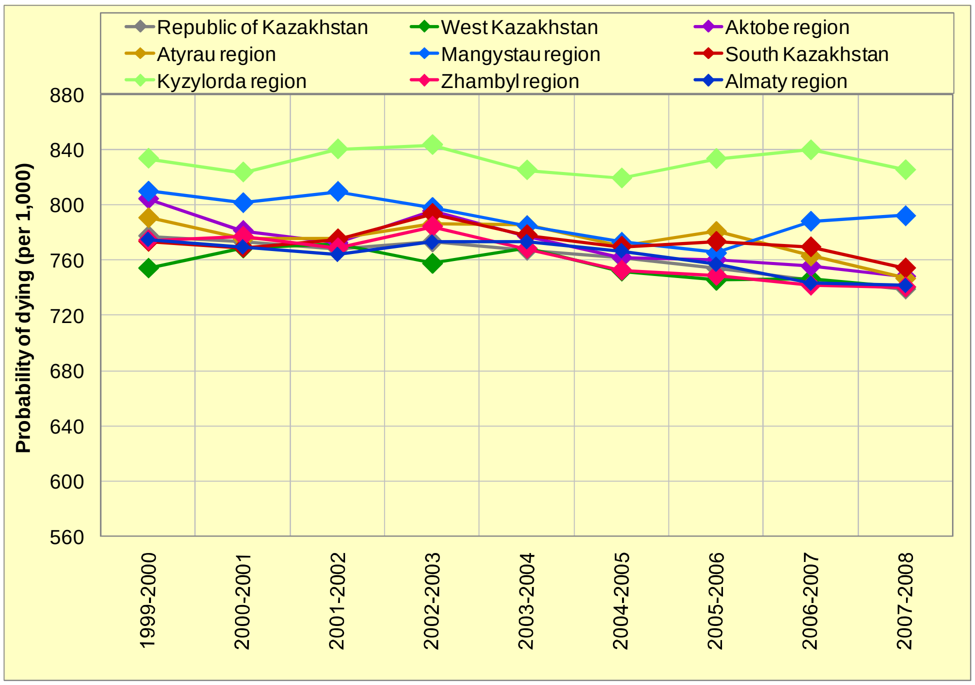


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Among the second group of regions in the period 1999-2000 female mortality level was above national in Aktobe, Atyrau, Mangystau, Kyzylorda regions with the highest value in Kyzylorda (833.4 per 1,000). West Kazakhstan, South Kazakhstan, Zhambyl, and Almaty regions indicated the below national level with the lowest value in West Kazakhstan (754.4 per 1,000). In the following periods the regions except Kyzylorda and Mangystau had the very close level to national one and the similar trend of decrease fluctuating over time (see Figure 11d). Kyzylorda region with the highest level had somehow fluctuating trend with stable level. Mangystau region was gradually decreasing the level between the periods 2001-2002 and 2005-2006 with the following increase. Between the periods 1999-2000 and 2007-2008 the level decreased in the regions with above national decrease in Aktobe and Atyrau regions (56.3 and 44.0 per 1,000 respectively). Other regions indicated the below national decrease with the lowest one in

Kyzylorda (8.3 per 1,000). In the period 2007-2008 the above national level was noted in all regions with the highest value in Kyzylorda (825.0 per 1,000). It is worth to note that West Kazakhstan, South Kazakhstan, Zhambyl, Almaty regions changed their below national level in the period 1999-2000 to above national one in the period 2007-2008 because of their below national decrease of level.

Figure 11d −Probability of dying for the age group 65-84, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 female mortality level in age group 65-84 was above national in central, eastern regions, northern regions Kostanai, Pavlodar, western regions Atyrau, Mangystau, Aktobe, southern region Kyzylorda with the highest value in Kyzylorda. The lowest values were noted in Astana and Almaty cities among the regions with below national level. Between the periods 1999-2000 and 2007-2008 the level in the country as well as all regions decreased with the biggest decrease in Astana city and the smallest one in Kyzylorda region. In the period 2007-2008 all central, eastern, western, southern regions, northern region North Kazakhstan had the above national level while the lowest level was noted in Astana and Almaty cities among the regions with below national level.

The lowest level of mortality for both sexes was noted in Astana city in both periods while the differentiation of level across other regions was not big. Moreover, the biggest improvement of level was noted namely in this city for both sexes. As a result, the difference between Astana and other regions broadened in the period 2007-2008 compared to 1999-2000. The biggest decrease of mortality level for both sexes in observed age group in Astana city would be related to its capital status. Firstly, after the gaining capital status the people of government bodies as well as the people of creative spheres moved to the city. And the substantial proportion of these people was in examined age group. These highly educated people tend to take care better than people with lower educational attainment. Secondly, the quality of healthcare facilities and medical innovations tend to be higher in municipal cities compared to other regions. Health of population in examined age group would be related firstly to healthcare access.

9.2.5 General performance of regional mortality levels by age groups

The examination of mortality level trends by age groups in the period 1999-2008 made the conditions to define the regions with the highest and lowest levels for the observed age groups in the periods 1999-2000 and 2007-2008 and the general picture of changes in the regions between two periods.

Table 6a – Regions with the lowest probability of dying for the age groups, 1999-2000, males and females, per 1,000

Males			
0-4		5-19	
Almaty	19.0	Astana	9.9
Astana	19.2	South Kazakhstan	10.1
Almaty region	21.8	Almaty	11.1
West Kazakhstan	26.2	Zhambyl region	12.8
North Kazakhstan	26.6	Aktobe region	13.2
20-64		65-84	
South Kazakhstan	431.8	Astana	822.8
Kyzylorda region	441.2	South Kazakhstan	853.9
Almaty region	464.0	Almaty	855.2
Astana	466.0	Almaty region	873.9
Zhambyl region	473.4	Aktobe region	878.3
Females			
0-4		5-19	
Almaty	14.4	Astana	4.0
Astana	17.4	Almaty	5.0
North Kazakhstan	17.8	Pavlodar region	7.0
Almaty region	18.2	Aktobe region	7.2
South Kazakhstan	21.6	Zhambyl region	7.3
20-64		65-84	
Almaty	200.1	Almaty	729.3
Astana	208.0	Astana	733.4
West Kazakhstan	224.0	West Kazakhstan	754.4
South Kazakhstan	225.4	South Kazakhstan	773.2
Mangystau region	231.1	North Kazakhstan	774.0

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 among five regions characterized by the lowest level of male mortality in age groups one can continually find Astana and Almaty cities (see Table 6a). The municipal cities observed the lowest male mortality level in all age groups. Despite the fact that South Kazakhstan region observed the lowest male mortality level in young, adult, and old age groups in age group 0-4 it did not indicate the lowest level. Almaty region was also favourable in all age groups except 5-19. Apart from other age groups the age group 20-64 indicated the geographical homogeneity observing the lowest male mortality in municipal cities and the southern regions. Generally, the southern regions were the most favourable along with municipal cities almost in all age groups.

Among the regions of other parts western region Aktobe in age groups 5-19 and 65-84, West Kazakhstan and North Kazakhstan in age group 0-4 indicated the lowest level of male mortality. The central and eastern regions were not in the list of regions with the lowest male mortality level in the period 1999-2000.

Table 6b – Regions with the highest probability of dying for the age groups, 1999-2000, males and females, per 1,000

Males			
0-4		5-19	
Mangystau region	40.6	Karagandy region	18.0
Pavlodar region	36.7	North Kazakhstan	17.8
Kyzylorda region	35.6	Pavlodar region	17.0
Zhambyl region	33.7	Akmola region	16.9
Kostanai region	31.6	Kostanai region	16.9
20-64		65-84	
Atyrau region	551.3	Karagandy region	914.4
Karagandy region	549.1	Akmola region	912.6
Aktobe region	544.9	Atyrau region	908.8
East Kazakhstan	539.6	Kyzylorda region	900.4
West Kazakhstan	539.2	Pavlodar region	893.8
Females			
0-4		5-19	
Mangystau region	31.7	Atyrau region	10.5
Pavlodar region	26.5	West Kazakhstan	9.1
Atyrau region	25.8	Almaty region	8.1
Aktobe region	25.4	Mangystau region	8.0
Kyzylorda region	25.4	Karagandy region	8.0
20-64		65-84	
Akmola region	258.9	Kyzylorda region	833.4
Aktobe region	257.3	Mangystau region	809.7
Karagandy region	251.6	Aktobe region	804.2
North Kazakhstan	248.9	Akmola region	797.6
Atyrau region	244.5	Atyrau region	791.0

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Astana and Almaty cities were in the first place in all age groups among the regions with the lowest level of female mortality (see Table 6a). It is worth to note that South Kazakhstan region did not indicate the lowest male mortality level in age group 0-4 while for females the lowest level was not noted in age group 5-19. The northern region North Kazakhstan in child and old age groups, western region West Kazakhstan in adult and old age groups indicated the lowest level. It is worth to note that the southern regions did not indicate the frequent favorability for females as it was observed for males.

The highest male mortality level in age groups was observed generally in main industrial and oil extracting regions (see Table 6b). In this term the age group 20-64 indicated the homogeneity observing the highest level only in these regions. Industrial regions Karagandy (except 0-4) and Pavlodar (except 20-64) were the least favourable continually noting the highest level almost in all age groups. Among the agricultural regions Kostanai in age groups 0-4 and 5-19, Akmola in age groups 5-19 and 65-84 indicated the highest level.

Female mortality level in age groups was also the highest mainly in industrial and oil-extracting regions. Western oil-extracting regions Atyrau (all age groups), Mangystau (except 20-64), Aktobe (except 5-19) regions continually demonstrated the highest level. Karagandy in young and adult age groups, Akmola in adult and old age groups, Kyzylorda in child and old age groups indicated the highest level of female mortality.

The evidence indicated that in the period 1999-2000 the level of mortality in all age groups for both sexes was the lowest in municipal cities. The southern regions especially South Kazakhstan were the most favourable almost in all age groups. The highest level for both sexes was noted mainly in western, central, and northern regions where the main industrial and oil-extracting regions were located.

Table 7a – Changes in probability of dying for the age groups between 1999-2000 and 2007-2008, males, index (1999-2000=100)

Regions	0-4	5-19	20-64	65-84
Akmola region	66.8	94.4	104.8	97.6
Aktobe region	79.6	102.3	91.1	98.6
Almaty region	82.5	99.7	102.2	97.0
Atyrau region	84.0	94.1	86.8	97.5
West Kazakhstan	80.5	81.4	92.5	97.9
Zhambyl region	73.8	99.6	98.2	97.0
Karagandy region	70.0	72.5	105.3	96.0
Kostanai region	74.4	74.4	103.5	97.8
Kyzylorda region	82.4	93.6	97.1	99.4
Mangystau region	70.8	70.6	88.1	105.3
South Kazakhstan	105.0	101.7	97.0	99.7
Pavlodar region	53.3	85.1	101.7	99.9
North Kazakhstan	88.9	84.1	102.6	98.8
East Kazakhstan	81.7	86.0	98.4	97.8
Astana	87.4	100.4	71.6	79.6
Almaty	101.5	77.0	87.1	93.9
Republic of Kazakhstan	82.6	87.2	96.8	97.1

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Between the periods 1999-2000 and 2007-2008 the level of male mortality decreased in all observed age groups in the country (see Table 7a). However, the decrease in age groups 20-64 and 65-84 was not as substantial as in age groups 0-4 and 5-19.

Male mortality level in age group 0-4 indicated the decrease in most of regions. The increase was noted only in South Kazakhstan region and Almaty city. The above national decrease was found in all regions except Atyrau, North Kazakhstan regions, and Astana city. Pavlodar and Akmola regions observed the biggest improvement among the regions.

In age group 5-19 male mortality level increased in Aktobe, South Kazakhstan regions, and Astana city. Other regions indicated the improvement with the above national decrease in West Kazakhstan, Karagandy, Kostanai, Pavlodar, North Kazakhstan, and East Kazakhstan regions.

In age group 20-64 more regions observed the increase of male mortality level compared to other age groups. Akmola, Karagandy, Almaty, Kostanai, Pavlodar, North Kazakhstan regions indicated the increase of level. Among these regions Karagandy and Pavlodar are the industrial zones. The above national improvement of level was noted in Aktobe, Atyrau, West Kazakhstan, Mangystau regions, and Astana, Almaty cities. It is worth to note that the improvement of male mortality in productive age group was noted in western oil-extracting regions, and the most favourable municipal cities.

In age group 65-84 male mortality level decreased in the country as well as the regions except Mangystau. The biggest improvement of level was noted in Astana city while the decrease in other regions was approximately equal to national one.

Table 7b – Changes in probability of dying for the age groups between 1999-2000 and 2007-2008, females, index (1999-2000=100)

Regions	0-4	5-19	20-64	65-84
Akmola region	64.2	109.2	101.5	96.8
Aktobe region	68.5	108.7	79.3	93.0
Almaty region	78.0	105.7	95.9	95.7
Atyrau region	67.8	85.3	80.7	94.4
West Kazakhstan	66.8	84.9	93.3	98.2
Zhambyl region	82.6	100.3	83.9	95.6
Karagandy region	74.2	85.1	103.9	95.7
Kostanai region	70.6	85.6	104.2	92.8
Kyzylorda region	95.1	97.9	86.8	99.0
Mangystau region	62.3	86.9	89.1	97.8
South Kazakhstan	112.2	90.2	90.9	97.5
Pavlodar region	62.9	77.9	95.6	93.2
North Kazakhstan	101.9	73.3	99.5	97.0
East Kazakhstan	92.5	98.4	95.4	95.4
Astana	75.3	136.8	69.6	79.2
Almaty	112.1	80.0	80.2	92.6
Republic of Kazakhstan	84.2	94.0	92.1	95.1

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Between two periods female mortality level also decreased in the country. However, more substantial decrease was noted only for age group 0-4 compared to older age groups (see Table 7b).

In age group 0-4 female mortality level increased in South Kazakhstan, North Kazakhstan regions, and Almaty city while the biggest decrease of level was noted in Akmola and Pavlodar regions as it was observed for males.

In age group 5-19 the level increased in Akmola, Aktobe, Almaty, Zhambyl regions, and Astana city. Pavlodar and North Kazakhstan regions indicated the biggest improvement.

Female mortality level in age group 20-64 increased in Akmola, Karagandy, and Kostanai regions while the western oil-extracting regions Aktobe, Atyrau, Mangystau, southern regions Kyzylorda, Zhambyl, South Kazakhstan, and municipal cities Astana, Almaty indicated the above national improvement with the biggest decrease in Astana city. The evidence demonstrated that northern, eastern, and central regions were not the favourable in term of female mortality level improvement.

In age group 65-84 the level decreased in all regions apart from other age groups. The biggest decrease was noted in Astana city while other regions indicated the decrease close to national one as it was examined for males.

The evidence demonstrated that mortality level for both sexes improved in most of regions in age group 0-4 apart from other age groups. Akmola and Pavlodar regions were the leaders in term of improvement among all regions. Astana city indicated the biggest decrease in adult and old age groups while in young age group the level increased in the city. Western oil-extracting regions and municipal cities indicated the above national decrease of mortality level in adult age group which would be explained by possible influence of socio-economically attractive regions on life potential of economically productive age group.

In the period 2007-2008 the level of male mortality was continually lowest in all age groups in Astana and Almaty cities as it was observed in the period 1999-2000 (see Table 8a). South Kazakhstan was also the most favourable in observed age groups except 0-4. In age group 0-4 Pavlodar and Akmola regions indicated the lowest level which was related to the biggest decrease of level in the regions. In age group 20-64 the level was the lowest in Mangystau region along with the southern regions and municipal cities which was related to above national decrease of level in the region. In age group 65-84 the southern regions and municipal cities were the most favourable in the observed period.

Female mortality level was the lowest in all age groups in municipal cities as it was examined for males (see Table 8a). South Kazakhstan region did not indicate the lowest level in age groups in the observed period apart from 1999-2000 which would be related to comparatively small decrease of level in the region. It is worth to note that in age group 20-64 Aktobe and Atyrau regions with the highest level in the period 1999-2000 observed the lowest level in the period 2007-2008 which was related to above national improvement of level in the regions.

Table 8a – Regions with the lowest probability of dying for the age groups, 2007-2008, males and females, per 1,000

Males			
0-4		5-19	
Astana	16.8	Almaty	8.5
Almaty region	18.0	Astana	10.0
Almaty	19.3	South Kazakhstan	10.3
Pavlodar region	19.5	Mangystau region	11.9
Akmola region	19.8	Kostanai region	12.6
20-64		65-84	
Astana	333.4	Astana	654.6
South Kazakhstan	418.7	Almaty	803.4
Almaty	420.7	Almaty region	848.1
Kyzylorda region	428.3	South Kazakhstan	851.3
Mangystau region	448.4	Zhambyl region	857.0
Females			
0-4		5-19	
Astana	13.1	Almaty	4.0
Almaty region	14.2	Astana	5.4
Akmola region	14.9	Pavlodar region	5.4
West Kazakhstan	15.4	North Kazakhstan	5.5
Almaty	16.1	Karagandy region	6.8
20-64		65-84	
Astana	144.7	Astana	581.2
Almaty	160.4	Almaty	675.3
Atyrau region	197.4	Kostanai region	725.9
Zhambyl region	200.1	Pavlodar region	733.0
Aktobe region	203.9	Zhambyl region	740.5

***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Among five regions characterized by the highest levels of male mortality Akmola (except 0-4) and Atyrau (except 20-64) regions continually indicated the highest level almost in all age groups in the examined period (see Table 8b). Kyzylorda and Mangystau regions in child and old age groups, East Kazakhstan and North Kazakhstan regions in young and adult age groups, Pavlodar region in young and old age groups indicated the highest level. It is worth to note that in age group 20-64 western regions did not indicate the highest level apart from 1999-2000. In this period the level was highest in central, northern, and eastern regions despite their agricultural or industrial status.

Female mortality level was the highest in Akmola (except 0-4) and Kyzylorda (except 20-64) regions almost in all age groups (see Table 8b). Mangystau, South Kazakhstan regions in child and old age groups, East Kazakhstan region in child and adult age groups, Karagandy region in adult and old age groups indicated the highest female mortality level. It is worth to note that South Kazakhstan region indicated the highest level in age group 0-4 for both sexes which was related to increase of level in the region.

Table 8b – Regions with the highest probability of dying for the age groups, 2007-2008, males and females, per 1,000

Males			
0-4		5-19	
South Kazakhstan	31.3	Akmola region	16.0
Kyzylorda region	29.4	Atyrau region	15.6
Mangystau region	28.7	North Kazakhstan	14.9
Atyrau region	26.1	Pavlodar region	14.4
Zhambyl region	24.9	East Kazakhstan	14.3
20-64		65-84	
Karagandy region	578.4	Mangystau region	938.3
Akmola region	558.5	Kyzylorda region	895.2
Kostanai region	547.2	Pavlodar region	893.0
North Kazakhstan	543.6	Akmola region	891.1
East Kazakhstan	530.7	Atyrau region	885.6
Females			
0-4		5-19	
South Kazakhstan	24.2	Atyrau region	9.0
Kyzylorda region	24.2	Akmola region	8.6
East Kazakhstan	20.1	Almaty region	8.6
Mangystau region	19.7	Aktobe region	7.8
Zhambyl region	19.6	Kyzylorda region	7.8
20-64		65-84	
Akmola region	262.8	Kyzylorda region	825.0
Karagandy region	261.3	Mangystau region	792.1
North Kazakhstan	247.7	Akmola region	771.7
Kostanai region	244.1	South Kazakhstan	754.0
East Kazakhstan	232.3	Karagandy region	753.3

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

General description of regional mortality levels by age groups for both sexes indicated that mortality level in all observed age groups was the lowest in thriving municipal cities in both periods. Between two periods the new capital Astana city indicated the biggest decrease in adult and old age groups. In adult (productive) age group the level was the highest in industrial and oil-extracting regions in the period 1999-2000. However, the above national improvement of level in western oil-extracting regions between two periods removed them from the list in the period 2007-2008. The decrease of level in most of regions was observed in age group 0-4 for both sexes while in adult age group the northern, central, eastern regions indicated the increase of level.

Ecologically unfavourable Kyzylorda region indicated the highest female mortality level in child and old age groups in both periods. Agricultural Akmola region was also considered to be the high-risky region in all age groups except 0-4 especially in the period 2007-2008. The evidence would be related to its border zone with industrial Karagandy region. The evidence demonstrated that the highest and the lowest levels of mortality in age groups and their changes were mainly related to socio-economic and ecological conditions of regions.

9.3 Trends of mortality level by causes of death

To describe the regional mortality trends by cause of death the leading causes of death for each age group were chosen. The leading cause of death for each age group was defined by the value of standardised death rate for cause for the definite age group in the country (see Appendices 12a 12b). Despite the fact that in age group 0-4 the value for external causes of death was higher than certain infectious and parasitic diseases the last cause was selected. Because this cause would explain the regional differences better than the external causes for the age group.

As the distribution of applied standard population is not equal across age groups the level of mortality measured by standardised death rate in one age group is not comparable with the other one.

9.3.1 Age group 0-4

For age group 0-4certain infectious diseases and respiratory system diseases were defined as the leading causes of death according to highest values of standardised death rate for these causes in this age group in the country.

9.3.1.1 Certain infectious and parasitic diseases

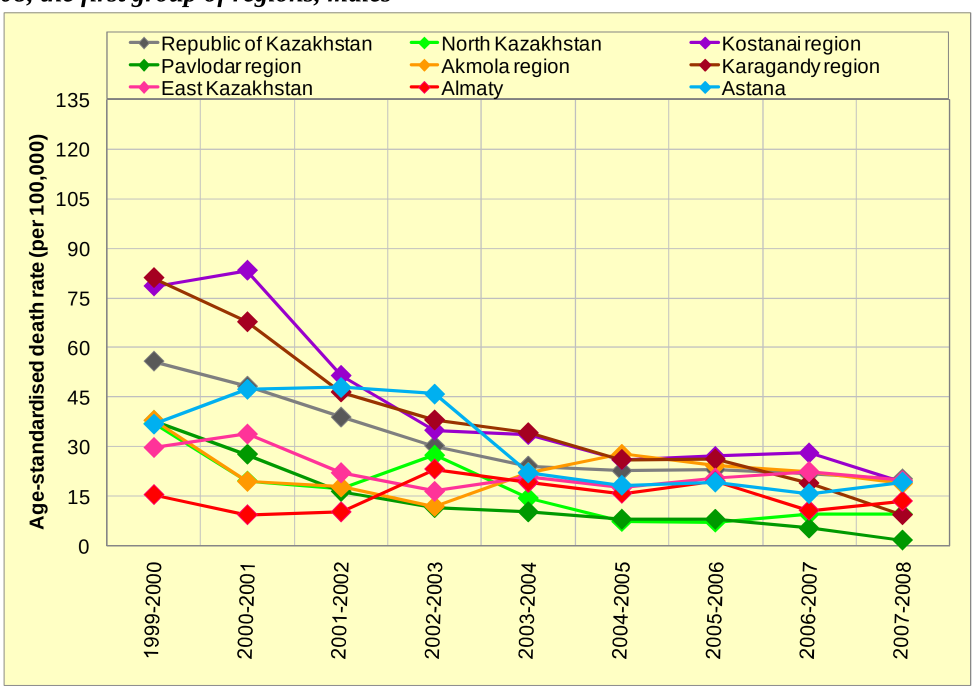
Standardised death rate for certain infectious and parasitic diseases in age group 0-4 was 55.7 deaths per 100,000 in the country in the period 1999-2000. Above national male mortality level was found in Karagandy (81.1 per 100,000) and Kostanai (78.5 per 100,000) regions while other regions of the first group indicated the below national level with the lowest value in Almaty city (15.4 per 100,000). In the following periods the regions as well as the country had the trend of the level decrease. Kostanai and Karagandy regions with the highest values for death rate had the greatest decreases.

Almaty city increasing the level between the periods 2001-2002 and 2002-2003 demonstrated the slow decrease with the weak fluctuation in the following periods (see Figure 12a). Akmola region decreasing the level between the periods 1999-2000 and 2002-2003 indicated the increase between the periods 2002-2003 and 2004-2005 and the slow decrease in following periods.

In the result of such trend between the periods 1999-2000 and 2007-2008 the level decreased in the country (from 55.7 to 20.3 per 100,000) as well as the regions. The above national decrease was noted in Kostanai, Pavlodar, and Karagandy regions. North Kazakhstan, Akmola, East Kazakhstan regions, Astana and Almaty cities indicated the below national decrease. In the period 2007-2008 all regions of first group had the below national level with the lowest value in Pavlodar (1.7 per 100,000). It is worth to note that Kostanai and Karagandy regions with the above national level in the period 1999-2000 demonstrated the below national level in the period 2007-2008 thanks to above national decrease of level in the regions.

In the period 1999-2000 among the regions of second group South Kazakhstan, Kyzylorda, Zhambyl, Mangystau, and Aktobe regions indicated the above national level with the highest value in Mangystau (125.7 per 100,000) while other regions demonstrated the below national level with the lowest value in West Kazakhstan (22.3 per 100,000). In the following periods the regions had the decrease of level over time with fluctuation (see Figure 12b). The most rapid decrease was noted in Mangystau region while Kyzylorda region decreasing the level between the periods 2000-2001 and 2003-2004 indicated the increase between the periods 2003-2004 and 2005-2006. As a result, Kyzylorda region observed the highest level among the regions between the periods 2004-2005 and 2007-2008. Between the periods 1999-2000 and 2007-2008 the level decreased in all regions with the above national decrease in Aktobe, Mangystau, Kyzylorda, Zhambyl regions and the below national one in West Kazakhstan, South Kazakhstan, and Almaty regions. In the period 2007-2008 the above national level was noted in West Kazakhstan, Aktobe, Atyrau, South Kazakhstan, Kyzylorda, Zhambyl regions with the highest value in Kyzylorda (41.3 per 100,000). The below national level was observed in Mangystau and Almaty regions (19.4 and 15.1 per 100,000 respectively).

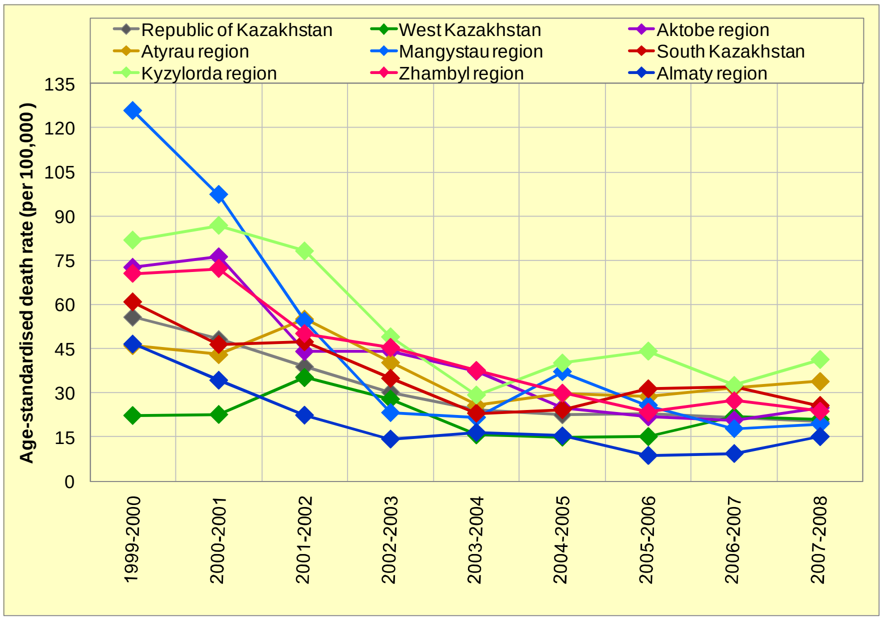
Figure 12a – Age-standardised death rate for certain infectious and parasitic diseases in age group 0-4, 1999-2008, the first group of regions, males



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

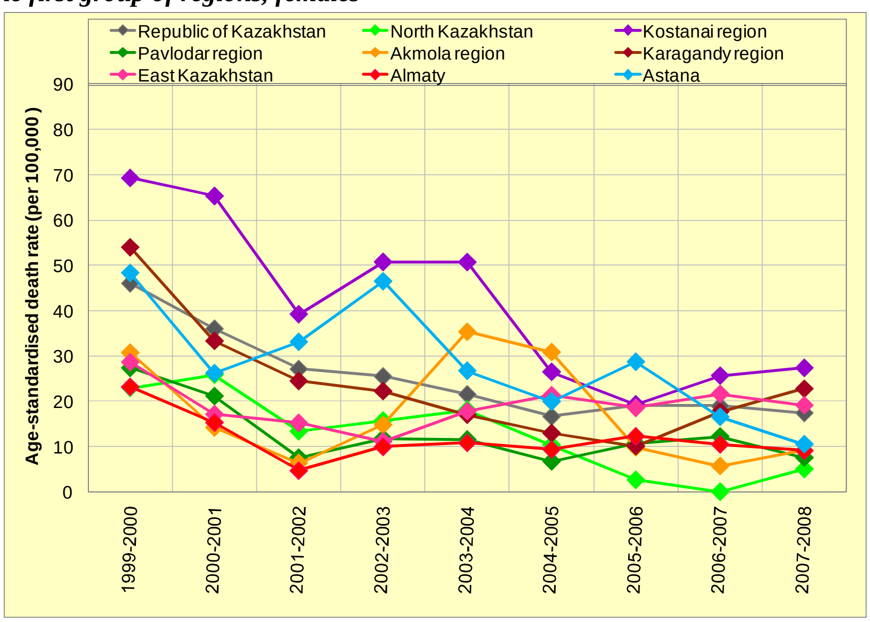
As a result, in the period 1999-2000 male mortality level from certain infectious and parasitic diseases in age group 0-4 was above national in northern region Kostanai, central region Karagandy, western regions Aktobe, Mangystau, southern regions South Kazakhstan, Zhambyl, Kyzylorda while the lowest value was noted in Almaty city among the regions with below national level. Between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as the regions with the biggest decrease in Mangystau. In the period 2007-2008 the level was above national in western regions West Kazakhstan, Aktobe, Atyrau, and southern regions South Kazakhstan, Zhambyl, Kyzylorda with the highest value in Kyzylorda. The northern, central, eastern regions, municipal cities, western region Mangystau, southern region Almaty had the below national level with the lowest value in Pavlodar.

Figure 12b – Age-standardised death rate for certain infectious and parasitic diseases in age group 0-4, 1999-2008, the second group of regions, males



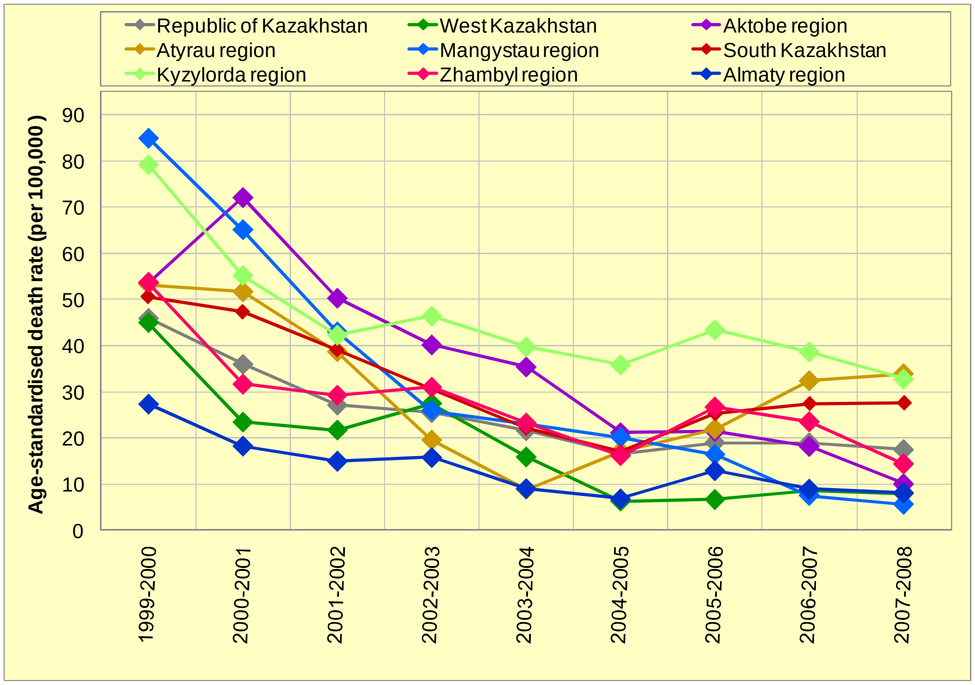
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 12c – Age-standardised death rate for certain infectious and parasitic diseases in age group 0-4, 1999-2008, the first group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 12d – Age-standardised death rate for certain infectious and parasitic diseases in age group 0-4, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality level from certain infectious and parasitic diseases was lower than that of males in the observed age group in the country in the period 1999-2000 (46.0 per 100,000). In the examined period among the regions of first group Kostanai and Karagandy regions, and Astana city had the above national female mortality level with the highest value in Kostanai (69.4 per 100,000). The lowest value was noted in North Kazakhstan region (22.9 per 100,000) among the regions with below national level. In the following periods the level was decreasing in the regions as well as the country with the strong fluctuation in Kostanai, Akmola regions and Astana city. However, Karagandy region gradually decreasing the level over time, from the period 2005-2006 increased it again (see Figure 12c). The slight increase of level from this period was also observed in Kostanai region while North Kazakhstan and Akmola regions slightly increased the level in the period 2007-2008. Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 46.0 to 17.4 deaths per 100,000. The above national decrease was noted in Kostanai, Karagandy regions, and Astana city. It is worth to note that these regions had the above national level in the period 1999-2000. In the period 2007-2008 the national level was 17.4 per 100,000 in the country. In this period the above national level was noted in Karagandy, Kostanai, and East Kazakhstan regions while North Kazakhstan indicated the lowest value (5.0 per 100,000) among the regions with below national level. It is worth to note that Astana city with the above national level in the period 1999-2000 indicated the below national level in the period 2007-2008 thanks to above national improvement of level in the city.

In the period 1999-2000 among the second group of regions female mortality level was above national in all regions except West Kazakhstan and Almaty (44.9 and 27.4 per 100,000). The highest level was noted in Mangystau (84.8 per 100,000) and Kyzylorda (79.2 per 100,000) regions. In the following periods the regions had the decrease of level over time (see Figure 12d). Mangystau region with highest value for the rate had the greatest improvement over observed period. Atyrau region rapidly decreasing the level between the periods 1999-2000 and 2003-2004, was increasing it again over time. Between the periods 1999-2000 and 2007-2008 the above national decrease was noted in West Kazakhstan, Aktobe, Mangystau, Kyzylorda, Zhambyl regions with the biggest one in Mangystau (79.3 per 100,000) while Atyrau, South Kazakhstan, and Almaty regions demonstrated the below national decrease with the smallest one in Atyrau (19.3 per 100,000). In the period 2007-2008 the level was above national in Atyrau, South Kazakhstan, and Kyzylorda regions with the highest value in Atyrau (33.8 per 100,000). West Kazakhstan, Aktobe, Mangystau, Zhambyl, and Almaty regions indicated the below national level with the lowest value in Mangystau (5.5 per 100,000). It is worth to note that Aktobe, Mangystau, Zhambyl regions with the above national level in the period 1999-2000 demonstrated the below national level in the period 2007-2008 thanks to above national decrease of level in the regions. Mangystau region with the highest level in the period 1999-2000 achieved the lowest level in the period 2007-2008 among the regions.

As a result, in the period 1999-2000 female mortality level was above national in northern region Kostanai, central region Karagandy, western regions Aktobe, Atyrau, and Mangystau, southern regions South Kazakhstan, Zhambyl, Kyzylorda, and municipal city Astana. The level decreased in the country as well as the regions with the biggest decrease in Mangystau region. In the period 2007-2008 the above national level was found in northern region Kostanai, central region Karagandy, eastern region East Kazakhstan, western region Atyrau, and southern regions South Kazakhstan and Kyzylorda. Aktobe, Mangystau, Zhambyl regions, and Astana city with the above national level in the period 1999-2000 demonstrated the above national level in the period 2007-2008 thanks to above national improvement of level in the regions.

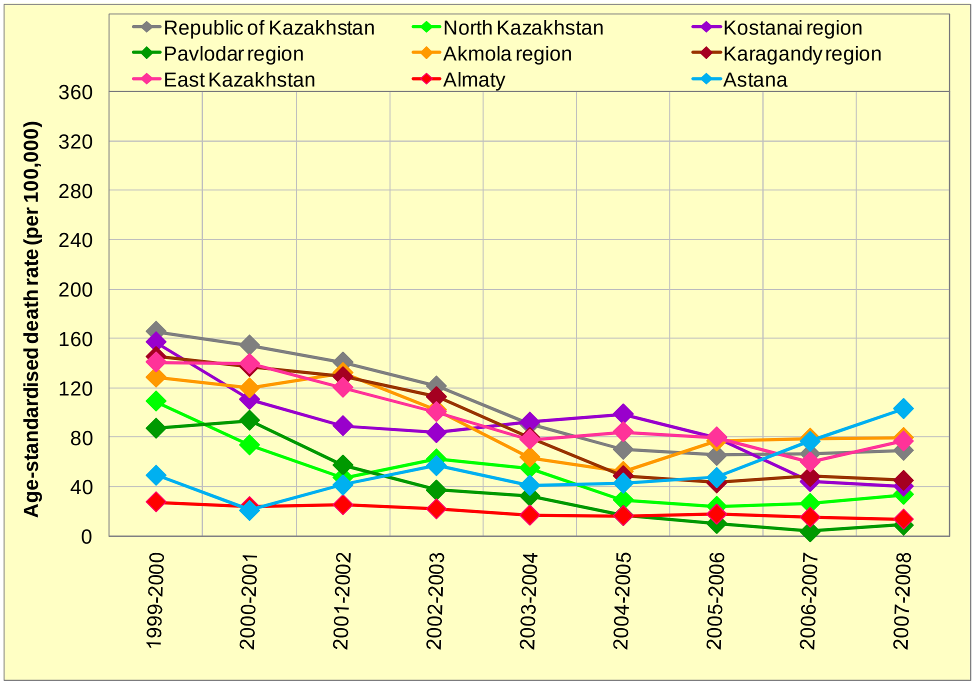
According to World Health Organisation Report the unsafe water, poor sanitation, and widespread poverty are the main factors of infectious diseases outbreak (World Health Organisation, 1999). The decrease of mortality level from infectious diseases in age group 0-4 for both sexes in the country as well as the regions between the periods 1999-2000 and 2007-2008 would be explained by socio-economic growth and the reduction of poverty incidence in the regions.

9.3.1.2 Diseases of the respiratory system

In the period 1999-2000 male mortality level from respiratory system diseases in age group 0-4 was 165.6 deaths per 100,000 in the country. In this period all regions of the first group had below national level with the lowest value in Almaty (27.5 per 100,000) and Astana (49.3 per 100,000) cities. In the following periods the country as well as the regions had the decrease of level over time (see Figure 13a). The regions with highest values for the rate had the greatest decreases over observed period.

Only Astana city was increasing the level from the period 2000-2001with somehow fluctuation over time.

Figure 13a – Age-standardised death rate for diseases of the respiratory system in age group 0-4, 1999-2008, the first group of regions, males



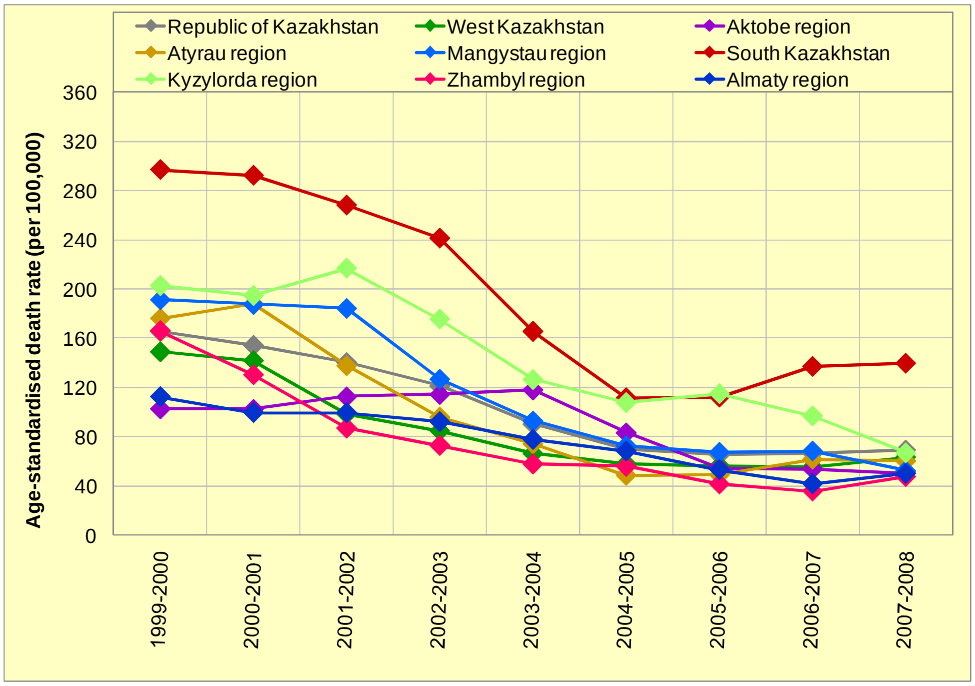
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 165.6 to 69.5 per 100,000. The above national decrease of level was noted in Kostanai and Karagandy regions (116.6 and 100.0 per 100,000 respectively). In the period 2007-2008 the level was above national in Akmola and East Kazakhstan regions, and Astana city while other regions indicated the below national level with the lowest value in Pavlodar (8.9 per 100,000). It is worth to note that Akmola, East Kazakhstan regions, and Astana city with the below national level in the period 1999-2000 indicated the above national level in the period 2007-2008 because of level increase in Astana, and the below national decrease of level in Akmola and East Kazakhstan regions.

Among the second group of regions the above national male mortality was noted in South Kazakhstan, Kyzylorda, Zhambyl, Mangystau, and Atyrau regions with the highest value in South Kazakhstan (296.7 per 100,000). In the following periods the regions had the improvement of level with the rapid decrease in the regions with the above national level (see Figure 13b). However, South Kazakhstan region rapidly decreasing the level between the periods 1999-2000 and 2005-2006 indicated the increase from the period 2005-2006. Between the periods 1999-2000 and 2007-2008 the level improved in all regions with the above national decrease in Atyrau, Mangystau, South Kazakhstan, Kyzylorda, Zhambyl regions. The below national decrease was noted in West Kazakhstan, Aktobe, and Almaty regions. In the result of such decrease in the period 2007-2008 the level was above national only in South Kazakhstan region (139.7 per

100,000). Atyrau, Mangystau, Kyzylorda, and Zhambyl regions with the above national level in the period 1999-2000 indicated the below national level in the period 2007-2008 thanks to above national improvement of level in the regions.

Figure 13b – Age-standardised death rate for diseases of the respiratory system in age group 0-4, 1999-2008, the second group of regions, males



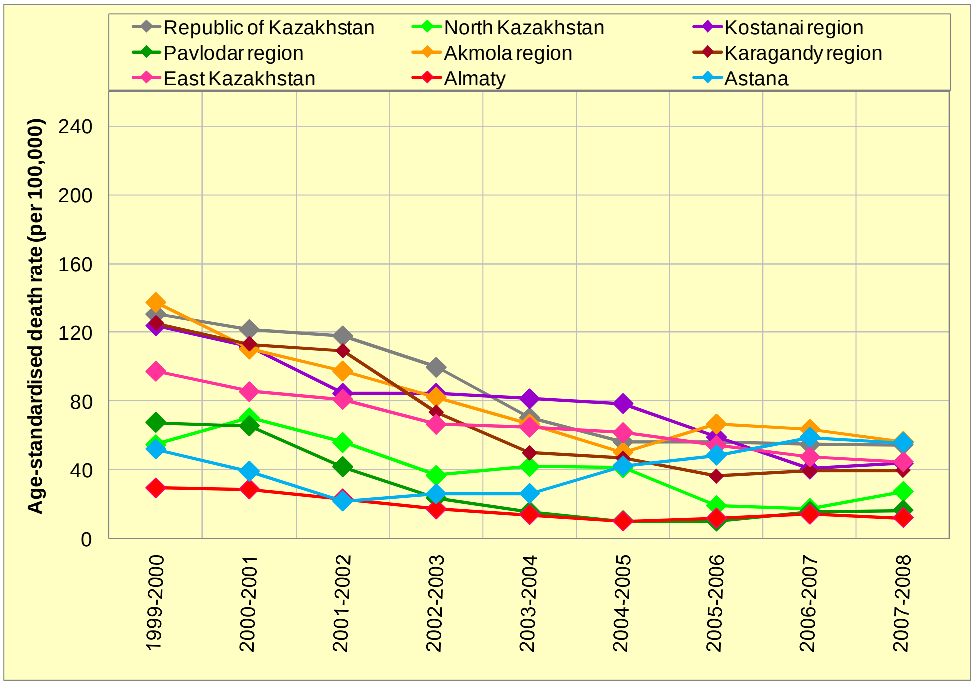
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 male mortality level from diseases of the respiratory system in age group 0-4 was above national in western Atyrau, Mangystau, and southern South Kazakhstan, Kyzylorda, Zhambyl regions with the highest value in South Kazakhstan while the lowest values were noted in Astana and Almaty cities among the regions with below national level. Between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as regions except Astana city. Astana city increased the level between two periods. In the period 2007-2008 the level was above national in Akmola, East Kazakhstan, South Kazakhstan regions, and Astana city. Pavlodar region indicated the lowest value among the regions with below national level.

In the period 1999-2000 female mortality level from respiratory system diseases was slightly lower than that of males in the country (130.7 per 100,000). Among the regions of first group the level was above national in Akmola region (137.3 per 100,000) while Almaty city had the lowest value (29.5 per 100,000) among the regions with below national level. In the following periods the regions as well as the country was decreasing the level with somehow fluctuation in Akmola and North Kazakhstan regions (see Figure 13c). Astana city slowly decreasing the level till the period 2001-2002 was increasing it gradually in the following periods. Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 130.7 to 54.6 per 100,000. The above national decrease was noted in Kostanai, Akmola, and Karagandy regions while North

Kazakhstan, Pavlodar, East Kazakhstan regions, and Almaty city indicated the below national decrease. The level increased in Astana city from 52.0 to 55.8 deaths per 100,000. In the period 2007-2008 the level was above national in Akmola region and Astana city (56.4 and 55.8 per 100,000 respectively) whose levels are slightly higher than national one.

Figure 13c – Age-standardised death rate for diseases of the respiratory system in age group 0-4, 1999-2008, the first group of regions, females

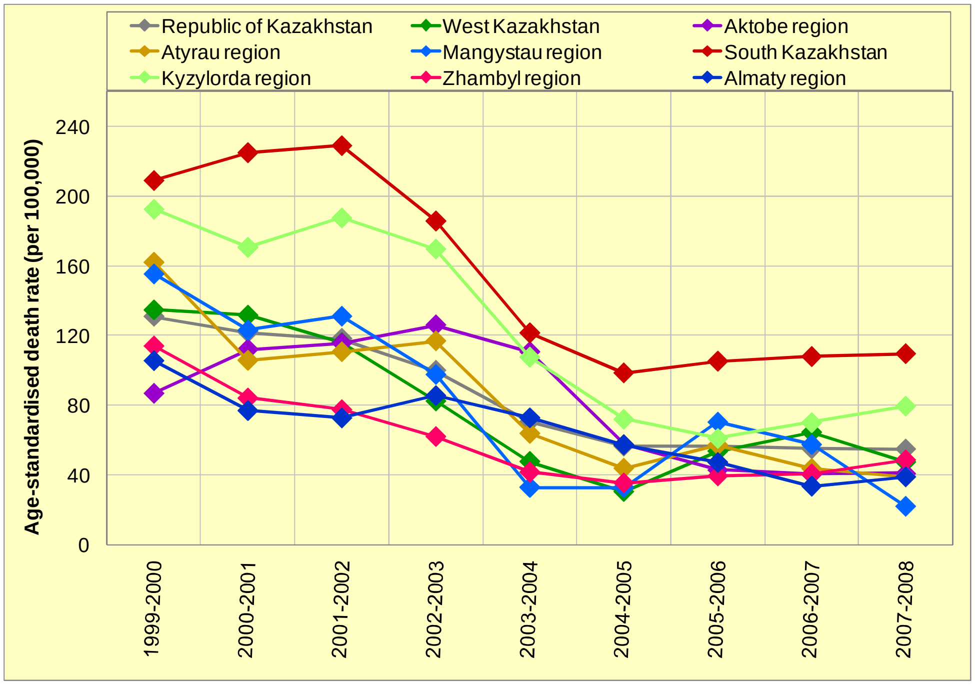


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 among the second group of regions female mortality level was above national in West Kazakhstan, Atyrau, Mangystau, South Kazakhstan, Kyzylorda regions with the highest value in South Kazakhstan (208.9 per 100,000). Aktobe, Zhambyl, and Almaty regions indicated the below national level with the lowest value in Aktobe (86.8 per 100,000). The regions had the rapid decrease of level between the periods 1999-2000 and 2004-2005 with following somehow stable trend (see Figure 13d). Between the periods 1999-2000 and 2007-2008 the level decreased in all regions with the above national decrease in West Kazakhstan, Atyrau, Mangystau, South Kazakhstan, and Kyzylorda. Aktobe, Zhambyl, and Almaty regions indicated the below national decrease. In the period 2007-2008 the level was above national in South Kazakhstan and Kyzylorda regions (109.4 and 79.5 per 100,000 respectively). Atyrau, Mangystau, and West Kazakhstan regions with the above national level in the period 1999-2000 indicated the below national level in the period 2007-2008. Mangystau region even indicated the lowest value (22.0 per 100,000) among the regions with below national level.

As a result, in the period 1999-2000 the above national female mortality level from diseases of the respiratory system was found in central region Akmola, western regions West Kazakhstan, Atyrau, Mangystau, and southern regions South Kazakhstan, Kyzylorda regions while Almaty city indicated the lowest value among the regions with below national level. All regions as well as the country except Astana city decreased the level with the biggest decrease in Mangystau. Astana city slightly increased the level. In the period 2007-2008 Astana city, central region Akmola, southern regions South Kazakhstan and Kyzylorda indicated the above national level while other regions indicated the below national level.

Figure 13d – Age-standardised death rate for diseases of the respiratory system in age group 0-4, 1999-2008, the second group of regions, females



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Mortality level from diseases of the respiratory system for both sexes decreased in the country as well as the regions except Astana city. Having the lowest level after Almaty city in the period 1999-2000 Astana increased the level for both sexes with the bigger increase for males. The main factors of respiratory system disease mortality are considered to be the heavy exposure to air pollution derived from indoor and outdoor sources, occupational related disorders, malnutrition and low birth weight, and multiple early lung infections (World Health Organization, 2002). The decrease of mortality level from this cause in age group 0-4 in the country as well as the regions indicated the socio-economic and healthcare improvement. The slight increase of level in Astana would be related to urban air pollution in the city.

9.3.2 Age group 5-19

The leading cause of death for age group 5-19 was considered to be the external causes of mortality as age-standardised death rate from other causes did not achieve even 10 deaths per 100,000 persons in the country and the regional variation was very low in the observed period.

9.3.2.1 External causes of mortality

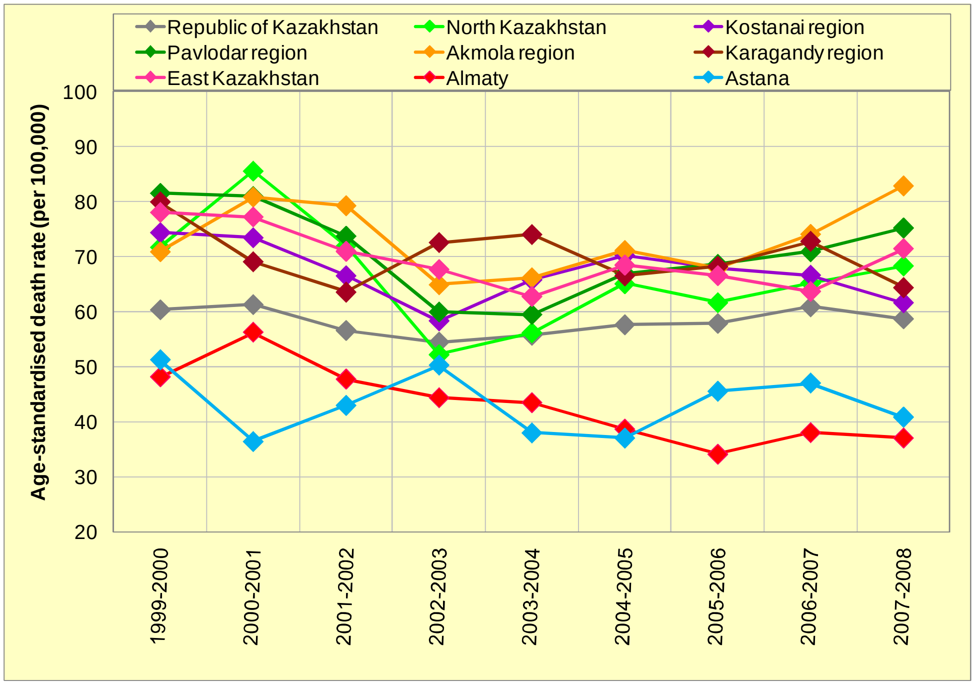
Male mortality level from external causes in age group 5-19 was 60.3 deaths per 100,000 in the country in the period 1999-2000. In this period among the first group of regions male mortality level was above national in all northern, central, and eastern regions while Almaty and Astana cities had the below national level (48.1 and 51.2 per 100,000 respectively). In the following periods the regions as well as the country except Almaty city were not observing the visible decrease or increase over time (see Figure 14a). Almaty city was gradually decreasing the level between the periods 2000-2001 and 2005-2006 with the following slight increase. The regions had the fluctuation of level over time. The strong fluctuation was noted in North Kazakhstan region which was rapidly decreasing the level till the period 2002-2003 with the following slow increase over time. Despite the fact that there was not noted the substantial decrease of level in the regions as well as the country they could decrease the level between the periods 1999-2000 and 2007-2008. The country had the slight decrease (from 60.3 to 58.7 per 100,000) between two periods while the regions had the above national decrease. In the period 2007-2008 the same regions had the above and below national level as they were observed in 1999-2000.

In the period 1999-2000 among the second group of regions the above national level was found in West Kazakhstan, Atyrau, Mangystau, and Kyzylorda regions with the highest value in Mangystau (77.3 per 100,000) while the lowest value was noted in South Kazakhstan region (30.6 per 100,000) among the regions with below national level. Apart from the first group of regions Almaty, South Kazakhstan, and Zhambyl regions in the second group had the gradual increase of level over time while Kyzylorda region indicated the rapid decrease between the periods 2002-2003 and 2005-2006 (see Figure 14b). The strong fluctuation of level was observed in Mangystau region which was rapidly decreasing the level between the periods 2000-2001 and 2002-2003, increased it till the period 2005-2006 with the following decrease.

Between the periods 1999-2000 and 2007-2008 the abovementioned regions with gradual increase over time increased the level with the biggest increase in South Kazakhstan (15.8 per 100,000) and Almaty (15.9 per 100,000) regions while other regions demonstrated the decrease with the biggest one in Mangystau (27.0 per 100,000). In the period 2007-2008 the regional levels were very close to national one. In this period the level was above national in Atyrau, West Kazakhstan, and Almaty regions with the highest value in Atyrau region (70.8 per 100,000). Aktobe, Mangystau, South Kazakhstan, Kyzylorda, and Zhambyl regions demonstrated the below national level with the lowest value in Kyzylorda (43.3 per 100,000).

As a result, in the period 1999-2000 male mortality level from external causes was above national in northern, central, eastern regions, western regions West Kazakhstan, Atyrau, Mangystau, and southern region Kyzylorda. Between the periods 1999-2000 and 2007-2008 the increase was observed in southern regions South Kazakhstan, Zhambyl, Almaty while other regions indicated the decrease with fluctuation in most of them. In the period 2007-2008 the level was above national in northern, central, eastern regions, western regions West Kazakhstan, Atyrau, and southern region Almaty.

Figure 14a – Age-standardised death rate for external causes of mortality in age group 5-19, 1999-2008, the first group of regions, males

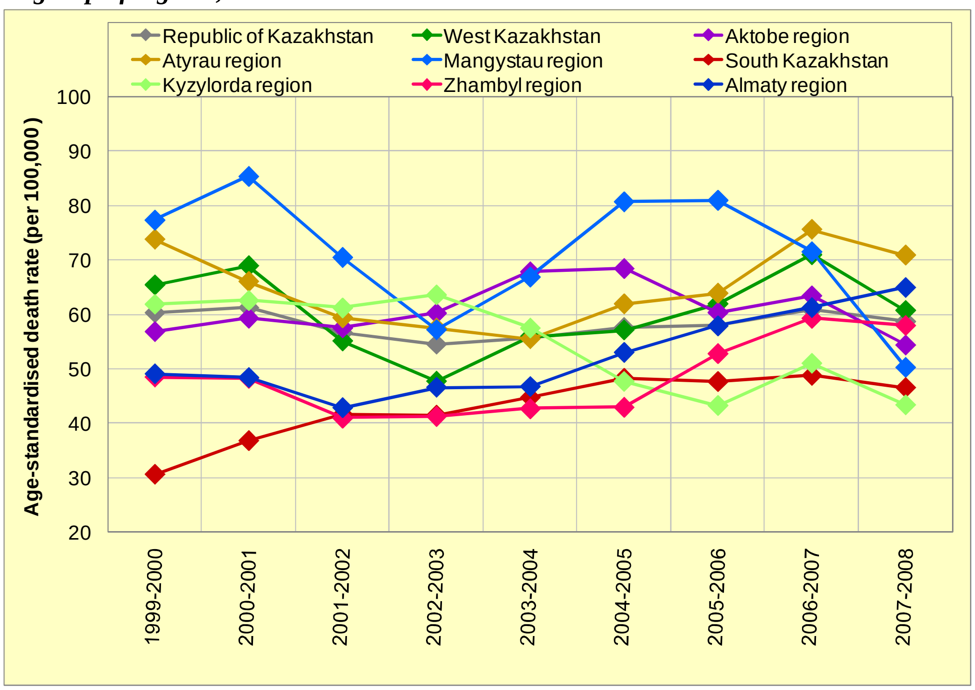


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality level from external causes in age group 5-19 was lower than that of males almost three times (22.3 per 100,000) in the country in the period 1999-2000. In this period among the regions of first group Kostanai, Pavlodar, Karagandy, East Kazakhstan regions had the above national level with the highest value in Kostanai (31.9 per 100,000) while the lowest value was noted in Astana city (12.6 per 100,000) among the regions with below national level. The regions had the fluctuation of level over time which seems very strong because of very low level of mortality (see Figure 14c). Between the periods 1999-2000 and 2007-2008 the level increased in Akmola, East Kazakhstan regions and Astana city while the biggest decrease was noted in Kostanai (11.2 per 100,000) among the regions with the level decrease. In the period 2007-2008 the national level was 25.7 deaths per 100,000 which indicated that the country had the increase of level compared to 1999-2000. Above national level was found in Akmola, Karagandy, and East Kazakhstan regions with the highest value in Akmola (35.9 per 100,000) while Almaty city had the lowest value (14.1 per 100,000) among the regions with below national level.

In the period 1999-2000 among the second group of regions the above national level was noted in West Kazakhstan, Kyzylorda, Atyrau and Mangystau regions. Atyrau region had the highest value with 31.8 deaths per 100,000. In the following periods the most of regions had the strong fluctuation as it was observed for the first group of regions (see Figure 14d). The gradual increase of level was noted in South Kazakhstan and Almaty regions while West Kazakhstan region indicated the increase with fluctuation over time. Atyrau and Kyzylorda regions demonstrated the decrease of level also with fluctuation. Mangystau region indicated the rapid decrease till the period 2001-2002 with the following rapid increase with fluctuation. This trend for Mangystau region indicated that the lowest level of female mortality in age group 5-19 in the period 2001-2002 was partly influenced by the level from external causes in the observed age group. Between the periods 1999-2000 and 2007-2008 the increase was observed in West Kazakhstan, South Kazakhstan, Almaty, and Zhambyl regions with the biggest increase in Almaty (12.8 per 100,000). The level decreased in Atyrau, Mangystau, and Kyzylorda regions. In the period 2007-2008 the level was above national in West Kazakhstan, Atyrau, Mangystau, South Kazakhstan, and Almaty regions with the highest value in Almaty (32.5 per 100,000). Aktobe and Kyzylorda regions indicated the below national level (21.6 and 18.8 per 100,000 respectively).

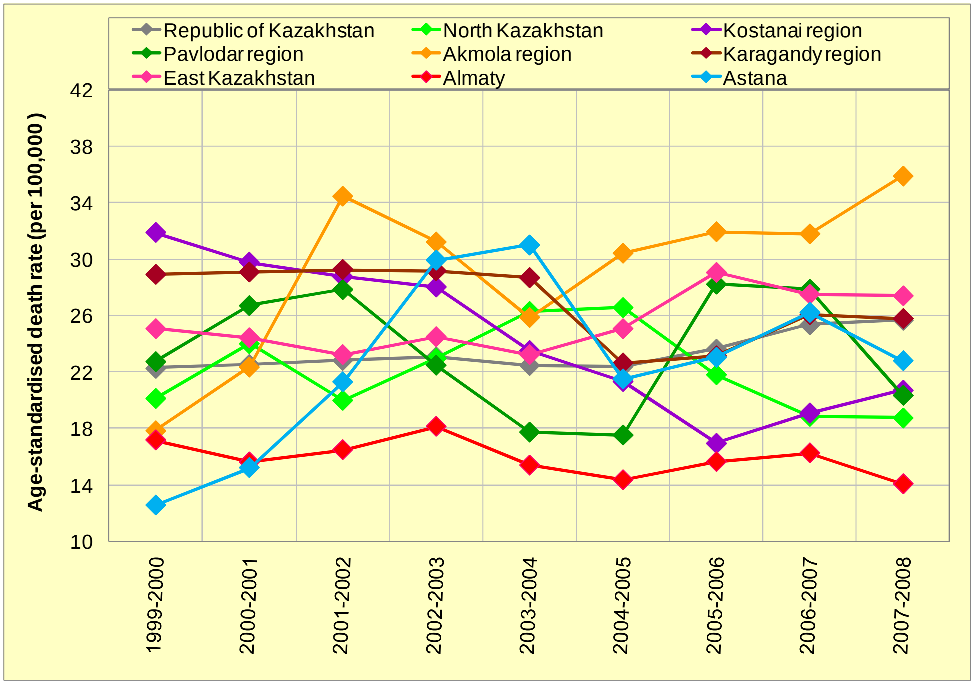
Figure 14b – Age-standardised death rate for external causes of mortality in age group 5-19, 1999-2008, the second group of regions, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

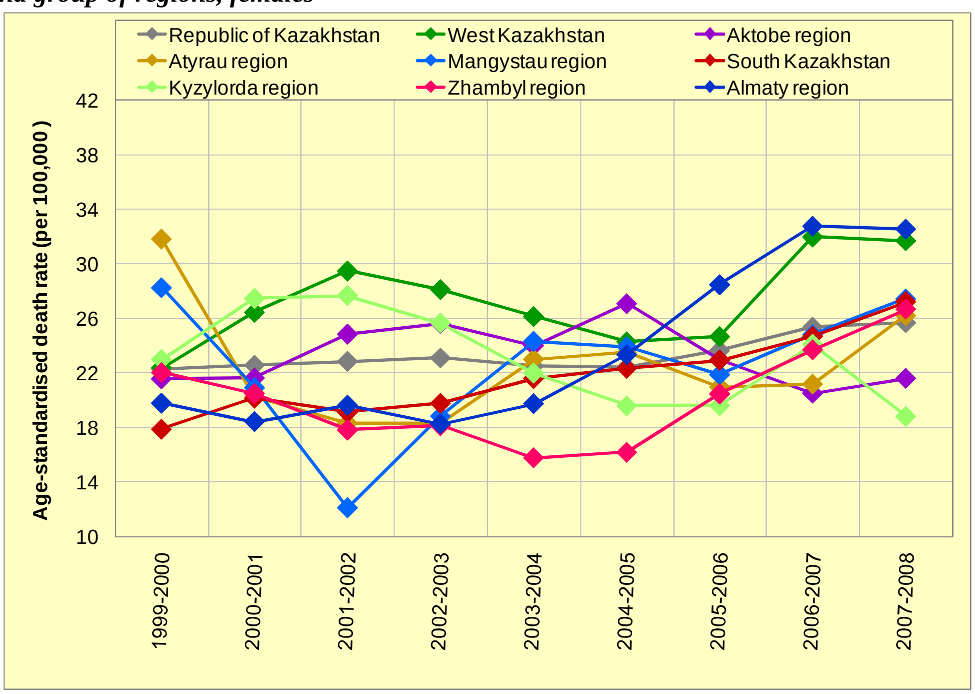
As a result, in period 1999-2000 female mortality level from external causes was above national in northern regions Kostanai, Pavlodar, central region Karagandy, eastern region East Kazakhstan, western regions West Kazakhstan, Atyrau, Mangystau, and southern region Kyzylorda with the highest values in Kostanai and Atyrau regions. Between the periods 1999-2000 and 2007-2008 the level increased in the country as well as Akmola, East Kazakhstan, West Kazakhstan, South Kazakhstan, Zhambyl, Almaty regions, and Astana city with the biggest increase in Akmola region. In the period 2007-2008 the above national level was noted in central, eastern regions, western regions West Kazakhstan, Atyrau, Mangystau, and southern regions South Kazakhstan, Zhambyl, and Almaty.

Figure 14c – Age-standardised death rate for external causes of mortality in age group 5-19, 1999-2008, the first group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 14d – Age-standardised death rate for external causes of mortality in age group 5-19, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The evidence indicated that in the period 1999-2000 mortality level for both sexes was above national in western regions West Kazakhstan, Atyrau, Mangystau, eastern region East Kazakhstan, and southern region Kyzylorda. However, female mortality level was above national only in some of northern and central regions while male mortality was the above national in all regions of these parts. For both sexes the level increased in South Kazakhstan, Zhambyl, and Almaty regions while it decreased in Kyzylorda region. Apart from males female mortality level increased in the country as well as in more regions compared to males. In the period 2007-2008 mortality level for both sexes was above national in central, eastern regions, western regions West Kazakhstan, Atyrau, and southern region Almaty.

Along with mortality from traffic accidents mortality from suicide and homicide especially in age group 15-19 is considered to be high in the country. According to the data of World Health Organisation Kazakhstan takes the third place in Europe by homicide rate among the young people aged 10-29 (10.66 per 100,000) after Russia and Albany (World Health Organization, 2010) while by suicide rate among the youth Kazakhstan takes the second place (34.5 per 100,000) after Russia among the countries of CIS (Bekirova, 2010).

9.3.3 Age group 20-64

For age group 20-64 neoplasms, diseases of the circulatory system, external cause of mortality were defined as the leading causes of death according to their higher level compared to other causes in the country.

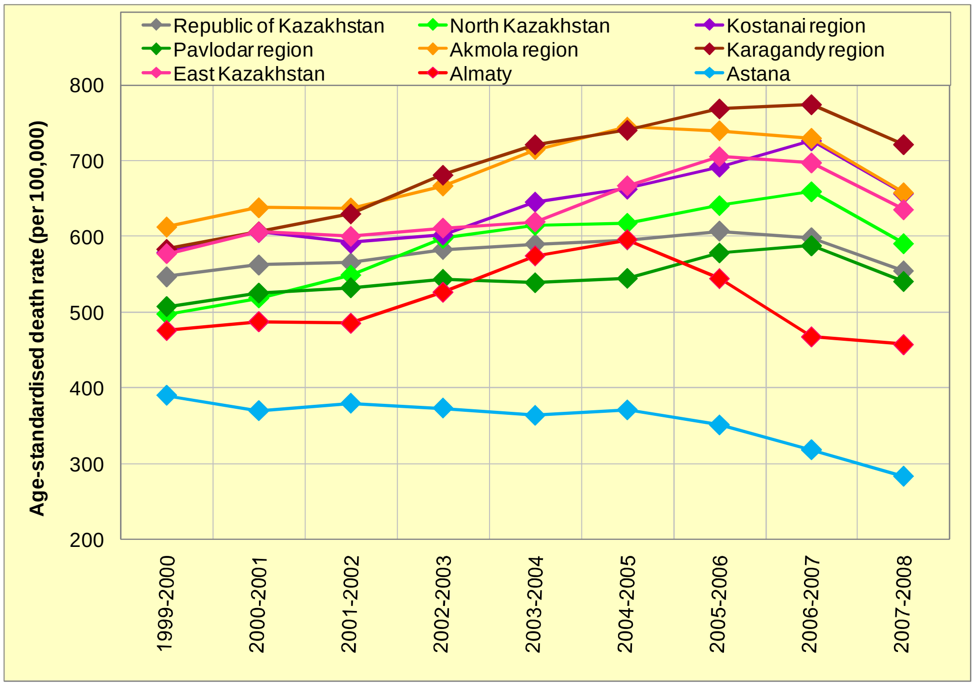
9.3.3.1 Diseases of the circulatory system

According to World Health Organization information cardiovascular diseases (CVDs) are the number one cause of death globally: more people die annually from CVDs than from any other cause (World Health Organization, 2011c). Male mortality level from diseases of circulatory system was 546.7 per 100,000 in the country in the period 1999-2000. In this period the above national level was found in Kostanai, Akmola, Karagandy, and East Kazakhstan regions while the lowest value was noted in Astana city (390.0 per 100,000) among the regions with below national level. It is worth to note that the regions except Astana city had the close level to national one. In the following periods the most of regions had the increase of level over time with the slight decrease in the period 2007-2008 (see Figure 15a). More rapid increase was observed in Karagandy, Akmola, East Kazakhstan, and Kostanai regions while the country and Pavlodar region had the slow increase over time. Astana city was slowly decreasing the level while Almaty city had more stable trend with fluctuation between the periods 2001-2002 and 2006-2007. The evidence indicated that the fluctuation in male mortality level trend in age group 20-64 in the city was partly explained by the trend of male mortality level from circulatory system diseases in the observed age group.

Between the periods 1999-2000 and 2007-2008 the level increased in all regions as well as the country (from 546.7 to 554.5 per 100,000) except Astana and Almaty cities. It is worth to note that in the regions the increase of level was above national with the biggest increase in Karagandy region (138.3 per 100,000). In municipal cities the level decreased between two periods with the biggest decrease in Astana city (107.1 per 100,000). In the period 2007-2008 the level was 554.5

deaths per 100,000 in the country. The above national level was found in all regions except Astana, Almaty cities, and Pavlodar region. It is worth to note that Pavlodar region had the smallest increase among the regions (33.1 per 100,000) of first group.

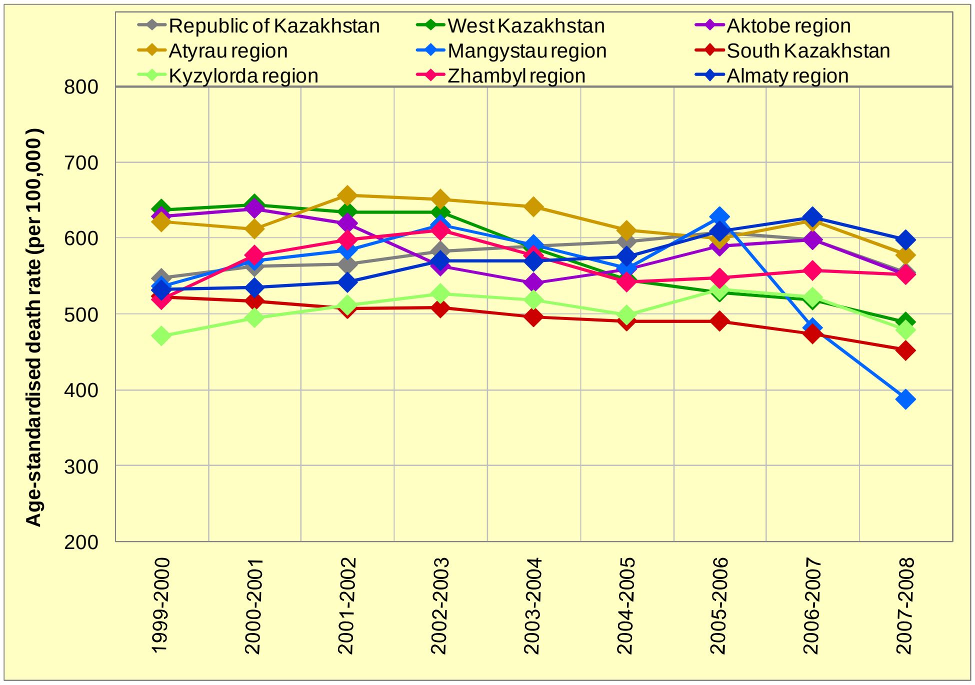
Figure 15a – Age-standardised death rate for diseases of the circulatory system in age group 20-64, 1999-2008, the first group of regions, males



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Among the second group of regions in the period 1999-2000 the above national level of male mortality was observed in West Kazakhstan, Aktobe, and Atyrau regions with the highest value in West Kazakhstan (637.3 per 100,000). Kyzylorda region had the lowest value (470.5 per 100,000) among the regions with below national level. In the following periods the regions were not observing the increase as it was noted for regions of the first group (see Figure 15b). Almaty region among them had the gradual increase over time with the slight decrease in the period 2007-2008. West Kazakhstan which observed the highest level in the period 1999-2000 was constantly decreasing it over time. Aktobe and Atyrau regions indicated the decrease with somehow fluctuation over time. Between the periods 1999-2000 and 2007-2008 Kyzylorda, Zhambyl, and Almaty regions increased the level while other regions indicated the decrease with the biggest decrease in West Kazakhstan region (148.7 per 100,000). It is worth to note that Mangystau region sharply decreased the level from 627.2 in the period 2005-2006 to 473.7 deaths per 100,000 in the period 2006-2007, and further to 387.9 in the period 2007-2008. Mortality level from respiratory system diseases sharply increased in the same periods in the region for both sexes (see Appendices 13a and 13b). This case was explained by author in chapter 5.3 as the problem of data quality. In the period 2007-2008 the above national level was found in Atyrau and Almaty regions (577.6 and 597.2 per 100,000 respectively) while the lowest value was noted in South Kazakhstan region (451.9 per 100,000) among the regions with the below national level.

Figure 15b – Age-standardised death rate for diseases of the circulatory system in age group 20-64, 1999-2008, the second group of regions, males

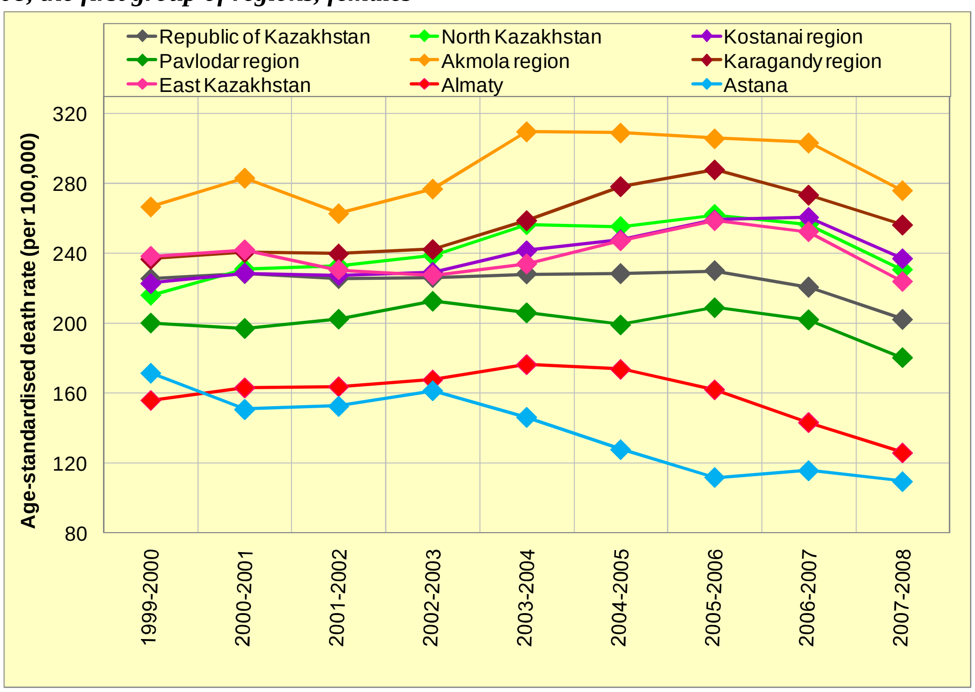


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 male mortality level from diseases of the circulatory system was above national in central, eastern regions, northern region Kostanai, western regions West Kazakhstan, Aktobe, Atyrau. Between the periods 1999-2000 and 2007-2008 the level increased in the country as well as all northern, central, eastern regions, and southern regions Kyzylorda, Zhambyl, Almaty. The decrease was observed in all western regions, southern region South Kazakhstan, and Astana, Almaty cities with the biggest improvement in West Kazakhstan region. In the period 2007-2008 the above national level was noted in central, eastern regions, northern regions Kostanai, North Kazakhstan, western region Atyrau, and southern region Almaty while the lowest value was observed in Astana city among the regions with below national level.

Female mortality level from diseases of the circulatory system in age group 20-64 was twice lower than that of males in the country in the period 1999-2000 (225.4 per 100,000). In this period among the regions of first group the above national level was observed in Akmola, Karagandy, East Kazakhstan regions with the highest value in Akmola region (266.8 per 100,000). Among the regions with below national level the lowest values were noted in Astana and Almaty cities (171.5 and 156.0 per 100,000 respectively). In the following periods the country had the stable trend with the slow decline from the period 2005-2006 (see Figure 15c). Akmola, Karagandy, North Kazakhstan, East Kazakhstan, and Kostanai regions were observing the slow increase with the slight decline in the period 2007-2008. More stable trend with weak fluctuation over time and the slight decrease in the period 2007-2008 was noted in Pavlodar region. Almaty city was slowly increasing the level till the period 2003-2004 with the following gradual decrease over time while Astana city was gradually decreasing the level with weak fluctuation over time. Between the periods 1999-2000 and 2007-2008 North Kazakhstan, Kostanai, Akmola, Karagandy regions demonstrated the increase of level with the biggest increase in Karagandy (19.3 per 100,000). Pavlodar, East Kazakhstan regions, Astana, Almaty cities indicated the improvement of level with the biggest decrease in Astana city (61.9 per 100,000). As a result, in the period 2007-2008 the national level was 202.3 per 100,000. The above national level was found in North Kazakhstan, Kostanai, Akmola, Karagandy, East Kazakhstan regions with the highest value in Akmola (276.1 per 100,000). The below national level was observed in Pavlodar region, and Almaty, Astana cities with the lowest value in Astana city (109.6 per 100,000).

Figure 15c – Age-standardised death rate for diseases of the circulatory system in age group 20-64, 1999-2008, the first group of regions, females

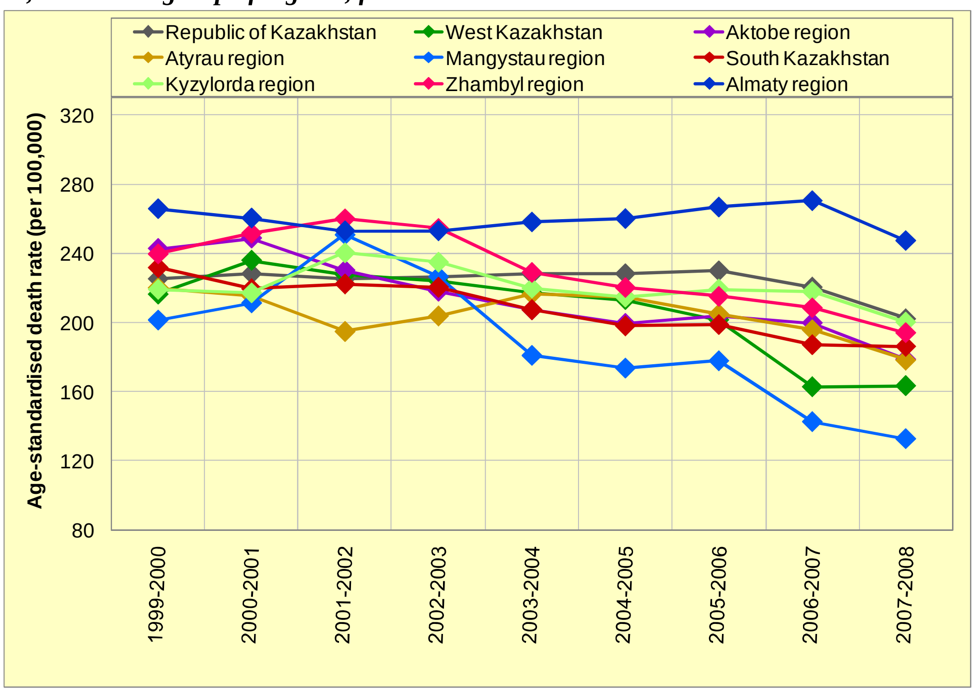


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The second group of regions indicated the very close level to national one apart from the first group of regions in the period 1999-2000. However, the above national level was observed in Almaty, South Kazakhstan, Zhambyl, Aktobe regions with the highest value in Almaty region (265.8 per 100,000). Among the regions with below national level the lowest value was noted in Mangystau region (201.4 per 100,000). In the following periods the regions had the trend of decrease except Almaty region (see Figure 15d). Almaty region was slowly increasing the level between the periods 2001-2002 and 2006-2007with the following slight decrease in the period 2007-2008. Zhambyl, Kyzylorda, Atyrau regions were decreasing the level with fluctuation while

Aktobe, South Kazakhstan, West Kazakhstan regions observed the decrease more smoothly. Mangystau region had the decrease of level between the periods 2001-2002 and 2005-2006 with further decrease in the following periods. Apart from males female mortality level did not indicate the sharp decrease in the period 2006-2007 while for respiratory system diseases the increase was visible sharp (see Appendix 13b). Despite this fact we have to take into account the case explained in chapter 5.3 for both sexes. In the period 2007-2008 the above national level was noted only in Almaty region. Other regions indicated the below national level with the lowest value in West Kazakhstan region (163.5 per 100,000). Between two periods the regions of the second group decreased the level apart from the first group regions with the biggest decrease in Aktobe region (64.1 per 100,000) and the smallest one in Almaty region (18.6 per 100,000).

Figure 15d – Age-standardised death rate for diseases of the circulatory system in age group 20-64, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 female mortality level from the diseases of circulatory system was above national in central, eastern regions, western region Aktobe, southern regions South Kazakhstan, Zhambyl, and Almaty while the lowest level was noted in Almaty, Astana cities. The increase of level was observed in central regions, and northern regions North Kazakhstan, Kostanai while the northern region Pavlodar, western, eastern, southern regions, and Astana, Almaty cities indicated the decrease with the biggest decrease in Aktobe region and Astana city. In the period 2007-2008 the above national level was found in northern part North Kazakhstan, Kostanai, central, eastern regions, and southern part Almaty region while the lowest level among the regions with the below national one was noted in Astana city.

The evidence indicated that the level of mortality from circulatory system diseases in age group 20-64 for both sexes was above national in central, eastern regions, northern region Kostanai, western region Aktobe. Between the periods 1999-2000 and 2007-2008 the level for males increased while the level for females decreased in the country. The increase of level was observed in central regions, northern regions Kostanai, North Kazakhstan while the decrease was noted in southern, western regions, Astana, Almaty cities for both sexes. In the period 2007-2008 the above national level was noted in central regions, northern regions North Kazakhstan, Kostanai, and southern region Almaty. The lowest level of mortality from circulatory system diseases for both sexes was noted in Astana city among the regions in both periods.

According to World Health Organisation information the people in low and middle-income countries are more exposed to risk factors leading to cardiovascular diseases and are less exposed to prevention efforts than people in high-income countries (World Health Organisation, 2011c). In the country western regions, and Astana, Almaty cities are considered to be the regions with rapid socio-economic development with more rapid increase of average income and the proportion of highly educated population. Namely these regions could improve mortality level from this cause for both sexes.

9.3.3.2 Neoplasms

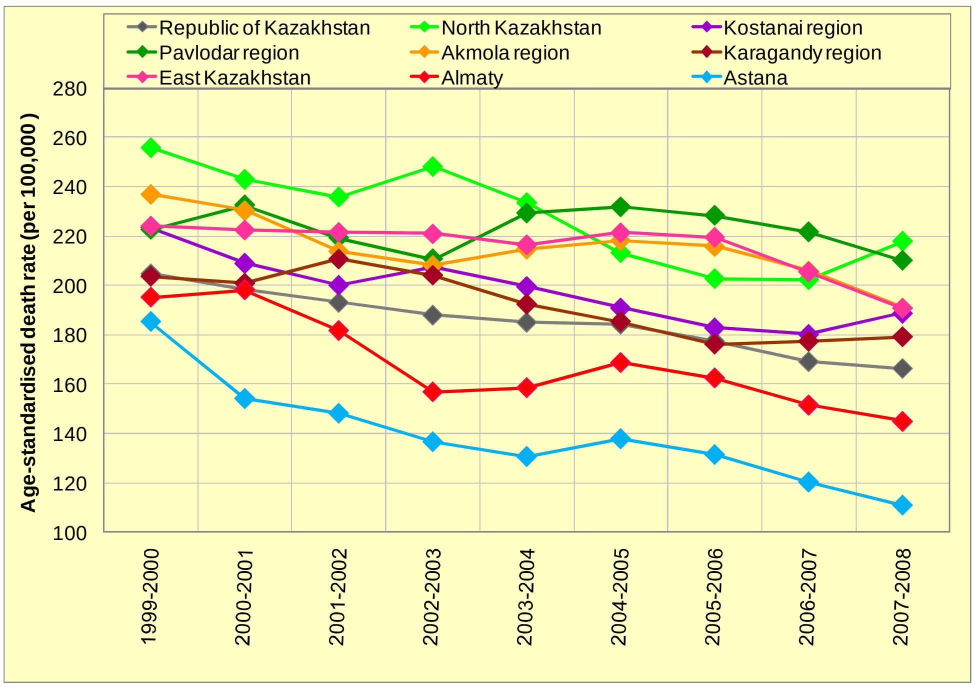
According to WHO (World Health Organisation) information cancer is a leading cause of death worldwide and accounted for 7.6 million deaths (around 13% of all deaths) in 2008 (World Health Organisation, 2011b).

This situation is not different for Kazakhstan. In age group 20-64 male mortality level from neoplasms was 204.7 deaths per 100,000 in the country. Among the regions of first group North Kazakhstan, Kostanai, Pavlodar, Akmola, East Kazakhstan had the above national level with the highest value in North Kazakhstan (255.9 per 100,000) in the period 1999-2000. The below national level was observed in Karagandy region (203.7 per 100,000), and Almaty, Astana cities (195.1 and 185.2 per 100,000 respectively). In the following periods the country as well as the regions indicated the gradual decrease of level over time (see Figure 16a).

Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 204.7 to 166.3 per 100,000. All regions observed the decrease with above national decrease in Akmola region, and Astana, Almaty cities. The below national decrease was observed in North Kazakhstan, Kostanai, Pavlodar, Karagandy, East Kazakhstan regions. In the period 2007-2008 the national level was 166.3 deaths per 100,000. The above national level was observed in all northern, central, and eastern regions while Astana and Almaty cities indicated the below national level.

Among the second group of regions the above national level was noted in West Kazakhstan, Aktobe, Atyrau regions with the highest value in West Kazakhstan (250.3 per 100,000) in the period 1999-2000.The lowest level was found in South Kazakhstan region (141.4 per 100,000) which was even lower than in Astana and Almaty cities. In following periods the level was decreasing in the regions with fluctuation over time (see Figure 16b). West Kazakhstan rapidly decreasing the level over time increased it in the period 2007-2008. Between the periods 1999-2000 and 2007-2008 all regions decreased the level with the above national decrease in Atyrau, Mangystau, and Aktobe regions. West Kazakhstan, South Kazakhstan, Kyzylorda, Zhambyl, and Almaty regions indicated the below national decrease. In the period 2007-2008 Aktobe (188.6 per 100,000) and West Kazakhstan (218.8 per 100,000) regions had above national level while South Kazakhstan region indicated again the lowest value (114.3 per 100,000) among the regions with below national level decreasing it over time. It is worth to note that Atyrau region indicated the below national level in the period 2007-2008 apart from 1999-2000 thanks to its above national improvement.

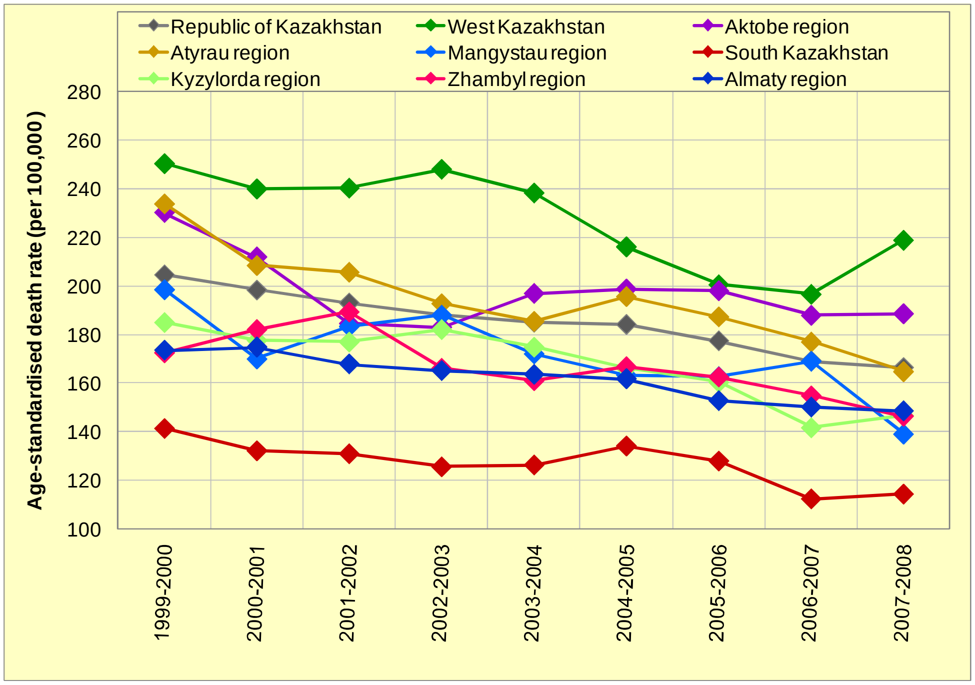
Figure 16a − Age-standardised death rate for neoplasms in age group 20-64, 1999-2008, the first group of regions, males



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 male mortality level from neoplasms in age group 20-64 was above national in northern, eastern regions, central region Akmola, western regions West Kazakhstan, Aktobe, Atyrau while it was lowest in South Kazakhstan region among the regions with below national level. Between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as the regions. The biggest decrease was noted in Astana, Almaty cities and Atyrau, Mangystau regions. In the period 2007-2008 the level was above national in northern, eastern regions, central region Akmola, and western regions West Kazakhstan, Aktobe regions while the lowest level was observed in Astana city and South Kazakhstan region.

Figure 16b – Age-standardised death rate for neoplasms in age group 20-64, 1999-2008, the second group of regions, males

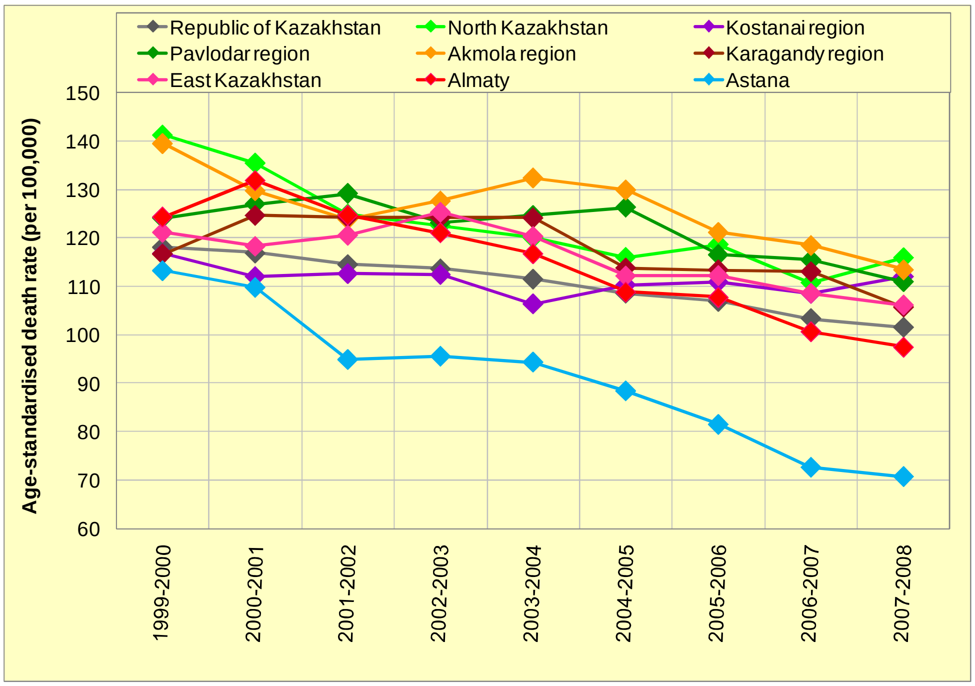


***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality level from observed cause was lower compared to males in the country in the period 1999-2000 (118.1 per 100,000). Above national level was observed in North Kazakhstan, Pavlodar, Akmola, East Kazakhstan regions, and Almaty city with the highest values in North Kazakhstan (141.3 per 100,000) and Akmola (139.5 per 100,000) regions. The lowest level was noted in Astana city (113.3 per 100,000) among the regions with below national level. In the following periods the regions had the trend of decrease over time with more rapid decrease in Astana city (see Figure 16c). Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 118.1 to 101.5 per 100,000. The above national decrease was noted in North Kazakhstan, Akmola regions, and Astana, Almaty cities with the biggest decrease in Astana (42.6 per 100,000). In the period 2007-2008 Astana and Almaty cities had the below national level (97.5 and 70.7 per 100,000 respectively) while other regions indicated the above national level.

Among the second group of regions West Kazakhstan, Aktobe, and Kyzylorda had above national level while South Kazakhstan (90.9 per 100,000) indicated the lowest value among the regions with below national one. In the following periods the regions of the second group had the fluctuation of level over time compared to regions of the first group (see Figure 16d). The strong fluctuation was observed in Mangystau region which was increasing the level between the periods 1999-2000 and 2004-2005 with fluctuation and was decreasing the level in the following periods. South Kazakhstan region did not indicate such decrease as it was observed for males, it slightly increased the level in the period 2007-2008. Between the periods 1999-2000 and 2007-2008 the level decreased in all regions except South Kazakhstan. South Kazakhstan region increased the level for 1.0 death between two periods. The biggest decrease was noted in Aktobe region (32.4 per 100,000) which had the highest level in the period 1999-2000. In the period 2007-2008 the level was above national in West Kazakhstan, Atyrau, and Kyzylorda regions with the highest value in West Kazakhstan region (119.0 per 100,000). It is worth to note that West Kazakhstan region had the smallest decrease among all regions (1.7 per 100,000).

Figure 16c – Age-standardised death rate for neoplasms in age group 20-64, 1999-2008, the first group of regions, females

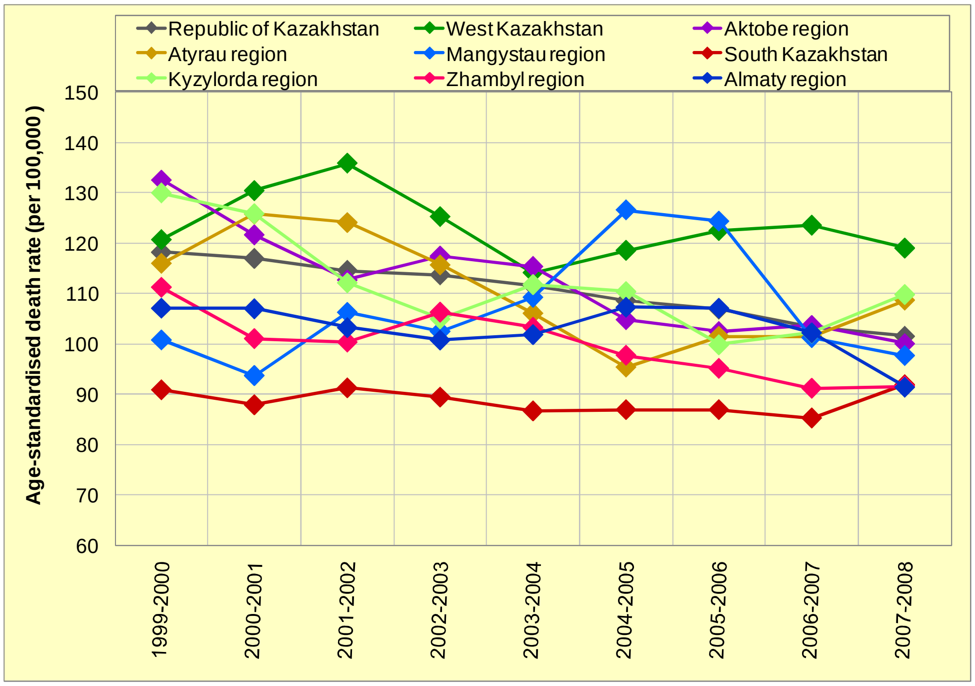


***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 female mortality level from neoplasms in age group 20-64 was above national in northern regions North Kazakhstan, Pavlodar, central region Akmola, eastern region East Kazakhstan, western regions West Kazakhstan, Aktobe, southern region Kyzylorda while South Kazakhstan region had the lowest level among all regions. Between the periods 1999-2000 and 2007-2008 the level decreased in all regions with the biggest decrease in Astana city and Atyrau region. South Kazakhstan increased the level slightly. In the period 2007-2008 the above national level was noted in all northern, central, eastern regions, western regions Atyrau, West Kazakhstan, and southern region Kyzylorda while the level was lowest in Astana city among the regions.

The evidence demonstrated that mortality level from neoplasms indicated the improvement for both sexes in the country as well as its regions with the bigger decrease for males. Among the regions the biggest improvement was noted in Astana city for both sexes. According to World Health Organization information tobacco use, alcohol use, and unhealthy diet are the main risk factors of cancer (World Health Organization, 2011b). It is well established that highly educated people are better informed about health damaging factors and are also less likely to smoke and use alcohol than lower educated ones (Groot and van den Brink, 2006). Therefore, the main factor of the biggest mortality decline from neoplasms in the city would be the highest proportion of population of highly educated population and its enormous increase there.

Figure 16d – Age-standardised death rate for neoplasms in age group 20-64, 1999-2008, the second group of regions, females



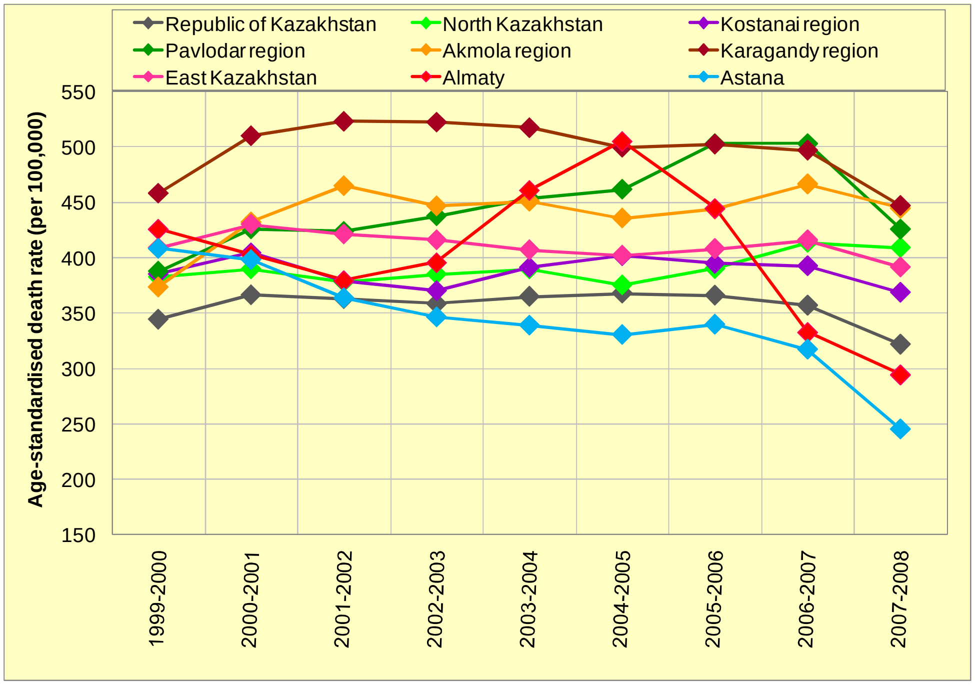
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

9.3.3.3 External causes of mortality

Male mortality level from external causes was 344.4 per 100,000 in the country in the period 1999-2000. All regions of the first group had the above national level in the period 1999-2000 with the highest value in Karagandy region (457.9 per 100,000). In the following periods the country had the stable trend from the period 2000-2001 with the slight decrease in the period 2007-2008 (see Figure 17a). The regions except Astana city did not observe the visible decrease of the level. Astana city was gradually decreasing the level over time while Akmola and Pavlodar regions were increasing the level with the slight decrease in the period 2007-2008. More stable trend was observed in Kostanai, North Kazakhstan, and East Kazakhstan regions.

The decrease of level in Almaty city was observed with fluctuation between the periods 2002-2003 and 2006-2007. This fluctuation indicated that the trend of male mortality level in age group 20-64 in the city was influenced by the trend of the level from external causes as well as the circulatory system diseases. Between the periods 1999-2000 and 2007-2008 the level increased in North Kazakhstan, Pavlodar, and Akmola regions with the biggest increase in Akmola region (70.7 per 100,000) while the decrease was found in other regions with the biggest one in Astana and Almaty cities (163.3 and 131.4 per 100,000). In the period 2007-2008 male mortality level was 322.0 per 100,000 in the country. The above national level was found in all regions of the first group except Almaty and Astana cities (294.5 and 244.9 per 100,000 respectively).

Figure 17a – Age-standardised death rate for external causes of mortality in age group 20-64, 1999-2008, the first group of regions, males

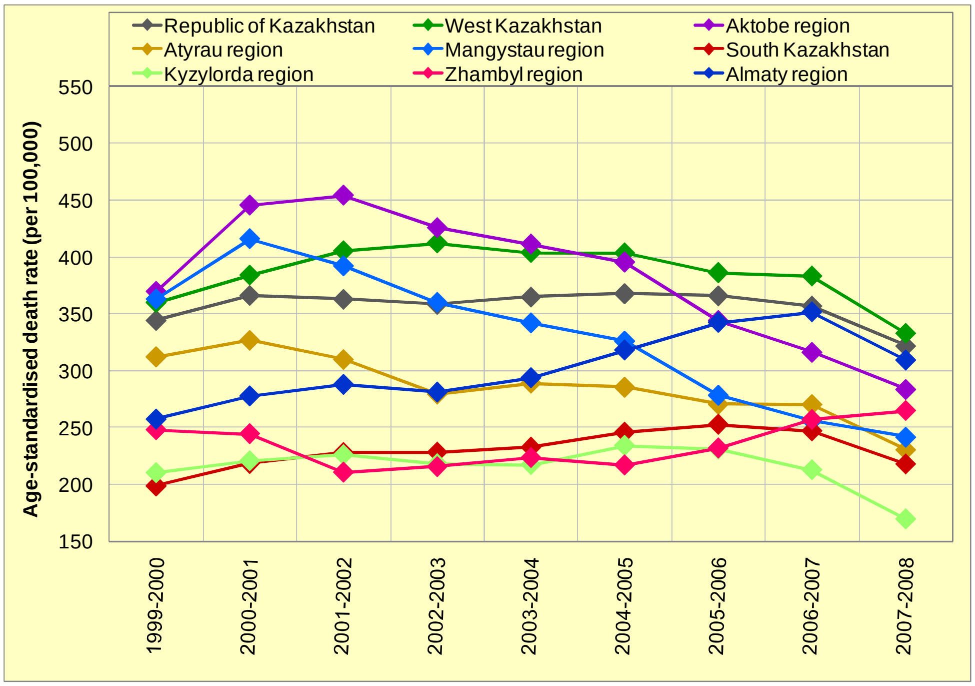


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 among the regions of second group the above national level was found in West Kazakhstan, Aktobe, and Mangystau regions with the highest value in Aktobe region (369.7 per 100,000). Atyrau, South Kazakhstan, Kyzylorda, Zhambyl, and Almaty regions indicated the below national level. The lowest level was noted in South Kazakhstan region with 198.9 deaths per 100,000. In the following periods Aktobe, Mangystau, Atyrau regions were observing the decrease (see Figure 17b). In contrary, Almaty and South Kazakhstan regions were observing the increase over time with the slight decrease in the period 2007-2008. Between the periods 1999-2000 and 2007-2008 the increase of level occurred in South Kazakhstan, Zhambyl, and Almaty regions with the biggest increase in Almaty region (51.7 per 100,000). Other regions indicated the improvement of level with the biggest decrease in Mangystau region (121.2 per 100,000). In the period 2007-2008 the above national level was noted only in West Kazakhstan region (332.7 per 100,000) while the lowest value was found in Kyzylorda region (169.5 per 100,000) among the regions with the below national level.

As a result, in the period 1999-2000 male mortality level from external causes in age group 20-64 was above national in all northern, central, eastern regions, western regions West Kazakhstan, Aktobe, Mangystau, and municipal Astana, Almaty cities. Between the periods 1999-2000 and 2007-2008 the level increased in northern regions North Kazakhstan, Pavlodar, central region Akmola, southern regions South Kazakhstan, Zhambyl, and Almaty while it decreased in western, eastern regions, northern region Kostanai, central region Karagandy, and southern region Kyzylorda with the biggest decrease in Astana city. In the period 2007-2008 the level was above national in all northern, central, eastern regions, and western region West Kazakhstan region while the level was lowest in Kyzylorda region among the regions with below national level.

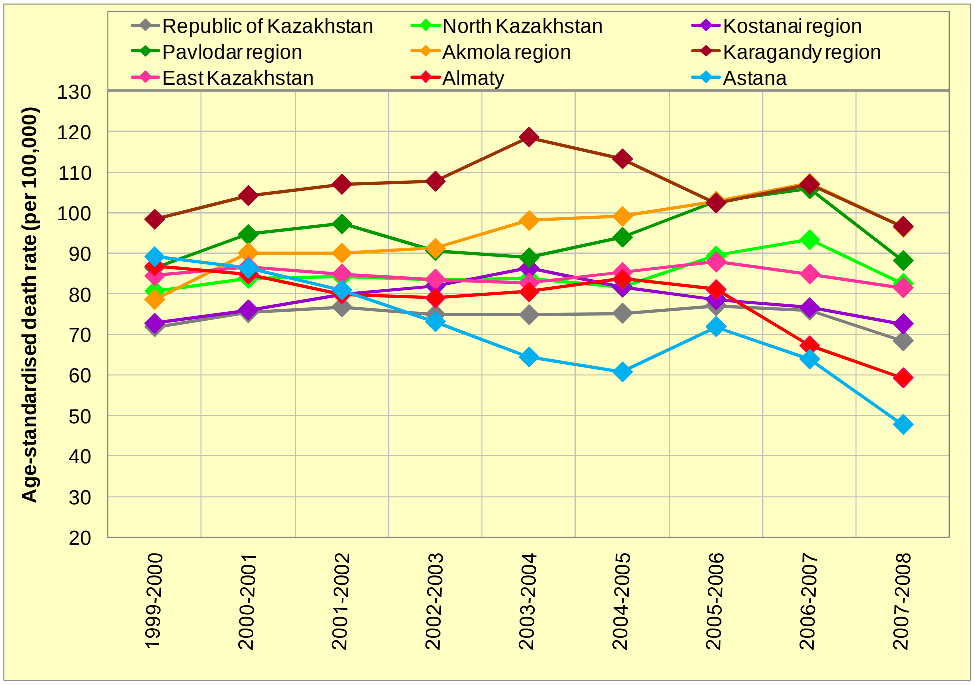
Figure 17b – Age-standardised death rate for external causes of mortality in age group 20-64, 1999-2008, the second group of regions, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality level from external causes in age group 20-64 was three times lower (71.8 per 100,000) than that of males in the country in the period 1999-2000. In this period all regions of the first group had above national level (see Figure 17c). Karagandy region had the highest level among all regions (98.4 per 100,000). In the following periods the national level was stable with the slight decrease in the period 2007-2008. The increase of the level was observed in Akmola, Pavlodar, and North Kazakhstan regions with the decrease in the period 2007-2008. Almaty and Astana cities were decreasing the level over time with fluctuation in Astana city. Between the periods 1999-2000 and 2007-2008 the national level decreased from 71.8 to 68.4 per 100,000. The level increased in North Kazakhstan, Pavlodar, Akmola regions with the biggest increase in Akmola region (17.8 per 100,000) while Astana and Almaty cities indicated the biggest decrease among the regions with the level decrease. In the period 2007-2008 the national level was 68.4 per 100,000. The above national level was observed in all regions except Astana and Almaty cities (47.7 and 59.3 per 100,000 respectively). Thanks to substantial decrease of level over time the municipal cities could indicate the below national level in the period 2007-2008 apart from 1999-2000.

Figure 17c – Age-standardised death rate for external causes of mortality in age group 20-64, 1999-2008, the first group of regions, females

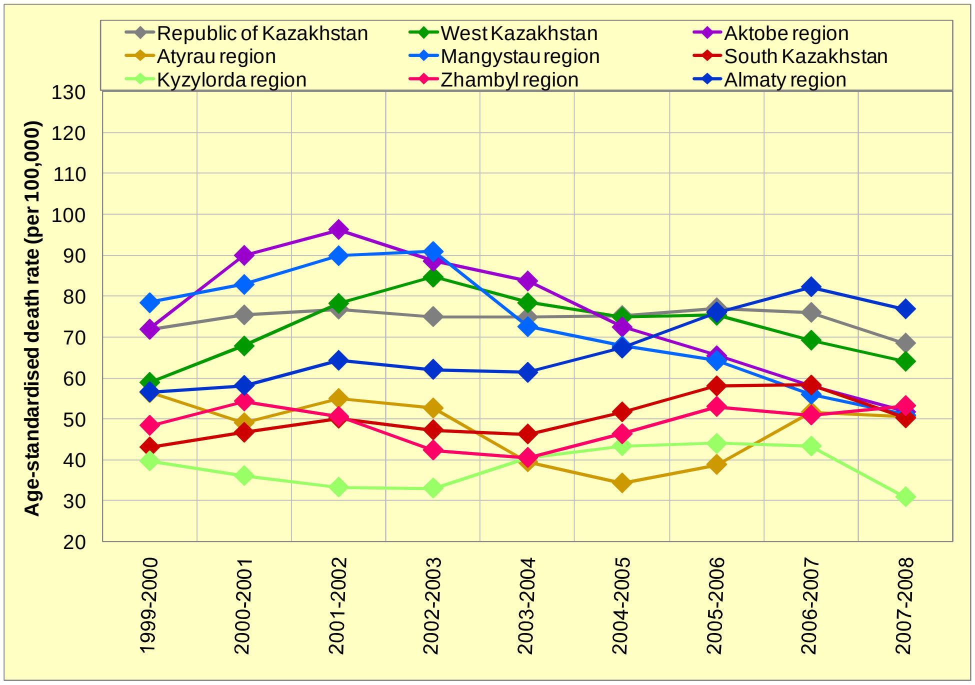


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 among the regions of second group only Aktobe and Mangystau (71.9 and 78.4 per 100,000 respectively) regions had the above national level. Kyzylorda region indicated the lowest level (39.7 per 100,000) among the regions which was almost twice lower than national level. In the following periods the regions indicated the different trend (see Figure 17d). Between the periods 1999-2000 and 2007-2008 the level increased in West Kazakhstan, South Kazakhstan, Zhambyl, Almaty regions with the biggest increase in Almaty region (20.2 per 100,000). The biggest decrease was noted in Mangystau region (27.5 per 100,000) among the regions with the level decrease. In the period 2007-2008 the above national level was noted only in Almaty region (76.8 per 100,000) while the lowest value was noted in Kyzylorda (30.9 per 100,000) among the regions with below national level as it was observed in the period 1999-2000.

As a result, in the period 1999-2000 the above national female mortality level from external causes was noted in all northern, central, eastern regions, western regions Aktobe, Mangystau, municipal Astana and Almaty cities with the highest level in Karagandy region while the below national level was observed in all southern regions, western regions West Kazakhstan, Atyrau. Between the periods 1999-2000 and 2007-2008 northern regions North Kazakhstan, Pavlodar, central region Akmola, western region West Kazakhstan, southern regions South Kazakhstan, Zhambyl increased the level with the biggest increase in Almaty region while other regions indicated the decrease of level with the biggest one in Astana, Almaty cities, and Mangystau region. In the period 2007-2008 all northern, central, eastern regions and southern region Almaty indicated the above national level with the highest level in central regions. The lowest level was noted in Kyzylorda region among the regions with below national level as it was observed in the period 1999-2000.

Figure 17d – Age-standardised death rate for external causes of mortality in age group 20-64, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The evidence demonstrated that in northern, central, and eastern regions mortality level from external causes for both sexes were above national in both periods. The evidence would be partly explained by industrial and urbanized character of East Kazakhstan, Karagandy, and Pavlodar regions which would be the reasons of external accidents. Moreover, the regions of these parts have highest proportion of Russian population among all regions (see Chapter 7.5). Kazakhs have stronger social network than their European counterparts which save them more from external causes (suicide, homicide and other self-destructive behaviour) (Becker and Urzhumova, 2005) which would be the reason of higher mortality level from external causes in northern, central, and eastern part regions.

9.3.4 Age group 65-84

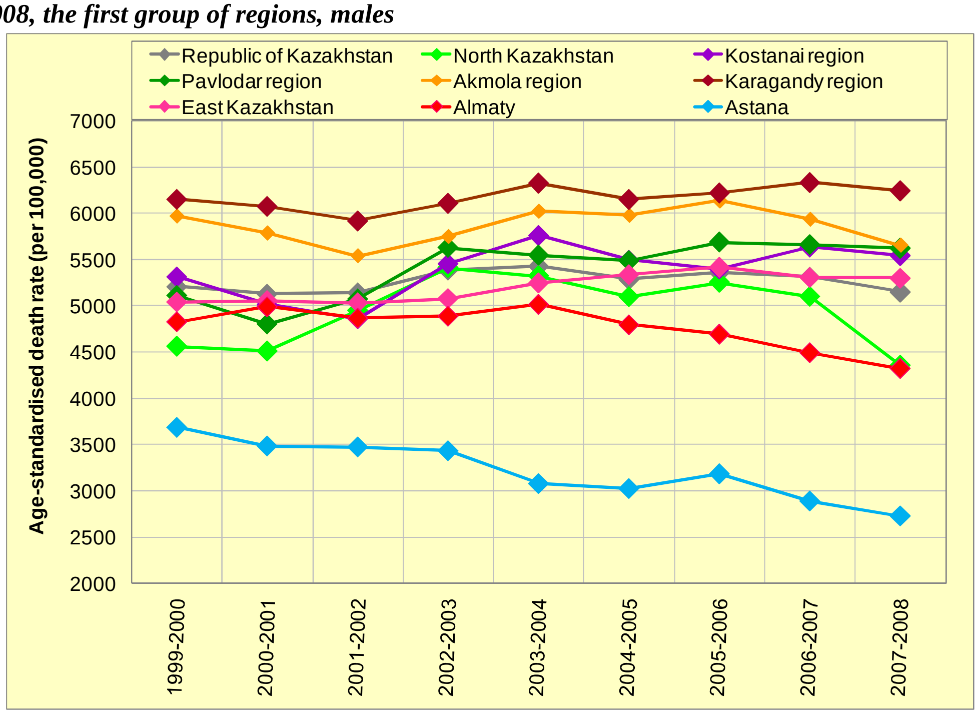
For age group 65-84 neoplasms, diseases of the circulatory system, diseases of the respiratory system were defined as the leading causes according to their highest level in the examined age group.

9.3.4.1 Diseases of the circulatory system

Male mortality level from diseases of circulatory system in age group 65-84 was 5209.3 deaths per 100,000 persons in the country in the period 1999-2000. Among the first group of regions the level was above national in Kostanai, Akmola, Karagandy regions with the highest value in Akmola and Karagandy regions (5971.9 and 6151.8 per 100,000 respectively). North Kazakhstan, Pavlodar, East Kazakhstan regions, and Astana, Almaty cities indicated the below national level with the lowest value in Astana city (3686.8 per 100,000). In the following periods the country as well as the regions did not observe the substantial decrease or increase (see Figure 18a).

Between the periods 1999-2000 and 2007-2008 the country observed the decrease from 5209.3 to 5152.1 deaths per 100,000 persons which was not quite big. North Kazakhstan, Akmola regions, Astana and Almaty cities indicated the decrease of level with the biggest decrease in Astana and Almaty cities (962.8 and 505.8 per 100,000 respectively). Kostanai, Pavlodar, Karagandy, East Kazakhstan regions observed the increase of level. In the period 2007-2008 the above national level was noted in Kostanai, Pavlodar, Akmola, Karagandy, East Kazakhstan regions with the highest level in Karagandy region (6244.0 per 100,000). The below national level was found in North Kazakhstan region, and Astana, Almaty cities with the lowest level in Astana city (2724.0 per 100,000). It is worth to note that Pavlodar and East Kazakhstan regions with the below national level in the period 1999-2000 indicated the above national level in the period 2007-2008 because of substantial increase of level in the regions.

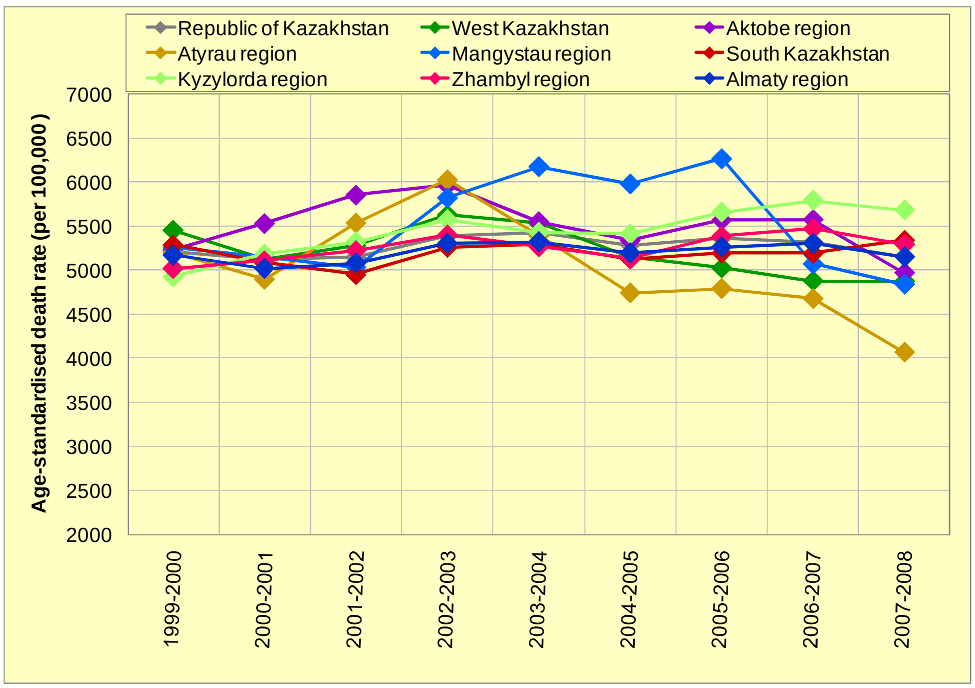
Figure 18.a – Age-standardised death rate for diseases of the circulatory system in age group 65-84, 1999-2008, the first group of regions, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 among the regions of second group West Kazakhstan, Aktobe, Mangystau, South Kazakhstan regions had the above national level with the highest value in West Kazakhstan (5455.2 per 100,000). Atyrau, Kyzylorda, Zhambyl, and Almaty regions indicated the below national level with the lowest value in Kyzylorda (4926.9 per 100,000). Atyrau region indicated the rapid increase between the period 2000-2001 and 2002-2003 with the following rapid decrease between the periods 2002-2003 and 2004-2005 (see Figure 18b). Kyzylorda region indicated the slow increase with weak fluctuation while Aktobe region demonstrated the decrease between the periods 1999-2000 and 2007-2008 with the stronger fluctuation over time. Other regions as well as the country had somehow stable level with weaker fluctuation over time. Between two periods Kyzylorda, Zhambyl, South Kazakhstan regions indicated the increase with the biggest one in Kyzylorda (754.4 per 100,000) while other regions indicated the decrease with the biggest decrease in Atyrau region (1130.7 per 100,000). In the period 2007-2008 the above national level was noted in South Kazakhstan, Zhambyl, Kyzylorda regions with the highest value in Kyzylorda region (5681.3 per 100,000) while Atyrau region demonstrated the lowest value (4067.0 per 100,000) among the regions with below national level.

Figure 18b – Age-standardised death rate for diseases of the circulatory system in age group 65-84, 1999-2008, the second group of regions, males

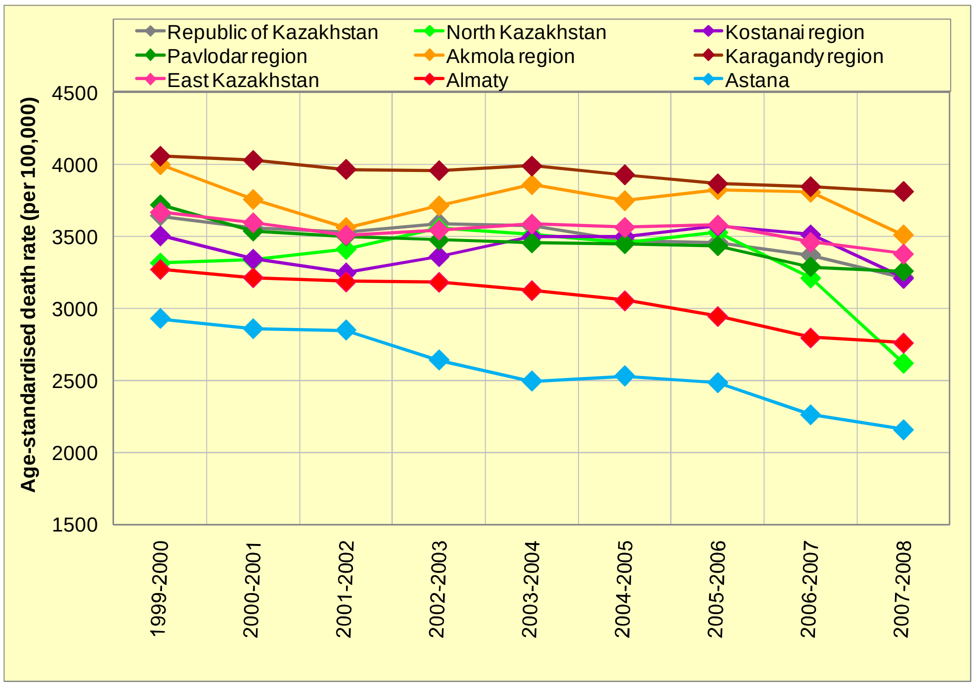


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 central regions, northern region Kostanai, western regions West Kazakhstan, Aktobe, Mangystau, and southern region South Kazakhstan indicated the above national level with the highest value in central region Karagandy while Astana city indicated the lowest value among the regions with below national level. Between the periods 1999-2000 and 2007-2008 the country as well as western regions, northern region North Kazakhstan, central region Akmola, southern region Almaty, and municipal Astana, Almaty cities indicated the decrease of level. Northern regions Kostanai, Pavlodar, central region Karagandy, eastern region East Kazakhstan, southern regions South Kazakhstan, Zhambyl, and Kyzylorda indicated the increase of level. In the period 2007-2008 central, eastern regions, northern regions

Kostanai, Pavlodar, southern regions South Kazakhstan, Zhambyl, and Kyzylorda demonstrated the above national level with the highest value in Karagandy region while Astana city indicated the lowest level among the regions with below national level. Pavlodar, East Kazakhstan, Kyzylorda, Zhambyl regions indicated the above national level in the period 2007-2008 apart from 1999-2000 because of level increase between two periods.

Figure 18c – Age-standardised death rate for diseases of the circulatory system in age group 65-84, 1999-2008, the first group of regions, females

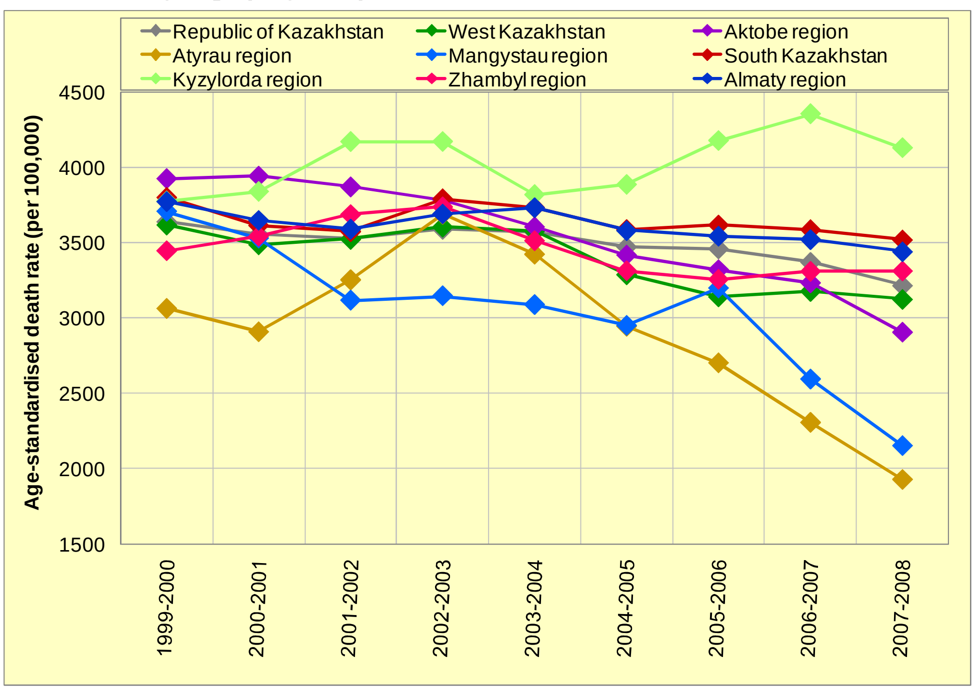


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality level was almost twice lower (3641.5 per 100,000) than that of males in the country in the period 1999-2000. Among the regions of first group Pavlodar, Akmola, Karagandy, East Kazakhstan regions indicated the above national level with the highest value in Karagandy region (4058.6 per 100,000) while North Kazakhstan, Kostanai regions, Astana, Almaty cities demonstrated the below national level with the lowest value in Astana city (2927.5 per 100,000). In the following periods the level was slowly decreasing in the regions (see Figure 18c). The national level was not notable because of very close and similar trend of Pavlodar, East Kazakhstan, and Kostanai regions. Almaty, Astana cities, Karagandy, East Kazakhstan regions indicated the decrease without any fluctuation while Akmola, North Kazakhstan, Kostanai regions observed the decrease with somehow fluctuation. As it was indicated by trends between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as all observed regions. The country decreased the level from 3641.5 to 3215.5 per 100,000. The above national decrease was noted in North Kazakhstan, Pavlodar, Akmola regions, and Astana, Almaty cities with the biggest decrease in Astana city (770.8 per 100,000) while Kostanai, Karagandy, East Kazakhstan regions indicated the below national decrease. In the period 2007-2008 the above national level was noted in Pavlodar, Akmola, Karagandy, East Kazakhstan regions as it was observed in the period 1999-2000. The below national level was observed in the same regions as it was noted in the period 1999-2000.

In the period 1999-2000 among the second group of regions Aktobe, Mangystau, South Kazakhstan, Kyzylorda, Almaty regions indicated the above national level with the highest value in Aktobe region (3924.2 per 100,000) while West Kazakhstan, Atyrau, Zhambyl regions demonstrated the below national level with the lowest value in Atyrau region (3060.7 per 100,000). In the following periods the regions had the similar trend of level as it was observed for males (see Figure 18d). Kyzylorda region indicated the increase of level over time with fluctuation while Atyrau region demonstrated the increase between the periods 2000-2001 and 2002-2003 with the following rapid decrease over time. Other regions indicated the slow decrease of level over time. Between the periods 1999-2000 and 2007-2008 the regions except Kyzylorda demonstrated the decrease with the biggest one in Atyrau and Aktobe regions (1135.8 and 1020.7 per 100,000 respectively). Kyzylorda region demonstrated the increase of level from 3641.5 to 3215.5 per 100,000. In the period 2007-2008 the above national level was noted in South Kazakhstan, Kyzylorda, Zhambyl, Almaty regions with the highest value in Kyzylorda region (4127.3 per 100,000). The below national level was observed in West Kazakhstan, Aktobe, Atyrau, Mangystau regions with the lowest value in Atyrau region (1924.8 per 100,000).

Figure 18d – Age-standardised death rate for diseases of the circulatory system in age group 65-84, 1999-2008, the second group of regions, females



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 the above national female mortality level was noted in central, eastern regions, northern region Pavlodar, western regions Aktobe, Mangystau, and southern regions South Kazakhstan, Kyzylorda, Almaty with the highest level in central Karagandy region. Between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as the regions with the biggest decrease in Aktobe and Atyrau regions. In the period 2007-2008 the above national level was noted in central, eastern, southern regions, and northern region Pavlodar. The lowest level was found in Atyrau region among the regions with below national level.

Mortality level from circulatory system diseases decreased in the country as well as the regions for females apart from males. Male mortality from this cause increased in northern regions Kostanai, Pavlodar, central region Karagandy, eastern region East Kazakhstan, southern regions South Kazakhstan, Zhambyl, and Kyzylorda. The biggest decrease of level for both sexes was observed in western region Atyrau while Astana and Almaty cities were favourable regions in both periods. It is worth to note that the sharp decrease of level for both sexes in Mangystau region in the period 2006-2007 would be the problem of data quality as it was explained in chapter 5.4.

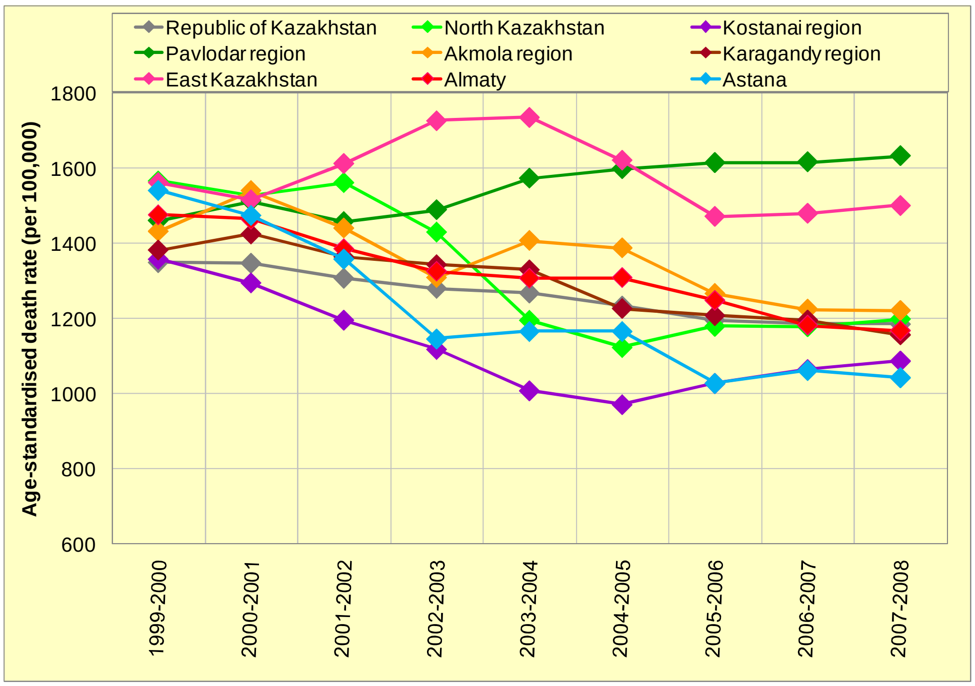
9.3.4.2 Neoplasms

Ageing is one of the fundamental factors for the development of neoplasms. In the period 1999-2000 male mortality level from neoplasms in age group 65-84 was 1348.7 per 100,000 in the country. In this period all regions of first group had the above national level with the highest value in North Kazakhstan (1565.7 per 100,000). In the following periods the national level was decreasing gradually over time (see Figure 19a). Kostanai, North Kazakhstan, Akmola, Karagandy regions, Astana, Almaty cities were decreasing the level with somehow fluctuation with more rapid decrease in Astana city. Pavlodar region was slowly increasing the level apart from other regions.

Between the periods 1999-2000 and 2007-2008 the country decreased the level for 162.9 deaths per 100,000. All regions except Pavlodar decreased the level with the biggest decrease in Astana city (for 496.9 deaths). Pavlodar region increased the level for 172.6 deaths per 100,000. In the period 2007-2008 the national level was 1185.9 per 100,000. The above national level was observed in North Kazakhstan, Pavlodar, Akmola, East Kazakhstan regions with the highest values in Pavlodar (1632.2 per 100,000) and East Kazakhstan (1500.7 per 100,000) regions. The below national level was noted in Kostanai, Karagandy regions, and Astana, Almaty cities with the lowest value in Astana city (1043.3 per 100,000).

In the period 1999-2000 among the second group of regions South Kazakhstan, Zhambyl, Almaty regions had much lower level while Kyzylorda region indicated the slight lower level than national one (1322.8 per 100,000). West Kazakhstan, Atyrau, Aktobe, and Mangystau regions had the above national level with the highest value in Aktobe (1588.1 per 100,000). In comparison with the first group of regions the regions of the second group did not indicate the notable decrease in the following periods (see Figure 19b). Mangystau region was increasing the level with fluctuation over time. Between the periods 1999-2000 and 2007-2008 the level increased in Mangystau and Zhambyl regions with the biggest increase in Mangystau (305.4 per 100,000) while other regions observed the decrease with the biggest one in Aktobe and Atyrau regions (294.0 and 280.7 per 100,000). In the period 2007-2008 the above national level was observed in Kyzylorda, West Kazakhstan, Aktobe, Mangystau regions with the highest value in Mangystau region (1663.8 per 100,000) while Atyrau, South Kazakhstan, Zhambyl, Almaty regions observed the below national level with the lowest value in South Kazakhstan region (807.2 per 100,000).

Figure 19a – Age-standardised death rate for neoplasms in age group 65-84, 1999-2008, the first group of regions, males



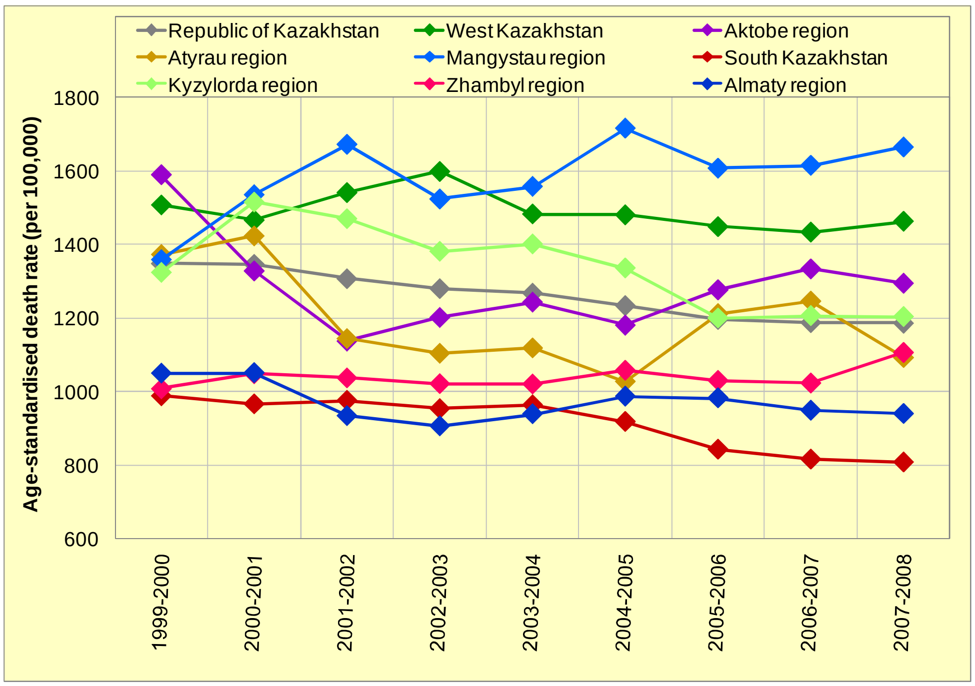
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 all northern, central, eastern, western regions, municipal cities had the above national level while all southern regions indicated the below national level. Between the periods 1999-2000 and 2007-2008 the level increased in Pavlodar, Mangystau, and Zhambyl regions with the biggest increase in Mangystau. The country as well as other regions decreased the level with the biggest decrease in Astana city and the below national decrease in East Kazakhstan, West Kazakhstan, Almaty, and Kyzylorda regions. In the period 2007-2008 the above national level was observed in northern regions North Kazakhstan, Pavlodar, central region Akmola, eastern region East Kazakhstan, western regions West Kazakhstan, Aktobe, Mangystau, and southern region Kyzylorda. If one compares two periods Kostanai, Karagandy, Atyrau regions, Astana, Almaty cities indicated the below national level in the end of the period apart from the beginning.

Female mortality level from neoplasms in age group 65-84 was twice lower than that of males in the country in the period 1999-2000 (647.9 per 100,000). Among the first group of regions

Akmola, East Kazakhstan regions, and Astana, Almaty cities had the above national level with the highest value in Astana city (756.0 per 100,000). The below national level was observed in North Kazakhstan, Pavlodar, Kostanai, Karagandy regions. In the following periods the level was decreasing in the country as well as the regions (see Figure 19c). Among them only Pavlodar region indicated the slow increase between the periods 1999-2000 and 2004-2005. Other regions observed the decrease with fluctuation over time while the country had the constant decrease without any fluctuation.

Figure 19b – Age-standardised death rate for neoplasms in age group 65-84, 1999-2008, the second group of regions, males

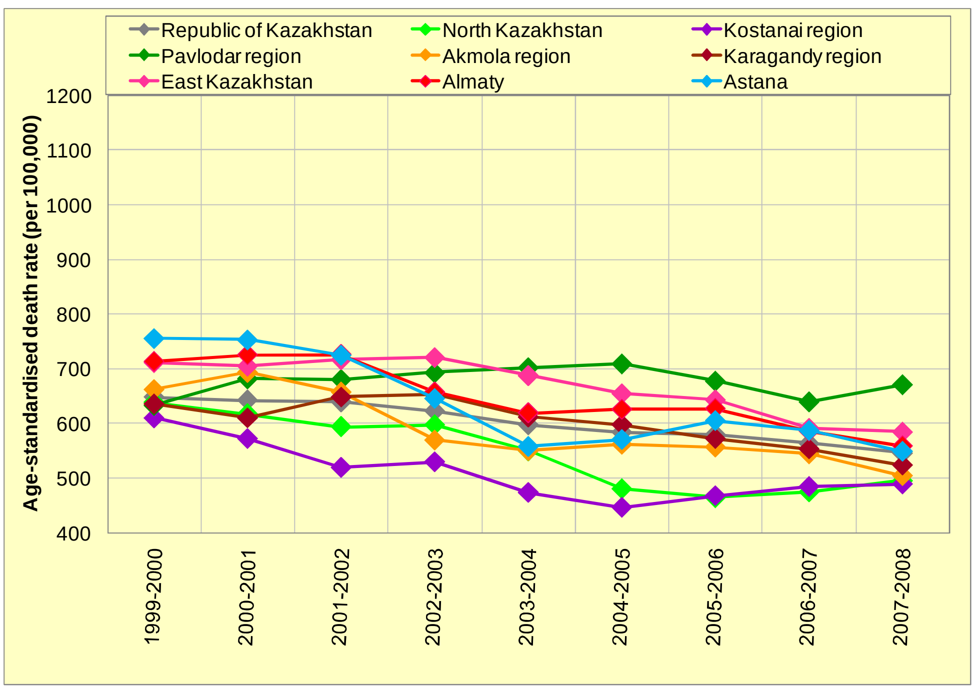


***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Between the periods 1999-2000 and 2007-2008 the country indicated the decrease from 647.9 to 546.2 deaths per 100,000. Pavlodar region increased the level (38.0 per 100,000) while other regions indicated the above national decrease with the biggest one in Astana city (206.5 per 100,000). In the period 2007-2008 the above national level was noted in Pavlodar, East Kazakhstan regions, and Astana, Almaty cities. The below national level was found in North Kazakhstan, Kostanai, Akmola, Karagandy regions. It is worth to note that Astana city with the highest level in the period 1999-2000 indicated the slight higher level than national one (549.5 per 100,000) in the period 2007-2008 with the biggest level of decrease. Pavlodar region with the below national level in the period 1999-2000 indicated the above national level in 2007-2008 because of the level increase between two periods.

In the period 1999-2000 among the regions of second group Mangystau, Kyzylorda, and Aktobe regions had the above national level with the highest values in Mangystau and Kyzylorda regions (990.0 and 880.9 per 100,000 respectively). It is worth to note that these regions had the highest level among the regions of both groups. The lowest level was noted in Almaty region (515.3 per 100,000) among the regions with below national level. In the following periods the regions of second group did not observe such a visible decrease of level as it was observed for first group of regions (see Figure 19d). Mangystau and Kyzylorda regions with the highest level were observing the decrease with stronger fluctuation in Mangystau region. Between the periods 1999-2000 and 2007-2008 the level increased only in West Kazakhstan region (77.4 per 100,000) while other regions observed the decrease with the above national decrease in Aktobe, Atyrau, Mangystau, Kyzylorda regions and the below national decrease in South Kazakhstan, Zhambyl, Almaty regions. In the period 2007-2008 the above national level was found in West Kazakhstan, Aktobe, Mangystau, and Kyzylorda regions with the highest values in Mangystau and Kyzylorda (816.7 and 705.0 per 100,000 respectively) regions as it was observed for the period 1999-2000. The below national level was noted in Atyrau, South Kazakhstan, Zhambyl, Almaty regions with the lowest value in Almaty region (445.2 per 100,000). West Kazakhstan region with the below national level in the period 1999-2000 observed the above national level in the period 2007-2008 because of level increase between two periods.

Figure 19c – Age-standardised death rate for neoplasms in age group 65-84, 1999-2008, the first group of regions, females



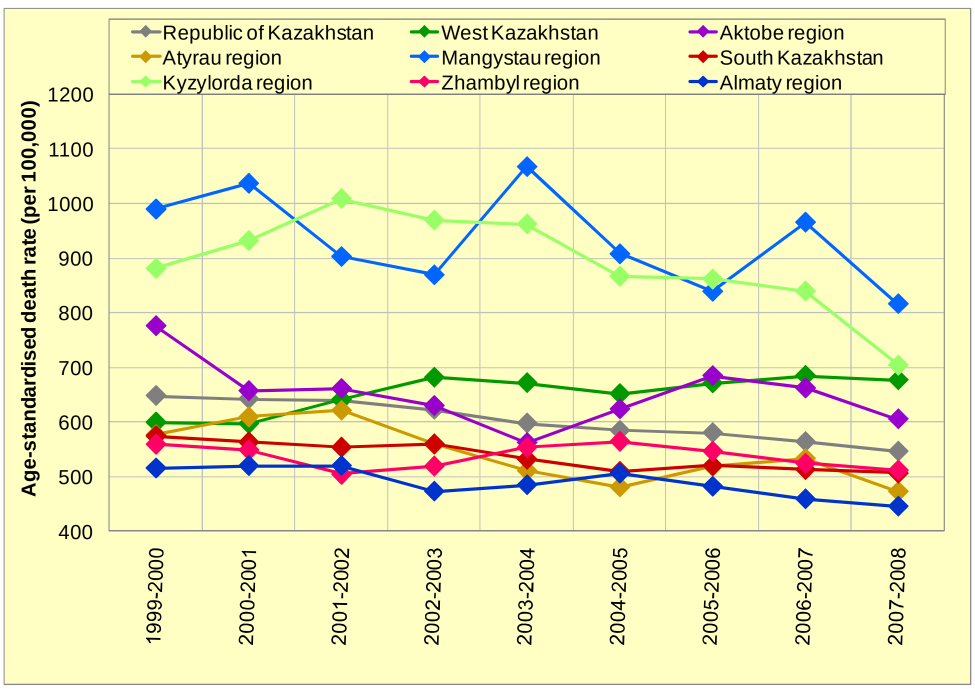
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 the above national female mortality level from neoplasms in age group 65-84 was noted in central region Akmola, eastern region East Kazakhstan, western regions Aktobe, Mangystau, southern region Kyzylorda, and municipal Astana, Almaty cities with the highest values in Mangystau and Kyzylorda regions. The below national level was noted in other regions with the lowest value in Almaty region. Between the periods 1999-2000 and

2007-2008 the level increased in Pavlodar and West Kazakhstan regions. The level decreased in the country as well as all other regions with the biggest decrease in Astana city. In the period 2007-2008 Pavlodar, East Kazakhstan, West Kazakhstan, Aktobe, Mangystau, Kyzylorda regions, Astana, Almaty cities indicated the above national level while other regions indicated the below national level with the lowest value in Almaty region as it was observed for the period 1999-2000. West Kazakhstan and Pavlodar regions indicated the above national level in the period 2007-2008 apart from 1999-2000 because of level increase in the regions between two periods.

The evidence demonstrated that the country as well as the most of regions decreased mortality level from neoplasms for both sexes. The level increased in Pavlodar region for both sexes, for males in Mangystau and Zhambyl regions, and for females in West Kazakhstan. The biggest decrease of level was observed in Astana city which would partly explain the biggest decrease of mortality level for both sexes in the observed age group in the city.

Figure 19d – Age-standardised death rate for neoplasms in age group 65-84, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

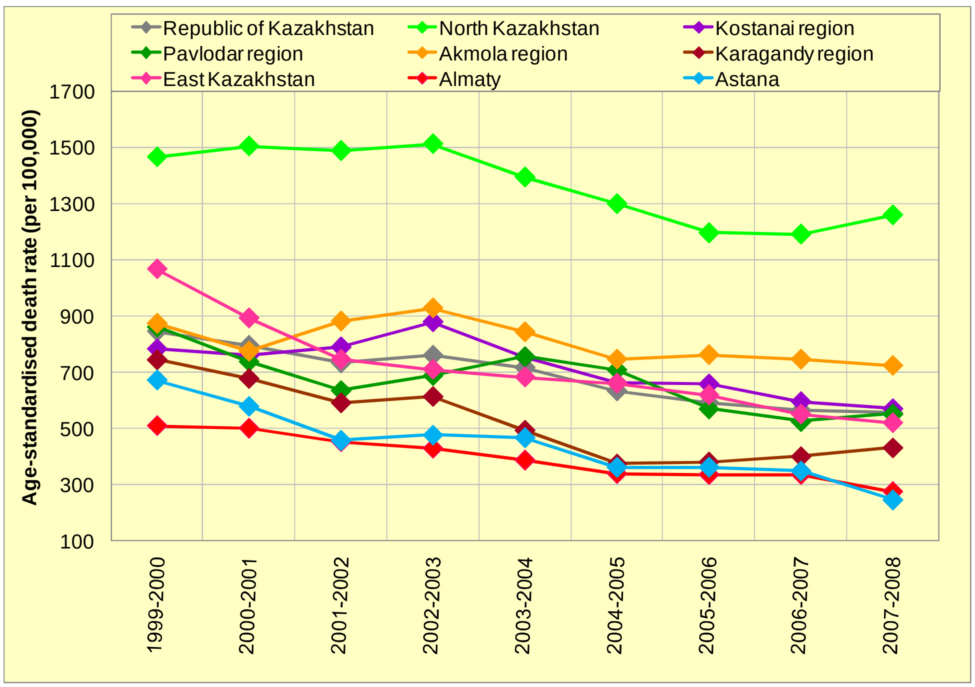
9.3.4.3 Diseases of the respiratory system

Male mortality level from diseases of respiratory system in age group 65-84 was 844.4 per 100,000 persons in the period 1999-2000. Among the regions of first group the above national level was observed in North Kazakhstan, Pavlodar, Akmola, and East Kazakhstan regions with the highest value in North Kazakhstan (1464.2 per 100,000) while Kostanai, Karagandy regions, and Astana, Almaty cities indicated the below national level with the lowest value in Almaty city

(508.7 per 100,000). In the following periods the country as well as the regions had the trend of gradual decrease over time (see Figure 20a).

Between the periods 1999-2000 and 2007-2008 the level decreased in the country from 844.4 to 556.0 per 100,000. As it was seen from the trends all observed regions decreased the level with above national decrease in Pavlodar, Karagandy, East Kazakhstan regions, and Astana city. North Kazakhstan, Kostanai, Akmola regions, and Almaty city had the below national decrease. In the period 2007-2008 the above national level was noted in North Kazakhstan, Kostanai, Akmola regions with the highest value in North Kazakhstan (1259.3 per 100,000). The lowest level among all regions was found in Astana city (247.0 per 100,000).

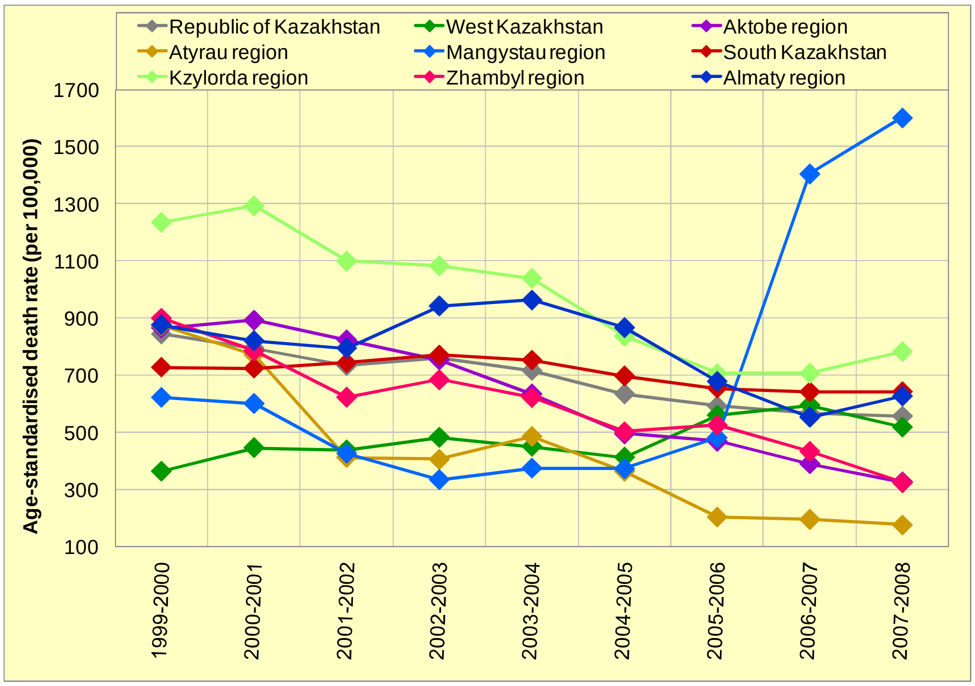
Figure 20a – Age-standardised death rate for diseases of the respiratory system in age group 65-84, 1999-2008, the first group of regions, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 among the regions of the second group the above national level was noted in Aktobe, Atyrau, Kyzylorda, Zhambyl, Almaty regions with the highest value in Kyzylorda (1235.2 per 100,000) while West Kazakhstan, Mangystau, South Kazakhstan regions indicated the below national level with the lowest value in West Kazakhstan (363.1 per 100,000). In the following periods the regions except West Kazakhstan indicated the decrease of level parallely with the country (see Figure 20b). West Kazakhstan region indicated the slow increase of the level over time with very slight decrease in the period 2007-2008. Between the periods 1999-2000 and 2007-2008 the level decreased in all examined regions except West Kazakhstan. West Kazakhstan region indicated the increase from 363.1 to 517.3 deaths per 100,000. The above national decrease was noted in Aktobe, Atyrau, Kyzylorda, Zhambyl regions while Almaty and South Kazakhstan regions demonstrated the below national decrease. In the period 2007-2008 the above national level was noted in South Kazakhstan, Kyzylorda, Almaty regions with the highest value in Kyzylorda region (784.0 per 100,000). The below national level was noted in West Kazakhstan, Aktobe, Atyrau, Zhambyl regions with the lowest value in Atyrau region (176.1 per 100,000). It is worth to note that Aktobe, Atyrau, Zhambyl regions with the above national level in the period 1999-2000 indicated the below national level in the period 2007-2008 thanks to above national decrease of level in the regions between two periods.

Figure 20b – Age-standardised death rate for diseases of the respiratory system in age group 65-84, 1999-2008, the second group of regions, males

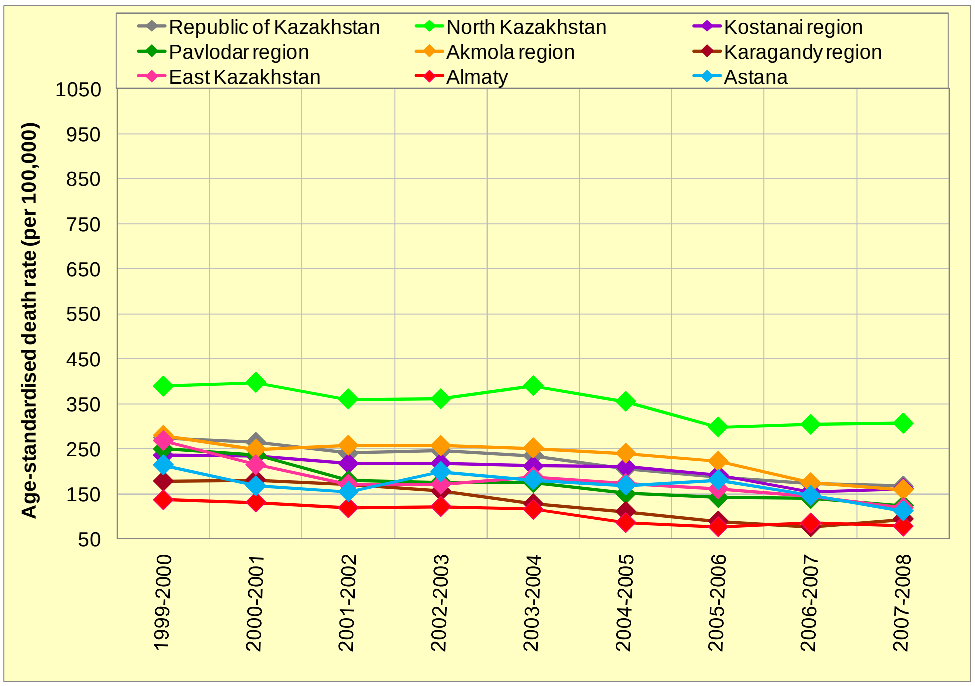


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 the above national male mortality level was noted in northern regions North Kazakhstan, Pavlodar, central region Akmola, eastern region East Kazakhstan, western regions Aktobe, Atyrau, southern regions Kyzylorda, Zhambyl, Almaty. The lowest value among the regions with below national level was noted in Almaty city. Between the periods 1999-2000 and 2000 the level increased only in West Kazakhstan region. The biggest decrease of level was observed in Atyrau region among the regions. In the period 2007-2008 the above national level was found in northern regions North Kazakhstan, Kostanai, central region Akmola, southern regions South Kazakhstan, Kyzylorda, Almaty regions. The lowest level among the regions with below national level was noted in Atyrau region.

Female mortality level was three times lower than that of males in the country in the period 1999-2000 (274.5 per 100,000). North Kazakhstan and Akmola regions had the above national level with the highest value in North Kazakhstan region (387.8 per 100,000). Kostanai, Pavlodar, Karagandy, and East Kazakhstan regions, Astana and Almaty cities indicated the below national level with the lowest value in Almaty (136.1 per 100,000). The regions as well as the country had the similar trend of decrease in the following periods (see Figure 20c). North Kazakhstan region and Astana city indicated the decrease with fluctuation over time apart from other regions. Between the periods 1999-2000 and 2007-2008 the level in the country decreased from 274.5 to 166.6 per 100,000. The above national decrease was noted in Pavlodar, Akmola, and East Kazakhstan regions while North Kazakhstan, Kostanai, Karagandy regions, and Astana, Almaty cities indicated the below national decrease. In the period 2007-2008 only North Kazakhstan region had the above national level (305.7 per 100,000) among the regions.

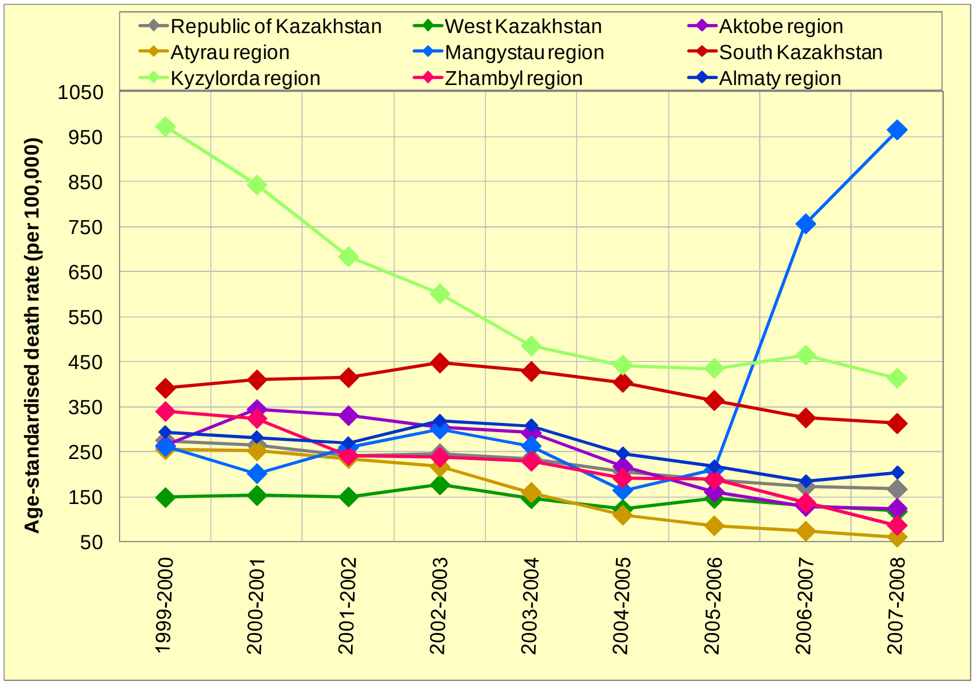
Figure 20c – Age-standardised death rate for diseases of the respiratory system in age group 65-84, 1999-2008, the first group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 South Kazakhstan, Kyzylorda, Zhambyl, Almaty regions indicated the above national level among the regions of second group with the highest value in Kyzylorda (972.9 per 100,000). The below national level was noted in West Kazakhstan, Atyrau, Aktobe, Mangystau regions with the lowest value in West Kazakhstan (148.3 per 100,000). In the following periods the regions except Kyzylorda indicated the slow decrease without fluctuation (see Figure 20d). Kyzylorda region with the highest level was rapidly decreasing the level over time. The above national decrease was noted in Aktobe, Atyrau, Kyzylorda, Zhambyl regions while West Kazakhstan, South Kazakhstan, and Almaty regions indicated the below national decrease. In the period 2007-2008 the above national level was noted in South Kazakhstan, Kyzylorda, Almaty regions with the highest level in Kyzylorda (412.8 per 100,000). The below national level was found in West Kazakhstan, Aktobe, Atyrau, and Zhambyl regions with the lowest level in Atyrau (60.1 per 100,000). It is worth to note that Zhambyl region indicated the below national level in the period 2007-2008 apart from 1999-2000 thanks to its above national decrease of level between two periods.

Figure 20d – Age-standardised death rate for diseases of the respiratory system in age group 65-84, 1999-2008, the second group of regions, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As a result, in the period 1999-2000 the above national female mortality level was noted in all southern regions, and northern region North Kazakhstan, central region Akmola. The lowest level among the regions was noted in Almaty city. Between the periods 1999-2000 and 2007-2008 the level decreased in the country as well as the regions. The biggest decrease was noted in Kyzylorda region. In the period 2007-2008 the above national level was noted in North Kazakhstan and southern regions South Kazakhstan, Kyzylorda, and Almaty while the lowest level was found in Atyrau region among all regions. Akmola and Zhambyl regions with the above national level in the period 1999-2000 indicated the below national level in the period 2007-2008 thanks to decrease of level in the regions between the periods.

Mortality level from respiratory system diseases in age group 65-84 decreased in the country as well as the regions for both sexes between observed periods. However, the level increased in West Kazakhstan region for males. In Mangystau region the sharp increase of mortality level from respiratory system diseases in the period 2006-2007 was not taken into account in the process of description as it was considered to be the possible problem of data quality (see Chapter 5.3).

9.4 Main finding

The finding of the chapter answers the second research question.

2. *What changes took place in regional trends of mortality level (overall mortality level, mortality by age groups and selected leading causes of death) for males and females in the period 1999-2008?*

2. In the period 1999-2008 life expectancy at birth for both sexes increased in the country. However, male life expectancy at birth slightly decreased in central regions, northern regions North Kazakhstan, Kostanai, and southern region Almaty. This decrease was partly explained by mortality increase from circulatory system diseases and external causes in age group 20-64 in the regions. The biggest increase of life expectancy at birth for both sexes was observed in Astana, Almaty cities, and western regions which were also partly explained by the big mortality decrease from abovementioned causes in age group 20-64. Mortality level from neoplasms in observed age group decreased in all regions with biggest decrease in Astana, Almaty cities, and western regions.

   Mortality level in age group 0-4 substantially decreased for both sexes in the regions except South Kazakhstan region and Almaty city. In these regions the level increased with the slight increase in Almaty city. The improvement of mortality level in this age group was partly explained by mortality decrease from certain infectious and parasitic diseases, respiratory system diseases.

   In age group 5-19 mortality level did not indicate the substantial change in the regions. However, in favourable Astana city the level slightly increased for both sexes.

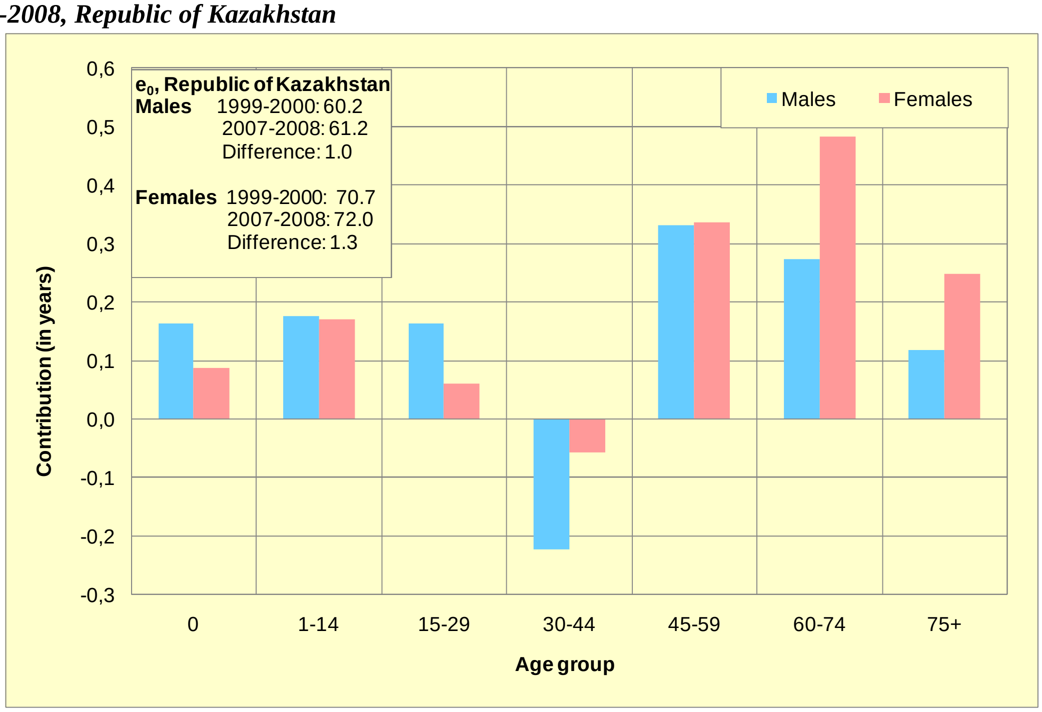
   In age group 65-84 mortality level for both sexes decreased in the regions except Mangystau region for males. Male mortality increase in Mangystau region was partly explained by mortality increase from neoplasms in observed age group. In this age group female mortality level from circulatory and respiratory system diseases also decreased in the country as well as all regions. Male mortality level from circulatory system diseases increased in Kyzylorda, from respiratory system diseases in West Kazakhstan region. It is worth to note that Astana and Almaty cities had the lowest level of mortality in observed age group among all regions in the period 1999-2000 with its further improvement over time.

Chapter 10

Contribution of age groups to the change in overall mortality level in the regions between the periods 1999-2000 and 2007-2008

The chapter analyses the contribution of age groups to the change in life expectancy at birth between the periods 1999-2000 and 2007-2008 in the country and its regions. The analysis was made with application of method proposed by Pressat (see Chapter 6.2.1.1).

Figure 21 –Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Republic of Kazakhstan



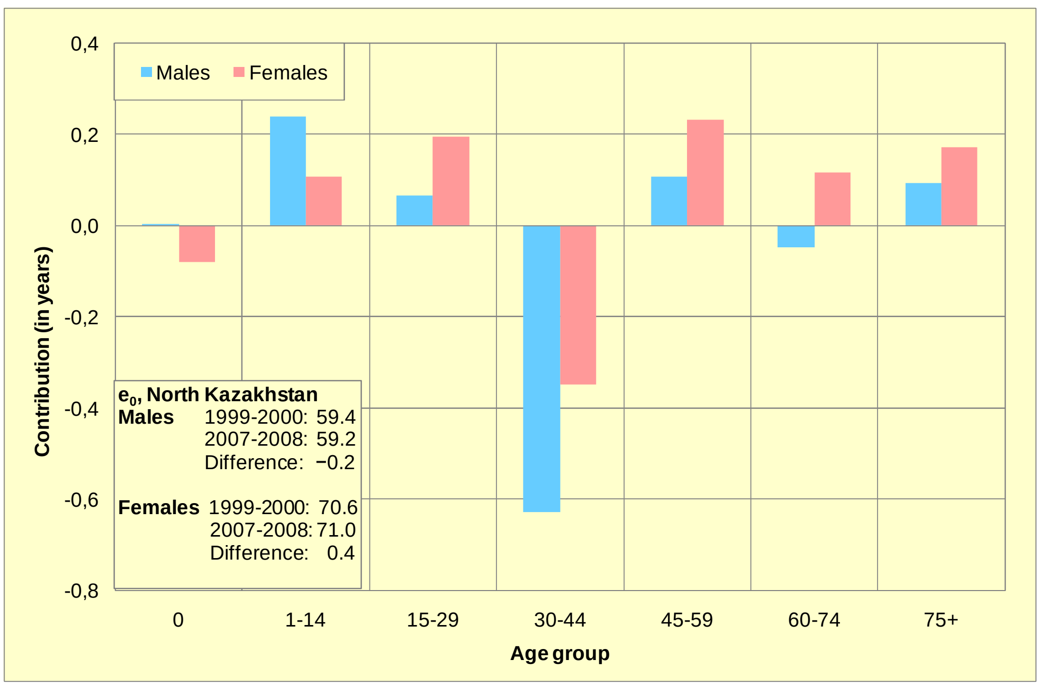
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the Republic of Kazakhstan male life expectancy at birth increased for 1.0 year while female one increased for 1.3 years between observed periods. All age groups except 30-44 contributed positively to the increase for both sexes (see Figure 21). The most positive contribution was assessed by mortality improvement in age groups 45-59 and 60-74 for both sexes. Age group 30-44 contributed negatively to the improvement for both sexes with the bigger contribution for males (-0.22 years).

10.1 Northern regions (North Kazakhstan, Kostanai, Pavlodar)

Male life expectancy at birth in North Kazakhstan region decreased for 0.2 years between the periods 1999-2000 and 2007-2008. Male mortality increase in age groups 30-44 (-0.63 years) and 60-74 (-0.05 years) contributed to the decrease with the bigger contribution of age group 30-44 (see Figure 22a). Other age groups contributed negatively to the decrease which identified that male mortality improved in these age groups in the end of the period in comparison with the beginning. Male mortality decrease in age group 1-14 assessed the largest negative contribution to male life expectancy at birth decrease (0.24 years).

Figure 22a − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, North Kazakhstan region



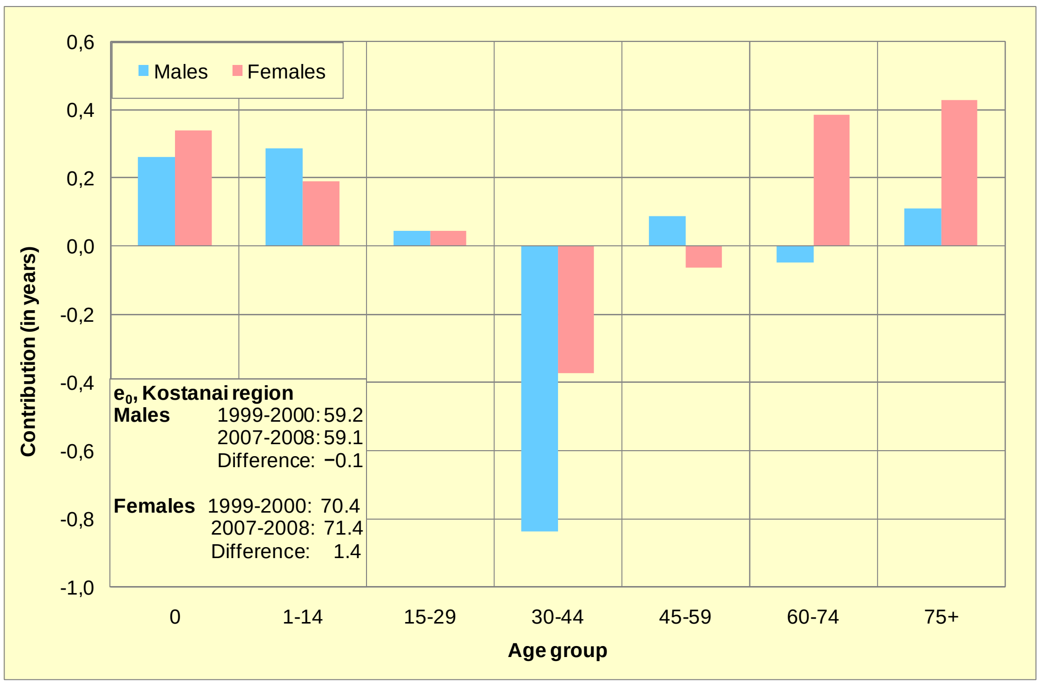
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Apart from male life expectancy at birth female one increased (0.4 years) in the region between observed periods. The age groups 1-14, 15-29, 45-59, 60-74, 75+ contributed positively to the increase which determined the improvement of female mortality in these age groups between two observed periods. The age groups 0 (-0.08 years) and 30-44 (-0.35 years) contributed negatively to the increase which specified the increase of female mortality in these age groups in the period 2007-2008.

In Kostanai region male life expectancy at birth decreased for 0.1 years between the periods 1999-2000 and 2007-2008.The age groups 30-44 (-0.84 years) and 60-74 (-0.05 years) contributed positively to the decrease with the largest contribution of age group 30-44. Other age groups made the contribution negatively to male life expectancy at birth decrease (see Figure 22b). Larger contribution was assessed by male mortality improvement in age groups 0 (0.26 years) and 1-14 (0.29 years).

Female life expectancy at birth increased for 1.0 year in the region between two observed periods. All age groups except 30-44 and 45-59 contributed positively to the increase of female life expectancy at birth. Female mortality improvement in age group 75+ (0.43 years) contributed the most to the increase. Age groups 30-44 (-0.37 years) and 45-59 (-0.06 years) contributed negatively to the rise of life expectancy at birth.

Figure 22b − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Kostanai region

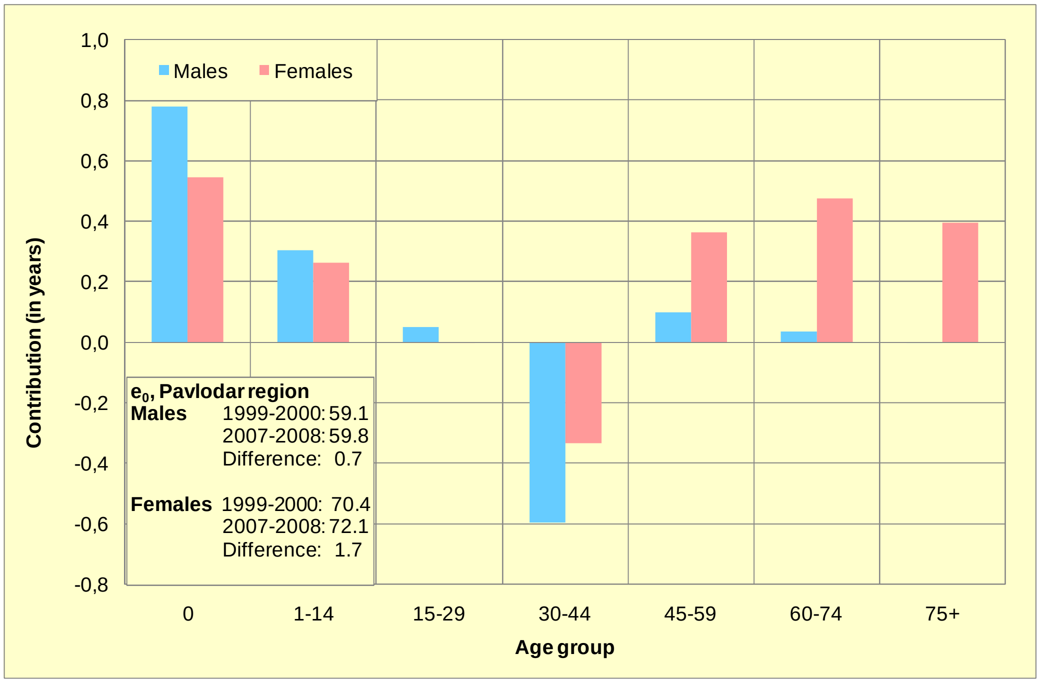


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Male life expectancy at birth increased (for 0.7 years) in Pavlodar region apart from other northern regions between observed periods. All age groups except 30-44 and 75+ contributed positively to the increase (see Figure 22c). The age group 0 (0.78 years) contributed the most which indicated the big improvement of infant mortality in the region in the examined period. Male mortality increase in age group 30-44 assessed the negative contribution (-0.60 years) to male life expectancy growth in the region.

In the region female life expectancy at birth also increased (1.7 years) between the periods 1999-2000 and 2007-2008 with the bigger increase compared to males. All age groups except 30-44 and 15-29 contributed positively to the increase with the largest contribution of age group 0 (0.54 years). Mortality increase in age group 30-44 (-0.33 years) assessed the negative contribution.

Figure 22c − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Pavlodar region



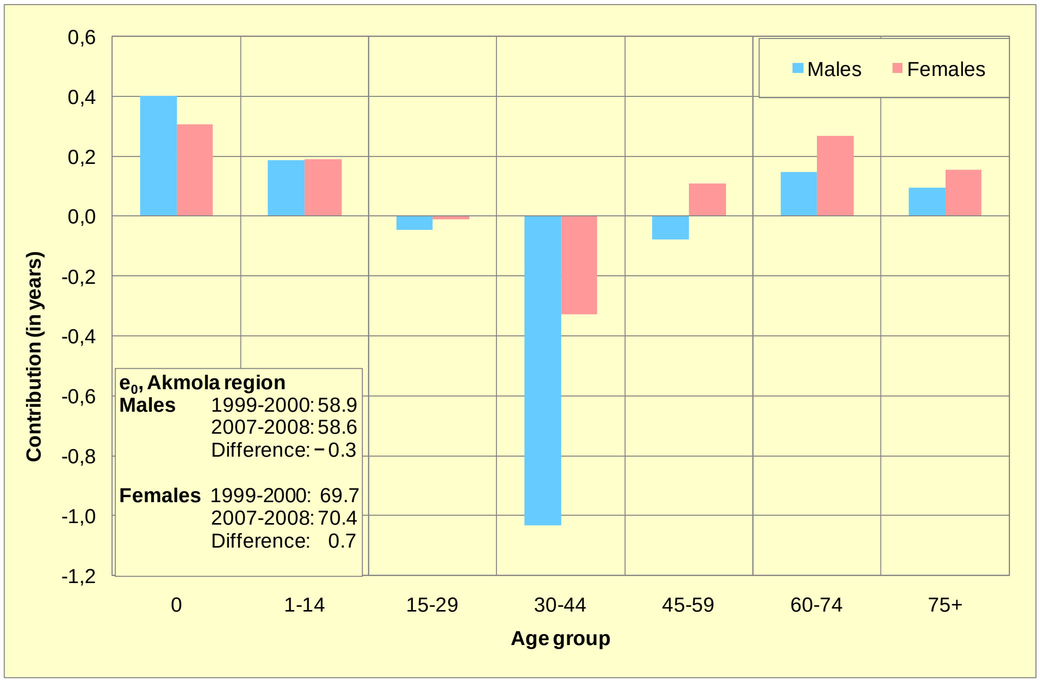
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Observing the contribution of age groups to the change in life expectancy at birth in northern regions between the periods 1999-2000 and 2007-2008, we noticed the common evidence. Change in life expectancy at birth for both sexes was mainly due to mortality increase in age group 30-44 between two periods in all observed regions. In North Kazakhstan, Kostanai regions male mortality increase in this age group contributed positively to the decrease of male life expectancy at birth while in Pavlodar it contributed negatively to the increase of male life expectancy at birth. Despite the fact that female life expectancy at birth increased in these regions female mortality in age group 30-44 contributed to the increase negatively.

10.2 Central regions (Akmola, Karagandy)

In Akmola region male life expectancy at birth decreased (-0.3 years) between the periods 1999-2000 and 2007-2008. It is worth to note that the biggest decrease of male life expectancy at birth was observed in Akmola region in comparison with other ones. Male mortality increase in age group 30-44 contributed the most to the decrease (-1.03 years) (see Figure 23a). The less contribution was made by age groups 45-59 (-0.08 years) and 15-29 (-0.05 years). Other age groups contributed to the decrease negatively with more contribution of age 0 which specified that in other age groups male mortality level improved in the period 2007-2008 in comparison with 1999-2000.

Figure 23a − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Akmola region



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

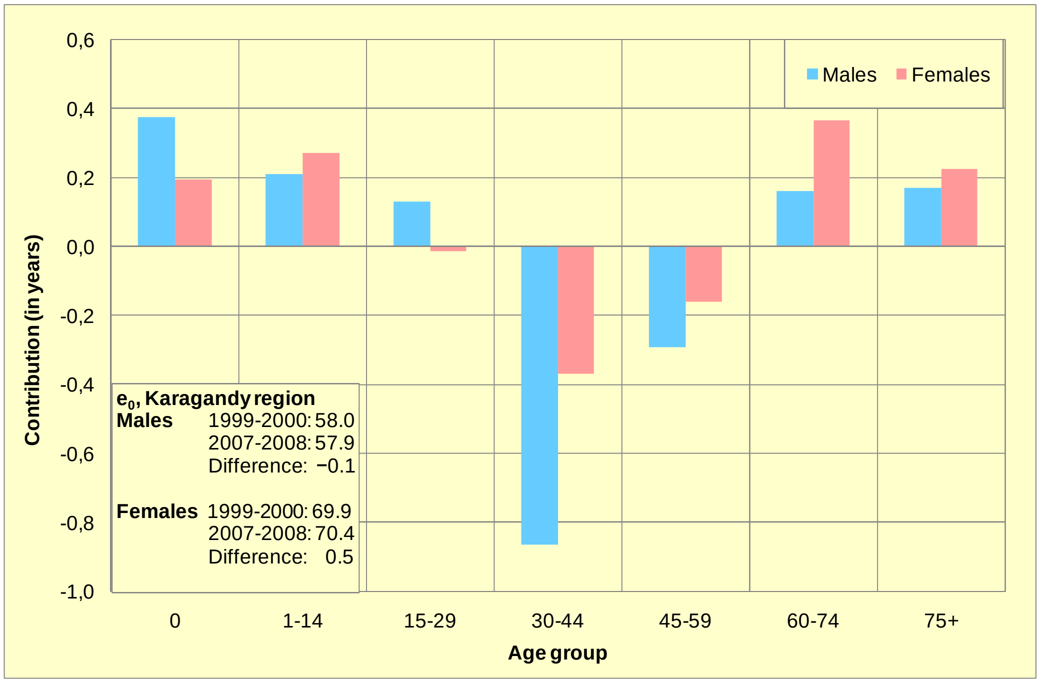
Apart from male life expectancy at birth female one increased (0.7 years) between observed periods in Akmola region. All age groups except 15-29 and 30-44 contributed positively to the increase with the most contribution of age 0 (0.31 years). This evidence identified that female mortality in age groups 15-29 (-0.01 years) and 30-44 (-0.33 years) increased in the period 2007-2008 in comparison with the period 1999-2000.This evidence was similar to the situation in northern regions where the age group 30-44 assessed the most contribution.

In Karagandy region male life expectancy at birth slightly decreased (-0.1 years) between the periods 1999-2000 and 2007-2008. Male mortality increase in age groups 30-44 (-0.87 years) and 45-59 (-0.29 years) contributed positively to this decrease with more contribution of age group 30-44 while in other age groups male mortality improved especially in age 0 (0.38 years) (see Figure 23b).

Apart from male life expectancy at birth female one increased (0.5 years) between observed periods. Infant, child and old ages contributed positively to the increase which identified the improvement of female mortality in these age groups. Age groups 15-29 (-0.01 years), 30-44 (-0.37 years), 45-59 (-0.16 years) contributed negatively to the increase of female life expectancy at birth with the bigger contribution of age group 30-44.

In central regions male life expectancy at birth decreased slightly while female one increased between observed periods. Mortality improvement in infant, child and old ages for both sexes contributed negatively to male life expectancy at birth decrease and positively to female life expectancy at birth increase while mortality increase in age group 30-44 assessed the most contribution for both sexes.

Figure 23b − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Karagandy region



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

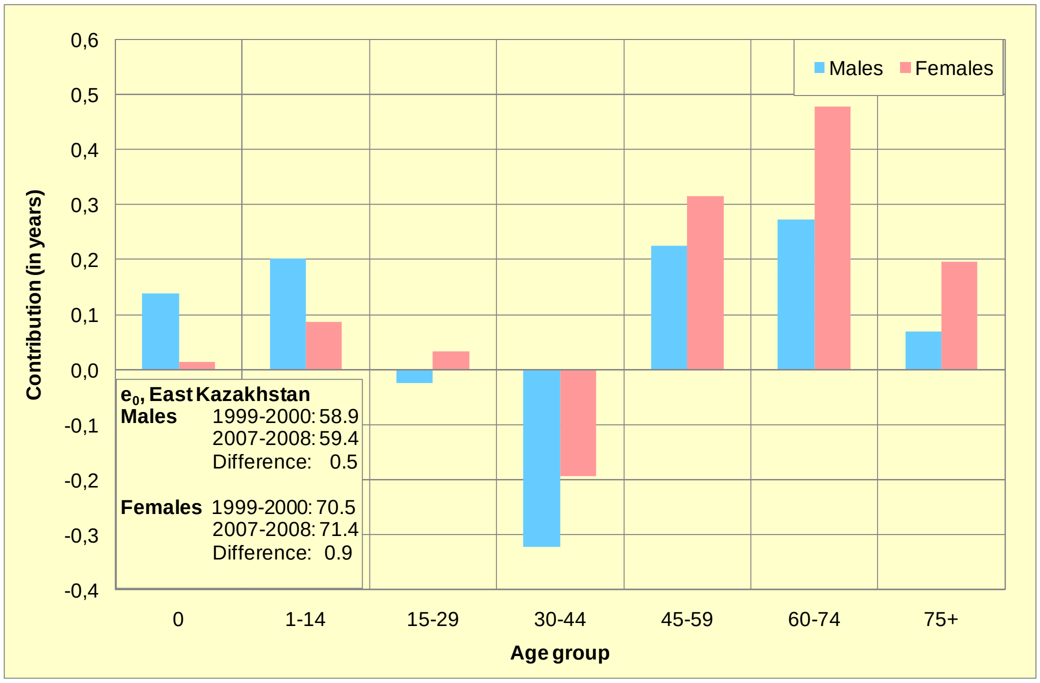
10.3 Eastern region (East Kazakhstan)

Eastern region includes only East Kazakhstan region. In East Kazakhstan region male as well as female life expectancy at birth increased between examined periods with bigger increase for females (0.5 years for males, 0.9 years for females). All age groups except 15-29 and 30-44 contributed positively to male life expectancy at birth increase with the most contribution of age group 60-74 (0.27 years) (see Figure 24). Age group 30-44 (-0.32 years) contributed the most negatively to the increase which identified the biggest increase of male mortality in this age group in comparison with other ones.

Female mortality increase in age group 30-44 contributed negatively to the increase (-0.19 years) and the contribution was not as big as for males (see Figure 24). The age group 60-74 (0.48 years) was the one which assessed the most positive contribution to the increase which expressed the improvement of female mortality in this age group.

Mortality increase in age group 30-44 and mortality improvement in age group 60-74 contributed the most to life expectancy at birth increase for both sexes.

Figure 24 – Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, East Kazakhstan region



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

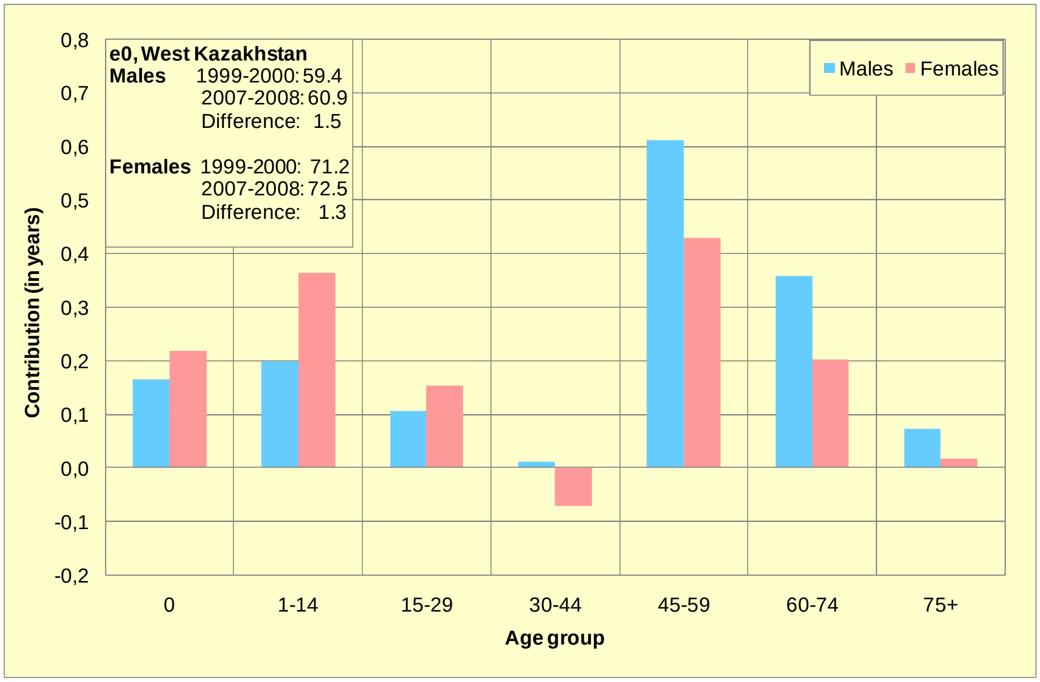
10.4 Western regions (West Kazakhstan, Aktobe, Atyrau, and Mangystau)

In West Kazakhstan region male as well as female life expectancy at birth increased between the periods 1999-2000 and 2007-2008 (1.5 years for males, 1.3 years for females). Apart from above observed regions of other parts in West Kazakhstan region male life expectancy at birth increased more than female one (for 1.5 years for males, for 1.3 years for females). Mortality improvement in all age groups contributed positively to the increase with the most contribution of age groups 45-59 (0.61 years) and 60-74 (0.36 years) (see Figure 25a).

Female mortality improvement in all age groups except the age group 30-44 assessed the substantial positive contribution to female life expectancy at birth increase. Mortality increase in age group 30-44 (-0.07 years) contributed negatively to the improvement of female life expectancy at birth. It is worth to note that the most positive contribution to male as well as female life expectancy at birth increase was assessed by mortality improvement in age group 45-59.

In Aktobe region male as well as female life expectancy at birth increased between the periods 1999-2000 and 2007-2008. Male life expectancy at birth increased for 1.6 years between two periods. Improvement of male mortality in all age groups except 30-44 and 75+ contributed positively to the increase (see Figure 25b). Male mortality increase in age groups 30-44 (-0.36 years) and 75+ (-0.05 years) contributed negatively to male life expectancy at birth increase between two periods. Male mortality improvement in age group 45-59 (1.01 years) contributed the most to the increase in comparison with other age groups.

Figure 25a − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, West Kazakhstan region



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female life expectancy at birth in the region also increased (2.8 years) between two periods with the bigger increase in comparison with male one. All age groups contributed positively to the increase which identified that female mortality decreased in all age groups between two periods. The age group 60-74 contributed the most to the increase with 0.93 years while the smallest contribution was made by age group 15-29 (0.04 years).

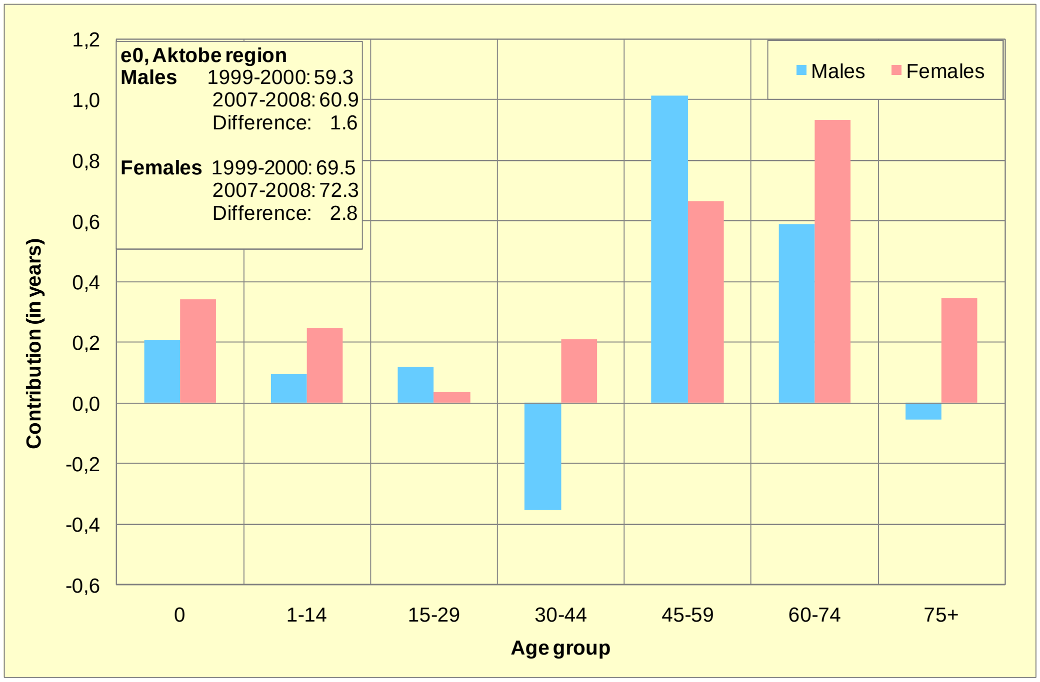
In Atyrau region male as well as female life expectancy at birth increased more significantly than other observed regions (2.6 years for males, 2.7 years for females). All age groups contributed positively to the increase of male life expectancy which indicated the improvement of male mortality in all age groups in the observed period (see Figure 25c). The biggest contribution was assessed by age group 45-59 (1.14 years) while age groups 0 (0.09 years) and 75+ (0.10 years) assessed the least contribution.

Female mortality improvement in all age groups contributed positively to female life expectancy increase in the region (see Figure 25c). Mortality improvement in age group 60-74 (0.86 years) contributed the most to the increase while age group 0 (0.22 years) contributed the least to the increase as it was observed for males.

In Mangystau region male as well as female life expectancy at birth increased between observed periods with the bigger increase for males as it was observed in West Kazakhstan region (2.3 years for males, 2.0 years for females). All age groups except 60-74 and 75+ contributed positively to the increase (see Figure 25d). The old age groups 60-74 (-0.05 years) and 75+ (-0.27

years) contributed negatively to the increase which defined the increase of male mortality in these age groups between two periods.

Figure 25b – Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Aktobe region

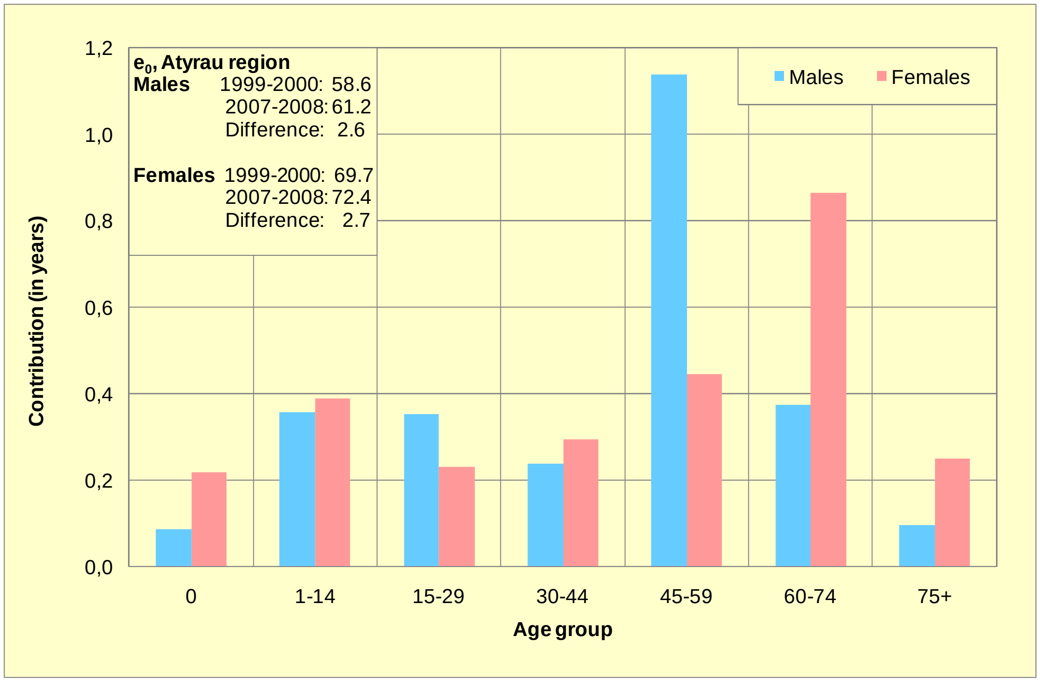


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Despite the fact that female life expectancy at birth increased less than male one all age groups contributed positively to the increase (see Figure 25d). The improvement of mortality in age 0 (0.75 years) assessed the biggest contribution to female life expectancy at birth increase. It is worth to note that Mangystau region observed the big improvement in infant age for males as well as females.

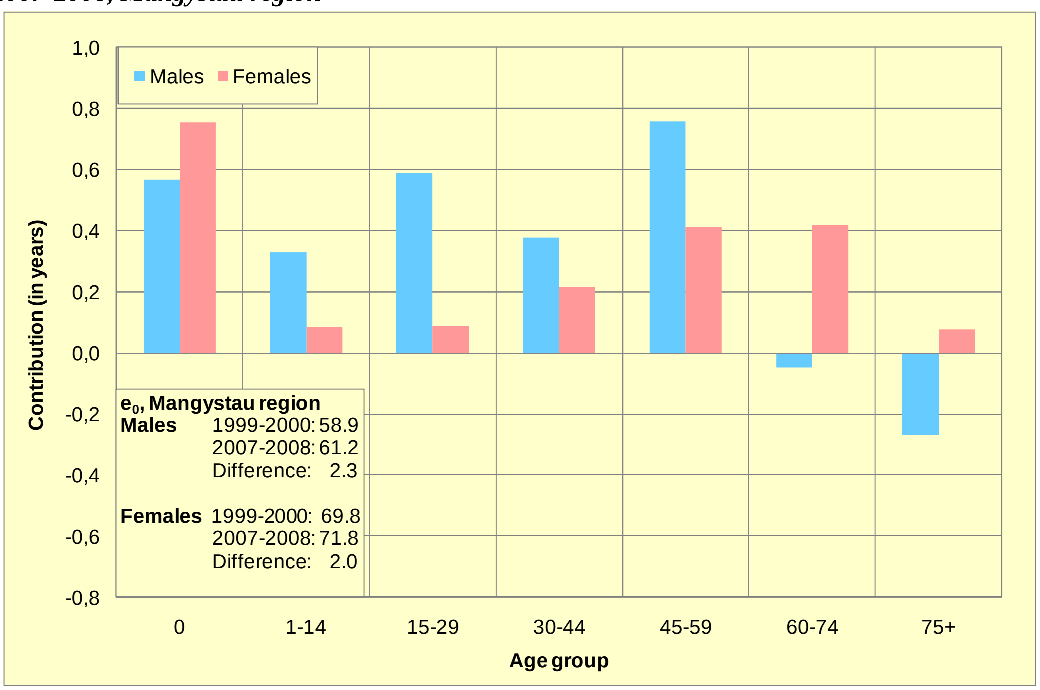
Western part regions could increase life expectancy at birth for both sexes between observed periods apart from above described regions of other parts. This increase was noted thanks to the improvement of mortality mainly in age groups 45-59 and 60-74. It is also worth to note that male as well as female mortality did not increase in age group 30-44 in western regions except Aktobe where it increased slightly for females.

Figure 25c − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Atyrau region



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 25d − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Mangystau region

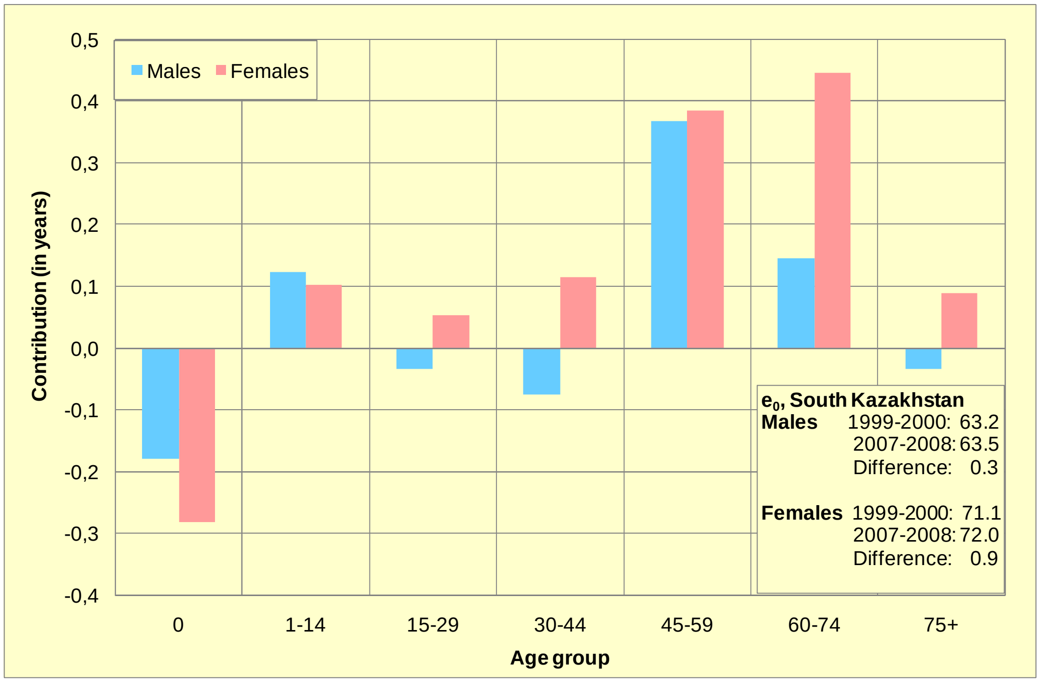


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

10.5 Southern regions (South Kazakhstan, Kyzylorda, Zhambyl, Almaty)

In South Kazakhstan region male as well as female life expectancy at birth increased between the periods 1999-2000 and 2007-2008 (0.3 years for males, 0.9 for females).

Figure 26a – Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, South Kazakhstan region



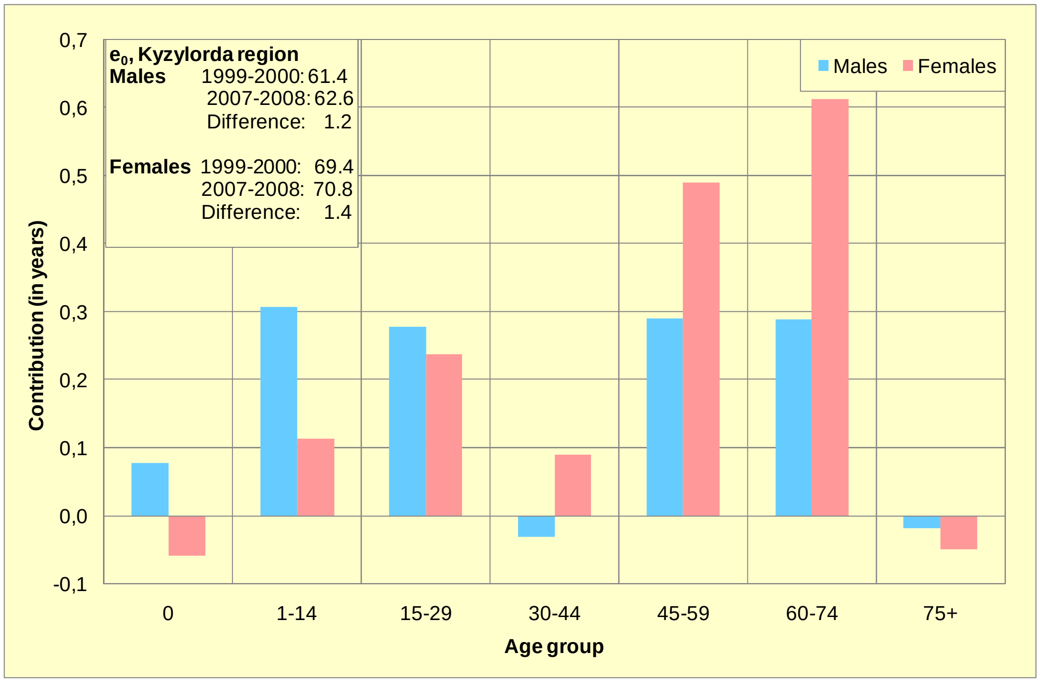
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Male mortality improvement in age groups 1-14 (0.12 years), 45-59 (0.37 years) and 60-74 (0.15 years) contributed positively to the increase with more contribution of age group 45-59. Male mortality increase in age groups 0 (-0.18 years), 15-29 (-0.03 years), 30-44 (-0.07 years), and 75+ (-0.03 years) contributed negatively to the increase (see Figure 26a). Male mortality increase in infant age assessed more negative contribution compared to other age groups.

Female life expectancy at birth observed the bigger increase than male one in the region between two observed periods. All age groups except age 0 contributed positively to the increase. Female mortality improvement in age group 60-74 (0.45 years) and 45-59 (0.38 years) contributed the most among other age groups. Female mortality increase in age 0 (-0.28 years) contributed negatively to female life expectancy increase as it was observed for males.

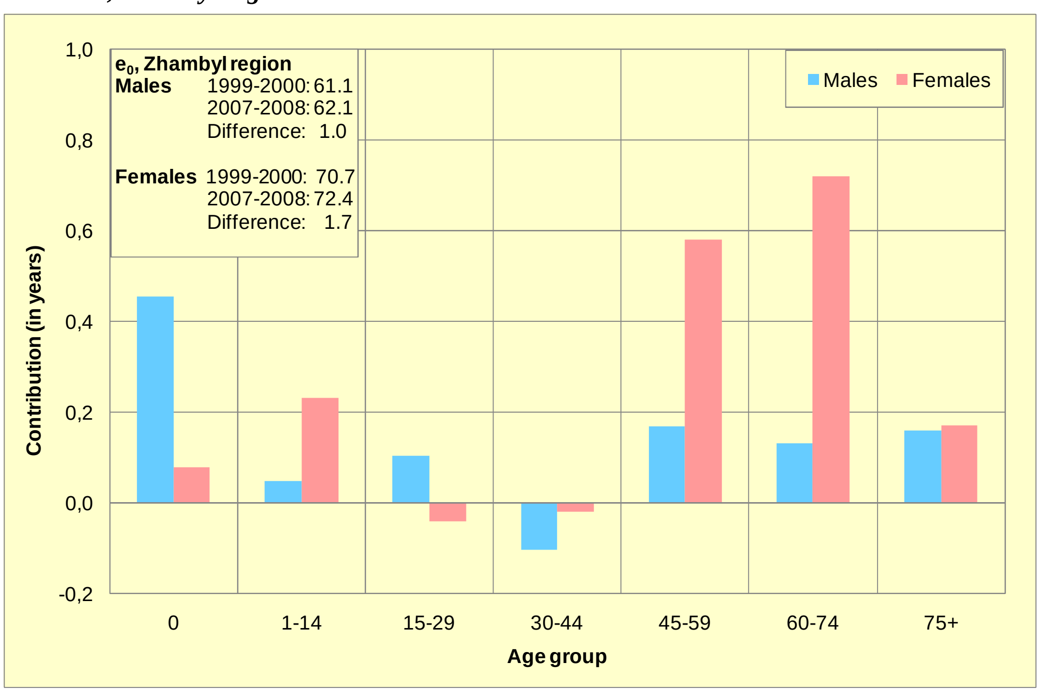
In Kyzylorda region male as well as female life expectancy at birth increased (1.2 years for males, 1.4 years for females) between the periods 1999-2000 and 2007-2008. Male mortality increase in age groups 30-44 (-0.03 years) and 75+ (-0.02 years) contributed negatively to the increase of male life expectancy at birth while other age groups contributed positively to the increase (see Figure 26b). Mortality improvement in age groups 1-14 (0.31 years), 15-29 (0.28 years), 45-59 (0.29 years), 60-74 (0.29 years) contributed the most to the increase.

Figure 26b − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Kyzylorda region



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 26c − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Zhambyl region



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female mortality increase in age groups 0 (-0.06 years) and 75+ (-0.05 years) contributed negatively to female life expectancy at birth increase while other age groups assessed the positive contribution. The most positive contribution was assessed by female mortality improvement in age groups 45-59 (0.49 years) and 60-74 (0.61 years).

Figure 26d − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Almaty region

***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Zhambyl region male life expectancy at birth increased for 1.0 year between the periods 1999-2000 and 2007-2008. Male mortality decline in all age groups except 30-44 contributed positively to the increase of male life expectancy at birth with the most contribution of age 0 (0.46 years) (see Figure 26c). Male mortality increase in age group 30-44 (-0.10 years) assessed the negative contribution to male life expectancy at birth increase.

Female life expectancy at birth increased for 1.7 years between observed periods in the region. Female mortality increase in age groups 15-29 (-0.04 years) and 30-44 (-0.02 years) contributed negatively to the increase while other age groups assessed the positive contribution. Mortality improvement among females in age groups 45-59 (0.58 years) and 60-74 (0.72 years) contributed mostly to female life expectancy at birth increase in the region.

In Almaty region apart from other southern part regions male life expectancy at birth decreased for 0.1 years in the period 2007-2008 in comparison with 1999-2000. Male mortality increase in age groups 15-29 (-0.13 years) and 30-44 (-0.51 years) contributed positively to the decrease with significantly more contribution of age group 30-44 (see Figure 26d). Male mortality improvement in age groups 0 (0.13 years), 60-74 (0.12 years), and 75+ (0.15 years) assessed more positive contribution than other age groups.

Female life expectancy at birth increased for 0.9 years in the region. Despite the fact that the age groups 15-29 (-0.01 years) and 30-44 (-0.19 years) contributed negatively to the increase their contribution was not as big as the positive contribution of age groups 45-59 (0.33 years) and 60-74 (0.34 years).

In observed southern part regions except Almaty region male life expectancy at birth increased between the periods 1999-2000 and 2007-2008. However, male mortality increase in age group 30-44 contributed negatively to male life expectancy at birth in Zhambyl, Kyzylorda, South Kazakhstan regions and positively to male life expectancy at birth decrease in Almaty region. Despite the fact that female life expectancy at birth increased in these regions female mortality increase in age group 30-44 contributed negatively to the increase in Almaty and Zhambyl regions. In South Kazakhstan, Kyzylorda regions female mortality decrease in this age group assessed the least contribution to female life expectancy increase. It is worth to note that female mortality improvement in age groups 45-59 and 60-74 assessed the positive contribution in all southern regions.

10.6 Municipal cities (Almaty, Astana)

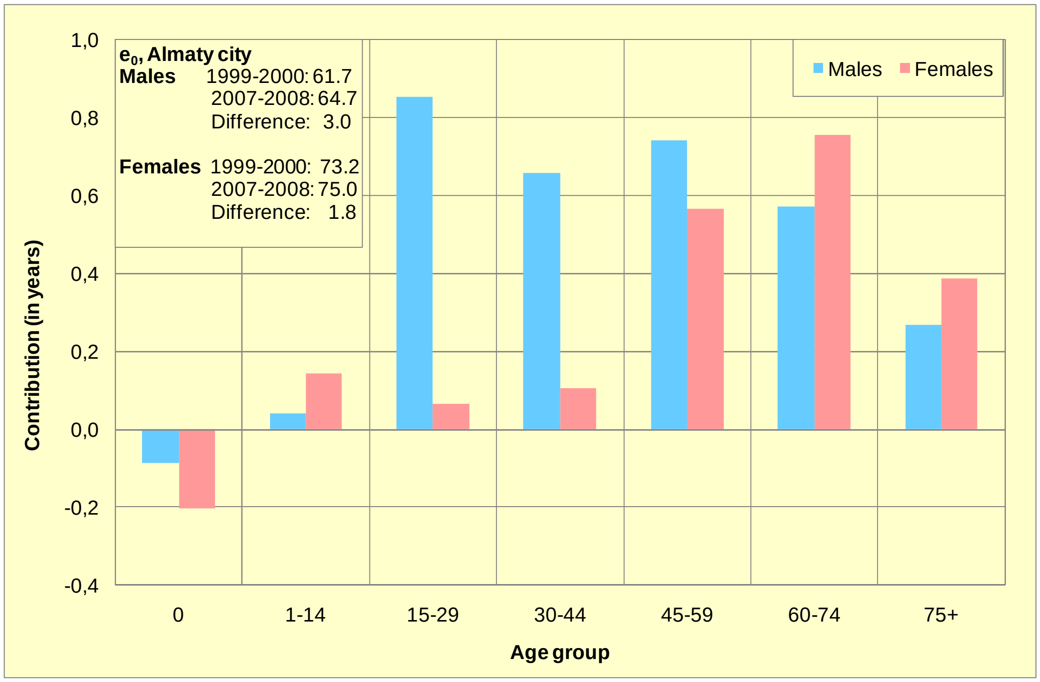
Municipal cities observed the most increase of life expectancy at birth for both sexes among all regions between the periods 1999-2000 and 2007-2008. Male life expectancy at birth increased in Almaty city for 3.1 years. Male mortality improvement in all age groups except infant age contributed positively to the increase (see Figure 27a). Improvement of mortality among males in age groups between 15 and 74 assessed the positive contribution. Infant male mortality increase assessed the negative contribution (-0.09 years) to male life expectancy at birth increase in the city.

It is worth to note that female life expectancy at birth increased less (1.8 years) than male one between examined periods. Female mortality increase in age 0 contributed negatively to female life expectancy at birth increase (-0.20 years) as it was observed for males (see Figure 27a). Female mortality improvement in age groups 45+ assessed positive contribution more than other age groups.

Astana city was the region which achieved significantly more increase of life expectancy at birth for both sexes in comparison with other observed regions. Male life expectancy at birth increased more (for 6.0 years) than female one (for 4.4 years) in the city between two periods as it was observed for Almaty city. Mortality increase in age group 1-14 contributed negatively to the increase of male as well as female life expectancy at birth (see Figures 27b). It is worth to say that age groups 45-59, 60-74 and 75+ contributed the most to the increase of life expectancy at birth for both sexes which demonstrated the improvement of mortality in older age groups for both sexes in the city.

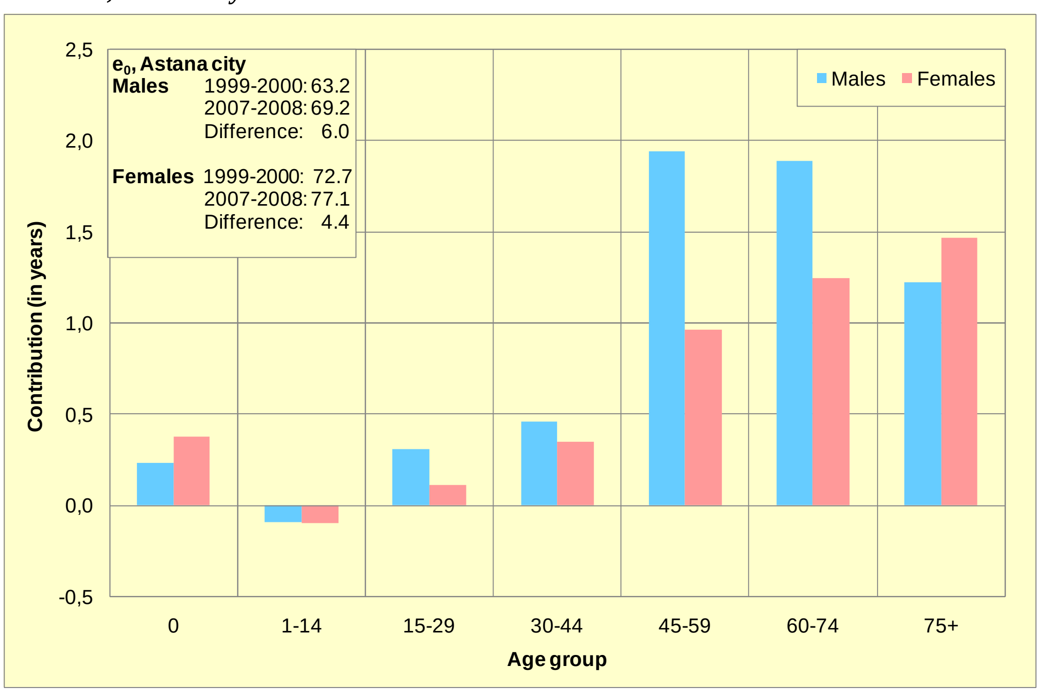
The evidence in Almaty and Astana cities indicated that in both cities male as well as female life expectancy at birth significantly increased between observed periods. In Almaty city mortality increase in infant age, in Astana city in age group 1-14 contributed negatively to the increase of life expectancy at birth of both sexes.

Figure 27a − Contributions of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Almaty city



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 27b − Contribution of age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Astana city



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

10.7 Main findings

The finding of the chapter answers the third research question.

3. What age groups contributed the most to the change in life expectancy at birth of males and females in the regions between the periods 1999-2000 and 2007-2008?

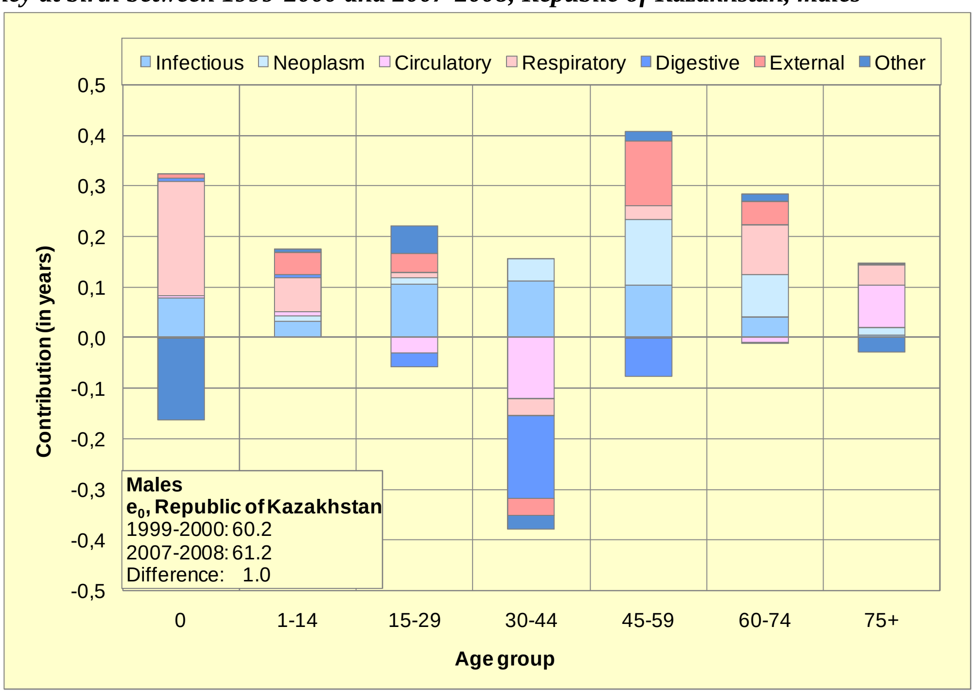
3. Mortality increase in age group 30-44 contributed negatively to life expectancy at birth increase for both sexes in the country. Mortality increase in this age group for both sexes assessed the most contribution in all northern, central, eastern regions, and southern region Almaty. Male mortality increase in this age group also contributed the most in southern regions Kyzylorda, Zhambyl, and western region Aktobe while for females it assessed the most contribution in West Kazakhstan region. In western regions Atyrau, Mangystau, and Astana, Almaty cities this age group did not indicate any negative contribution. However, mortality increase in infant age in Almaty city, in age group 1-4 Astana city, for males in age groups 60-74 and 75+ in Mangystau region contributed negatively to life expectancy at birth increase. Infant mortality improvement for both sexes assessed the most contribution in Pavlodar, Akmola, and Mangystau regions, for males it contributed the most in Kostanai, Karagandy and Zhambyl regions apart from females. In western regions West Kazakhstan, Atyrau, Aktobe, southern South Kazakhstan, and Astana city male mortality improvement in age group 45-59 assessed the most positive contribution. Female mortality improvement in age group 60-74 assessed the most positive contribution in southern regions, East Kazakhstan, West Kazakhstan, Atyrau, Aktobe regions, and Almaty city.

Chapter 11

Contribution of selected causes of death to the change in overall mortality level in the regions between the periods 1999-2000 and 2007-2008

The chapter analyses the contribution of selected causes of death to the change in life expectancy at birth between the periods 1999-2000 and 2007-2008 in the country and its regions. The analysis was made with application of method proposed by Pollard (see Chapter 6.2.1.2).

Figure 28a – The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Republic of Kazakhstan, males

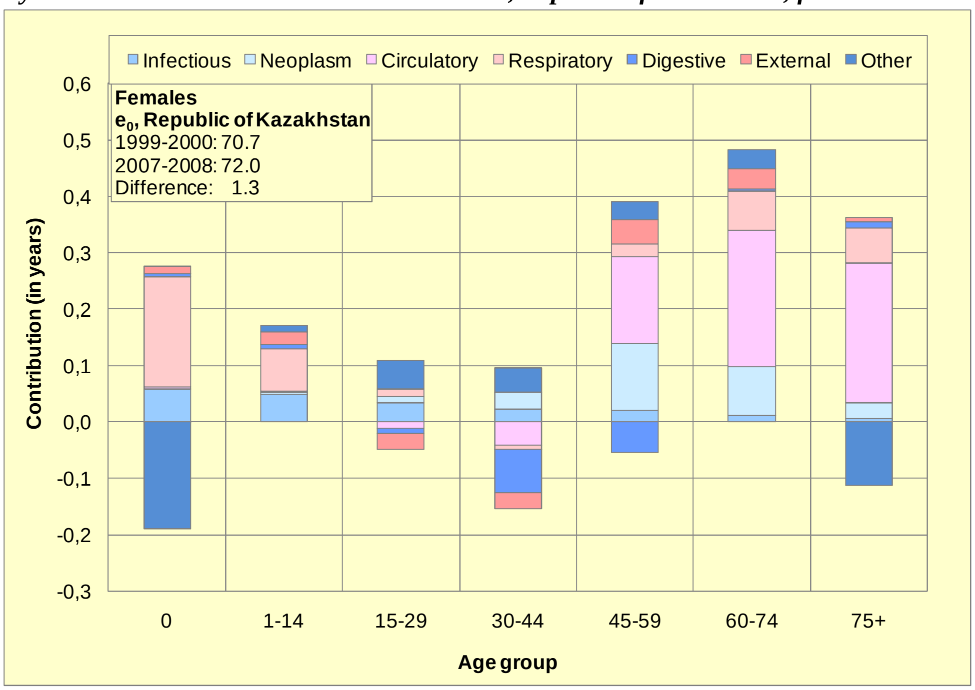


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the Republic of Kazakhstan male life expectancy at birth increased for 1.0 year between observed periods. The greatest positive contribution to the increase came from mortality improvement from infectious (0.48 years) and respiratory system diseases (0.43 years) (see Figure 28a). The second biggest contribution was due to mortality decrease from neoplasms (0.30

years) and external causes of death (0.24 years). However, mortality increase from respiratory system diseases and external causes of death contributed negatively to the increase in age group 30-44. The biggest negative contribution was due to mortality increase from digestive system diseases (-0.25 years). Its substantial contribution occurred among males aged 30-44 (-0.16 years). Mortality increase from the group of other causes (-0.12 years) and circulatory system diseases (-0.06 years) also contributed negatively to the increase. The biggest negative contribution of circulatory system diseases was assessed in age group 30-44 (-0.12 years) while mortality increase from the group of other causes mostly occurred in infant age (-0.16 years).

Figure 28b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Republic of Kazakhstan, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female life expectancy at birth increased for 1.3 years between examined periods. The greatest positive contribution to the increase came from mortality improvement from circulatory (0.60 years) and respiratory system diseases (0.43 years) (see Figure 28b). Mortality decrease from circulatory system diseases occurred in age groups 45-59, 60-74, and 75+ while improvement of mortality from respiratory system diseases occurred mostly in infant age (0.20 years). The second biggest contribution was primarily due to mortality improvement from neoplasms (0.28 years) and infectious diseases (0.20 years). Their positive contribution occurred in all age groups. The slight positive contribution was due to mortality decrease from external causes (0.07 years). However, in age groups 15-29 and 30-44 this cause assessed the negative contribution. Mortality increase from the group of other causes (-0.13 years) and digestive system diseases (-0.11 years) assessed the negative contribution to female life expectancy at birth increase. The biggest negative contribution of mortality increase from the group of other causes was assessed in infant (-0.19 years) and oldest ages (75+) (-0.11 years) while mortality increase from digestive system diseases mostly occurred in age groups 30-44 and 45-59.

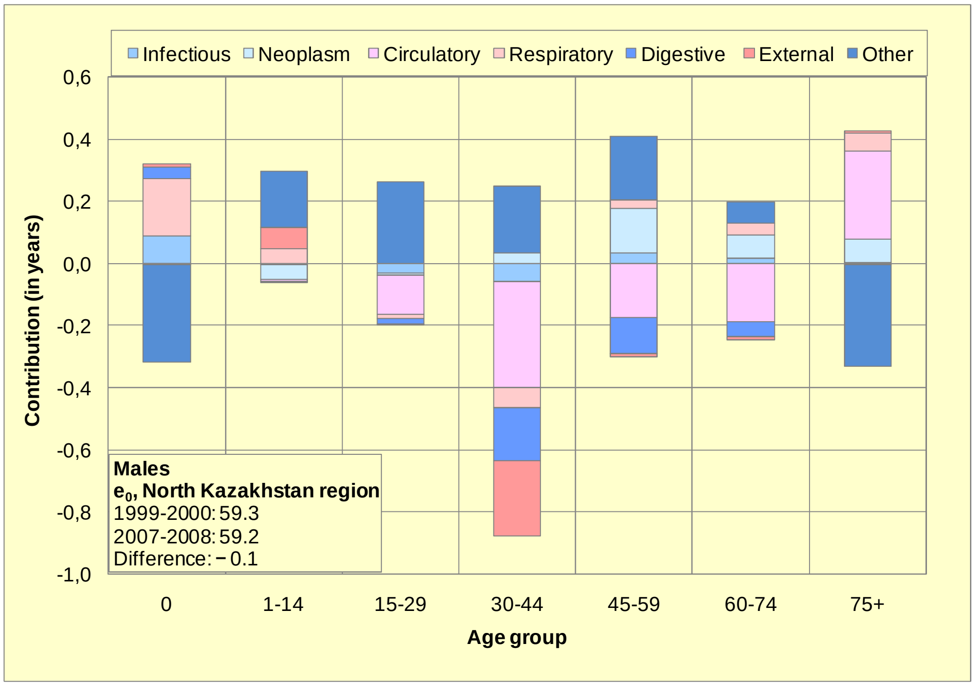
In the country mortality improvement from respiratory system diseases, infectious diseases, neoplasms, and external causes contributed positively to life expectancy at birth increase for both sexes. Mortality increase from digestive system diseases and the group of other causes contributed negatively to the increase. Male mortality increase from circulatory system diseases assessed the slight negative contribution while female mortality improvement from this cause assessed the greatest positive contribution. For both sexes mortality increase even from improved causes negatively contributed in age group 30-44.

11.1 Northern regions (North Kazakhstan, Kostanai, Pavlodar)

In North Kazakhstan region male life expectancy decreased for 0.2 years in the period 2007-2008 compared to 1999-2000. The greatest positive contribution to the decrease came from major rise of mortality from circulatory system diseases (-0.56 years) mainly in age groups between 15 and 74 with the biggest rise among males in age group 30-44 (-0.34 years) (see Figure 29a). In this age group male mortality from external causes also contributed positively to the decrease (-0.24 years) while in other age groups this cause did not demonstrate such a big contribution. The second great positive contribution was primarily due to the increase of mortality from the digestive system diseases (-0.32 years). Its biggest positive contribution occurred in age groups 30-44 and 45-59. Mortality drop from respiratory system diseases (0.28 years), the group of other causes (0.29 years), neoplasms (0.28 years), and infectious diseases (0.05 years) contributed negatively to male life expectancy decrease in the region. However, the group of other causes indicated the substantial positive contribution in infant and old age groups (75+). Mortality rise from infectious and respiratory system diseases occurred in age group 30-44.

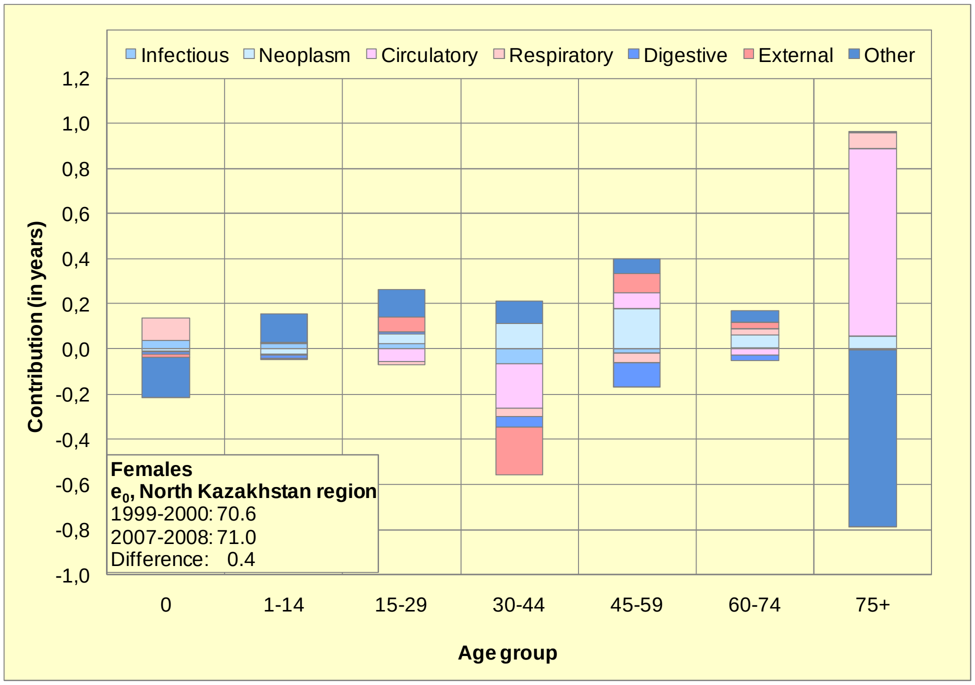
Female life expectancy at birth increased for 0.4 years in the period 2007-2008 compared to 1999-2000 in North Kazakhstan region. The greatest positive contribution to the increase came from the drop of mortality from circulatory system diseases (0.63 years) mainly in age 75+ (see Figure 29b). The second great positive contribution was due to mortality drop from Neoplasms (0.42 years). The contribution of this cause was significant in age groups from 15 to 75+. Mortality drop from respiratory system diseases also contributed positively to female life expectancy increase (0.11 years). The positive contribution of this cause was notable in ages 0 and 75+. The negative contribution to female life expectancy increase came from mortality rise from the group of other causes (-0.51 years), the digestive system diseases (-0.21 years) and external causes (-0.04 years). The negative contribution of the group of other causes was substantial in ages 0 and 75+ while the digestive system diseases notably contributed in age groups 30-44 and 45-59. Mortality rise from external causes assessed the substantial negative contribution in age group 30-44.

Figure 29a− The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, North Kazakhstan region, males



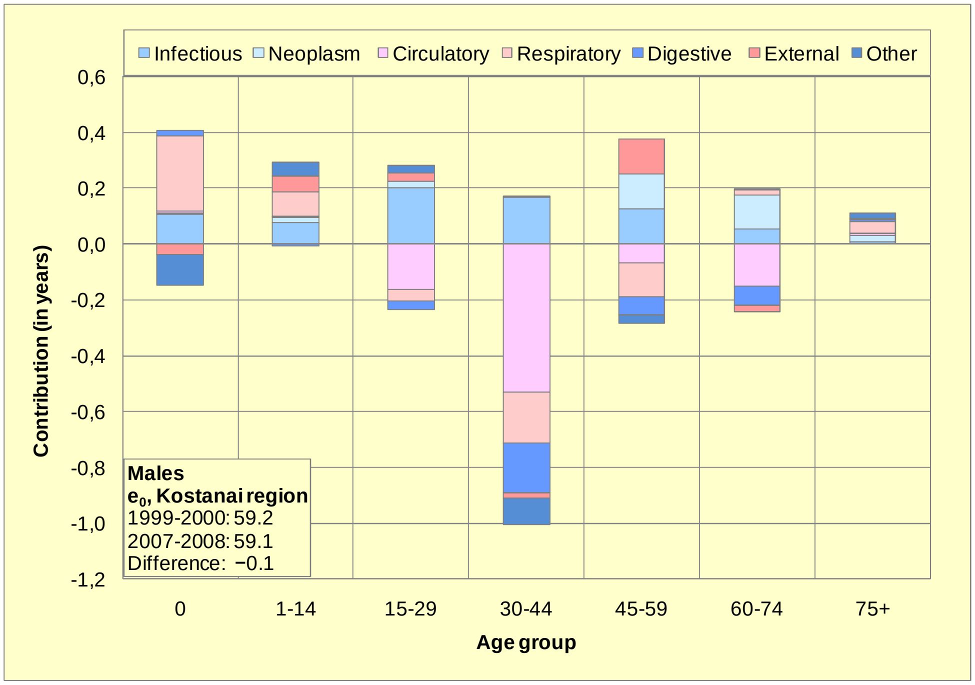
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 29b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, North Kazakhstan region, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 30a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Kostanai region, males



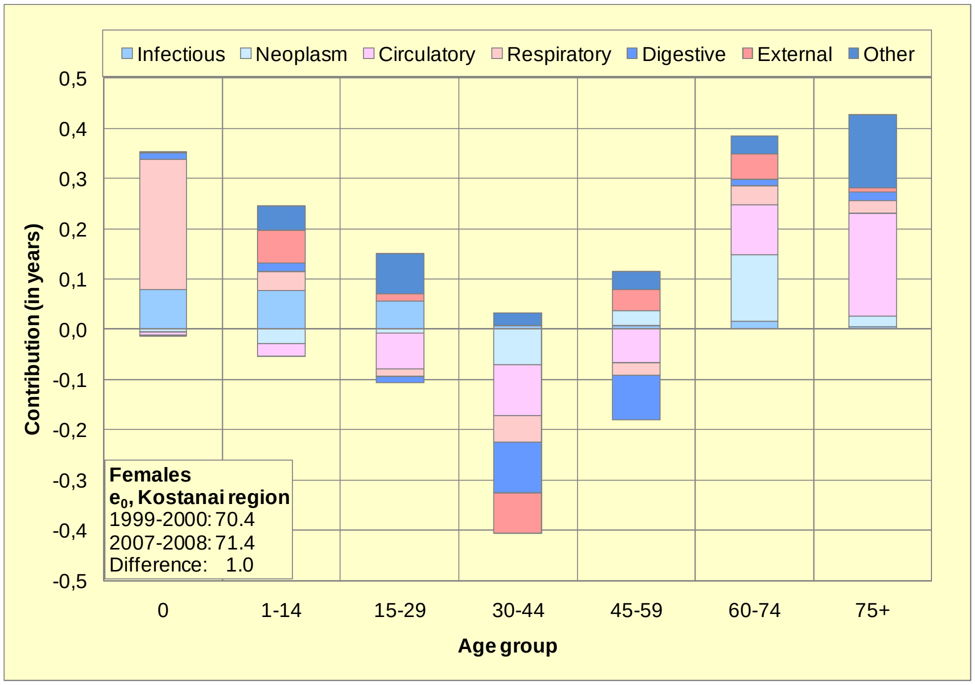
***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In North Kazakhstan region mortality rise from digestive system diseases and external causes contributed positively to male life expectancy decrease and negatively contributed to female life expectancy increase. Mortality from circulatory system diseases increased among males aged 15-74 while it improved mostly among females aged 75+. The increase of mortality from circulatory system diseases, external causes, digestive system diseases, infectious diseases observed mainly age group 30-44 for both sexes with greater one among males.

In Kostanai region male life expectancy at birth decreased for 0.1 years between the periods 1999-2000 and 2007-2008. The greatest positive contribution to the decrease came from circulatory system diseases which accounted for 0.89 years (see Figure 30a). The contribution was biggest in age group 30-44 (-0.53 years). The second great positive contribution was due to mortality rise from digestive system diseases (-0.33 years). The contribution of this cause was also biggest in age group 30-44 (-0.18 years). Mortality rise from the group of other causes also contributed positively to the decrease (-0.15 years) with the biggest contribution among males aged 0 and 30-44. Mortality drop from infectious diseases (0.74 years), neoplasms (0.32 years), external causes (0.14 years), and respiratory system diseases (0.17 years) contributed negatively to male life expectancy decrease. However, respiratory system diseases indicated the substantial positive contribution in age groups 30-44 and 45-59.

Female life expectancy at birth in Kostanai region increased for 1.0 year between observed periods. The increase was primarily due to mortality improvement in infant, young and old age groups (see Figure 30b). The greatest positive contribution came from mortality drop from the group of other causes in all age groups which accounted for 0.37 years. The second great positive contribution came from mortality fell from respiratory system diseases (0.27 years) and infectious diseases (0.25 years). The improvement of these causes was significant in infant and old age groups. Respiratory system diseases assessed the negative contribution in age groups 15-29, 30-44, and 45-59. Mortality fell from external cause (0.10 years), neoplasms (0.07 years), and circulatory system diseases (0.03 years) assessed the slight positive contribution to the increase. Their positive contribution was more significant in old age groups 60-74 and 75+. Circulatory system diseases indicated the negative contribution in age groups 15-29. 30-44, and 45-59. In age group 30-44 neoplasms and external cause also negatively contributed to female life expectancy increase. Mortality rise from digestive system diseases negatively contributed to female life expectancy at birth increase (-0.14 years) with the bigger contribution in age groups 30-44 and 45-59.

Figure 30b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Kostanai region, females



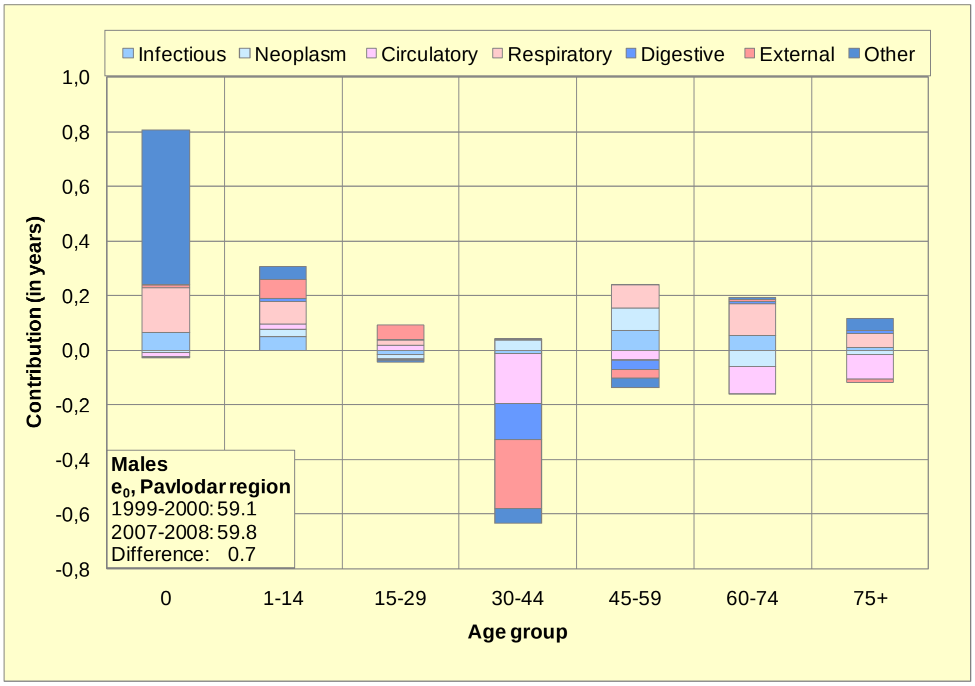
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Kostanai region mortality level from digestive system indicated the increase among males as well as females. Mortality rise from main causes as circulatory system diseases, respiratory system diseases occurred mainly in age group 30-44 for both sexes indicating the greater positive contribution to male life expectancy at birth decrease in the region.

In Pavlodar region male life expectancy at birth increased for 0.7 years between two periods while other northern regions demonstrated the decrease. The biggest contribution came from mortality drop from the group of other causes in infant age (0.57 years) and respiratory system diseases in all age groups (0.52 years) (see Figure 31a). Mortality from infectious diseases in all age groups except 15-29, 30-44 contributed also positively to male life expectancy increase.

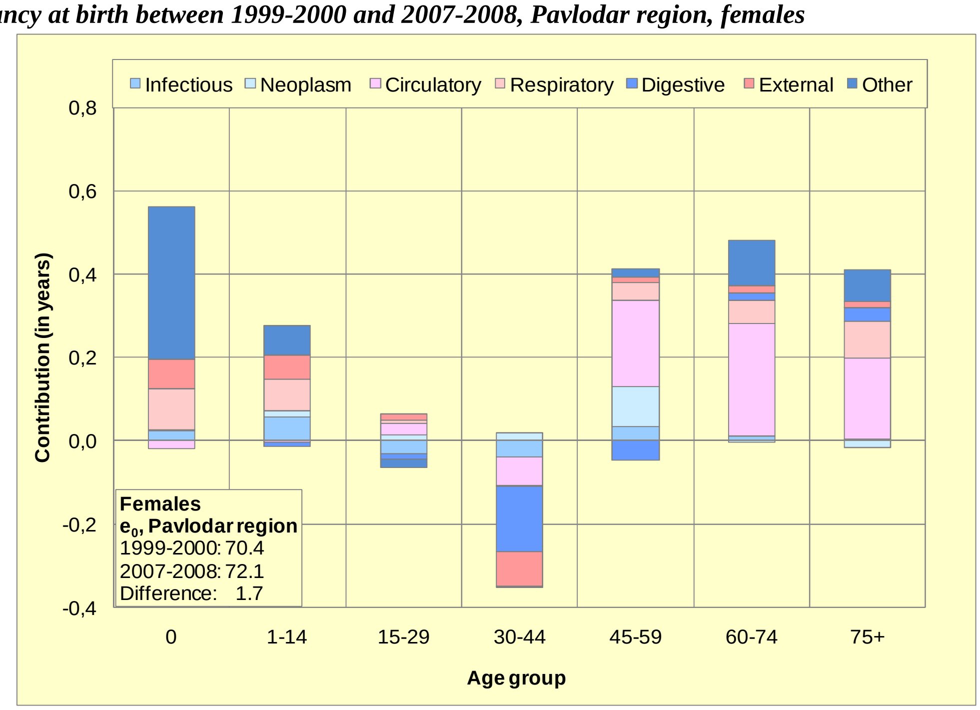
Mortality rise from circulatory system diseases (-0.39 years), external causes (-0.15 years), digestive system diseases (-0.14 years) contributed negatively to male life expectancy increase. The negative contribution of these causes was more substantial in age group 30-44.

Figure 31a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Pavlodar region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 31b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Pavlodar region, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female life expectancy at birth increased for 1.7 years between two periods in Pavlodar region. All causes of death except the digestive system diseases contributed positively to female life expectancy increase. The greatest positive contribution came from mortality improvement from circulatory system diseases (0.61 years) and the group of other causes (0.62 years) (see Figure 31b). The positive contribution of circulatory system diseases was substantial in age groups 45+ while the group of other causes was highly contributed in age groups 0, 1-14, and 60+. The second great positive contribution was due to mortality improvement from respiratory system diseases (0.37 years). Its positive contribution was notable also in young (0, 1-14) and old age groups (45+). Mortality drop from neoplasms (0.12 years) and external causes (0.10 years) also contributed positively to female life expectancy increase in the region. The positive contribution of neoplasms was significant in age group 45-59 while external cause contributed positively in all age groups except 30-44. The negative contribution of digestive system diseases was substantial in age groups 30-44 and 45-59. It is worth to note that mortality rise from circulatory system diseases, external causes, infectious diseases occurred mainly in age group 30-44.

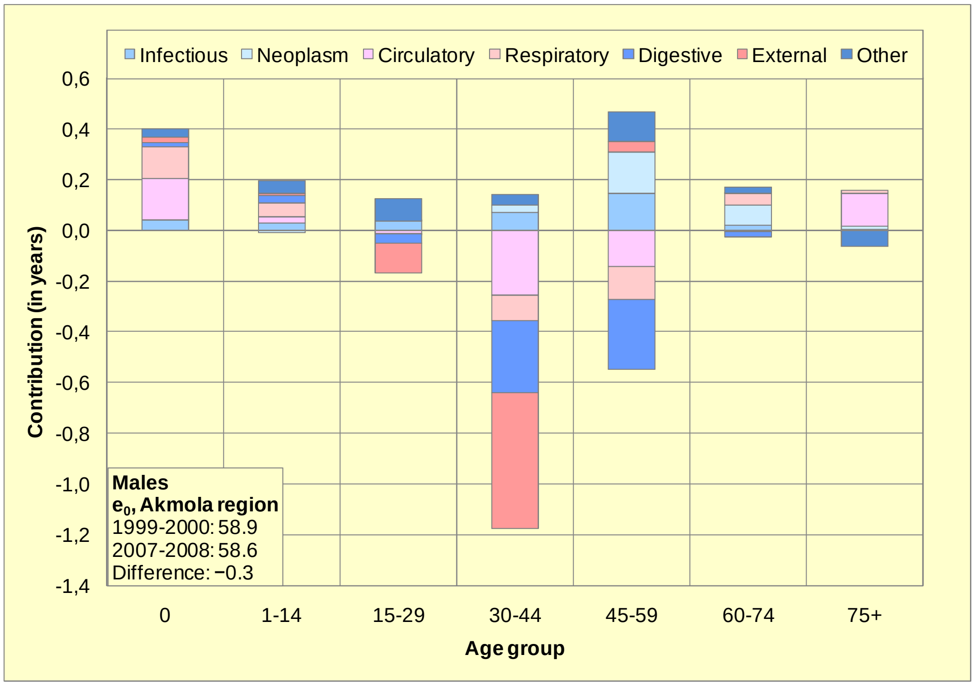
In Pavlodar region mortality rise from digestive system diseases contributed negatively to life expectancy at birth of both sexes. Mortality from circulatory system diseases and external causes negatively contributed to male life expectancy at birth increase apart from female one. Mortality increase from circulatory system diseases, external causes and digestive system diseases substantially occurred in age group 30-44 for both sexes.

11.2 Central regions (Akmola, Karagandy)

In Akmola region male life expectancy at birth decreased for 0.3 years between the periods 1999-2000 and 2007-2008 which was the biggest decrease among all regions. Mortality rise from external causes assessed the greatest positive contribution to the decrease (-0.58 years) mainly in age groups 15-29 and 30-44 (-0.12 and -0.53 years respectively) (see Figure 32b). The second great positive contribution came from mortality increase from digestive system diseases (-0.57 years) mostly in age groups 30-44 and 45-59 (-0.28 and -0.27 years respectively). Mortality rise from respiratory system diseases in age groups 30-44 and 45-59 assessed the substantial positive contribution to male life expectancy decrease (-0.10 and -0.13 year respectively). Mortality drop from infectious diseases (0.34 years), the group of other causes (0.29 years), and neoplasms (0.27 years) assessed the negative contribution to male life expectancy decrease. The negative contribution of neoplasms was significant in age groups 45-59 and 60-74 while infectious diseases mostly contributed in age groups 30-44 and 45-59. Mortality from the group of other causes improved in all age groups except the age 75+.

In Akmola region female life expectancy increased for 0.7 years in the period 2007-2008 compared to 1999-2000. The biggest positive contribution came from mortality drop from circulatory system diseases which accounted for 0.67 years (see Figure 32b). The contribution was great in age 75+. The second great positive contribution was due to mortality fell from respiratory system diseases (0.36 years) and neoplasms (0.27 years). The positive contribution of respiratory system diseases was biggest in infant age (0.18 years) and neoplasms in age groups 45-59 and 60-74 (0.12 and 0.11 years respectively).The substantial negative contribution to female life expectancy increase came from external cause mainly in age groups from 1 to 44, digestive system diseases in age groups 30-44 and 45-59, group of other causes in ages 0 and 75+.

Figure 32a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Akmola region, males

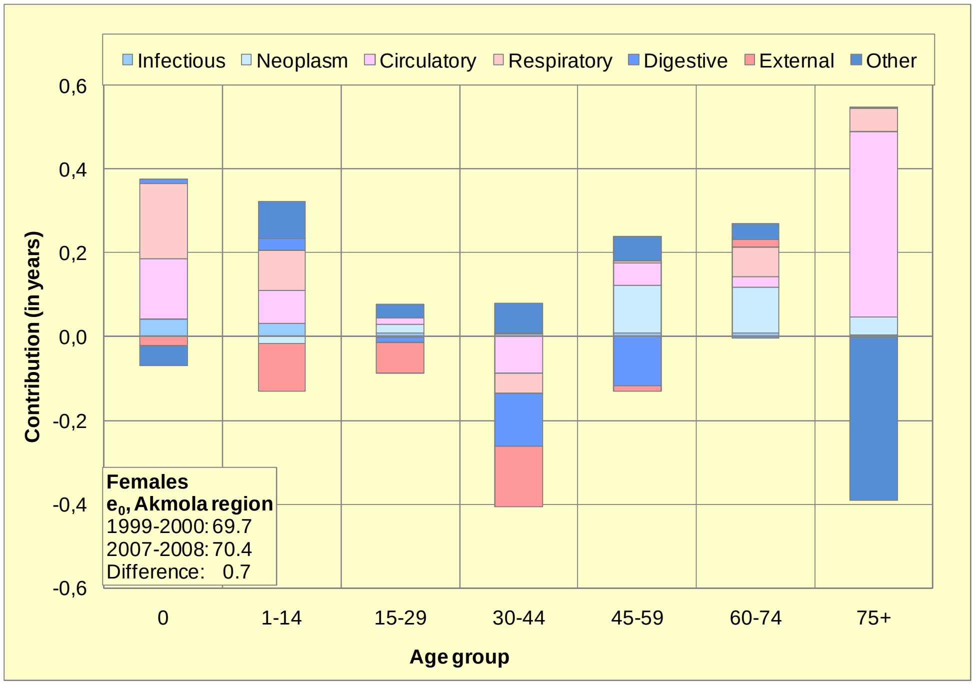


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Akmola region mortality rise from digestive system diseases and external causes contributed to male as well female life expectancy change. Mortality from circulatory system diseases contributed positively to male life expectancy decrease while for females it indicated the great improvement. Mortality rise from circulatory system diseases, external causes, and digestive system diseases occurred mainly in age group 30-44 for both sexes with greater rise among males.

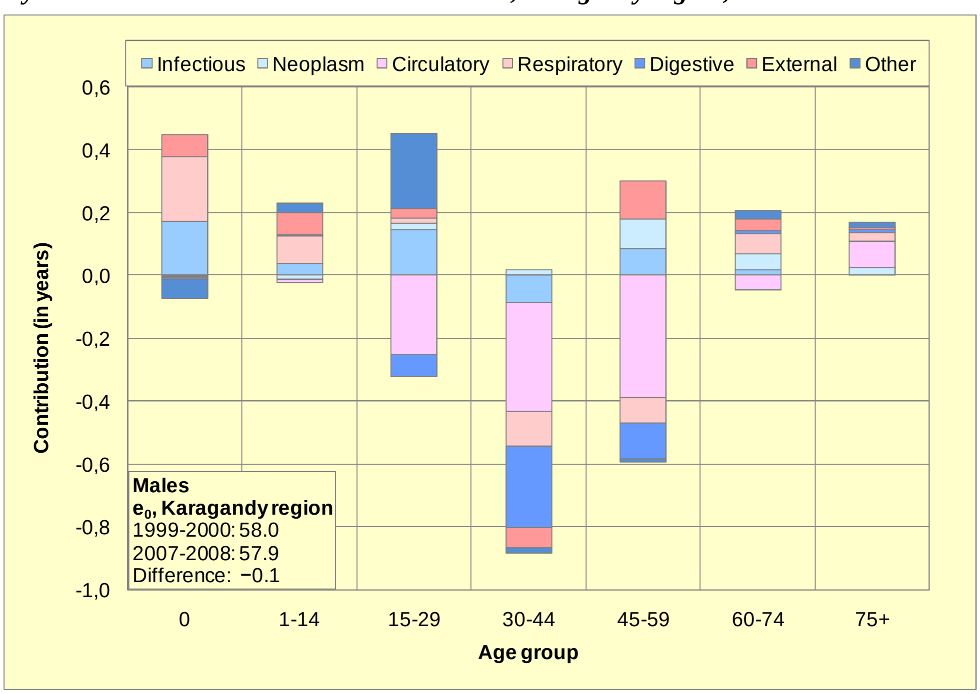
In Karagandy region male life expectancy at birth slightly decreased (for 0.1 years) between the periods 1999-2000 and 2007-2008. The decrease was mainly due to the mortality rise from circulatory system diseases (-0.96 years) mainly in age groups 15-29, 30-44, and 45-59 (see Figure 33a). The second great positive contribution came from digestive system diseases (-0.43 years) which was also highest in aforementioned age groups. Mortality drop from infectious diseases (0.37 years), external causes (0.27 years), respiratory system diseases (0.22 years), the group of other causes (0.22 years), and neoplasms (0.19 years) contributed negatively to male life expectancy decrease in the region. However, in age group 30-44 these causes (except neoplasms) assessed the positive contribution to the decrease.

Figure 32b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Akmola region, females



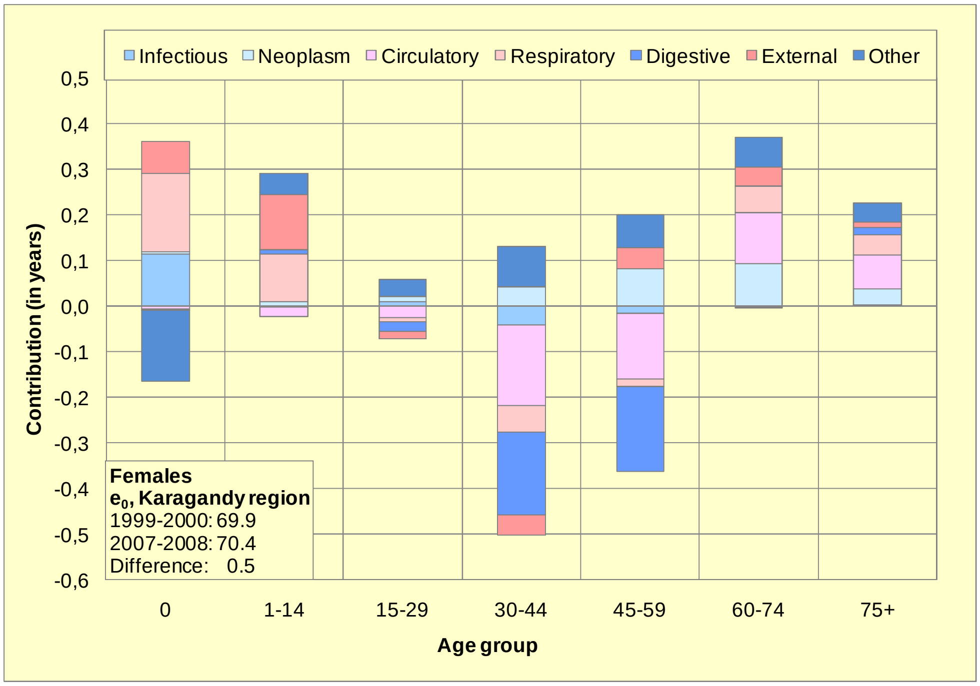
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 33a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Karagandy region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 33b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Karagandy region, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Karagandy region female life expectancy at birth increased for 0.5 years in the period 2007-2008 compared to 1999-2000. The greatest positive contribution came from mortality improvement from neoplasms (0.28 years) and respiratory system diseases (0.29 years) (see Figure 33b). The substantial positive contribution of mortality fell from respiratory system diseases was in young (0, 1-14) and old age groups (60-74, 75+). The second big positive contribution was due to mortality drop from external causes (0.23 years) and the group of other causes (0.20 years). However, mortality from external causes indicated the negative contribution in age groups 15-29 and 30-44 while mortality from the group of other causes increased in infant age. Mortality improvement from infectious diseases contributed to female life expectancy increase slightly (0.07 years) mainly in infant age. Mortality rise from digestive system diseases (-0.37 years) and circulatory system diseases (-0.19 years) assessed the negative contribution to female life expectancy increase with the biggest contribution in age groups 30-44 and 45-59.

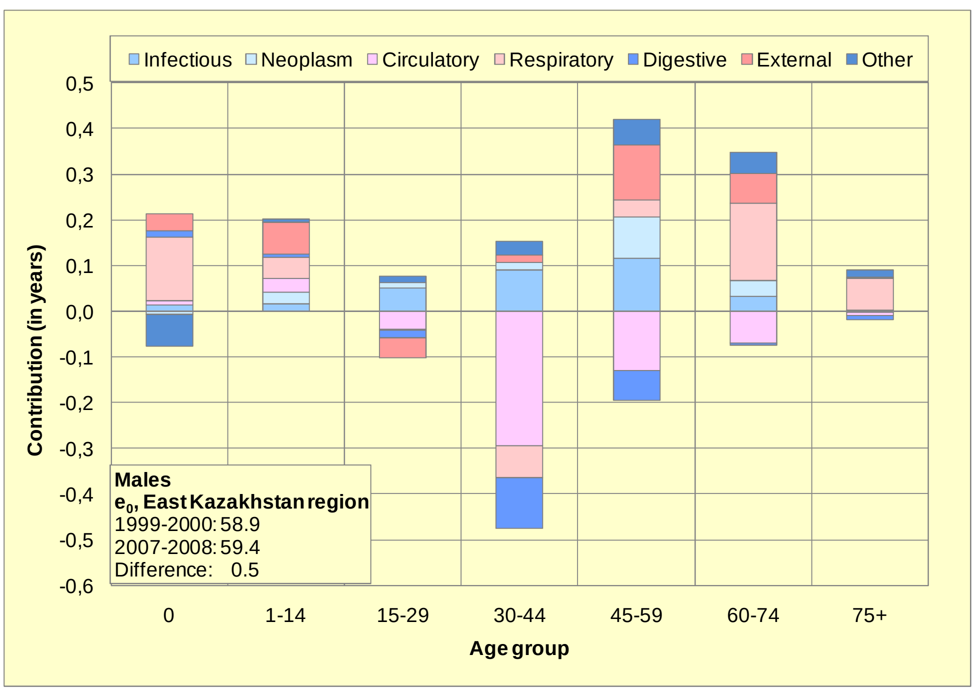
11.3 Eastern region (East Kazakhstan)

In East Kazakhstan region male life expectancy at birth increased from 58.9 years in 1999-2000 to 59.4 years in 2007-2008 (for 0.5 years). The greatest positive contribution came from major drop of mortality from respiratory system diseases (0.39 years) and infectious diseases (0.32 years) (see Figure 34a).The second great positive contribution was due to mortality drop from external causes (0.27 years), then neoplasms (0.17 years) and the group of other causes (0.10

years). Mortality drop from respiratory system diseases occurred mainly in age groups 0, 1-14 and 45+ while mortality from infectious diseases improved in all age groups. Mortality from external causes declined in all age groups except 15-29 while Neoplasms improved in all age groups except infant and 75+. The group of other causes also improved in all age groups except infant one. The greatest negative contribution to male life expectancy increase in the region came from mortality rise from circulatory system diseases which accounted for 0.5 years. It was essential mainly in age group 30-44. The second great negative contribution was primarily due to the increase of mortality from digestive system diseases (-0.2 years). The contribution was biggest in age groups 30-44 and 45-59.

Female life expectancy at birth increased for 0.9 years which was slightly higher than for male life expectancy at birth. The biggest positive contribution was due to the decrease of mortality from respiratory system diseases (0.44 years) in all age groups (see Figure 34b). The second great contribution came from neoplasms (0.28 years) and circulatory system diseases (0.23 years). Mortality from neoplasms improved in all age groups except 30-44 while circulatory system diseases in this age group indicated the substantial negative contribution (-0.12 years). It was worth to note that mortality from digestive system diseases negatively contributed (-0.15 years) to female life expectancy increase especially in age groups from 15 to 59.

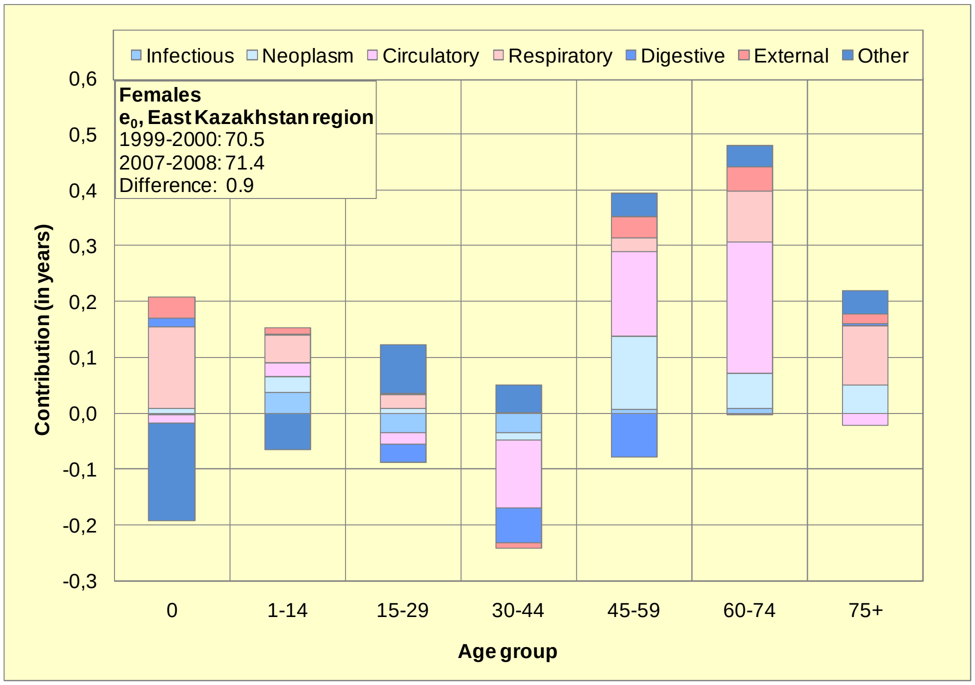
Figure 34a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, East Kazakhstan region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In East Kazakhstan region male as well as female life expectancy increased in the period 2007-2008 compared to 1999-2000. The great positive contribution to male life expectancy increase came from respiratory system diseases, infectious diseases, and external causes while female life expectancy at birth increased due to mortality improvement from respiratory system diseases, circulatory system diseases, and neoplasms. The improvement of these causes occurred mainly in older age groups (45+) for both sexes while causes of death in age group 30-44 indicated substantial negative contribution to male as well as female life expectancy increase.

Figure 34b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, East Kazakhstan region, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

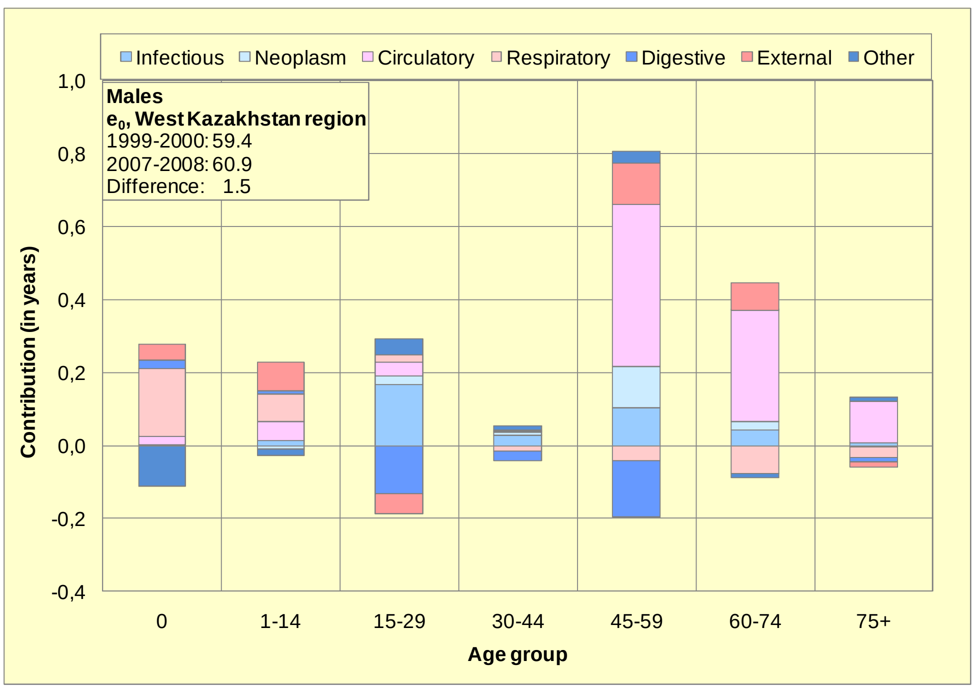
11.4 Western regions (West Kazakhstan, Aktobe, Atyrau, Mangystau)

In West Kazakhstan region male life expectancy increased for 1.5 years which was substantially higher than in aforementioned Pavlodar and East Kazakhstan regions where the increase of male life expectancy at birth was observed. The increase was mainly due to mortality improvement from circulatory system diseases (0.98 years) and infectious diseases (0.36 years) in all age groups (see Figure 35a). Mortality improvement from external causes (0.24 years), neoplasms (0.16 years), and respiratory system diseases (0.12 years) also contributed positively to male life expectancy increase in the region. However, external causes in age groups 15-29 and 75+, respiratory system diseases in age groups from 30 to 75+ indicated the negative contribution to the increase. Mortality from digestive system diseases (-0.29 years) and the group of other causes (-0.04 years) also contributed negatively to the increase. The negative contribution of digestive system diseases was great in age groups 15-29, 30-44, and 45-59 while the group of other causes substantially contributed in infant age (-0.11 years).

In West Kazakhstan region female life expectancy increased for 1.3 years which was slightly lower than the increase of male life expectancy increase in the region. The greatest positive contribution came from mortality drop from circulatory system diseases (0.77 years) and infectious diseases (0.33 years) in all age groups (see Figure 35b). The second positive contribution was mainly due to mortality fell from respiratory system diseases (0.26 years) and the group of other causes (0.16 years). However, mortality from respiratory system diseases contributed negatively in age groups 30-44 and 45-59 while the group of other causes indicated the negative contribution in infant age. The causes of death which assessed the substantial negative contribution to the increase were digestive system diseases in age groups 30-44 and 45-59 and external cause of death in infant and middle age groups (15-29, 30-44, 45-59). It is worth to note that mortality rise from main causes negatively contributed to female life expectancy increase mainly in age group 30-44.

In West Kazakhstan region male as well as female life expectancy at birth increased mainly due to mortality drop from circulatory system diseases and infectious diseases. Mortality rise from digestive system diseases assessed the substantial negative contribution to the increase of male as well as female life expectancy at birth.

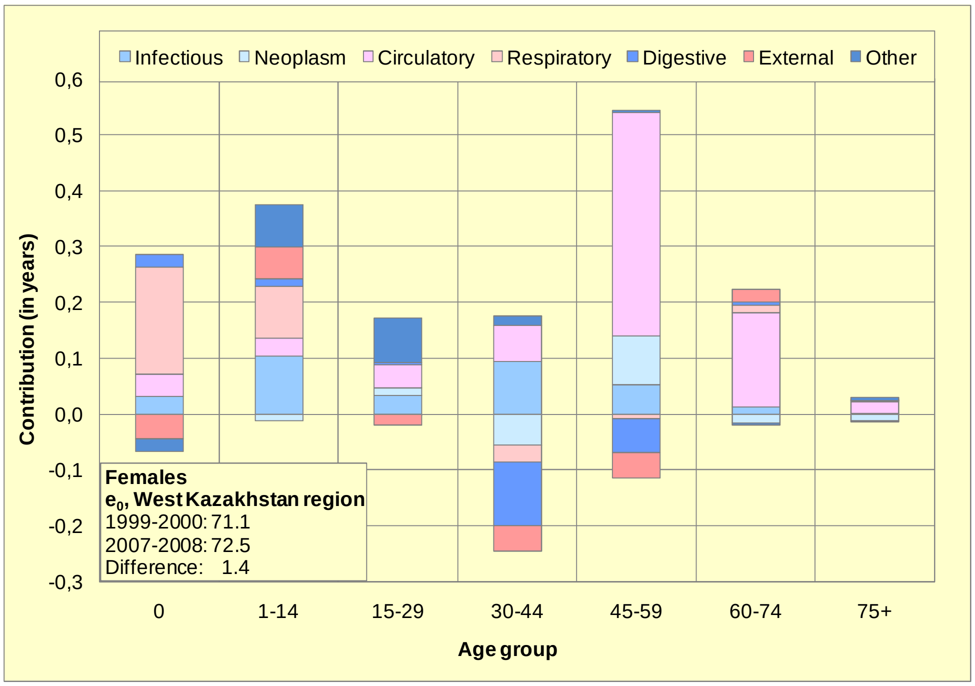
Figure 35a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, West Kazakhstan region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Aktobe region male life expectancy at birth increased for 1.6 years between observed periods. All causes of death except digestive system diseases and the group of other causes contributed positively to male life expectancy increase (see Figure 36a). The greatest positive contribution was mainly due to mortality drop from external causes (0.88 years), infectious diseases (0.65 years) in all age groups, and respiratory system diseases (0.60 years) in all age groups except 15-29. The improvement of mortality from circulatory system diseases in older age groups 45+ and neoplasms in age groups from 30 to 74 also indicated the substantial positive contribution. The greatest negative contribution came from mortality rise from the group of other causes (-1.24 years) with the biggest one in age group 30-44 (-0.45 years). Mortality rise from digestive system diseases and circulatory system diseases were also biggest among men aged 30-44.

Figure 35b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, West Kazakhstan region, females

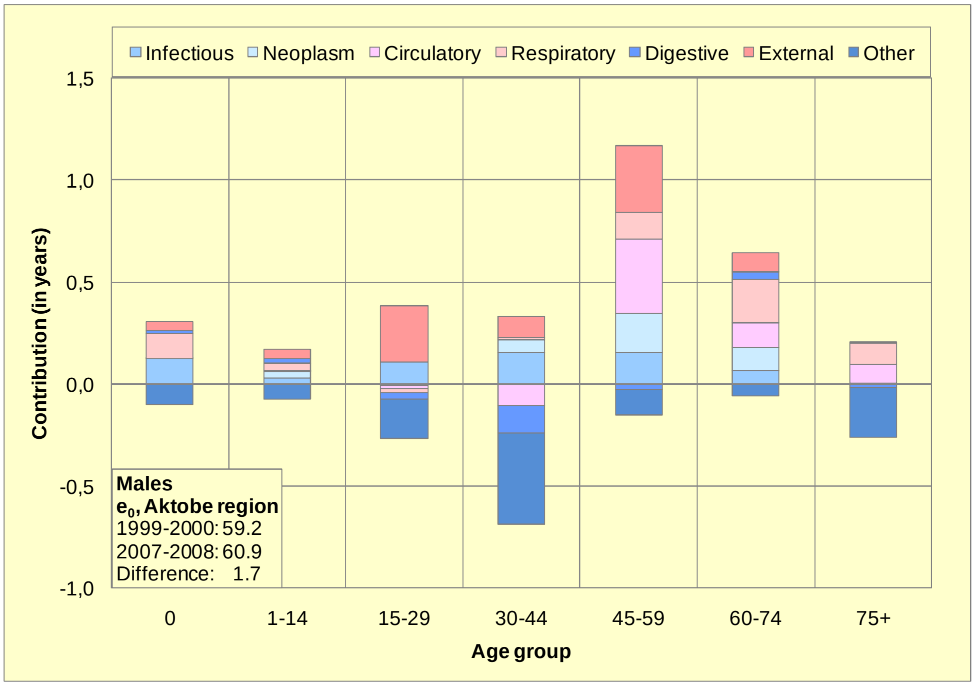


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female life expectancy at birth increased for 2.8 years in Aktobe region which was substantially higher than male life expectancy increase in the region. All causes of death except digestive system diseases and the group of other causes contributed positively to female life expectancy increase (see Figure 36b). The greatest positive contribution came from circulatory system diseases (1.84 years), neoplasms (0.53 years), and external causes of death (0.48 years). Mortality improvement from respiratory system diseases (0.43 years) and infectious diseases (0.42 years) also substantially contributed to the increase. Mortality improvement occurred mainly in old age groups (45+) mainly due to the improvement of mortality from circulatory system diseases with the greatest one among females aged 75+. However, in this age mortality from the group of other causes substantially increased which accounted for 0.81 years of negative contribution.

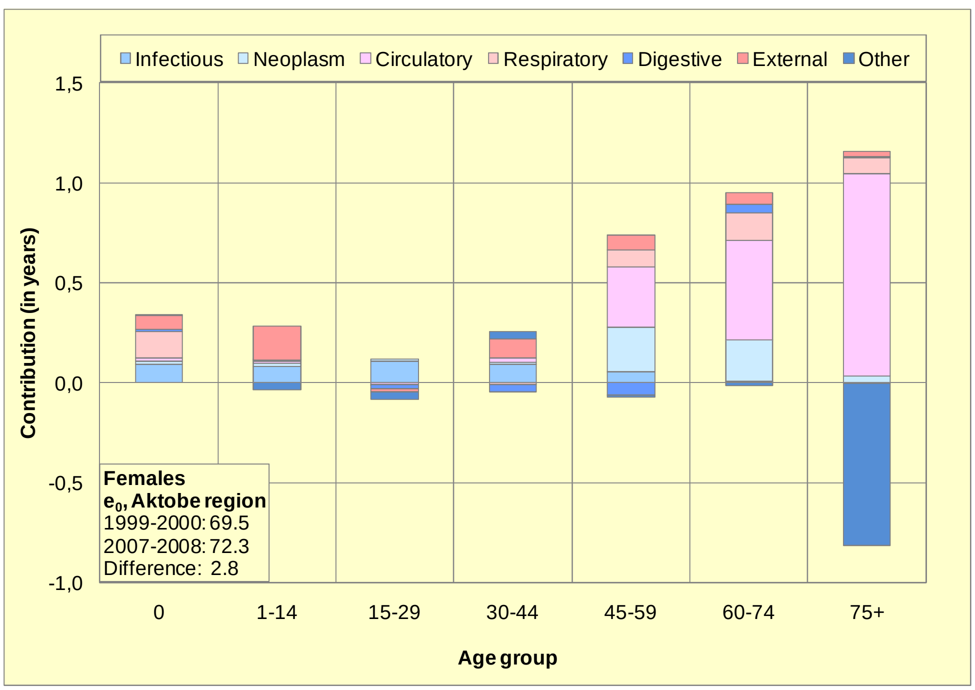
In Aktobe region all causes of death except digestive system diseases and the group of other causes contributed positively to male as well as female life expectancy increase. For males mortality improvement occurred in age group 45-59 while for females the age groups 45+ indicated the greater positive contribution to female life expectancy increase.

Figure 36a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Aktobe region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

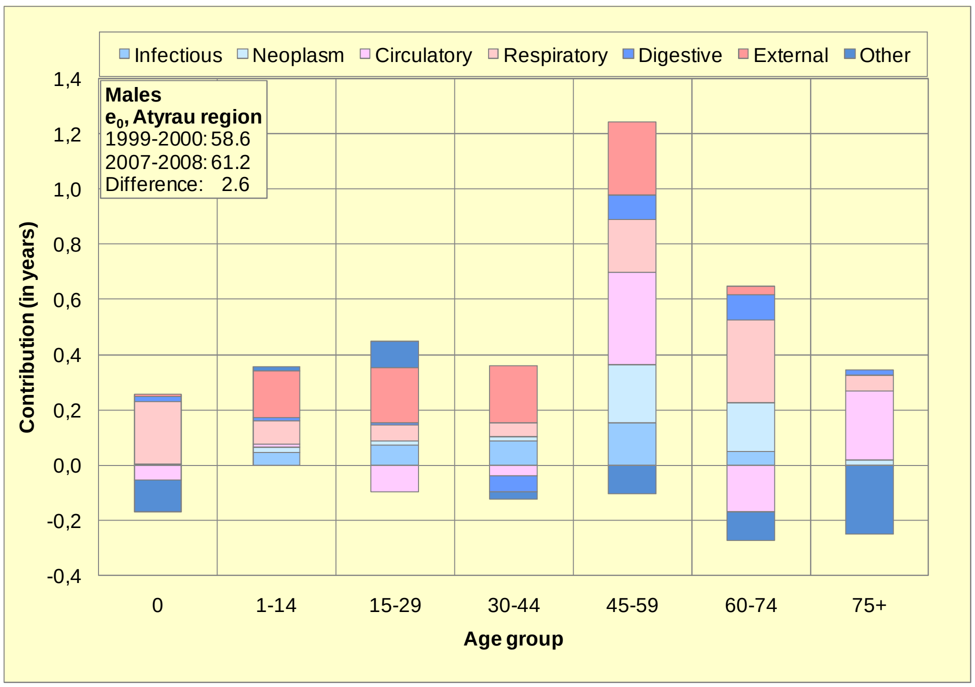
Figure 36b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Aktobe region, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Atyrau region male life expectancy at birth increased for 2.6 years in the period 2007-2008 compared to 1999-2000. All causes of death except the group of other causes contributed positively to male life expectancy increase in the region (see Figure 37a). The greatest positive contribution came from mortality drop from respiratory system diseases (0.97 years) and external causes (0.88 years) which occurred almost in all age groups. The second great positive contribution was mainly due to mortality fell from infectious diseases (0.41 years) and neoplasms (0.45 years). The third great positive contribution came from circulatory (0.24 years) and digestive system diseases (0.18 years). The group of other causes contributed negatively (-0.49 years) to the increase with greater contribution among males aged 75+, 60-74, 0, and 45-59. Mortality from improved causes of death substantially contributed in age groups 45-59 and 60-74. Despite the fact that mortality from circulatory system diseases contributed positively as a whole to the increase in age groups 15-29, 30-44, and 60-74 it contributed negatively.

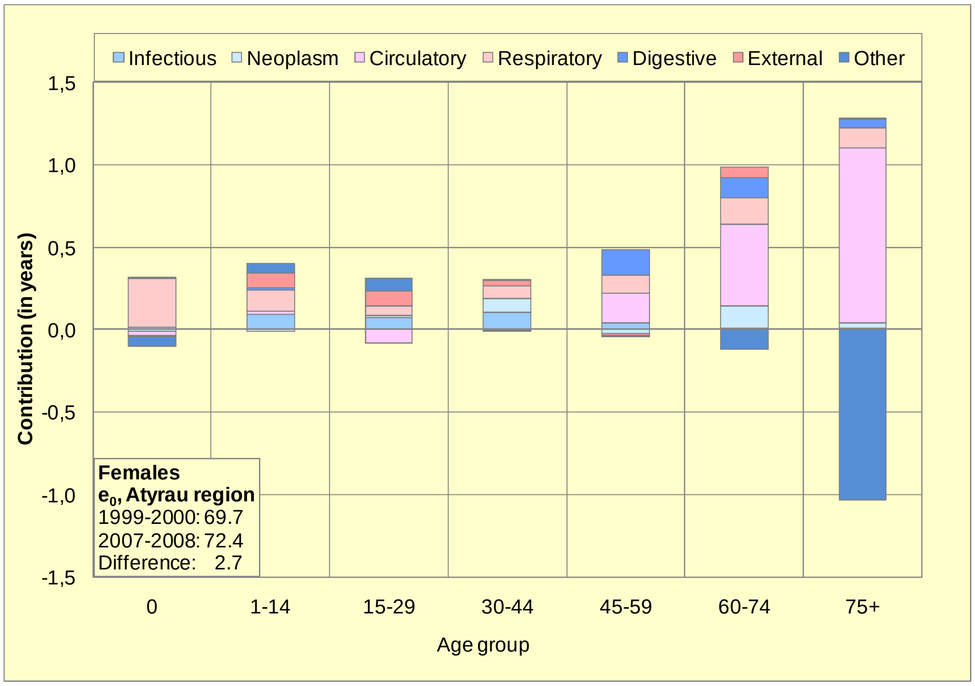
Figure 37.a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Atyrau region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Atyrau region female life expectancy at birth increased for 2.7 years which was slightly higher than male life expectancy increase in the region. All causes of death except the group of other causes contributed positively to female life expectancy increase in the region (see Figure 37.2). This cause of death indicated the negative contribution in age groups 0, 60-74 and 75+ with the greatest contribution among females aged 75+ (-1.03 years). The greatest positive contribution came from circulatory system diseases (1.65 years) and respiratory system diseases (0.94 years). Mortality improvement from digestive system diseases (0.36 years) and infectious diseases (0.35 years) indicated the second great contribution to the increase. Neoplasms (0.23 years) and external cause (0.25 years) mortality drop contributed less than aforementioned causes. Mortality improvement from aforementioned causes occurred almost in all age groups with the highest improvement in older age groups (45+). It is worth to note that mortality increase from circulatory system diseases in age group 15-29 indicated the slight negative contribution (-0.08 years)

Figure 37b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Atyrau region, females



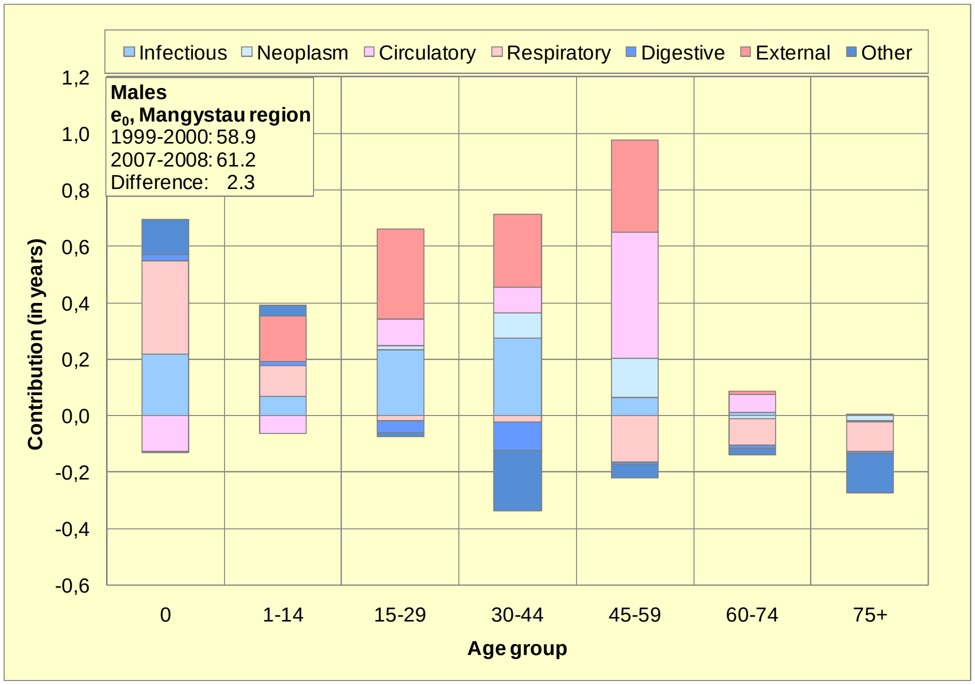
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Atyrau region male as well as female life expectancy at birth increased significantly in the period 2007-2008 compared to 1999-2000. All causes of death except the group of other causes contributed positively to the increase with the greatest contribution from external causes for males, circulatory system diseases for females, and respiratory system diseases for both sexes.

In Mangystau region male life expectancy at birth increased for 2.3 years in the period 2007-2008 compared to 1999-2000. All causes of death except the digestive system diseases (-0.13 years) and the group of other causes (-0.28 years) contributed positively to the increase (see Figure 38a). The greatest positive contribution came from external causes (1.08 years) and infectious diseases (0.88 years) which improved almost in all age groups (except external cause in infant age (0.003 years)). The second big positive contribution was due to mortality fell from circulatory system diseases (0.50 years) and neoplasms (0.21 years). The slight positive contribution came from respiratory system diseases (0.03 years). All age groups except 60-74 and 75+ assessed the great positive contribution from aforementioned causes with the greatest contribution among males aged 45-59.

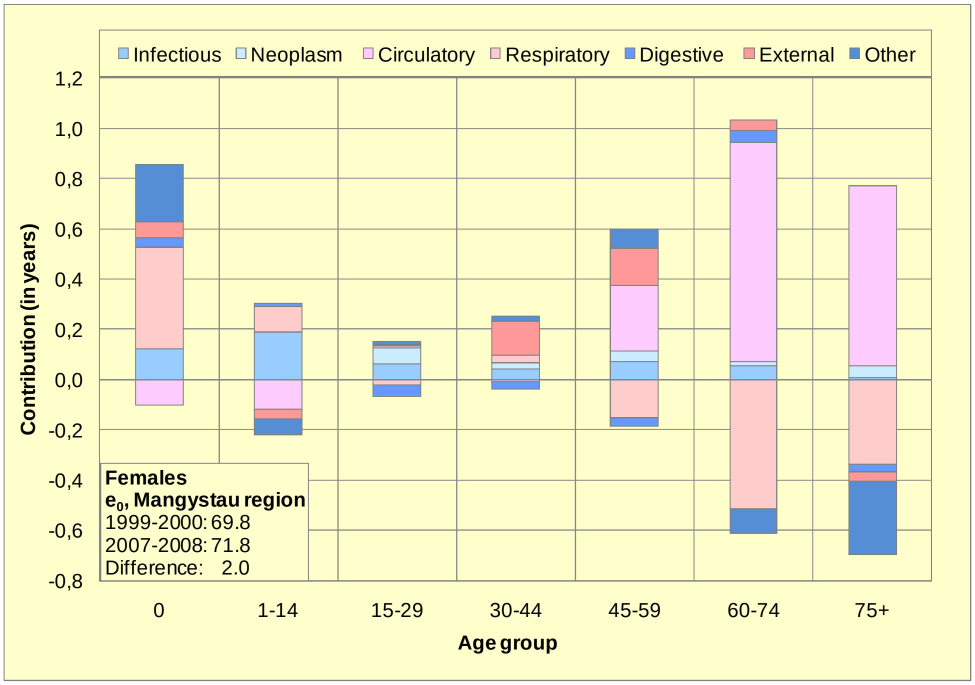
Female life expectancy at birth increased for 2.0 years in the region between observed periods. All causes of death except the respiratory system diseases (-0.49 years), the group of other causes (0.12 years), and the digestive system diseases (-0.04 years) contributed positively to the increase (see Figure 38b). The greatest positive contribution came from circulatory system diseases (1.63 years) and infectious diseases (0.55 years).

Figure 38a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Mangystau region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 38b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Mangystau region, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Except the older age groups mortality improvement from respiratory system diseases, infectious diseases, and the group of other causes in infant age indicated the substantial positive contribution to female life expectancy increase. However, in this age and the age group 1-14 mortality from circulatory system diseases negatively contributed to the increase.

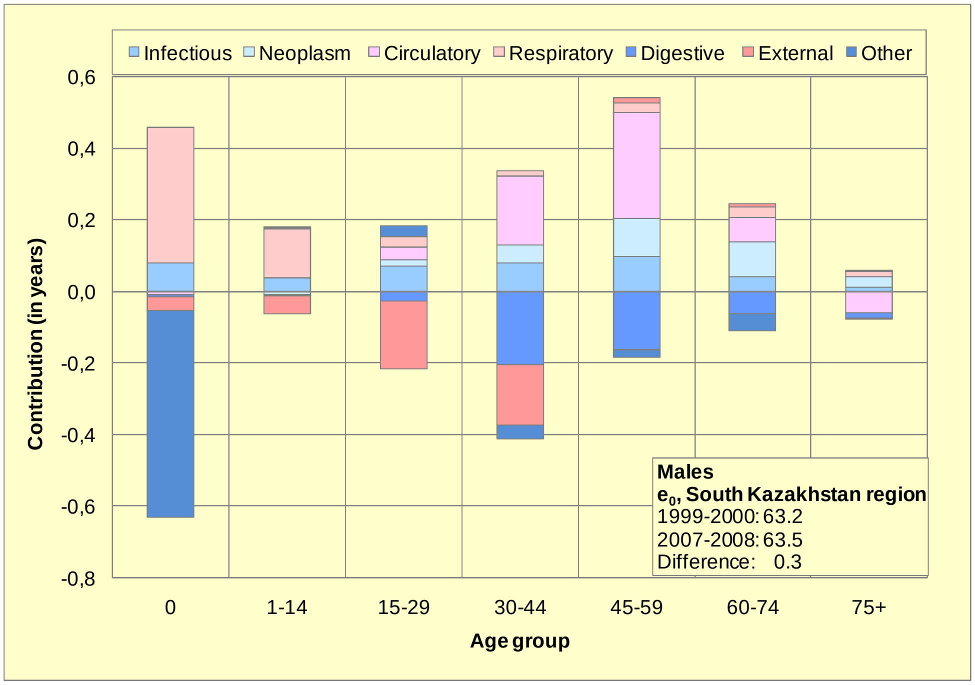
In Mangystau region all causes of death except digestive system diseases and the group of other causes contributed positively to male as well as female life expectancy at birth. Mortality improvement from circulatory system diseases contributed positively while respiratory system contributed negatively in the observed period for males as well as females. However, this contribution would be the problem of data quality as it was described in chapter 5.3.

11.5 Southern regions (South Kazakhstan, Kyzylorda, Zhambyl, and Almaty)

In South Kazakhstan region male life expectancy at birth increased for 0.3 years in the period 2007-2008 compared to 1999-2000. The greatest positive contribution came from circulatory system diseases and respiratory system diseases which accounted for 0.52 and 0.64 years respectively (see Figure 39a). The positive contribution of circulatory system diseases was highest in age groups 30-44 and 45-59 (0.19 and 0.30 years respectively) while the contribution of respiratory system diseases was significant in age groups 0 and 1-14 (0.38 and 0.14 years respectively). The second great positive contribution was due to mortality drop from infectious diseases (0.41 years) and neoplasms (0.29 years). Mortality from infectious diseases improved in all age groups while neoplasms contributed substantially in age groups from 30 to 74. Mortality increase from the group of other causes (-0.64 years), digestive system diseases (-0.48 years), and external causes (-0.42 years) contributed negatively to male life expectancy increase. For the group of other causes it was significant in infant age (-0.58 years), external causes contributed substantially in age groups from 1to 44, digestive system diseases increased almost in all age groups (except the age group 1-14 for which it was 0.0003) with the highest contribution in age groups 30-44 and 45-59 (-0.20 and -0.16 years respectively).

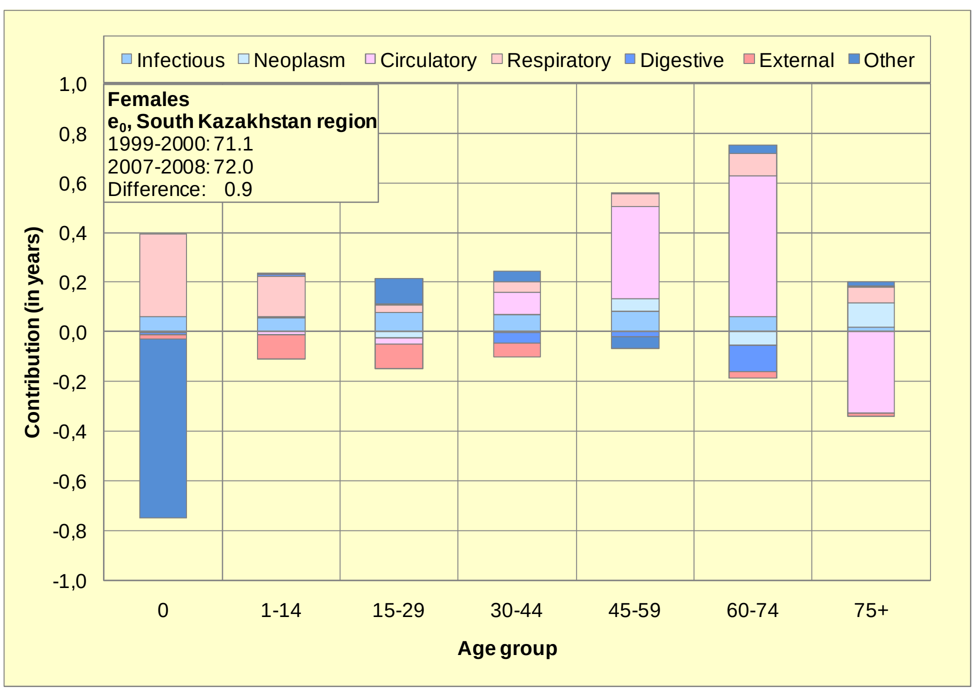
In South Kazakhstan region female life expectancy at birth increased for 0.9 years between the observed periods. Mortality improvement from respiratory system diseases and circulatory system diseases assessed the greatest positive contribution to the increase which accounted for 0.77 and 0.66 years respectively (see Figure 39b). The positive contribution of circulatory system diseases was highest in age groups 45-59 and 60-74 (0.37 and 0.57 years respectively) while the respiratory system diseases assessed the biggest positive contribution in age groups 0 and 1-14 (0.33 and 0.16 years respectively). Mortality drop infectious diseases (0.43 years) in all age groups indicated the second great positive contribution to the increase. The group of other causes (-0.55 years), external causes (-0.31 years), and digestive system diseases (-0.16 years) contributed negatively to female life expectancy increase in the region. The negative contribution of the group of other causes was highest in infant age (-0.72 years), while external cause indicated the significant negative contribution in age groups 1-14 and 15-29. The negative contribution of digestive system diseases was notable in age group 60-74 (-0.11 years).

Figure 39a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, South Kazakhstan region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 39b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, South Kazakhstan region, females

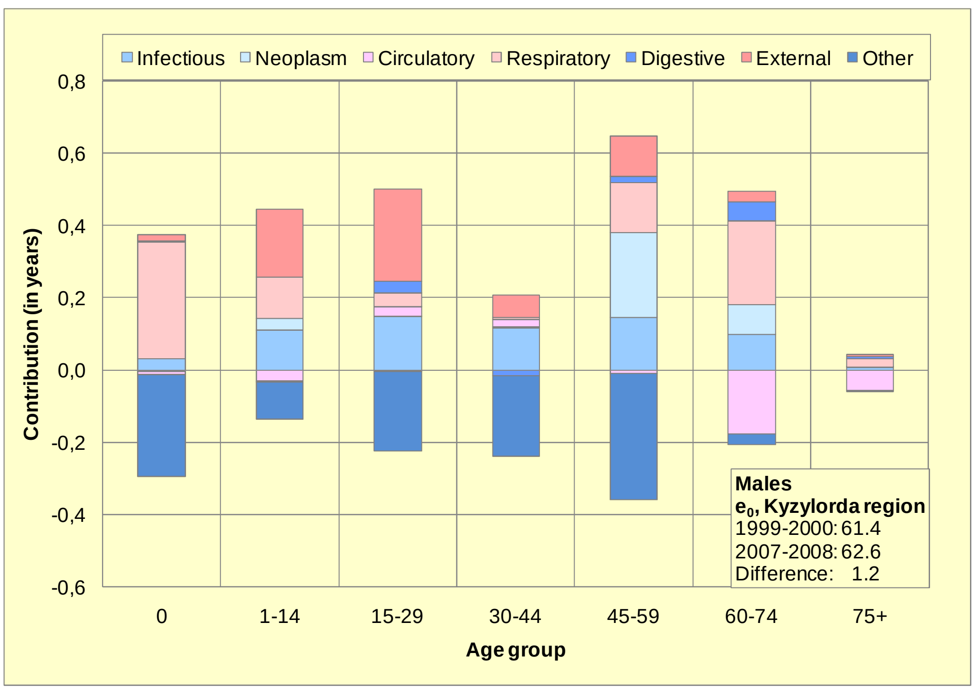


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Generally, male as well as female life expectancy at birth increase in the region occurred because of mortality drop from circulatory system diseases, infectious diseases, respiratory system diseases while the group of other causes, external causes, and the digestive system diseases indicated the negative contribution to life expectancy at birth of both sexes.

In Kyzylorda region male life expectancy at birth increased for 1.2 years in the period 2007-2008 compared to 1999-2000. The greatest positive contribution to the increase came from respiratory system diseases (0.87 years), external causes (0.67 years), and infectious diseases (0.66 years). All of these causes had the significant improvement in all age groups (see Figure 40a). The second great contribution was primarily due to mortality drop from neoplasms (0.34 years) with higher contribution in age groups 45-59 and 60-74. Mortality rise from the group of other causes (-1.21 years) and circulatory system diseases (-0.23 years) indicated the negative contribution to male life expectancy increase in the regions. The contribution of the group of other causes was significant almost in all age groups (except 75+) while circulatory system diseases assessed the notable negative contribution in age groups 60-74 and 75+.

Figure 40a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Kyzylorda region, males

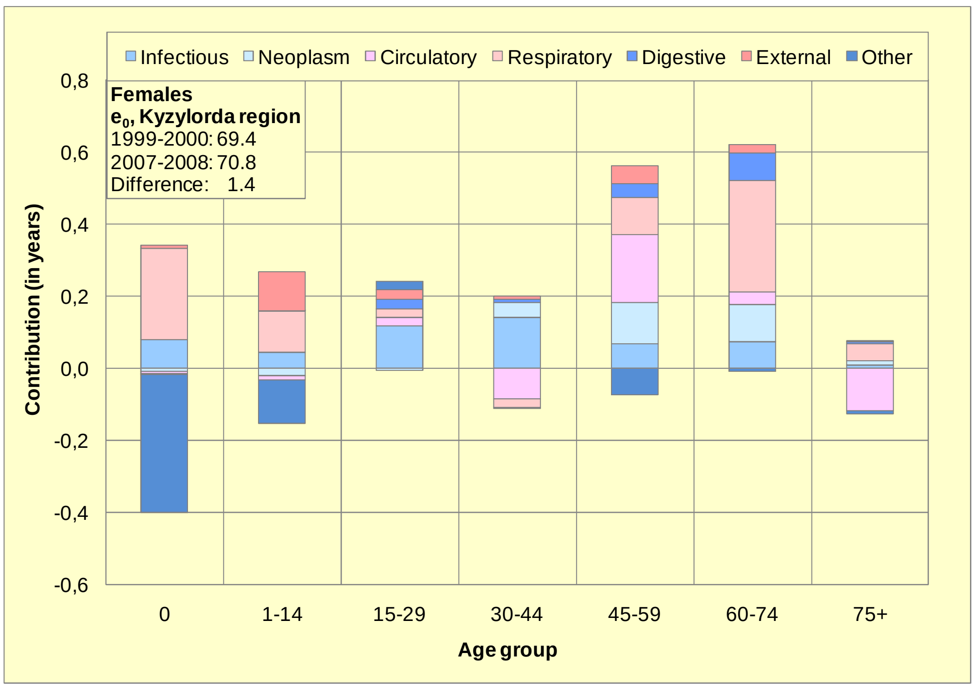


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female life expectancy at birth increased for 1.4 years in the region between observed periods. All causes of death except the group of other causes contributed positively to the increase. The greatest positive contribution was due to mortality drop from respiratory system diseases (0.83 years) and infectious diseases (0.53 years) (see Figure 40b). The second great contribution came from neoplasms (0.24 years), external causes (0.23 years) and digestive system diseases (0.15 years). Mortality improvement from circulatory system diseases indicated the slight positive contribution (0.03 years) to female life expectancy increase. Respiratory system diseases contributed greater in age groups 0, 1-14 and older age groups (45+) while infectious diseases assessed the significant positive contribution in all age groups except 75+. Mortality improvement from neoplasms was substantial in age groups 45-59 and 60-74 while external causes improved in all age groups with the greatest one in 1-14. As indicated above mortality from the group of other causes contributed negatively (-0.57 years) with the greatest contribution in infant age (-0.38 years). It is worth to note that mortality from circulatory system diseases contributed negatively in age groups 30-44 and 75+.

Male as well as female life expectancy at birth in Kyzylorda region increased mainly due to mortality improvement from respiratory system diseases, external causes, infectious diseases, and neoplasms. The group of other causes indicated the negative contribution to life expectancy at birth of both sexes. Mortality from circulatory system diseases contributed negatively to male life expectancy at birth while it positively contributed to female life expectancy only slightly. Improvement of mortality occurred significantly in all age groups except the age 75+ for both sexes in the region.

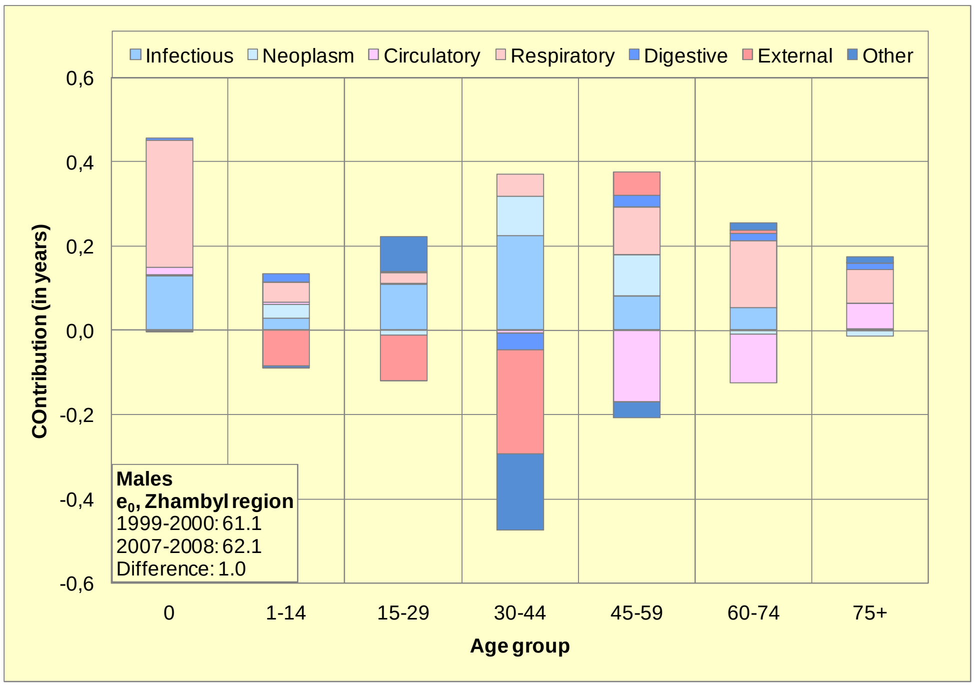
Figure 40b* − *The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Kyzylorda region, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Male life expectancy at birth increased for 1.0 year in Zhambyl region in the period 2007-2008 compared to 1999-2000. The greatest positive contribution came from respiratory system diseases (0.78 years) and infectious diseases (0.63) (see Figure 41a). The improvement of mortality from these causes occurred in all age groups with the biggest improvement of respiratory system diseases among infants and infectious diseases among men aged 30-44. The second great positive contribution was due to mortality drop from neoplasms (0.19 years) and digestive system diseases (0.05 years). The positive contribution of neoplasms was substantial in age groups 30-44 and 45-59 while digestive system diseases did not indicate such a substantial positive contribution in age groups. Mortality rise from external causes (-0.38 years), circulatory system diseases (-0.21 years), and the group of other causes (-0.11 years) indicated the negative contribution to male life expectancy increase in the region. The negative contribution of external causes was essential in age groups from 1 to 44 while circulatory system diseases indicated the substantial negative contribution in age groups 45-59 and 60-74. The group of other causes negatively contributed in age groups 30-44 and 45-59.

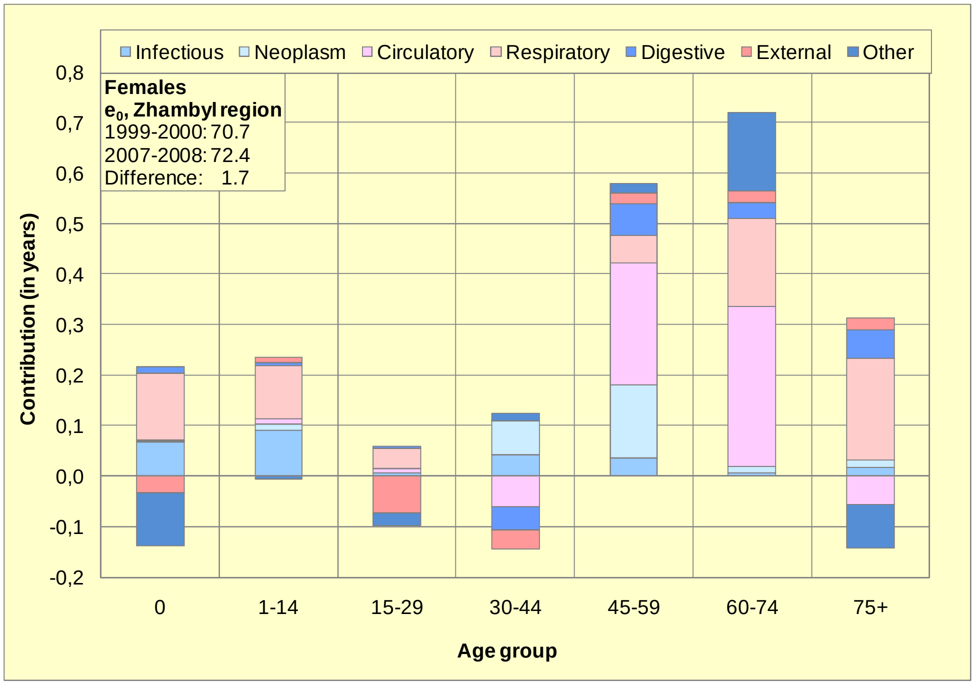
Figure 41a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Zhambyl region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

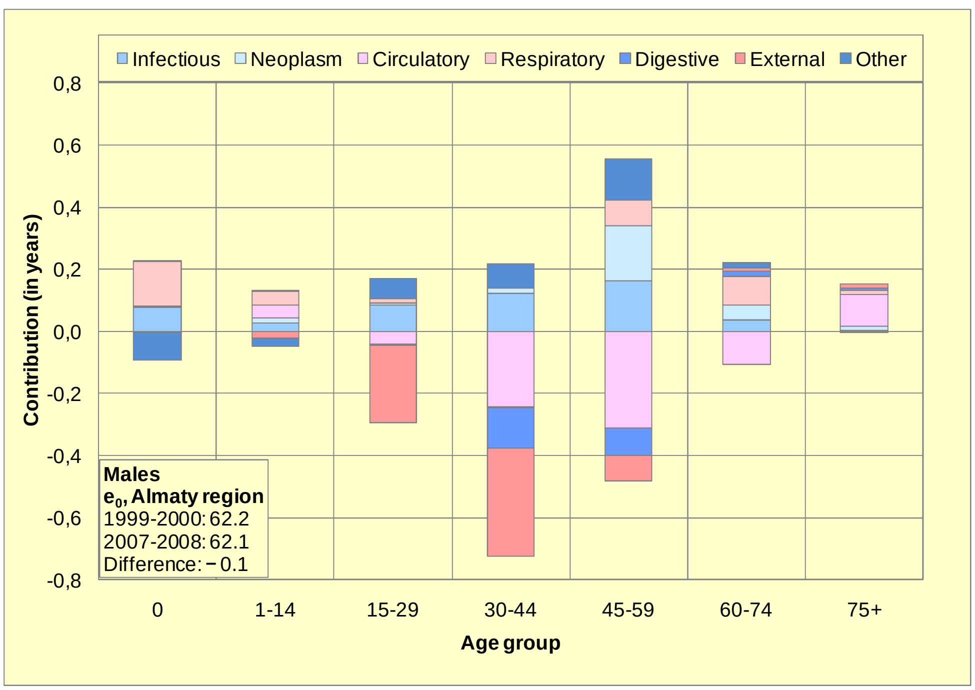
Female life expectancy at birth increased for 1.7 years in the period 2007-2008 compared to 1999-2000 in the region. All causes of death except the group of other causes and external causes contributed positively to the increase (see Figure 41b). The greatest positive contribution came from respiratory system diseases (0.71 years) and circulatory system diseases (0.46 years). The second great positive contribution was due to mortality drop from infectious diseases (0.26 years), neoplasms (0.26 years) and digestive system diseases (0.13 years). The improvement of mortality from respiratory system diseases occurred in all age groups with higher positive contribution in younger (0, 1-14) and older ones (60-74, 75+). Circulatory system diseases indicated the greatest positive contribution in age groups 45-59 and 60-74. Mortality from neoplasms positively contributed the most in age groups 30-44 and 45-59. Despite the fact that the negative contribution of external causes (-0.07 years) and the group of other causes (-0.04 years) was not the significant as a whole the negative contribution of external cause in age groups 0, 15-29, and 30-44 and the group of other cause in age groups 0 and 75+ was substantial.

Figure 41b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Zhambyl region, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

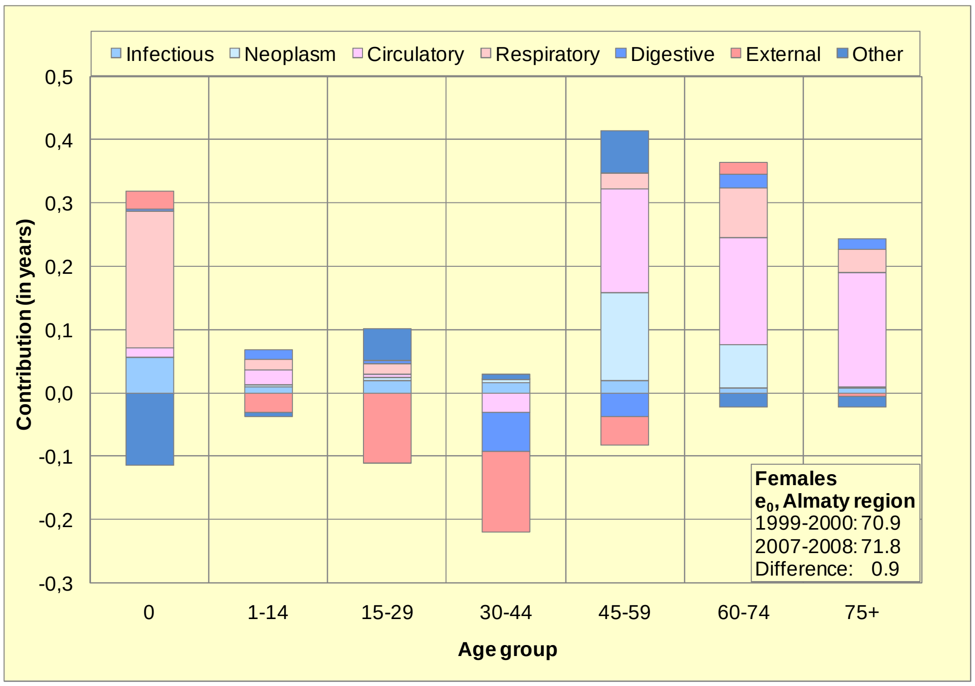
Figure 42a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Almaty region, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Zhambyl region mortality improvement from respiratory system diseases, infectious diseases, neoplasms, and digestive system diseases positively contributed to male as well as female life expectancy increase. Mortality increase from external causes and the group of other causes negatively contributed to life expectancy at birth of both sexes. Circulatory system diseases contributed negatively to male life expectancy increase while female mortality drop from this cause indicated the great positive contribution to the increase. Male mortality improvement occurred mainly in infant and middle age groups, however the age group 30-44 indicated also the negative contribution from external and the group of other causes.

Figure 42b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Almaty region, females



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Almaty region male life expectancy at birth decreased for 0.1 years in the period 2007-2008 compared to 1999-2000. The greatest positive contribution to male life expectancy decrease came from external causes (-0.56 years) and circulatory system diseases (-0.68 years) (see Figure 42a). The second great positive contribution was due to mortality rise from digestive system diseases (-0.19 years). The contribution of external causes was substantial in age groups 15-29, 30-44, and 45-59 while circulatory system diseases contributed positively the most in age groups 30-44, 45-59, and 60-74. Mortality rise from digestive system diseases also occurred mainly in age groups 30-44 and 45-59. The substantial negative contribution to male life expectancy at birth was due to mortality drop from infectious diseases (0.52 years) in all age groups, respiratory system diseases (0.39 years) in all age groups except the age group 30-44, and neoplasms (0.28 years) in all age groups. The group of other causes also contributed negatively to the decrease indicating the biggest negative contribution in age groups 15-29, 30-44, and 45-59.

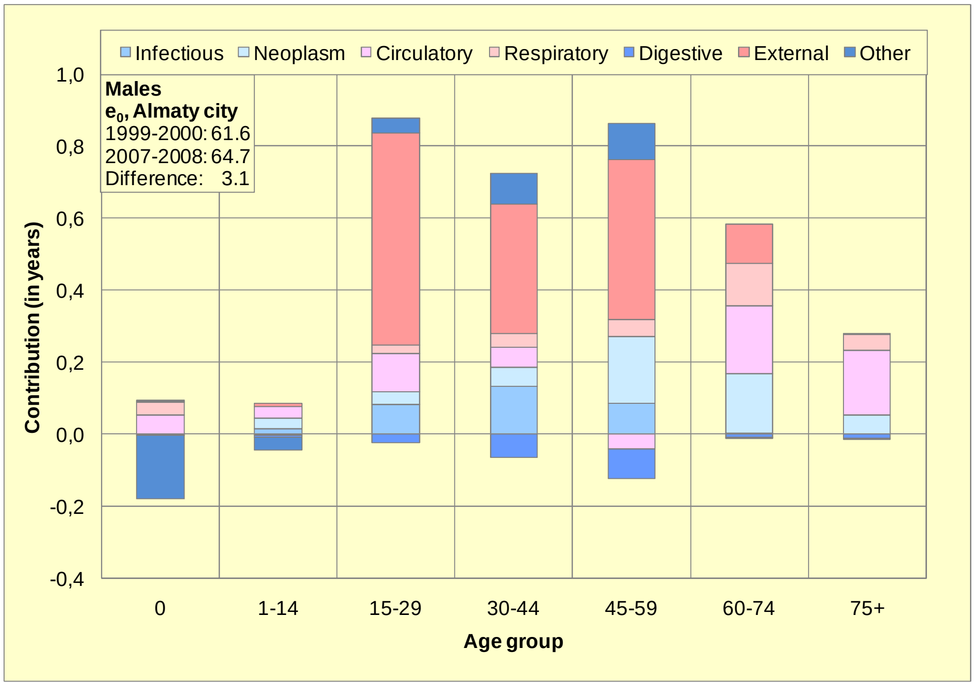
Female life expectancy at birth increased for 0.9 years in Almaty region in the period 2007-2008 compared to 1999-2000. The greatest contribution came from circulatory system diseases (0.53 years) and the respiratory system diseases (0.39 years) (see Figure 42b). The contribution of circulatory system diseases was biggest in age groups 45+ while respiratory system disease indicated the biggest contribution in infant age (0.21 years). The second great positive contribution was due to mortality drop from neoplasms (0.22 years) and infectious diseases (0.14 years). The contribution of neoplasms was biggest among females aged 45-59 and 60-74 while infectious system diseases contributed positively in all age groups with the biggest one in infant age. The great negative contribution to female life expectancy at birth came from external causes especially in age groups 1-14, 15-29, 30-44, and 45-59. Mortality rise from digestive system diseases (-0.04 years) and the group of other causes (-0.03 years) also assessed the negative contribution to female life expectancy increase with the significant contribution of digestive system diseases in age groups 30-44 and 45-59 and the group of other causes in infant age.

Male life expectancy at birth decrease in Almaty region occurred mainly due to mortality rise from external causes, circulatory system diseases, and digestive system diseases in adult age groups while female life expectancy at birth increased in the region due to mortality improvement from circulatory system diseases in old age groups and respiratory system diseases in infant age. Mortality rise from external causes in adult age groups negatively contributed to female life expectancy at birth. The evidence indicated mortality rise from external causes for both sexes in the period 2007-2008 compared to the period 1999-2000.

11.6 Municipal cities (Almaty, Astana)

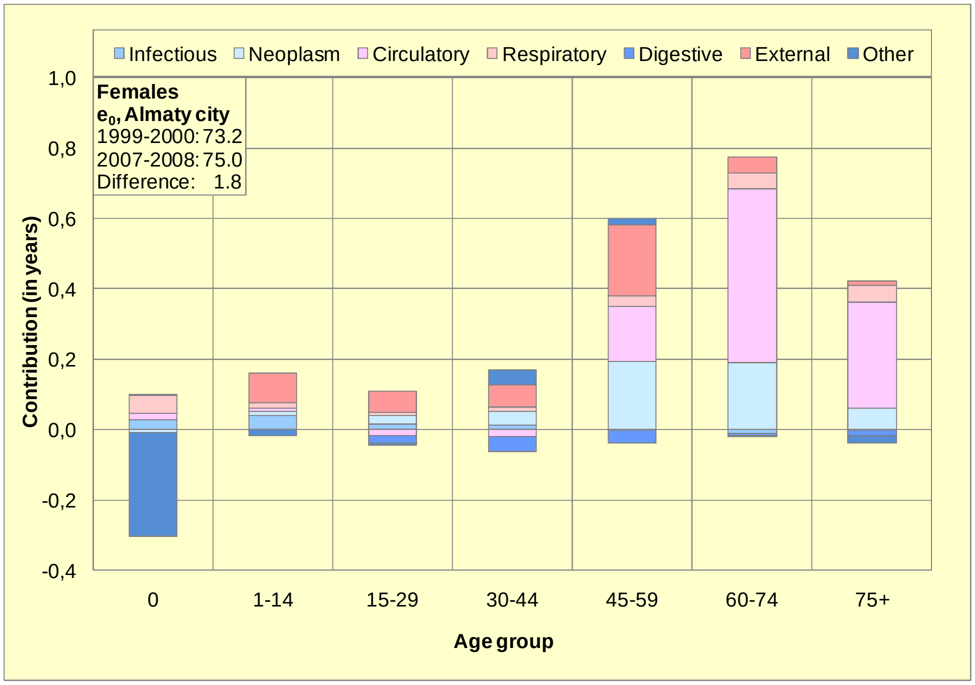
Male life expectancy at birth increased for 3.0 years in the period 2007-2008 compared to 1999-2000 in Almaty city. Mortality improvement from all causes except the digestive system diseases contributed positively to the increase (see Figure 43a). The greatest positive contribution came from external causes which accounted for 1.51 years. The contribution of this cause was biggest in age groups 15-29, 30-44 and 45-59. The second great positive contribution was due to mortality drop from circulatory system diseases (0.58 years) and neoplasms (0.52 years). Mortality fell from circulatory system diseases contributed significantly in age groups 60-74 and 75+ while neoplasms assessed the substantial positive contribution age groups 45-59 and 60-74. The third great positive contribution came from infectious (0.32 years) and respiratory system diseases (0.30 years). Mortality drop from infectious diseases contributed mostly in age groups 15-29, 30-44, and 45-59 while respiratory system diseases contributed more equally in age groups. Mortality improvement from the group of other causes contributed to male life expectancy increase slightly (0.01 years). Mortality rise from digestive system diseases contributed negatively mainly age groups 30-44 and 45-59 while the increase of mortality from the group of other causes contributed mostly in infant age.

Figure 43a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Almaty city, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 43b − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Almaty city, females

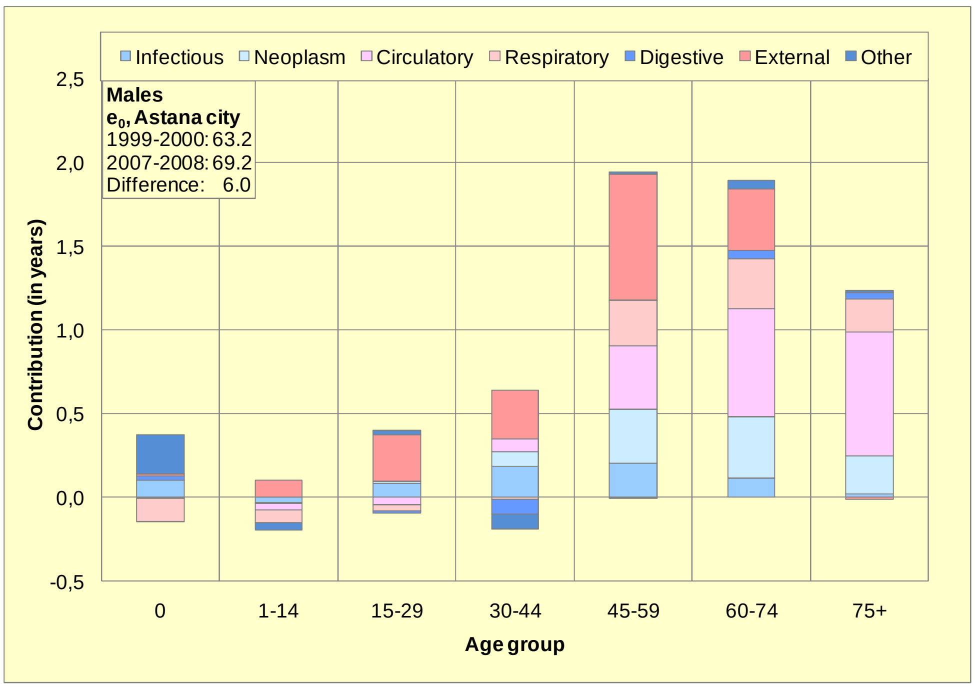


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Female life expectancy at birth increased for 1.8 years in the observed period in Almaty city. The biggest positive contribution came from circulatory system diseases (0.94 years) mainly in age groups 45-59, 60-74, and 75+ (see Figure 43b). The second great positive contribution was due to mortality drop from neoplasms (0.51 years) and external causes (0.47 years). The contribution of neoplasms was substantial in age groups 45-59 and 60-74 while external cause highly contributed in age group 45-59. Mortality rise from the group of other causes (0.27 years) and digestive system diseases (0.12 years) contributed negatively to female life expectancy increase. The contribution of the group of other causes was substantial in infant age while digestive system disease contributed notably in age groups 15-29, 30-44 and 45-59.

In Almaty city male mortality improvement from external causes in adult age groups and female mortality drop from circulatory system diseases in old age groups greatly contributed to the increase of their life expectancies at birth. Mortality rise from digestive system diseases in age groups 15-29, 30-44 and 45-59 contributed negatively to male as well as female life expectancy at birth.

Figure 44a − The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Astana city, males



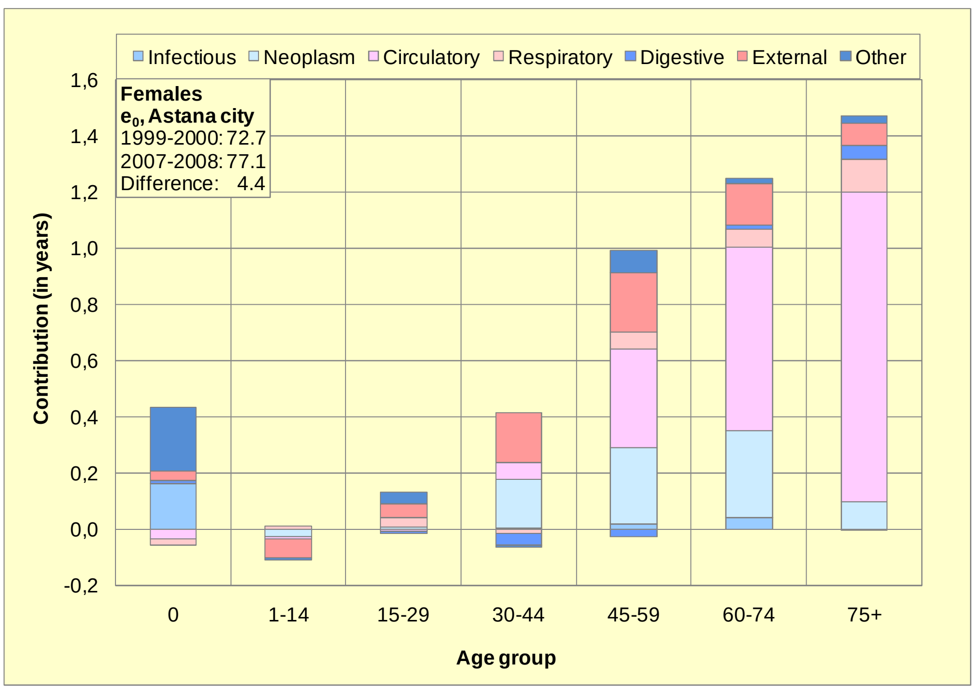
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In Astana city male life expectancy at birth increased for 6.0 years in the period 2007-2008 compared to 1999-2000. All causes of death contributed positively to the increase of male life expectancy at birth (see Figure 44a). The greatest positive contribution came from external causes (1.79 years) and circulatory system diseases (1.75 years). The improvement of mortality from external causes contributed highly in age groups 45-59 and 60-74 and circulatory system diseases in age groups 45-59, 60-74, and 75+. The second great contribution was due to mortality drop from neoplasms (1.02 years) mainly in age groups 45+. Mortality fell from infectious system diseases and respiratory system diseases contributed for 0.68 and 0.50 years respectively. The contribution of infectious diseases was biggest in age groups 30-44 and 45-59 while respiratory system diseases contributed highly in age groups 45+.

In Astana city female life expectancy at birth increased for 4.4 years in the period 2007-2008 compared to 1999-2000. All causes of death contributed positively to the increase as it was observed for males (see Figure 44b). However, mortality from digestive system diseases did not indicate any contribution as a whole indicating the slight positive contribution in age groups 60-74 and 75+ and negative contribution in age groups 30-44 and 45-59. The greatest positive contribution came from circulatory system diseases (2.12 years) with biggest contribution in age groups 45+. The second great contribution was due to mortality drop from neoplasms (0.83 years) and external cause (0.63 years) which were highest in age groups 30+. The group of other causes and infectious diseases contributed positively mainly in infant age (0.23 and 0.16 years respectively). Mortality rise from external causes contributed negatively in age group 1-14.

In Astana city male as well as female life expectancy at birth increased due to mortality improvement from circulatory system diseases, external causes, and neoplasms in age groups 45+.

Figure 44b* − *The contributions of selected main causes of death by age groups to the change in life expectancy at birth between 1999-2000 and 2007-2008, Astana city, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

11.7 Main findings

The finding of the chapter answers the forth research question.

4. *What selected main causes of death contributed the most (mostly in what age groups) to the change in life expectancy at birth of males and females in the regions between the periods 1999-2000 and 2007-2008?*

4. Male mortality improvement from infectious diseases and respiratory system diseases and mortality increase from digestive system diseases assessed the biggest contribution to male life expectancy increase in the country. Male mortality improvement from infectious diseases contributed the most in Akmola (45-59), Almaty (30-44, 45-59), Karagandy (infant), and Kostanai (infant, 15-59) regions. Male mortality decline from respiratory system diseases contributed the most in East Kazakhstan, Atyrau (infant, 60-74), South Kazakhstan, Kyzylorda, Zhambyl (infant) regions. Male mortality increase from digestive system diseases contributed negatively in all regions with the biggest contribution in Almaty city (30-44 and 45-59) and West Kazakhstan (15-29 and 45-59) region.

Male mortality increase from circulatory system diseases (30-44) contributed the most to male life expectancy at birth change in northern, eastern regions, central region Karagandy, and southern region Almaty while the improvement from this cause contributed the most in West Kazakhstan region (45-59) and Astana city (45+). Male mortality improvement from external causes in Aktobe and Mangystau (15-59) regions, Astana (45-59) and Almaty (15-59) cities assessed the biggest positive contribution while the increase from this cause contributed the most in Akmola (30-44) region. Male mortality increase from the group of other causes assessed the biggest negative contribution in Aktobe (30-44), Mangystau (30-44), Atyrau (75+), South Kazakhstan (infant), and Kyzylorda (0-59) regions.

Female mortality improvement from circulatory and respiratory system diseases and mortality increase from the group of other causes and digestive system diseases assessed the greatest contribution to female life expectancy at birth increase in the country. Female mortality improvement from circulatory system diseases contributed the most in western regions (West Kazakhstan – 45-59, Aktobe – 75+, Atyrau – 75+, Mangystau – 60+), North Kazakhstan (75+), Akmola (75+), Almaty (45+) regions, and Almaty and Astana cities (45+). Mortality improvement from respiratory system diseases contributed the most in Karagandy (infant), southern regions South Kazakhstan (infant), Zhambyl (60+), and Kyzylorda (infant and 60-74) while its increase contributed the most in Mangystau (60+) region. Mortality increase from the group of other causes contributed the most in North Kazakhstan, Aktobe, Atyrau (75+), South Kazakhstan, Kyzylorda regions, and Almaty city (infant) while its improvement contributed the most in Kostanai (75+) and Pavlodar (infant) regions. Mortality increase from digestive system diseases contributed the most in Kostanai, Pavlodar (30-44), Karagandy, East Kazakhstan (30-44 and 45-59), and West Kazakhstan (30-44) regions.

Female mortality improvement from Neoplasms contributed the most only in East Kazakhstan region (45-59). Mortality increase from external causes contributed the most in Akmola (30-44) and Almaty regions (15-29, 30-44).

Chapter 12

Changes in association of regional differences in measures of diversity in age at death and expectation of life between the periods 1999-2000 and 2007-2008

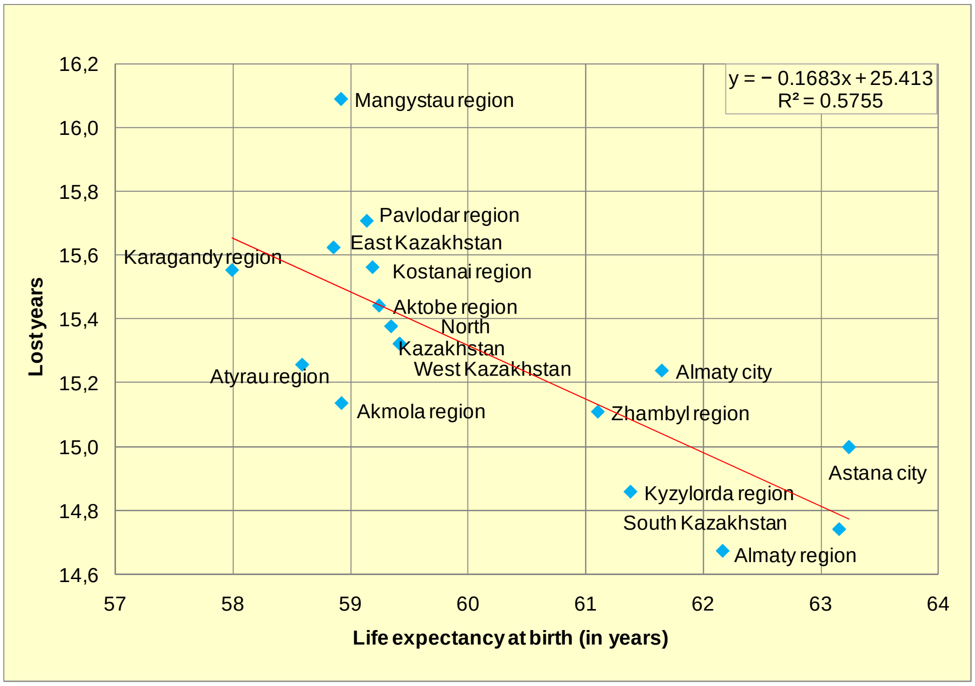
In the chapter the association of regional differences in measures of interindividual inequality in age at death (Average life expectancy losses attributable to death (e^{ψ}), Gini coefficient for whole age range and age range 40-80) and expectation of life was examined for the periods 1999-2000 and 2007-2008 for males and females separately. Gini coefficient was estimated for whole age range and age range 40-80 because in last one inter-individual inequality is higher in comparison with the whole range which includes the very young and very old ages in which the inequality is not as high as in middle ages. The changes in measures of interindividual inequality in age at death and length of life across regions between two periods were also investigated.

12.1 Average life expectancy losses and life expectancy at birth

One of measures of interindividual diversity in age at death is the average life expectancy losses attributable to death (e^{ψ}). According to Shkolnikov et al. (2011) it generally followed Keyfitz's idea that "everybody dies prematurely" because every death "deprives the person involved of the reminder of his expectation of life".

Figure 45a demonstrated that the average life expectancy losses for males were higher mainly in the regions where lower male life expectancy at birth was observed while lower average life expectancy losses were noted mainly in the regions with higher male life expectancy at birth in the period 1999-2000 (see Figure 45a). The average life expectancy losses for males were highest in Mangystau region (16.1 years) where comparatively lower male life expectancy at birth (58.9 years) was observed. However, Karagandy region which had the lowest male life expectancy at birth (58.0 years) among all regions noted much lower lost years of average life expectancy (15.6 years) compared to Mangystau region. Astana city had the highest male life expectancy at birth (63.2 years) but not the lowest average life expectancy losses (15.0 years) among all regions. This evidence indicated that Mangystau region had the higher interindividual diversity in age at death compared to Karagandy region. Despite its lowest life expectancy at birth among all regions Astana city had higher diversity in age at death compared to South Kazakhstan, Kyzylorda and Almaty regions (see Figure 45a).

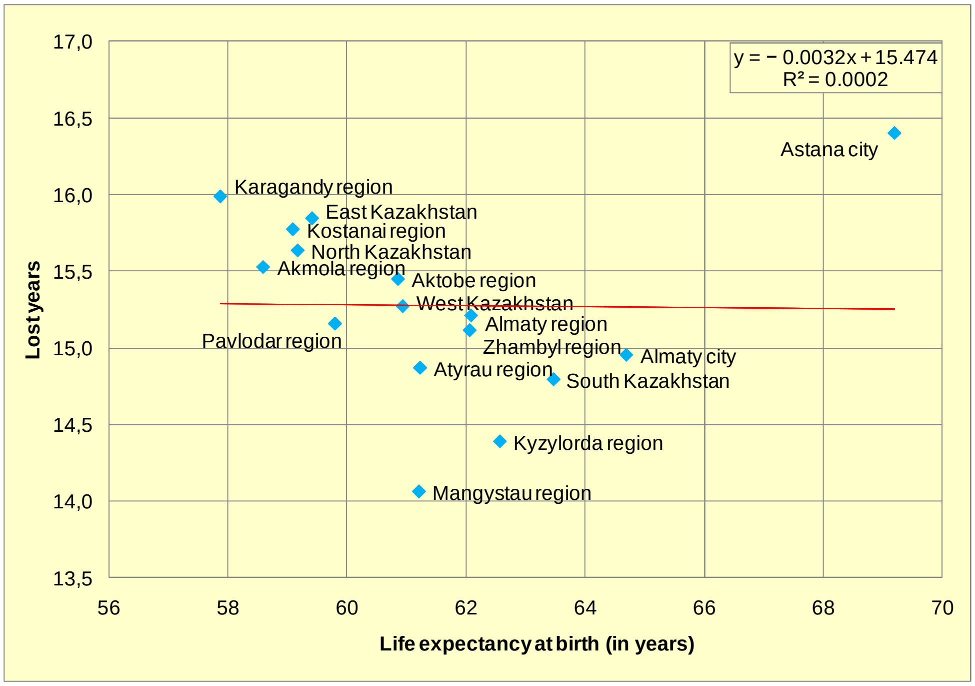
Figure 45a − Average life expectancy losses versus life expectancy at birth, 1999-2000, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 2007-2008 the situation significantly changed. There was almost no association (R^2=0.0002) between regional differences in average life expectancy losses and life expectancy at birth for males (see Figure 45b). The evidence indicated that Karagandy region with the lowest life expectancy at birth (57.9) had the average life expectancy losses at 16.0 years while Astana city with the highest life expectancy at birth (69.2) demonstrated even higher average life expectancy losses (16.4). However, it is important to observe the changes in life expectancy at birth and average life expectancy losses between the periods 1999-2000 and 2007-2008 across regions (see Table 9a). We defined here four groups of regions. 1. Akmola, Almaty, Karagandy, Kostanai, North Kazakhstan regions decreased life expectancy at birth and increased the average life expectancy losses. 2. Atyrau, West Kazakhstan, Kyzylorda, Mangystau, Pavlodar regions increased life expectancy at birth and decreased the average life expectancy losses. 3.Aktobe and Zhambyl regions despite the increase of life expectancy at birth did not change the average life expectancy losses values. 4. South Kazakhstan, East Kazakhstan regions and Astana city increased their life expectancy at birth as well as their average life expectancy losses. In the first group of regions interindidvidual inequality in age at death increased along with male life expectancy at birth decrease while the second group of regions indicated vise versa changes. Interindividual inequality in age at death did not change in the third group of regions while the forth group of regions indicated the increase of interindividual inequality in age at death parallely with life expectancy increase.

Figure 45b − Average life expectancy losses versus life expectancy at birth, 2007-2008, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 1999-2000 the relationship between regional differences of average life expectancy losses for females and female life expectancy at birth was even stronger (R^2=0.727) than it was observed for males (see Figure 45c). Regions with lower female life expectancy at birth indicated higher average life expectancy losses while Astana and Almaty cities with the highest female life expectancy at birth (72.7 and 73.2 years respectively) demonstrated the lowest average life expectancy losses (11.9 years in Astana city, 11.6 years in Almaty city).

In the period 2007-2008 the coefficient of determination was lower (R^2=0.3208) in comparison with 1999-2000 for females which indicated the weaker relationship between regional variability in average life expectancy losses and life expectancy at birth (see Figure 45d). Astana city with the highest female life expectancy at birth (77.1 years) demonstrated higher average life expectancy losses (11.8 years) in comparison with Almaty city which had lower female life expectancy at birth (75.0 years) and lower average life expectancy losses (11.2 years) in comparison with Astana city.

If one observes the change in life expectancy at birth and average life expectancy losses between two periods female life expectancy at birth increased in all regions apart from male one. However, not all regions indicated the decrease of average life expectancy losses (see Table 9b). Almaty and East Kazakhstan regions did not change the values of average life expectancy losses while Karagandy, Kostanai, North Kazakhstan regions even increased average life expectancy losses. The evidence demonstrated that interindividual inequality in age at death increased in

Karagandy, Akmola, and North Kazakhstan regions despite the increase of life expectancy at birth.

Table 9a − Changes in average life expectancy losses and life expectancy at birth between 1999-2000 and 2007-2008, males

Regions	e_0, 1999-2000	e_0, 2007-2008	e^{ψ}, 1999-2000	e^{ψ}, 2007-2008	Change in e_0	Change in e^{ψ}
Akmola region	58.9	58.6	15.1	15.5	-0.3	0.4
Aktobe region	59.2	60.9	15.4	15.4	1.6	0.0
Almaty region	62.2	62.1	14.7	15.2	-0.1	0.5
Atyrau region	58.6	61.2	15.3	14.9	2.6	-0.4
West Kazakhstan	59.4	60.9	15.3	15.3	1.5	-0.1
Zhambyl region	61.1	62.1	15.1	15.1	1.0	0.0
Karagandy region	58.0	57.9	15.6	16.0	-0.1	0.4
Kostanai region	59.2	59.1	15.6	15.8	-0.1	0.2
Kyzylorda region	61.4	62.6	14.9	14.4	1.2	-0.5
Mangystau region	58.9	61.2	16.1	14.1	2.3	-2.0
South Kazakhstan	63.2	63.5	14.7	14.8	0.3	0.1
Pavlodar region	59.1	59.8	15.7	15.2	0.7	-0.6
North Kazakhstan	59.3	59.2	15.4	15.6	-0.2	0.3
East Kazakhstan	58.9	59.4	15.6	15.8	0.6	0.2
Astana	63.2	69.2	15.0	16.4	6.0	1.4
Almaty	61.6	64.7	15.2	15.0	3.0	-0.3

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

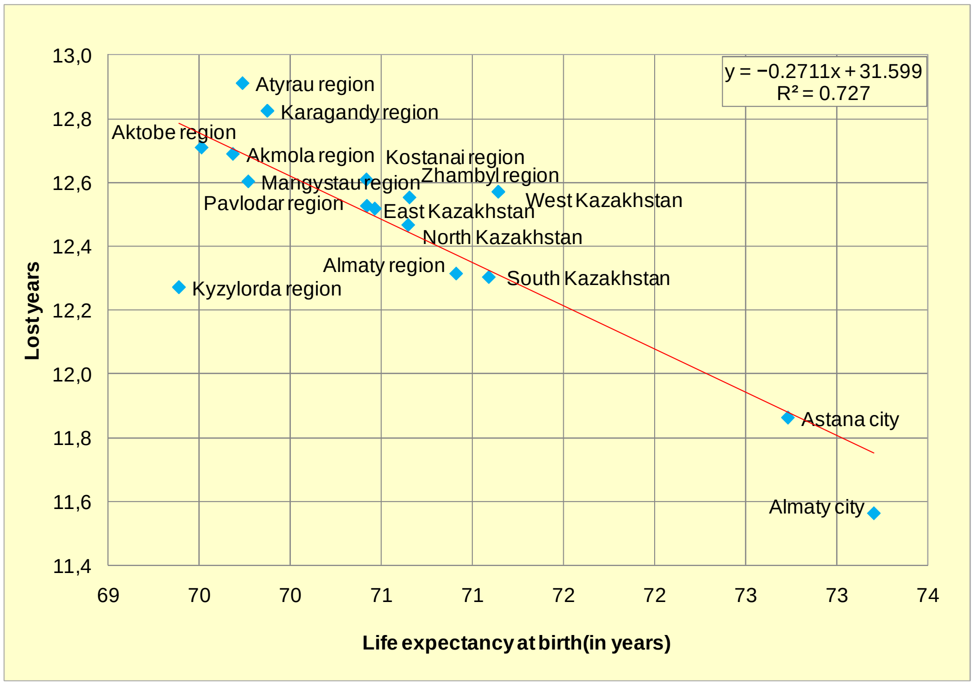
Table 9b − Changes in average life expectancy losses and life expectancy at birth between 1999-2000 and 2007-2008, females

Regions	e_0, 1999-2000	e_0, 2007-2008	e^{ψ}, 1999-2000	e^{ψ}, 2007-2008	Change in e_0	Change in e^{ψ}
Akmola region	69.7	70.4	12.7	12.6	0.7	-0.1
Aktobe region	69.5	72.3	12.7	11.9	2.8	-0.8
Almaty region	70.9	71.8	12.3	12.3	0.9	0.0
Atyrau region	69.7	72.4	12.9	11.9	2.7	-1.1
West Kazakhstan	71.1	72.5	12.6	11.9	1.3	-0.7
Zhambyl region	70.7	72.4	12.6	12.0	1.7	-0.5
Karagandy region	69.9	70.4	12.8	13.0	0.5	0.2
Kostanai region	70.4	71.4	12.6	12.9	0.9	0.3
Kyzylorda region	69.4	70.8	12.3	11.6	1.4	-0.7
Mangystau region	69.8	71.8	12.6	11.4	2.0	-1.2
South Kazakhstan	71.1	72.0	12.3	12.1	0.9	-0.2
Pavlodar region	70.4	72.1	12.5	12.3	1.7	-0.2
North Kazakhstan	70.6	71.0	12.5	12.6	0.4	0.2
East Kazakhstan	70.5	71.4	12.5	12.5	0.9	0.0
Astana	72.7	77.1	11.9	11.8	4.4	-0.1
Almaty	73.2	75.0	11.6	11.2	1.8	-0.3

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

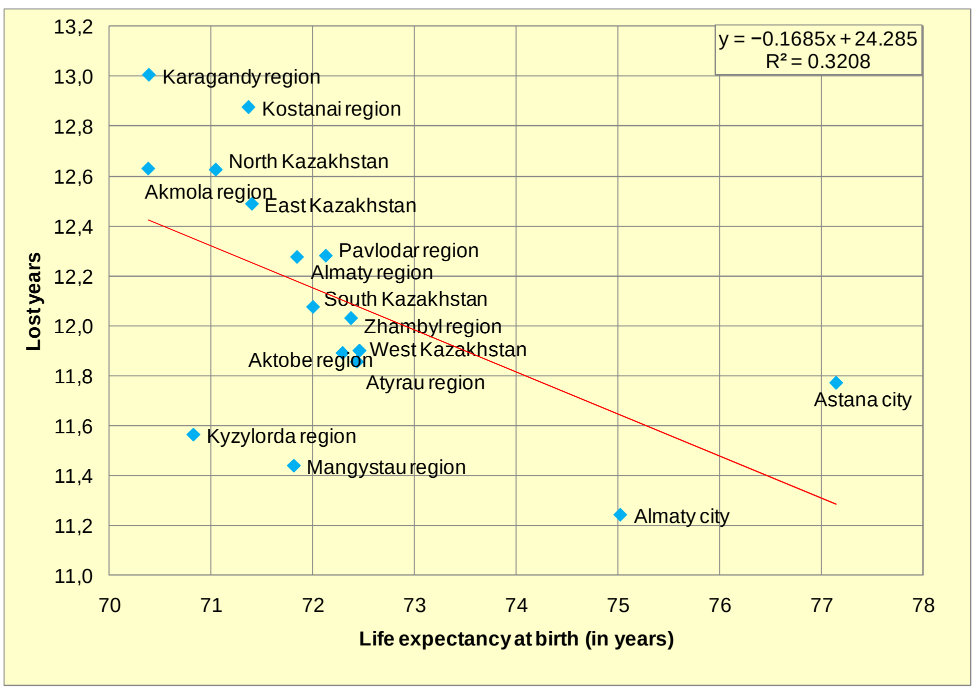
The evidence of relationship of regional differences in average life expectancy losses and life expectancy at birth for both sexes in the periods 1999-2000 and 2007-2008 indicated that the relationship was stronger in the period 1999-2000 for both sexes in comparison with 2007-2008.

Figure 45c − Average life expectancy losses versus life expectancy at birth, 1999-2000, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 45d − Average life expectancy losses versus life expectancy at birth, 2007-2008, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

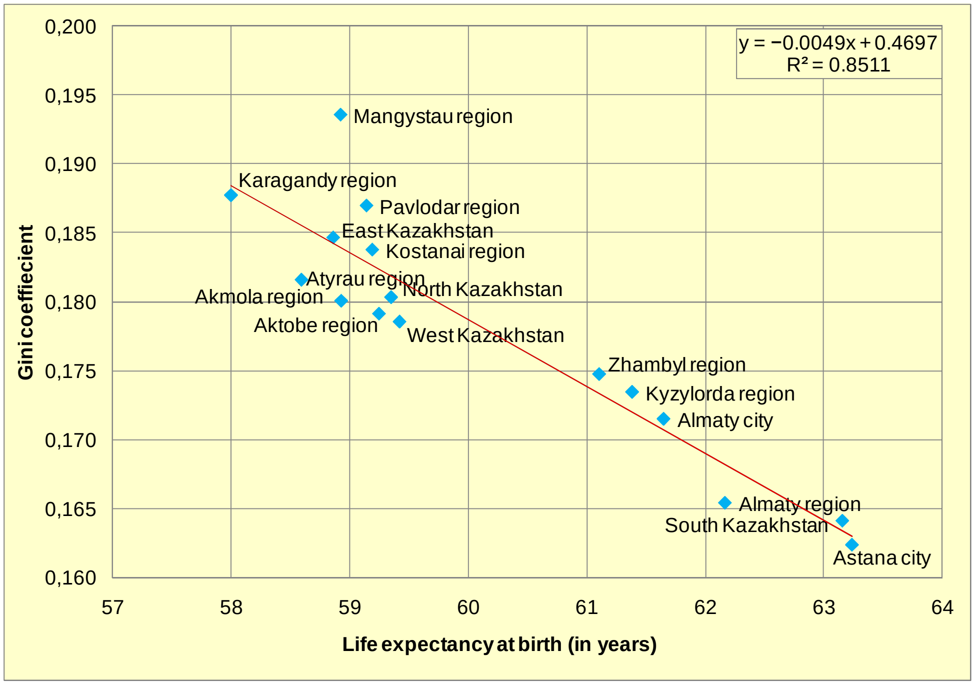
In the period 2007-2008 the relationship weakened especially for males. The changes in life expectancy at birth and average life expectancy losses for both sexes across regions between two periods indicated that in one regions life expectancy at birth increase coincided with the decrease of average life expectancy losses or vise verse while other regions despite the increase of life expectancy at birth did not change or increased average life expectancy losses.

12.2 Gini coefficient and expectation of life

12.2.1 Gini coefficient and life expectancy at birth

Gini coefficient as a measure of inequality in distribution of length of life between individuals was used by Shkolnikov et al. (2003) for numerous countries.

Figure 46a* − *Gini coefficient versus life expectancy at birth, 1999-2000, males

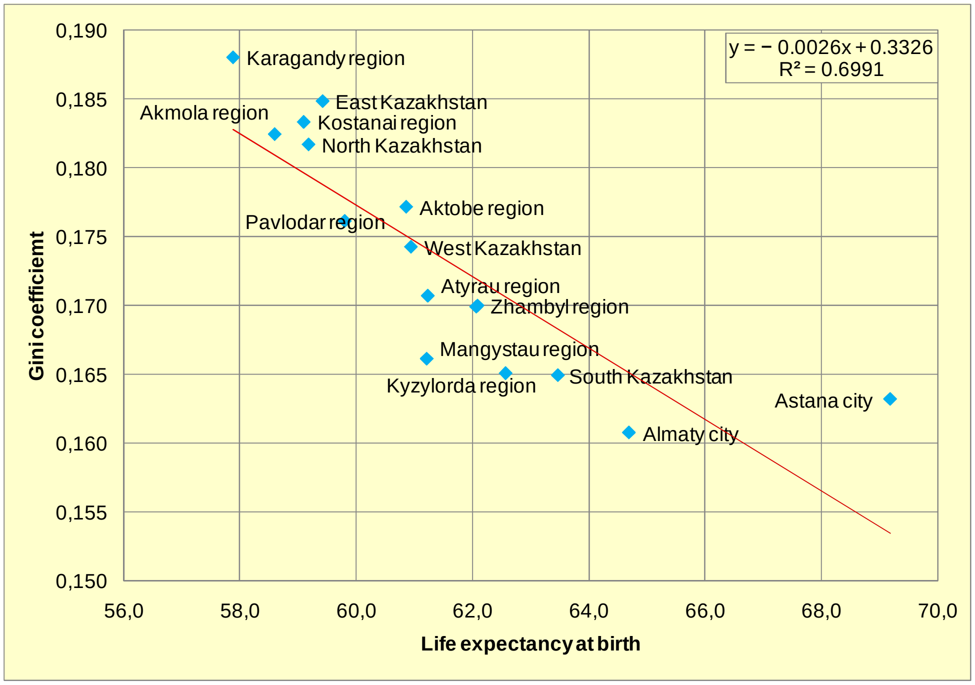


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 46a demonstrated that the regions with higher male life expectancy at birth indicated lower Gini coefficient value for males while higher value of Gini coefficient for males was found in the regions with lower male life expectancy at birth in the period 1999-2000. Mangystau region with lower male life expectancy at birth (58.9 years) demonstrated the highest value of Gini coefficient among males (0.194) while Astana city with the highest male life expectancy at birth (63.2 years) indicated the lowest value of Gini coefficient (0.162) among regions. Karagandy region with the lowest male life expectancy at birth observed lower value of Gini coefficient among males than Mangystau region. This evidence indicated that despite the fact that Karagandy region had the lowest male life expectancy at birth the length of life was more equally distributed among males in comparison with Mangystau region. Astana city demonstrated that highest male life expectancy at birth in the city was the most equally distributed among males of the city in comparison with all other regions.

In the period 2007-2008 the relationship of regional differences in Gini coefficient and male life expectancy at birth reduced in comparison with 1999-2000 (see Figure 46b). Karagandy region with the lowest male life expectancy at birth (57.9 years) demonstrated the highest Gini coefficient (0.188) while Astana city with the highest male life expectancy at birth (69.2) did not indicate the lowest value of Gini coefficient (0.163) among the regions. Almaty city with much lower life expectancy at birth (64.7) compared to Astana city indicated the lowest value of Gini coefficient (0.161) among all regions.

Figure 46b – Gini coefficient versus life expectancy at birth, 2007-2008, males



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The table of changes in life expectancy at birth and Gini coefficient values across regions between two periods indicated that Akmola, Almaty, North Kazakhstan regions increased the value of Gini coefficient parallely with the decrease of life expectancy at birth while Karagandy and Kostanai regions did not change the value of Gini coefficient despite the decrease of life expectancy at birth in the regions (see Table 10a). Among the regions with the increase of life expectancy at birth South Kazakhstan region and Astana city indicated the slight increase of Gini coefficient values while East Kazakhstan region did not change the Gini coefficient value at all.

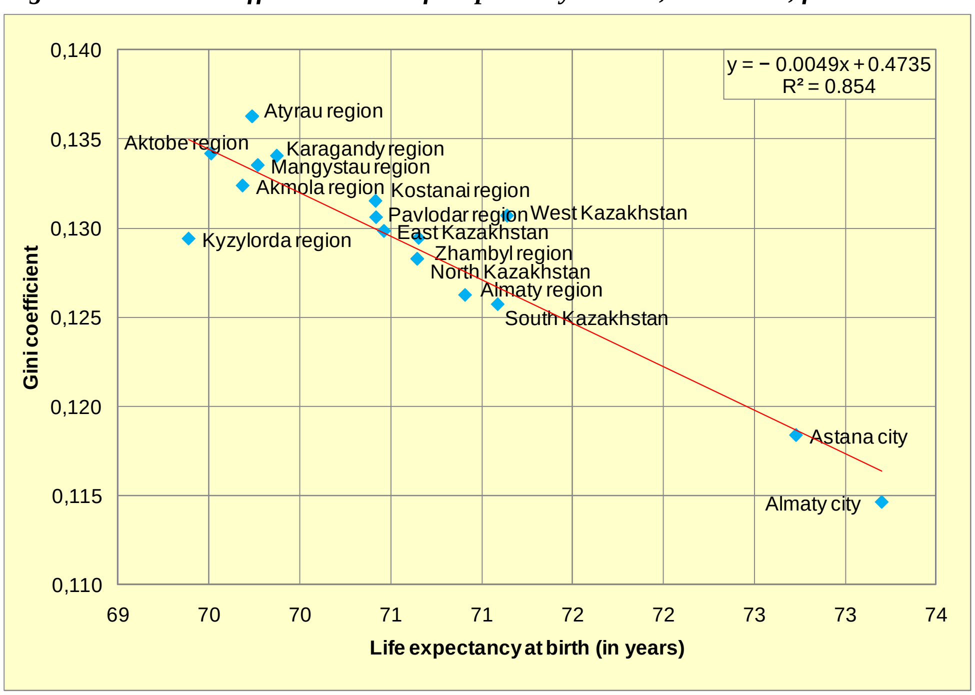
The evidence indicated that Akmola, Almaty, North Kazakhstan, South Kazakhstan, Kostanai regions indicated more unequal distribution of average length of life among individuals in the period 2007-2008 in comparison with 1999-2000 whereas East Kazakhstan, Kostanai, Karagandy regions indicated the same distribution in both periods. All western regions (Atyrau, West Kazakhstan, Mangystau, Aktobe) and Zhambyl, Kyzylorda regions indicated the increase of life expectancy at birth as well as more equal distribution of average length of life in the period 2007-2008 compared to 1999-2000.

Table 10a − Changes in Gini coefficient and life expectancy at birth between 1999-2000 and 2007-2008, males

Regions	e_0, 1999-2000	e_0, 2007-2008	Gini, 1999-2000	Gini, 2007-2008	Change in e_0	Change in Gini
Akmola region	58.9	58.6	0.180	0.182	-0.3	0.002
Aktobe region	59.2	60.9	0.179	0.177	1.6	-0.002
Almaty region	62.2	62.1	0.165	0.170	-0.1	0.005
Atyrau region	58.6	61.2	0.182	0.171	2.6	-0.011
West Kazakhstan	59.4	60.9	0.179	0.174	1.5	-0.004
Zhambyl region	61.1	62.1	0.175	0.170	1.0	-0.005
Karagandy region	58.0	57.9	0.188	0.188	-0.1	0.000
Kostanai region	59.2	59.1	0.184	0.183	-0.1	0.000
Kyzylorda region	61.4	62.6	0.173	0.165	1.2	-0.008
Mangystau region	58.9	61.2	0.194	0.166	2.3	-0.027
South Kazakhstan	63.2	63.5	0.164	0.165	0.3	0.001
Pavlodar region	59.1	59.8	0.187	0.176	0.7	-0.011
North Kazakhstan	59.3	59.2	0.180	0.182	-0.2	0.001
East Kazakhstan	58.9	59.4	0.185	0.185	0.6	0.000
Astana	63.2	69.2	0.162	0.163	6.0	0.001
Almaty	61.6	64.7	0.171	0.161	3.0	-0.011

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 46c − Gini coefficient versus life expectancy at birth, 1999-2000, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Gini coefficient for females was higher in the regions with lower female life expectancy at birth while lower Gini coefficient was observed in the regions with higher female life expectancy at birth in the period 1999-2000 (see Figure 46c). Kyzylorda region with the lowest female life expectancy at birth (69.4 years) indicated Gini coefficient at the level 0.129 while Atyrau region with higher female life expectancy at birth (69.7 years) demonstrated the highest level of Gini coefficient among females (0.136). The evidence indicated that despite the lower female life expectancy at birth in Kyzylorda region the average length of life among females was more equally distributed in the region in comparison with Atyrau and many other regions. The lowest Gini coefficient (0.115) was observed in Almaty city with the highest female life expectancy at birth was (73.2 years). Astana city with lower female life expectancy at birth (72.7 years) indicated higher Gini coefficient (0.118) compared to Almaty city. Astana and Almaty cities along with their highest female life expectancy at birth indicated their distribution among females more equally in comparison with other regions.

Table 10b − Changes in Gini coefficient and life expectancy at birth between 1999-2000 and 2007-2008, females

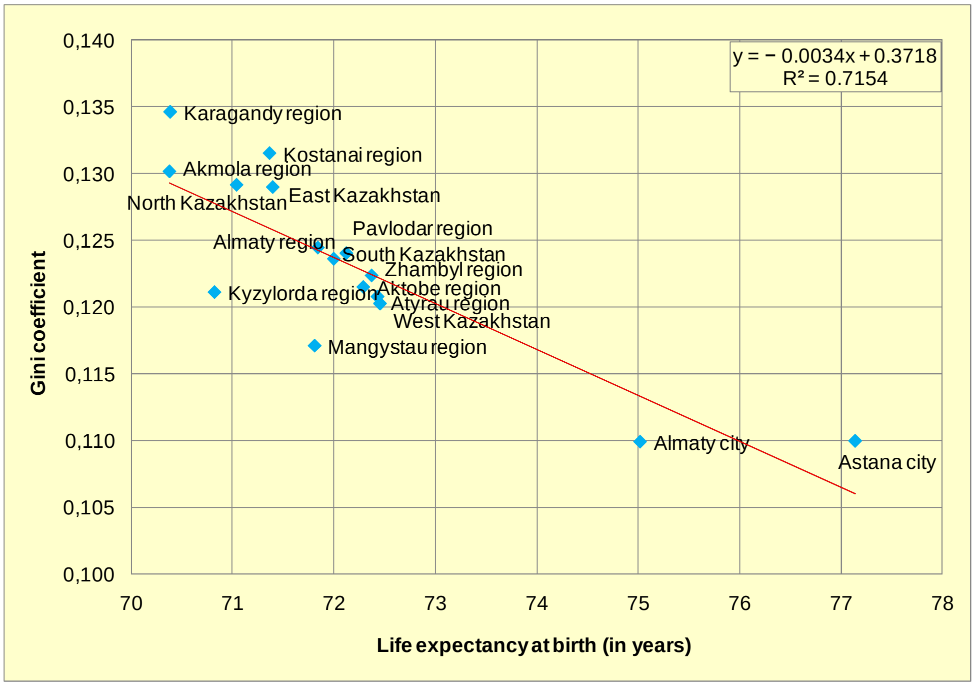
Regions	e_0, 1999-2000	e_0, 2007-2008	Gini, 1999-2000	Gini, 2007-2008	Change in e_0	Change in Gini
Akmola region	69.7	70.4	0.132	0.130	0.7	-0.002
Aktobe region	69.5	72.3	0.134	0.121	2.8	-0.013
Almaty region	70.9	71.8	0.126	0.124	0.9	-0.002
Atyrau region	69.7	72.4	0.136	0.121	2.7	-0.015
West Kazakhstan	71.1	72.5	0.131	0.120	1.3	-0.010
Zhambyl region	70.7	72.4	0.129	0.122	1.7	-0.007
Karagandy region	69.9	70.4	0.134	0.135	0.5	0.001
Kostanai region	70.4	71.4	0.132	0.132	0.9	0.000
Kyzylorda region	69.4	70.8	0.129	0.121	1.4	-0.008
Mangystau region	69.8	71.8	0.134	0.117	2.0	-0.016
South Kazakhstan	71.1	72.0	0.126	0.124	0.9	-0.002
Pavlodar region	70.4	72.1	0.131	0.124	1.7	-0.007
North Kazakhstan	70.6	71.0	0.128	0.129	0.4	0.001
East Kazakhstan	70.5	71.4	0.130	0.129	0.9	-0.001
Astana	72.7	77.1	0.118	0.110	4.4	-0.008
Almaty	73.2	75.0	0.115	0.110	1.8	-0.005

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 2007-2008 the association of regional differences between Gini coefficient and life expectancy at birth for females was weaker than in the period 1999-2000 (see Figure 46d). Karagandy region with the lowest female life expectancy at birth (70.4 years) indicated the highest Gini coefficient (0.135) among all regions. Astana and Almaty cities with the different levels of female life expectancy at birth (77.1 and 75.0 years respectively) indicated the equal lowest Gini coefficient (0.110) compared to other regions. Female life expectancy at birth increased in all regions but not all regions indicated the decrease of Gini coefficient value between two periods (see Table 10b). Karagandy and North Kazakhstan regions slightly increased Gini coefficient values while Kostanai region did not change the value of Gini coefficient.

The association of Gini coefficient and life expectancy at birth across regions was strong for both sexes in the period 1999-2000 as well as 2007-2008. However, the association reduced in the period 2007-2008 compared to 1999-2000. The changes in Gini coefficient and life expectancy at birth in the regions between two periods indicated the diversity across regions. Generally, the regions with higher life expectancy at birth indicated lower inequality in its distribution among individuals while the regions with lower life expectancy at birth demonstrated higher inequality in both periods.

Figure 46d − Gini coefficient versus life expectancy at birth, 2007-2008, females



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

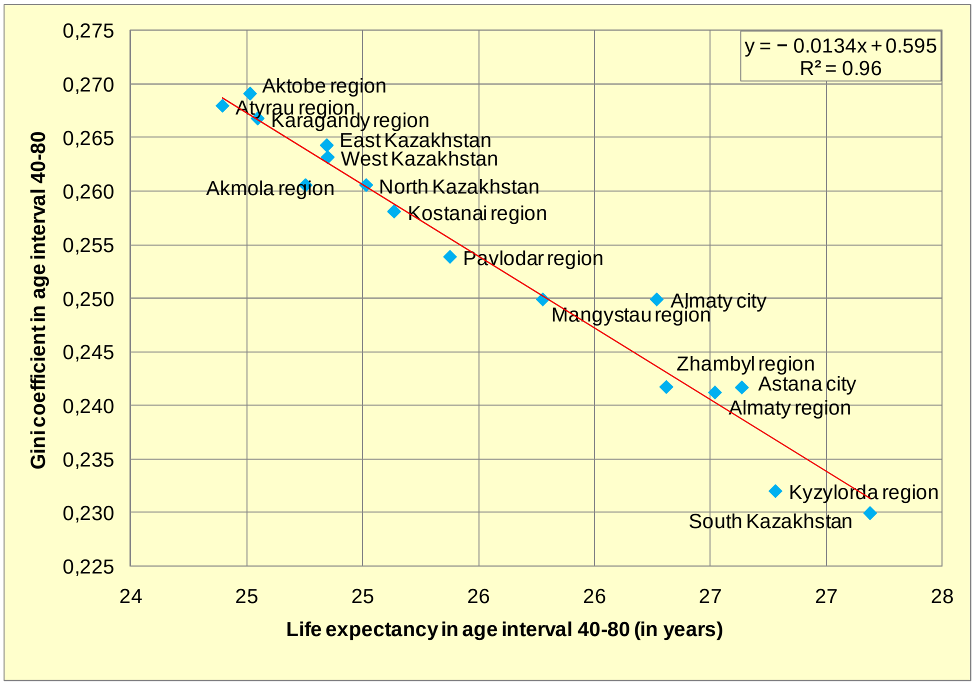
12.2.2 Gini coefficient in age interval 40-80 and expectation of life in age interval 40-80

The regional differences of Gini coefficient and expectation of life in age interval 40-80 for males in the period 1999-2000 was very strongly associated which indicated that higher Gini coefficient was in the regions where lower expectation of life was observed (see Figure 47a). And this evidence concerned almost each region of the country. However, Atyrau region with the lowest expectation of life for males indicated lower Gini coefficient than Aktobe region which demonstrated higher male life expectancy. South Kazakhstan region with the highest male life expectancy indicated the lowest Gini coefficient.

In the period 2007-2008 the association of regional differences in male life expectancy and Gini coefficient was as strong as it was observed for the period 1999-2000 (see Figure 47b). Karagandy region with the lowest male life expectancy (24.1 years) indicated the highest Gini coefficient (0.282) while Astana city with the highest male life expectancy (30.3 years) demonstrated the lowest Gini coefficient (0.196) among all regions. Akmola, Karagandy, Kostanai, North Kazakhstan regions decreased the expectation of life and parallely increased the

Gini coefficient values in age interval 40-80 in the period 2007-2008 in comparison with 1999-2000 (see Table 11a). Among the regions which increased the expectation of life in the observed age interval Almaty and East Kazakhstan regions did not change the value of Gini coefficient while Pavlodar region increased the coefficient value.

Figure 47a − Gini coefficient in age interval 40-80 versus expectation of life in age interval 40-80, 1999-2000, males

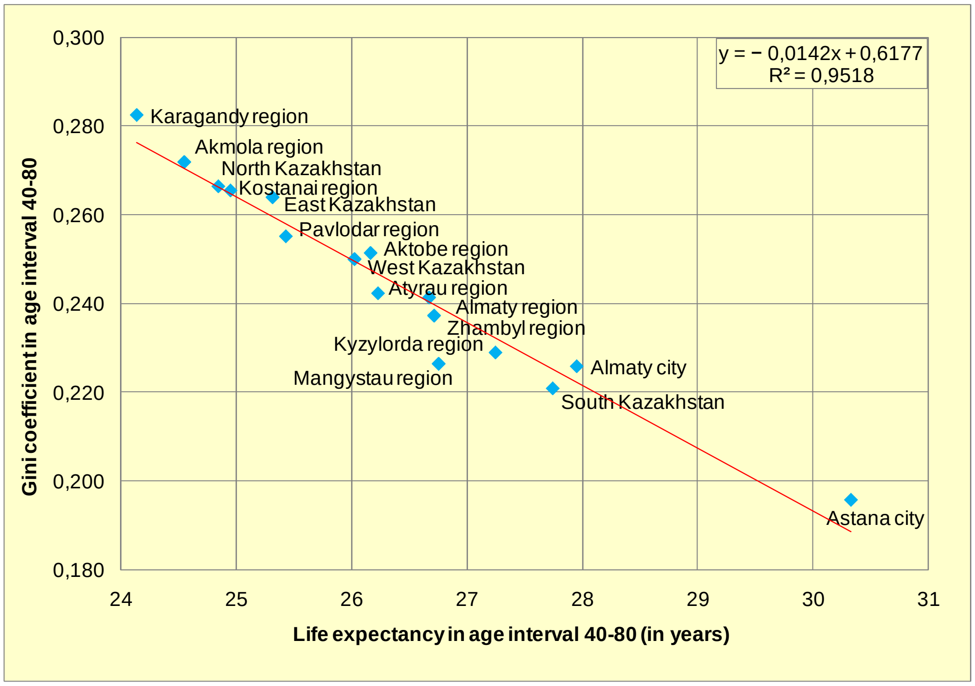


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Gini coefficient for females was higher in the regions with lower female life expectancy while lower level of Gini coefficient was observed in the regions with higher life expectancy (see Figure 46.3). In the period 1999-2000 the highest Gini coefficient (0.164) for females was found in Akmola region where the lowest female life expectancy was noted (31.5 years) while Almaty city with the highest female life expectancy (33.2 years) indicated the lowest Gini coefficient (0.140).

In the period 2007-2008 the association degree of regional differences in the expectation of life and Gini coefficient in the observed age interval was even higher than in the period 1999-2000 (see Figure 47d). Akmola region had the lowest female life expectancy but slightly lower Gini coefficient compared to Karagandy region which had the lower expectation of life. Astana city indicated the highest life expectancy as well as the lowest Gini coefficient in the observed age interval among all regions. Female life expectancy increased and Gini coefficient decreased in age interval 40-80 in all regions except Karagandy and Kostanai regions between two periods (see Table 11b). The Gini coefficient in these regions increased between two periods which identified more unequal distribution of the expectation of life among female individuals in the regions in the period 2007-2008 compared to 1999-2000.

Figure 47b − Gini coefficient in age interval 40-80 versus expectation of life in age interval 40-80, 2007-2008, males



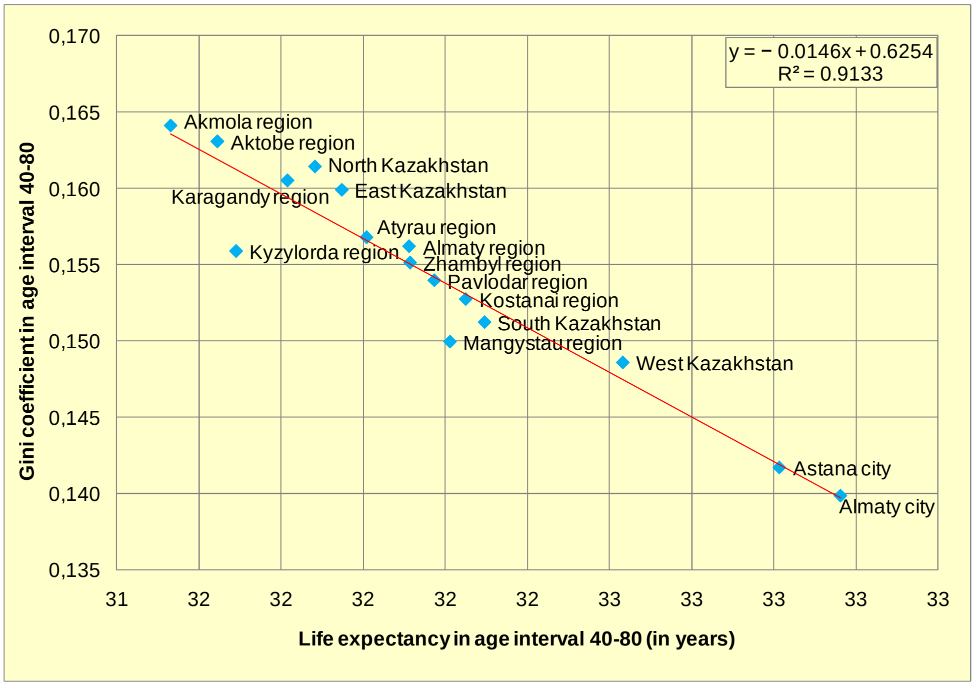
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 11a − Changes in Gini coefficient in age interval 40-80 and expectation of life in age interval 40-80 between 1999-2000 and 2007-2008, males

Regions	1999-2000, e_{40-80}	2007-2008, e_{40-80}	Gini $_{40-80}$	Gini $_{40-80}$	Change in e_{40-80}	Change in Gini $_{40-80}$
Akmola region	24.8	24.5	0.261	0.272	-0.2	0.011
Aktobe region	24.5	26.2	0.269	0.251	1.6	-0.018
Almaty region	26.5	26.7	0.241	0.241	0.2	0.000
Atyrau region	24.4	26.2	0.268	0.242	1.8	-0.026
West Kazakhstan	24.8	26.0	0.263	0.250	1.2	-0.013
Zhambyl region	26.3	26.7	0.242	0.237	0.4	-0.004
Karagandy region	24.5	24.1	0.267	0.282	-0.4	0.016
Kostanai region	25.1	24.9	0.258	0.265	-0.2	0.007
Kyzylorda region	26.8	27.2	0.232	0.229	0.5	-0.003
Mangystau region	25.8	26.8	0.250	0.226	1.0	-0.023
South Kazakhstan	27.2	27.7	0.230	0.221	0.6	-0.009
Pavlodar region	25.4	25.4	0.254	0.255	0.1	0.001
North Kazakhstan	25.0	24.8	0.261	0.266	-0.2	0.006
East Kazakhstan	24.8	25.3	0.264	0.264	0.5	0.000
Astana	26.6	30.3	0.242	0.196	3.7	-0.046
Almaty	26.3	27.9	0.250	0.226	1.7	-0.024

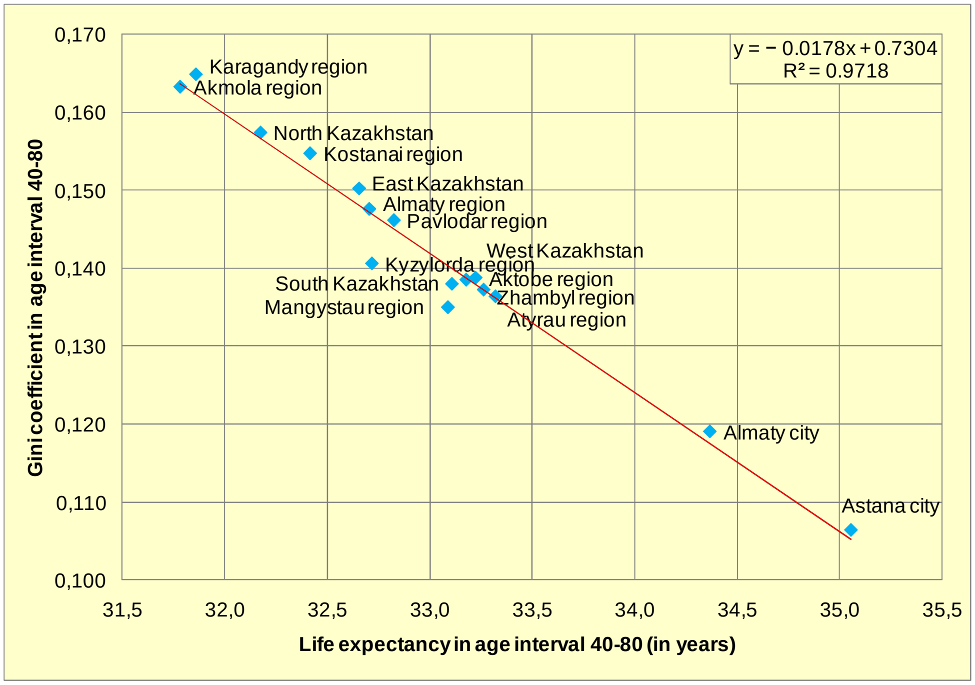
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 47c – Gini coefficient in age interval 40-80 versus expectation of life in age interval 40-80, 1999-2000, females



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Figure 47d – Gini coefficient in age interval 40-80 versus expectation of life in age interval 40-80, 2007-2008, females



***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The association of regional differences in Gini coefficient and expectation of life in age interval 40-80 was very strong for both sexes in the periods 1999-2000 and 2007-2008. The changes in Gini coefficient and life expectancy at birth were not even in the regions between two periods. The very strong association of Gini coefficient and expectation of life across regions demonstrated the higher inequality in distribution of average length of life in age interval 40-80 among individuals in the regions with lower expectation of life in the observed age interval while the regions with higher expectation of life in the examined age interval indicated the lower inequality.

Table 11b − Changes in Gini coefficient in age interval 40-80 and expectation of life in age interval 40-80 between 1999-2000 and 2007-2008, females

Regions	1999-2000, $e_{40\text{-}80}$	2007-2008, $e_{40\text{-}80}$	Gini $_{40\text{-}80}$	Gini $_{40\text{-}80}$	Change in $e_{40\text{-}80}$	Change in Gini $_{40\text{-}80}$
Akmola region	31.5	31.8	0.164	0.163	0.3	-0.001
Aktobe region	31.6	33.2	0.163	0.139	1.6	-0.024
Almaty region	32.1	32.7	0.156	0.148	0.6	-0.009
Atyrau region	32.0	33.3	0.157	0.136	1.3	-0.020
West Kazakhstan	32.6	33.2	0.149	0.139	0.5	-0.010
Zhambyl region	32.1	33.3	0.155	0.137	1.1	-0.018
Karagandy region	31.8	31.9	0.161	0.165	0.1	0.004
Kostanai region	32.3	32.4	0.153	0.155	0.2	0.002
Kyzylorda region	31.7	32.7	0.156	0.141	1.0	-0.015
Mangystau region	32.2	33.1	0.150	0.135	0.9	-0.015
South Kazakhstan	32.3	33.1	0.151	0.138	0.8	-0.013
Pavlodar region	32.2	32.8	0.154	0.146	0.7	-0.008
North Kazakhstan	31.9	32.2	0.161	0.157	0.3	-0.004
East Kazakhstan	31.9	32.7	0.160	0.150	0.7	-0.010
Astana	33.0	35.1	0.142	0.106	2.0	-0.035
Almaty	33.2	34.4	0.140	0.119	1.2	-0.021

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

12.3 Main finding

The finding of the chapter answers the fifth research question.

5. *What changes took place in association of regional differences in measures of inequality in age at death and expectation of life for males and females between the periods 1999-2000 and 2007-2008?*

5. The evidence of association of regional differences in expectation of life and measures of inequality in age at death in the periods 1999-2000 and 2007-2008 demonstrated that the regions with lower expectation of life demonstrated the higher inequality in age at death while the regions with lower expectation of life indicated the lower inequality. However, the association of average life expectancy losses and expectation of life was weaker than the

association of Gini coefficient and expectation of life. The changes in expectation of life and measures of inequality in age at death in the regions between two periods demonstrated that in some regions with the increase of life expectancy the inequality in age at death decreased while the other regions indicated the increase of life expectancy parallely with the increase of inequality. The last evidence was explained by Shkolnikov et al. (2011) as an expansion of death to advanced ages and also difficulties in further reduction of mortality at young and middle adult ages.

Our analysis in this chapter was one of ways of comparison the regional mortality inequalities in the observed periods which provided the base into determinants of variation in inequality in age at death across time and regions.

Chapter 13

Factors of regional mortality differentiation in Kazakhstan in the periods 1999-2000 and 2007-2008

The chapter determines the factors of regional mortality differentiation in Kazakhstan in the beginning (1999-2000) and the end (2007-2008) of the observed period. We constructed the data set from selected socio-economic and demographic indicators for each region for the periods1999-2000 and 2007-2008. The stepwise and maximum r-square improvement model selections of multiple regression analysis were used to define the relation between aforementioned variables and life expectancy at birth in the beginning as well as the end of the period. Canonical correlation analysis was used for defining the association of mortality by age groups with abovementioned selected variables. The operationalisation of variables was given in Table 9.

Table 12 −The operationalisation of selected explanatory variables

Variables	Abbreviation	Operationalisation
Highest educational attainment	HIGHEDU	The proportion of population with high and incomplete high education, per 1,000 persons
Industrial production	INDPROD	The volume of industrial production, dollar per capita
Russian population	RUSSIAN	The proportion of Russian population, percentage
Gross regional product	GRP	Gross regional product, dollar per capita
Unemployment rate	UNEMP	The unemployment rate, percentage
Poverty	POVERTY	The proportion of population with income below subsistence minimum, percentage
Total Fertility Rate	TFR	Total fertility rate
Crude Divorce Rate	DIV	Crude Divorce rate, per 1,000 persons

Source: *Agency of Statistics of the Republic of Kazakhstan*

13.1 Factors of regional mortality differentiation in the period 1999-2000

13.1.1 Overall mortality level

The summary of stepwise selection model for male life expectancy at birth in the period 1999-2000 demonstrated that the explanatory variables INDPROD, GRP, POVERTY, and DIV were significant at the level 0.1500 and stayed in the model (see Table 13). The variables in the table are located according to order of entering in each step of stepwise selection model. The variables were added one by one to the model, and the F statistic (the column F value) for a variable to be added had to be significant at the level 0.1500 (the column Pr>F). After all significant variables were entered the variable RUSSIAN was removed because it did not produce an F statistic significant at the level 0.1500 any more. The column Model R-Square indicates the overall measure of the strength of association and does not reflect the extent to which any particular independent variable is associated with the dependent variable. When the R^2 equals to 1, it means the strong determination of the model. In this case R^2 was at the level 0.8824 when all significant explanatory variables were entered. C (p) (Colin Mallows statistic) was decreasing in each step of stepwise selection. The value of C (p) is smaller the fit of model is better. In the level 1.5437 it indicated better fit of model.

Table 13 − Summary of stepwise selection model, 1999-2000, males

Step	Variable Entered	Variable Removed	Label	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	INDPROD		INDPROD	0.1843	0.1843	40.31	3.16	0.0970
2	RUSSIAN		RUSSIAN	0.2531	0.4374	26.08	5.85	0.0310
3	GRP		GRP	0.2689	0.7064	10.83	10.99	0.0062
4	POVERTY		POVERTY	0.1160	0.8224	5.39	7.19	0.0214
5	DIV		DIV	0.0629	0.8853	3.36	5.48	0.0413
6		RUSSIAN	RUSSIAN	0.0029	0.8824	1.54	0.25	0.6255

Notes: *The partial R-Square measures the marginal contribution of one explanatory variable when all others are already included in stepwise regression model.*
F value (F statistic) is the Mean Square Model divided by the Mean Square Error.
Pr>F is the p-value associated with the above F-statistic. It is used in testing the null hypothesis that all of the model coefficients are 0.

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The maximum r-square improvement model begins by finding the-one variable model producing the highest R^2. The first step of maximum r-square improvement model entered the variable INDPROD as the best 1-variable model with R^2 = 0.1843 and C (p) = 40.31, the regression coefficient (the column parameter estimate) indicated the negative value (b = − 0.0006) which determined that entered variable was negatively related to male life expectancy at birth (see Table 14a). The second step added the variable RUSSIAN and R^2 increased to 0.4374 while C (p) decreased to 26.08. The negative value of regression coefficient for the variable indicated its negative relation to male life expectancy at birth (b = − 0.0584) (see Table 14b). In the result of third step the variable GRP entered, R^2 increased to 0.7064 and C (p) decreased to 10.83.The entered variable indicated its positive relation to male life expectancy at birth (b = 0.0023) (see Table 14c).

Table 14a − Maximum R-Square Improvement: Step 1, 1999-2000, males

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	60.68	0.4987	37102	14808.10	<.0001
INDPROD	-0.0006	0.0004	7.93	3.16	0.097

Variable INDPROD entered: R-Square = 0.1843 and C (p) = 40.31

The above model is the best 1-variable model found

***Notes:** Parameter estimate is the value for the regression equation for predicting the dependent variable from the independent variable.*

Standard error is associated with the coefficients.

*The Type II SS are commonly called the partial sums of squares. The Type II SS for a particular variable is the increase in MODEL SS due to adding the variable to a model that already contains all the other variables in the MODEL statement. **Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In maximum r-square improvement model once the two variable model is obtained, each of the variables in the model is compared to each variable not in the model. For each comparison, the maximum r-square improvement model determines if removing one variable and replacing it with the other variable increases R^2. Therefore, forth step removed the variable RUSSIAN and entered the variable POVERTY, R^2 increased to 0.7652 and C (p) decreased to 7.08, the entered variable POVERTY indicated its positive relation to male life expectancy at birth (b = 0.0980) (see Table 14d). In the result of the fifth step variable DIV entered, R^2 increased to 0.8824 and C (p) decreased to 1.54. The variable indicated its negative relation to male life expectancy at birth (b= − 1.39) (see Table 14e). The p-value (the column Pr>F) for the variable was changing in the result of adding the new variable in each step of maximum r-square improvement model because each added variable provided its boost to the model.

Table 14b − Maximum R-Square Improvement: Step 2, 1999-2000, males

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	62.61	0.9051	8905.54	4785.44	<.0001
INDPROD	-0.0009	0.0003	15.03	8.07	0.0139
RUSSIAN	-0.0584	0.0241	10.88	5.85	0.0310

Variable RUSSIAN entered: R-Square = 0.4374 and C (p) = 26.08

The above model is the best 2-variable model found

***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The number of variables which were entered till the sixth step of maximum r-square improvement model coincided with the number of variables in the summary table of stepwise selection. And the final values of R^2 as well as the C (p) were the same in both selections. However, the difference between two models is that all switches are evaluated before any switch is made in the maxr model. In the stepwise model, the "worst" variable might be removed without considering what adding the "best" remaining variable might accomplish. Therefore, the variable "Russian" was removed in the last step of stepwise selection while maximum r-square improvement model considered its removal before entering the variable POVERTY.

Table 14c − Maximum R-Square Improvement: Step 3, 1999-2000, males

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	62.13	0.6957	8393.20	7976.20	<.0001
INDPROD	-0.0021	0.0004	24.52	23.30	0.0004
GRP	0.0023	0.0007	11.56	10.99	0.0062
RUSSIAN	-0.0913	0.0207	20.49	19.47	0.0008

Variable GRP entered: R-Square = 0.7064 and C (p) = 10.83
The above model is the best 3-variable model found
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The regression (the column parameter estimate) and the standardised regression (standardised estimate) coefficients of selected variables are described in a separate table (see Table 10.7). Their positive or negative values identify the direction of the relationship between explanatory variables and dependent variable. The gross regional product (b = 0.0043. stb = 1.79) and the proportion of poor population were positively associated with male life expectancy at birth while crude divorce rate (b = − 1.39, stb = − 0.4889) and the volume of industrial production (b = − 0.0031, stb = − 2.20) were negatively related to it. Because the variables may have different units and scales we look at the standardised regression coefficient to assess what explanatory variable was more closely related to dependent variable. The greater values of standardised regression coefficient (stb= − 2.20, stb=1.79) for the variables INDPROD and GRP in comparison with other variables indicated the strongest contribution of industrial production volume and gross regional product to male life expectancy at birth compared to other variables.

Table 14d − Maximum R-Square Improvement: Step 4, 1999-2000, males

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	56.11	0.8994	3274.39	3891.39	<.0001
INDPROD	-0.0028	0.0005	29.65	35.24	<.0001
GRP	0.0034	0.0007	17.94	21.33	0.0006
POVERTY	0.0980	0.0187	23.02	27.36	0.0002

Variable RUSSIAN removed: R-Square = 0.7652 and C (p) = 7.0579 Variable POVERTY entered
The above model is the best 4-variable model found
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As the result of analysis indicated male life expectancy at birth was positively related to gross regional production and the proportion of poor population, and negatively related to crude divorce rate and the volume of industrial production in 1999-2000. Male life expectancy at birth apart from female one indicated the geographical homogeneity in the observed period. Male life expectancy at birth was lower (below national) in northern, central, eastern, western regions while it was higher (above national) in southern regions and the two municipal cities in the period 1999-2000 (national was 60.2) (see Chapter 9.1). Hence, this evidence can be explained by several factors.

Table 14e − Maximum R-Square Improvement: Step 5, 1999-2000, males

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	58.31	0.9404	1767.80	3844.17	<.0001
INDPROD	-0.0031	0.0004	33.95	73.83	<.0001
GRP	0.0043	0.0006	22.98	49.96	<.0001
POVERTY	0.0833	0.0146	15.07	32.77	0.0001
DIV	-1.3860	0.4187	5.04	10.96	0.0070

Variable DIV entered: R-Square = 0.8824 and C (p) = 1.54

The above model is the best 5-variable model found

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 15 − Parameter and Standardised Estimates of factors, 1999-2000, males

Parameter Estimates						
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Standardized Estimate**
Intercept	1	58.3080	0.9404	62.00	<.0001	0
INDPROD	1	-0.0031	0.0004	-8.59	<.0001	-2.2018
GRP	1	0.0043	0.0006	7.07	<.0001	1.7906
POVERTY	1	0.0833	0.0146	5.72	0.0001	0.9169
DIV	1	-1.3860	0.4187	-3.31	0.0070	-0.4889

Notes: *t value is the t-statistics used in testing whether a given coefficient is significantly different from zero.*

Pr > |t|- *This column shows the 2-tailed p-values used in testing the null hypothesis that the coefficient (parameter) is 0.*

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Firstly, the main industrial and oil extracting regions are located in northern (Pavlodar), central (Karagandy), eastern (East Kazakhstan), and western (Atyrau, Mangystau are main) parts as described in chapter 7.1. Despite the fact that these regions are economically prosperous they are considered to be also environmentally damaged (see chapter 7.3). Moreover, the regions had higher proportion of employees employed in unhealthy work conditions compared to other regions. And these regions had lowest male life expectancy at birth among all regions (Karagandy – 58.0, Atyrau – 58.6, East Kazakhstan – 58.9, Mangystau – 58.9, Pavlodar – 59.1) in the examined period. The negative relation of the volume of industrial production to male life expectancy at birth would be explained by possible effect of environmental degradation and the occupation of employees in unhealthy working conditions in industrial and oil extracting regions.

Secondly, among abovementioned regions Pavlodar (2.5), Mangystau (2.3), East Kazakhstan (2.3), Karagandy (2.3) had higher rate of divorce while the southern regions (South Kazakhstan, Kyzylorda, and Zhambyl) indicated the lowest rate of divorce (0.9, 1.3, and 1.1 respectively) and above national male life expectancy at birth in the observed period (see Appendix 14a). Regional differences of divorce level would be connected with the urbanisation level of regions as well as the cultural differences (Valkonen et al., 2008, Mortelmans et al., 2009). This differentiation would be related to urbanized character of Pavlodar, Mangystau, East Kazakhstan, and Karagandy regions (see Chapter 7.1). Divorce rate would be one possible factor of regional male mortality differentiation. In this sense it is well established that divorced people tend to die earlier from different diseases (Sbarra and Nietert, 2009) and are at higher risk of suicide than the married (Kposowa, 2003).

The positive relation of poverty incidence to male life expectancy at birth would be explained by the fact that the southern regions (South Kazakhstan, Kyzylorda, Zhambyl, and Almaty) had higher proportion of poor population, but higher male life expectancy at birth compared to other ones. This evidence would be explained by the fact that these regions are mainly agricultural, rural and less environmentally damaged (except Kyzylorda). Moreover, these regions with the highest proportion of Kazakh population are considered to be the regions with preserved traditional and cultural values. The lowest rate of divorce in the regions would explain the strong family bonds which would influence on regional male mortality differences.

Thirdly, the municipal cities Astana and Almaty had above national male life expectancy at birth (63.2 and 61.6 years respectively) as indicated above. These cities had high size of gross regional product (after Atyrau and Mangystau regions) which indicated the higher level of living standard of cities compared to other regions (see chapter 7.2). Moreover, apart from Atyrau and Mangystau regions, the cities had the highest proportion of population with highest educational attainment, the lowest incidence of poverty, and the highest proportion of employees employed in service-sector (see Chapter 7.6). These advantages of municipal cities would explain the low level of male mortality in the cities and the positive relation of gross regional product with male life expectancy at birth.

The overall conclusion can be made that regional male life expectancy at birth differentiation was positively associated with the level of living standard, poverty incidence, and negatively associated with the industrial position and the level of divorce rate.

Table 16 − Summary of stepwise selection model, 1999-2000, females

Step	Variable Entered	Variable Removed	Label	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	HIGHEDU		HIGHEDU	0.6186	0.6186	10.26	22.71	0.0003
2	INDPROD		INDPROD	0.0826	0.7012	7.44	3.59	0.0805
3	GRP		GRP	0.0496	0.7508	6.55	2.39	0.1482
4		HIGHEDU	HIGHEDU	0.0309	0.7199	6.35	1.49	0.2459
5	DIV		DIV	0.0719	0.7918	4.15	4.14	0.0645

Source: *Author’s calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The summary of stepwise selection model for female life expectancy at birth indicated that the variable HIGHEDU entered the first but after entering the variables INDPROD and GRP it was not significant at the level 0.1500, and removed from the model. The variables INDPROD, GRP, and DIV were significant at the level 0.1500 and stayed in the model (see Table 16). HIGHEDU was the variable which entered in the first step of maximum r-square improvement model with R^2=0.6186 and C (p) = 10.26. The variable indicated its positive relation to female life expectancy at birth (b=0.0138) (see Table 17a). The variable INDPROD was added in the second step increasing the R^2 of the model to 0.7012, and decreasing C (p) to 7.44. The variable was negatively related to female life expectancy at birth (b= − 0.0003) (see Table 17b). The third step removed the variable HIGHEDU and entered the variable GRP, in this case R^2 increased to 0.7199, and C (p) decreased to 6.3508 (see Table 17c). The entered variable GRP indicated its positive relation to female life expectancy at birth (b=0.0019). The forth step entered the variable DIV, and R^2 increased to 0.7918, C (p) decreased to 4.15 (see Table 17d). The variable was negatively related to female life expectancy at birth (b= − 0.6591). Here, the main difference between two models was determined by the fact that variable HIGHEDU was removed after entering the variables INDPROD and GRP in the result of stepwise selection while maximum r-square improvement model considered the removing of the variable HIGHEDU and entering the variable GRP in one step.

Table 17a − Maximum R-Square Improvement: Step 1, 1999-2000, females

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	68.6482	0.4447	11348	23825.10	<.0001
HIGHEDU	0.0138	0.0029	10.82	22.71	0.0003

Variable HIGHEDU entered: R-Square = 0.6186 and C (p) = 10.26
The above model is the best 1-variable model found
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 17b − Maximum R-Square Improvement: Step 2, 1999-2000, females

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	68.94	0.4371	9998.68	24878.70	<.0001
HIGHEDU	0.0133	0.0027	10.0471	25.00	0.0002
INDPROD	-0.0003	0.0001	1.4435	3.59	0.0805

Variable INDPROD entered: R-Square = 0.7012 and C (p) = 7.44
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The table of regression and standardised regression coefficients indicated that the gross regional product (b=0.0026, stb=1.6589) was positively while the volume of industrial production (b= -0.0015, stb= − 1.6466) and crude divorce rate (b= − 0.6591, stb= − 0.3646) were negatively related to female life expectancy at birth (see Table 18). The higher value of standardised regression coefficient for the variable GRP (stb= 1.6589) compared to other variables indicated that the gross regional product was the stronger predictor of female life expectancy at birth than other indicators.

Table 17c − Maximum R-Square Improvement: Step 3, 1999-2000, females

Variable	**Parameter Estimate**	**Standard Error**	**Type II SS**	**F Value**	**Pr > F**
Intercept	69.59	0.3142	18474	49034	<.0001
INDPROD	-0.0012	0.0002	11.9482	31.71	<.0001
GRP	0.0019	0.0004	10.3739	27.53	0.0002

Variable HIGHEDU removed: R-Square = 0.7199 and C (p) = 6.35 Variable GRP entered
The above model is the best 2-variable model found
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The stronger positive relation of gross regional production to female life expectancy at birth would be related to the fact that in the observed period highest female life expectancy at birth among all regions was found in Astana and Almaty cities (72.7 and 73.2 years respectively). Gross regional product size per capita was highest in these cities as it was described for males. The evidence indicated that higher level of living standard would be the possible factor of regional differentiation of life expectancy at birth for both sexes in the observed period.

Table 17d − Maximum R-Square Improvement: Step 4, 1999-2000, females

Variable	**Parameter Estimate**	**Standard Error**	**Type II SS**	**F Value**	**Pr > F**
Intercept	70.35	0.4681	6853.36	22588.90	<.0001
INDPROD	-0.0015	0.0002	12.17	40.12	<.0001
GRP	0.0026	0.0004	9.80	32.30	0.0001
DIV	-0.6591	0.3238	1.26	4.14	0.0645

Variable DIV entered: R-Square = 0.7918 and C (p) = 4.15
The above model is the best 3-variable model found
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The volume of industrial production was negatively related to female life expectancy at birth in the observed period as it was noted for males. Environmental degradation and unhealthy working conditions in industrial and oil extracting regions would have the possible effect on health of females as well as males. The lowest female life expectancy at birth was examined in Kyzylorda (69.4), Aktobe (69.5), Akmola (69.7), Atyrau (69.7), Mangystau (69.7), and Karagandy (69.9) regions. Among these regions Atyrau, Mangystau, Aktobe, Karagandy regions are environmental damaged because of their industrial position, Kyzylorda region is also ecologically unfavorable because of catastrophic Aral Sea in its territory as it was mentioned in chapter 7.3.

Crude divorce rate was the negative possible factor of female life expectancy at birth as it was observed for males. Among the regions with lower female life expectancy at birth Karagandy (2.3), Mangystau (2.3), Akmola (1.8), Aktobe (1.7) regions had higher divorce rate. The evidence indicated that regional differentiation of female life expectancy at birth would be related to regional differentiation of divorce rate in the observed period.

The overall conclusion can be made that regional differentiation of life expectancy at birth for both sexes was positively associated with the level of living standard, and negatively associated with the volume of industrial production and the level of divorce in the observed period. The evidence indicated that mortality level for both sexes was the highest mainly in urbanized industrial and oil extracting regions. Municipal cities with the most favourable socio-economic conditions had the lowest level of mortality for both sexes. Apart from females male mortality level was below national in all southern regions which would be explained by agricultural, rural, and traditional character of regions despite their higher scale of poverty.

Table 18 − Parameter and Standardised Estimates of factors, 1999-2000, females

Parameter Estimates						
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Standardized Estimate**
Intercept	1	70.35	0.4681	150.30	<.0001	0
INDPROD	1	-0.0015	0.0002	-6.33	<.0001	-1.6466
GRP	1	0.0026	0.0004	5.68	0.0001	1.6589
DIV	1	-0.6591	0.3238	-2.04	0.0645	-0.3646

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

13.1.2 Mortality level by age groups

In the result of canonical correlation analysis four canonical variables for mortality and explanatory indicators were made (because the number of dependent variables are four (${}_5q_0$. ${}_{15}q_5$. ${}_{45}q_{20}$ and ${}_{20}q_{65}$)).

Table 19a − Canonical correlation coefficients, 1999-2000, males

	Canonical Correlation	**Adjusted Canonical Correlation**	**Approximate Standard Error**	**Squared Canonical Correlation**
1	*0.9728*	0.9546	0.0138	0.9465
2	*0.9098*	0.8648	0.0445	0.8277
3	0.6907	0.5059	0.1350	0.4770
4	0.5755	.	0.1727	0.3312

Notes: *Adjusted Canonical Correlations are less biased than the raw correlations. These adjusted values may be negative.*

Approximate Standard Error is the approximate standard errors for the canonical correlations.

Squared Canonical Correlation is the squares of the canonical correlations.

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

For male mortality by age groups in 1999-2000 SAS computed the correlation between the new canonical variables MORTALITY1 and EXPLANATORY1. This "canonical correlation" has a value of 0.9728. The correlation between the new canonical variables MORTALITY2 and EXPLANATORY2 is 0.9098. Two more canonical variables have the correlation values 0.6907 and 0.5755 (see Table 19a). These values give an overall feel for the degree of association between the mortality and explanatory variables. At 0.9628 and 0.9087 the relationship is fairly strong. The next table of the printout provides a PCA (Principal Component Analysis) type decomposition of the canonical variables (see Table 19b). From this we see that the first canonical variables accounted for most of the data variability (74.02 %) and the approximate F test shows the significant value (p = 0.0835). The second canonical variables accounted for 20.10% of the data variability (p=0.3787). The data variability of other two canonical variables is near zero. Thus, only the first two canonical variables from four new canonical variables have any potential meaning.

Hence, we look at the canonical variables of mortality indicators MORTALITY1, MORTALITY2 and those of explanatory indicators EXPLANATORY1, EXPLANATORY2. The first set of correlations examines the relationships between the attributes and their respective canonical variables (see Tables 19c and 19d). From this we see that MORTALITY1 is highly correlated with ${}_{15}q_5$ and ${}_{45}q_{20}$ measurements and that EXPLANATORY1 is related to total fertility rate and the proportion of Russian population. MORTALITY2 is highly correlated with ${}_5q_0$ and ${}_{20}q_{65}$ while EXPLANATORY2 is highly correlated with poverty, total fertility rate, and the highest educational attainment.

Table 19b − Decomposition of canonical variables, 1999-2000, males

Eigenvalue	**Difference**	**Proportion**	**Cumulative**	**Likelihood Ratio**	**Approx. F Value**	**Num DF**	**Den DF**	**Pr > F**
17. 7	12.89	*0.7402*	0.7402	0.0032	1.91	32	16	0.0835
4.8	3.89	*0.2010*	0.9411	0.0603	1.18	21	15	0.3787
0.9	0.42	0.0382	0.9793	0.3492	0.69	12	12	0.7342
0.5		0.0207	1	0.6688	0.69	5	7	0.6451

Notes: *Eigenvalue is the eigenvalues of the product of the model matrix and the inverse of the error matrix.*

Difference is the difference between the given eigenvalue and the next-largest eigenvalue.

Likelihood Ratio is the likelihood ratio for testing the hypothesis that the given canonical correlation and all smaller ones are equal to zero in the population.

Num DF, Den DF are the degrees of freedom used in determining the F values.

Pr > F - This is the p-value associated with the F value of a given test statistic.

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Next, we look at the cross correlations of the original MORTALITY variables and EXPLANATORY canonical variables and visa versa (see Tables 19e and 19f). ${}_{15}q_5$ and ${}_{45}q_{20}$ are highly correlated with the explanatory canonical variable EXPLANATORY1. This variable is mainly related to total fertility rate and the proportion of Russian population. ${}_5q_0$ and ${}_{20}q_{65}$ are highly correlated with the explanatory canonical variable EXPLANATORY2. This variable is mainly related to poverty, total fertility rate, and the highest educational attainment.

Table 19c − Correlations between mortality indicators and their canonical variables, 1999-2000, males

	Mortality1	Mortality2	Mortality3	Mortality4
q5	0.1441	*0.9059*	0.1505	0.3687
q20	*0.8222*	0.5061	0.1189	-0.2317
q65	*0.9101*	0.0618	-0.4074	-0.0436
q85	0.5116	*0.7614*	-0.1480	-0.3696

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

This makes sense as the higher young and adult age male mortality (${}_{15}q_5$ and ${}_{45}q_{20}$) the higher proportion of Russian population the regions can perform (note that RUSSIAN is positively correlated with EXPLANATORY1). The higher child and old age male mortality (${}_5q_0$ and ${}_{20}q_{65}$), the higher total fertility rate, poverty and the lower proportion of population with highest educational attainment the regions perform (note that HIGHEDU is negatively while TFR, POVERTY are positively correlated with EXPLANATORY2)

Therefore, an overall conclusion can be made that the canonical correlation of 0.9728 for the first canonical variable was mainly due to relationships between ${}_{15}q_5$ and ${}_{45}q_{20}$ measurements and total fertility rate and the proportion of Russian population. The canonical correlation of 0.9098 for the second canonical variable was mainly due to relationships between ${}_5q_0$ and ${}_{20}q_{65}$ measurements and total fertility rate, poverty, the proportion of population with highest educational attainment.

Table 19d − Correlations between explanatory indicators and their canonical variables, 1999-2000, males

	Explanatory1	Explanatory2	Explanatory3	Explanatory4
HIGHEDU	-0.3130	*-0.6012*	-0.1653	0.1128
INDPROD	0.3034	0.3719	-0.2931	0.4290
GRP	0.2781	-0.1927	-0.2875	0.5149
UNEMP	-0.3675	0.4269	-0.0067	0.0471
POVERTY	-0.4803	*0.6837*	0.1447	0.1579
DIV	0.3990	-0.2462	0.1211	0.2868
TFR	-0.5305	*0.6748*	-0.0370	0.1058
RUSSIAN	*0.5949*	-0.4745	0.2838	-0.3585

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

As the result of analysis indicated young and adult age male mortality (${}_{15}q_5$ and ${}_{45}q_{20}$) was positively related to proportion of Russian population. In the observed period young and adult age male mortality rate was below national in southern regions (South Kazakhstan, Kyzylorda, Zhambyl, Almaty regions) along with Astana and Almaty cities. Northern, central, eastern, and western regions indicated the above national young and adult age male mortality (see Chapters 9.2.2 and 9.2.3). As described in chapter 7.5 the southern regions had the lowest proportion of Russian population while the northern, central, and eastern part regions had the highest proportion of Russian population. The evidence of southern-northern differential male mortality in age groups 5-19 and 20-64 would be explained by several factors. Firstly, Kazakhs would have the stronger social support networks than the European ethnic groups which help them avoid the suicide, homicide and other self-destructive behaviors (Becker and Urzhumova, 2005) and this evidence would be even stronger in the regions with the lowest proportion of Russian population. In this sense we have to take into account southern-northern differences of male mortality from external causes in age groups 5-19 and 20-64 (see chapters 9.3.2.1 and 9.3.3.3). Secondly, the northern, central, eastern, and western regions include the big industrial and oil extracting regions Karagandy, Pavlodar, East Kazakhstan, Atyrau, and Mangystau. These regions had the big industrial status from the Soviet period and unhealthy working conditions, external accidents in working places, environmental degradation in these regions would serve as the additional factor of higher male mortality in the regions apart from southern agricultural secure regions. It was considered that Kazakhs tend to live in these less environmentally damaged regions and work in less dangerous occupations (Becker and Urzhumova, 2005) while Russians tend to live in industrial regions and more occupied in industry (Andreev, 2007). Thirdly, ethnic Kazakhs are commonly believed to consume less alcohol than their European counterparts because of their Muslim identity (Becker and Urzhumova, 2005). However, we had no available data for lifestyle indicators across regions.

Table 19e − Correlations between mortality indicators and the canonical variables of explanatory indicators, 1999-2000, males

	Explanatory1	**Explanatory2**	**Explanatory3**	**Explanatory4**
q5	0.1402	*0.8242*	0.1039	0.2122
q20	*0.7999*	0.4604	0.0821	-0.1333
q65	*0.8854*	0.0562	-0.2814	-0.0251
q85	0.4977	*0.6927*	-0.1022	-0.2127

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 19f − Correlations between explanatory indicators and the canonical variables of mortality indicators, 1999-2000, males

	Mortality1	**Mortality2**	**Mortality3**	**Mortality4**
HIGHEDU	-0.3045	*-0.5470*	-0.1141	0.0649
INDPROD	0.2952	0.3383	-0.2024	0.2469
GRP	0.2706	-0.1753	-0.1986	0.2963
UNEMP	-0.3576	0.3884	-0.0046	0.0271
POVERTY	-0.4673	*0.6221*	0.0999	0.0908
DIV	0.3882	-0.2240	0.0837	0.1651
TFR	-0.5161	*0.6139*	-0.0256	0.0609
RUSSIAN	*0.5787*	-0.4317	0.1960	-0.2063

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Male mortality in child and old ages was positively related to total fertility rate, poverty scale, and negatively associated with the proportion of population with highest educational attainment. It identified that child and old age mortality was higher mainly in the regions with lower proportion of Russian population, lower proportion of highly educated population and with higher proportion of poor population. It is worth to note that in the observed period total fertility rate and poverty scale were highly and positively correlated (see Appendix 6a). The evidence indicated that regions with the lowest proportion of Russian population and the regions with highest incidence of poverty were the same (South Kazakhstan, Kyzylorda, Zhambyl, Atyrau, Mangystau regions) in the examined period.

Table 20a − Canonical correlation coefficients, 1999-2000, females

	Canonical Correlation	Adjusted Canonical Correlation	Approximate Standard Error	Squared Canonical Correlation
1	*0.9637*	0.9384	0.0184	0.9288
2	*0.8967*	0.8427	0.0506	0.8040
3	0.7333	0.5931	0.1194	0.5377
4	0.6151	0.5822	0.1605	0.3784

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

It is well documented that poverty, maternal education, and total fertility rate are the important factors of infant and child mortality. Poverty creates barriers in access to healthy food, proper sanitation in some rural areas, access to health care and education about proper nutrition and prenatal care (Eudy, 2009) while education allows mothers to become less fatalistic about their children's illnesses, be more capable of manipulating available health facilities and to change the traditional balance of familial relationships with profound effects on child care (Caldwell, 1981). The positive relation of child mortality (especially infant mortality) with total fertility rate would be explained by variables as birth order, mother's age, or the length of previous birth interval linked to fertility levels (Taucher, 1989). The regional differences in chain of factors as poverty, total fertility rate, and proportion of population with highest educational attainment would be the main reason of regional child mortality differentiation.

Table 20b − Decomposition of canonical variables, 1999-2000, females

Eigenvalue	Difference	Proportion	Cumulative	Likelihood Ratio	Approx. F Value	Num DF	Den DF	Pr > F
13.04	8.93	*0.6893*	0.6893	0.0040	1.77	32	16	0.1110
4.10	2.94	*0.2170*	0.9063	0.0563	1.22	21	14	0.3501
1.16	0.55	0.0615	0.9678	0.2874	0.87	12	12	0.5968
0.61		0.0322	1	0.6216	0.85	5	7	0.5546

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The main reason of relation of old age mortality level with the same indicators would be explained by the fact that old age as well as child mortality level was higher in the same regions (see Appendix 9). We consider the relation of old age male mortality only with the proportion of population with highest educational attainment and poverty incidence taking into account the fact that it is not established about relationship of fertility level with old age mortality. The old age male mortality did not indicate the big regional differentiation as it was observed for age groups

0-4 and 20-64. However, in the observed period Astana city had the lowest level of old age male mortality among other regions (822.8 per 1,000). This evidence would be explained by the fact that the city as the new capital attracted more population with highest educational attainment from other regions including Almaty city. The group of highly educated, wealthier people in old age (65+) moved to new capital as the heads of government and because of other reasons. It was well documented that wealthier old man would have lower death rate than less wealthy men (Menchik, 1993). Astana city with the highest proportion of highly educated people and the lowest proportion of poor population had the lowest level of male mortality in old age in the observed period.

Table 20c − Correlations between mortality indicators and their canonical variables, 1999-2000, females

	Mortality1	Mortality2	Mortality3	Mortality4
q5	*0.8649*	0.2976	-0.1664	-0.3685
q20	*0.8242*	-0.3826	0.4175	-0.0035
q65	*0.7120*	-0.4140	-0.4216	0.3793
q85	*0.8857*	0.2499	-0.2112	0.3293

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 20d − Correlations between explanatory indicators and their canonical variables, 1999-2000, females

	Explanatory1	Explanatory2	Explanatory3	Explanatory4
HIGHEDU	*-0.7809*	0.3650	0.1811	-0.1749
INDPROD	*0.5346*	0.0756	0.3496	-0.5613
GRP	-0.0559	0.1901	0.2809	-0.7259
UNEMP	0.3113	0.2585	-0.0728	0.3176
POVERTY	*0.5999*	0.3269	0.4055	0.1805
DIV	-0.3428	0.3280	-0.3869	-0.4242
TFR	*0.6039*	0.3102	0.5786	0.3737
RUSSIAN	*-0.5047*	-0.3818	-0.4697	-0.1119

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

For female mortality by age groups in 1999-2000 the canonical correlation of first canonical variables of mortality and explanatory indicators was 0.9637, and this value indicated the fairly strong association between indicators (see Table 20a). The table of PCA (Principal Component Analysis) type decomposition of the canonical variables showed that the first canonical variables accounted for most of the data variability (68.93 %) and the approximate F test shows the significant value (p = 0.1110). The second canonical variables accounted for 21.70% of the data variability with the value of significance 0.3501 (see Table 20b). The share of other two canonical variables was near zero. Thus, only the first two canonical variables had any potential meaning.

The table of relationships between the attributes and their respective canonical variable demonstrated that MORTALITY1 is highly correlated with all mortality indicators and that EXPLANATORY1 is related to poverty, the highest educational attainment, the volume of industrial production, total fertility rate, and the proportion of Russian population (see Tables 20c and 20d). The cross correlation tables of the original mortality variables and explanatory canonical variables indicated that mortality indicators in all age group are highly correlated with the explanatory canonical variable EXPLANATORY1. This variable was mainly related to poverty scale, total fertility rate, the highest educational attainment, the volume of industrial production, and the proportion of Russian population (see Tables 20e and 20f).

The higher female mortality in all age groups, the lower proportion of population with highest educational attainment, the higher volume of industrial production, the higher total fertility rate, the higher level of poverty, and the lower proportion of Russian population the regions can perform (note that INDPROD. TFR. and POVERTY are positively while HIGHEDU and RUSSIAN are negatively correlated with EXPLANATORY1).

Table 20e − Correlations between mortality indicators and the canonical variables of explanatory indicators, 1999-2000, females

	Explanatory1	**Explanatory2**	**Explanatory3**	**Explanatory4**
q5	*0.8335*	0.2668	-0.1221	-0.2267
q20	*0.7943*	-0.3431	0.3062	-0.0022
q65	*0.6862*	-0.3712	-0.3092	0.2333
q85	*0.8536*	0.2241	-0.1548	0.2026

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 20f − Correlations between explanatory indicators and the canonical variables of mortality indicators, 1999-2000, females

	Mortality1	**Mortality2**	**Mortality3**	**Mortality4**
HIGHEDU	*-0.7526*	0.3273	0.1328	-0.1076
INDPROD	*0.5152*	0.0678	0.2563	-0.3453
GRP	-0.0539	0.1704	0.2059	-0.4465
UNEMP	0.3000	0.2318	-0.0534	0.1954
POVERTY	*0.5782*	0.2931	0.2973	0.1110
DIV	-0.3304	0.2941	-0.2837	-0.2610
TFR	*0.5820*	0.2781	0.4243	0.2299
RUSSIAN	-0.4864	-0.3424	-0.3444	-0.0688

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The relation of female mortality in all observed age groups with abovementioned indicators would be explained by the fact that the level of female mortality in all age groups was lowest in Astana and Almaty cities among all regions and was highest mainly in Mangystau, Atyrau, Aktobe, Kyzylorda regions.

Astana and Almaty cities had the highest proportion of population with highest educational attainment among the regions. Along with the receiving the knowledge about healthy risks, promoting the healthy behaviour and working in secure conditions high educated women tend to be socially advanced, free from traditional values and change her behavioural pattern and attitude

(Williamson and Boehmer, 1997). Moreover, the poverty incidence was lowest in the cities in the observed period. The concentration of population with highest educational attainment, quality of healthcare, its access in the cities could have its effect on lowest female mortality level in all age groups.

Abovementioned Atyrau, Mangystau, Kyzylorda, Aktobe regions are oil extracting regions with the high volume of industrial production. However, they are considered to have the environmental degradation (see Chapter 7.3). As described in chapter 7.3 Kyzylorda region is ecologically polluted because of catastrophic Aral Sea in its territory and the poor health of children and women in the region was noticed not only by national researchers but also the foreign ones. Moreover, Atyrau, Mangystau, and Kyzylorda regions had above national incidence of poverty and above national level of fertility (see Chapters 7.2 and 7.3). Poor nutrition, lower access to healthcare related to poverty in conditions of environmental degradation would affect on female child mortality as well as the health of women as mother.

The observation of regional mortality differentiation by age groups indicated that male mortality in child and old ages was higher in the regions with lower proportion of Russian population, higher fertility level and poverty incidence while young and adult age male mortality was higher in the regions with higher proportion of Russian population and lower level of fertility. The evidence was explained by above national male mortality level in child and old ages in southern and western regions, and above national young and adult age male mortality in northern, central, and eastern regions. Moreover, the child and old age male mortality level was lowest in Astana and Almaty cities with the highest proportion of highly educated population. The relation of female mortality level in all observed age groups with the proportion of population with highest educational attainment, the fertility level, the poverty incidence, the proportion of Russian population and the volume of industrial production was explained by the highest level of female mortality in oil-extracting regions with the above national level of fertility and poverty incidence, the low proportion of Russian population (Atyrau, Mangystau, Kyzylorda) and the lowest female mortality level in Astana and Almaty cities with the highest proportion of highly-educated population.

13.2 Factors of regional mortality differentiation in the period 2007-2008

13.2.1 Overall mortality level

In the end of the period (2007-2008) the summary of stepwise selection model for male life expectancy at birth indicated that the variables HIGHEDU and DIV were significant at the level 0.1500 and stayed in the model (see Table 21). The first step of maximum R-Square improvement model entered the variable HIGHEDU, and the R^2 was 0.6187, C (p) was 15.21 (see Table 22a). The entered variable indicated its positive relation to male life expectancy at birth (b= 0.0167).

The second step entered the variable DIV, and the R^2 increased to 0.8750, C (p) decreased to 0.2061 (see Table 22b). The variable DIV was negatively related to male life expectancy at birth (b= − 2.0384).

The regression and the standardised regression coefficients for the variables HIGHEDU and DIV demonstrated that the highest educational attainment (b=0.0200. stb=0.9400) was related to male life expectancy at birth positively while crude divorce rate (b= − 2.0384, stb= − 0.5117) was negatively associated with male life expectancy at birth. The higher value of standardised regression coefficient for the variable HIGHEDU (stb=0.7806) compared to the variable DIV indicated the higher contribution of highest educational attainment to male life expectancy at birth (see Table 23).

Table 21 − Summary of stepwise selection model, 2007-2008, males

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Label	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	HIGHEDU		HIGHEDU	0.6187	0.6187	15.2123	22.72	0.0003
2	DIV		DIV	0.2383	0.857	0.2061	21.66	0.0005

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the end of the period (2007-2008) the geographical homogeneity of regional male life expectancy at birth differentiation somehow changed apart from the beginning. The western regions, mainly Atyrau and Mangystau with below national male life expectancy at birth in the beginning of the period indicated much higher male life expectancy at birth in the end of the period increasing it substantially (Atyrau – 2.6, Mangystau – 2.3). Therefore, in the end of the period northern, central, eastern regions and western regions Aktobe, West Kazakhstan indicated lower (below national) male life expectancy at birth while southern, western (Atyrau, Mangystau) regions and two municipal cities had higher (above national) male life expectancy at birth (national was 61.2).

Table 22a − Maximum R-Square Improvement: Step 1, 2007-2008, males

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	57.54	0.9226	12240	3888.95	<.0001
HIGHEDU	0.0167	0.0035	71.49	22.72	0.0003

Variable HIGHEDU entered: R-Square = 0.6187 and C (p) = 15.2123
The above model is the best 1-variable model found
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

One of possible reasons of such evidence is the rapid economic development of municipal cities and main oil-extracting Atyrau and Mangystau regions. Favourable environment (the labor force requirements, high level of living standard, and high size of wage) created in these regions led to the increase of population with highest educational attainment there. Astana and Almaty cities, Atyrau and Mangystau regions had the highest proportion of highly educated population among all regions in the end of the period as described in chapter 7.4. The concentration of population with high education in these regions and related favourable factors to the concentration could increase male life expectancy in the regions demonstrating Astana and Almaty cities as the regions with highest male life expectancy at birth among all regions in the end of the period (69.2 and 64.7 years respectively).

Crude divorce rate was negatively related to male life expectancy at birth in the end of the period as it was observed for the beginning. In the observed period apart from 1999-2000 the crude divorce rate was highly positively related with proportion of Russian population which indicated the higher divorce level in northern, central, and eastern regions compared to southern and western ones (see Appendices 6b and 14b). As mentioned in chapter 13.1.1 one of features of regional differentiation in divorce level is the cultural difference of regions. The highest proportion of titular nationality in southern and western part regions would have its effect on preservation of traditional and religious values. These values would have effect on demographic behaviour of population (Mortelmans et al., 2009) including the level of divorce.

Table 22b − Maximum R-Square Improvement: Step 2, 2007-2008, males

Variable	**Parameter Estimate**	**Standard Error**	**Type II SS**	**F Value**	**Pr > F**
Intercept	61.62	1.0548	4338.04	3412.32	<.0001
HIGHEDU	0.0200	0,0023	92.93	73.10	<.0001
DIV	-2.0384	0.4380	27.54	21.66	0.0005

Variable DIV entered: R-Square = 0.8750 and C (p) = 0.2061
The above model is the best 2-variable model found
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The variable HIGHEDU was significant at the level 0.1500 and stayed in the model in the result of stepwise selection for female life expectancy at birth in the observed period (see Table 24). The first step of maximum R-square improvement model entered the variable HIGHEDU, and the R^2 was 0.7975, C (p) was -2.8018 (see Table 25).

The values of regression and standardised regression coefficients for the variable HIGHEDU indicated that the highest educational attainment was positively (b=0.0117. stb=0.8930) related to (see Table 26) female life expectancy at birth in the end of the period.

Table 23 − Parameter and Standardised Estimates of factors, 2007-2008, males

Parameter Estimates						
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Standardized Estimate**
Intercept	1	61.62	1.0548	58.42	<.0001	0
HIGHEDU	1	0.0200	0.0023	8.55	<.0001	0.9310
DIV	1	-2.0384	0.4380	-4.65	0.0005	-0.5117

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the end of the period female life expectancy at birth was positively associated with the highest educational attainment. The role of highest educational attainment was significant for females as well as males in the end of the period. Female life expectancy increased more in Astana city (4.4 years), Aktobe (2.8 years), Atyrau (2.7 years), Mangystau (2.0) regions, and Almaty (1.8 years) city. As a result, Astana and Almaty cities indicated the highest female life expectancy at birth (77.1 and 75.0 years respectively) among all regions in the end of the period. The proportion of highly educated population as the indicator of economic development increased mainly in these economically attractive regions and was the highest in Astana and Almaty cities. More rapid socio-economic development of these regions would have its effect on the bigger decrease of female mortality level there compared to other regions.

Table 24 − Summary of stepwise selection model, 2007-2008, females

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Label	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	HIGHEDU		HIGHEDU	0.7975	0.7975	-2.8018	55.15	<.0001

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the observed period male as well as female life expectancy at birth was positively related to the proportion of highly educated population apart from the period 1999-2000. The evidence would be explained by the increasing role of Astana and Almaty cities in the end of the period compared to the period. Especially, Astana city had the highest life expectancy at birth for both sexes among all regions thanks to its enormous increase over time. The city as the new capital turned into concentration center of highly educated population in the observed period. Almaty city and western oil-extracting regions also attracted highly educated population more than the other ones. Therefore, the proportion of highly educated population was not only social indicator but also the economic indicator, clearly the indicator of economic development. The relation of male life expectancy at birth with divorce rate in both periods indicated the above national male mortality level in northern, central, and eastern regions and below national level in southern ones.

Table 25 − Maximum R-Square Improvement: Step 1, 2007-2008, females

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	69.48	0.4148	17848	28056.4	<.0001
HIGHEDU	0.0117	0.0016	35.0826	55.15	<.0001

Variable HIGHEDU entered: R-Square = 0.7975 and C (p) = -2.8018

The above model is the best 1-variable model found

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 26 − Parameter and Standardised Estimates of factors, 2007-2008, females

Parameter Estimates						
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**	**Standardized Estimate**
Intercept	1	69.48	0.4148	167.5	<.0001	0
HIGHEDU	1	0.0117	0.0016	7.43	<.0001	0.8930

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

13.2.1 Mortality level by age groups

For male mortality by age groups in 2007-2008 the canonical correlation between canonical variables MORTALITY1 and EXPLANATORY1 was 0.9906 while the canonical correlation between canonical variables MORTALITY2 and EXPLANATORY2 had the value 0.9403. At these values the relationship was very strong (see Table 27a). The table of PCA (Principal Component Analysis) type decomposition of the canonical variables indicated that the first canonical variables accounted for most of the data variability (83.82 %) and the approximate F test shows the significant value (p = 0.0044). The second canonical variables accounted for 12.26% of the data variability. The share of other two canonical variables was near zero. Thus, only the first two canonical variables had any potential meaning (see Table 27b).

Table 27a − Canonical correlation coefficients, 2007-2008, males

	Canonical Correlation	**Adjusted Canonical Correlation**	**Approximate Standard Error**	**Squared Canonical Correlation**
1	*0.9906*	0.9846	0.0049	0.9812
2	*0.9403*	0.9092	0.0299	0.8841
3	0.8040	0.7209	0.0913	0.6463
4	0.6172	0.5367	0.1599	0.3809

Table 27b − Decomposition of canonical variables, 2007-2008, males

Eigenvalue	**Difference**	**Proportion**	**Cumulative**	**Likelihood Ratio**	**Approx. F Value**	**Num DF**	**Den DF**	**Pr > F**
52.2	44.5409	*0.8382*	0.8382	0.0005	3.5500	32	16	0.0044
7.6	5.8030	*0.1226*	0.9608	0.0254	1.8400	21	15	0.1150
1.8	1.2124	0.0294	0.9901	0.2190	1.1400	12	12	0.4138
0.6		0.0099	1.0000	0.6191	0.8600	5	7	0.5498

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The table of relationships between the attributes and their respective canonical variable demonstrated that MORTALITY1 is highly correlated with ${}_{5}q_{0}$ and ${}_{20}q_{65}$ measurements and that EXPLANATORY1 is related to poverty, the highest educational attainment, and the volume of industrial production. MORTALITY2 is highly correlated with ${}_{15}q_{5}$ and ${}_{45}q_{20}$ while

EXPLANATORY2 is highly correlated with total fertility rate, and the proportion of Russian population (see Tables 27c and 27d).

Table 27c − Correlations between mortality indicators and their canonical variables, 2007-2008, males

	Mortality1	Mortality2	Mortality3	Mortality4
q5	*0.6668*	-0.2558	-0.5008	0.4890
q20	0.3437	*0.6923*	-0.4110	-0.4834
q65	0.2419	*0.9642*	0.0955	0.0513
q85	*0.8951*	0.4415	0.0126	0.0614

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 27d − Correlations between explanatory indicators and their canonical variables, 2007-2008, males

	Explanatory1	Explanatory2	Explanatory3	Explanatory4
HIGHEDU	*-0.6541*	-0.5938	0.2766	0.0000
INDPROD	*0.5669*	-0.2054	-0.1664	-0.3417
DIV	-0.3586	0.4591	0.7085	-0.0657
GRP	0.0133	-0.4211	0.0669	-0.3409
TFR	0.5335	*-0.7531*	-0.2931	0.1541
UNEMP	0.2454	-0.4778	0.2501	-0.0764
POVERTY	*0.7925*	-0.3688	-0.007	-0.1382
RUSSIAN	-0.4346	*0.7143*	0.364	0.1644

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The cross correlation tables of the original mortality variables and explanatory canonical variables indicated that ${}_5q_0$ and ${}_{20}q_{65}$ are highly correlated with the explanatory canonical variable EXPLANATORY1. This variable was mainly related to poverty, the highest educational attainment, and the volume of industrial production. ${}_{15}q_5$ and ${}_{45}q_{20}$ are highly correlated with the explanatory canonical variable EXPLANATORY2. This variable was mainly related to total fertility rate, and the proportion of Russian population (see Tables 27e and 27f).

The higher child and old age male mortality (${}_5q_0$ and ${}_{20}q_{65}$) the lower proportion of population with highest educational attainment, the higher volume of industrial production, and the higher scale of poverty the regions can perform (note that INDPROD and POVERTY are positively while HIGHEDU is negatively correlated with EXPLANATORY1). The higher young and adult age male mortality (${}_{15}q_5$ and ${}_{45}q_{20}$), the higher proportion of Russian population, the lower total fertility rate the regions can perform (note that TFR is negatively while RUSSIAN was positively correlated with EXPLANATORY2).

In the period 2007-2008 the child and old age male mortality had the same possible factors with the period 1999-2000. However, the volume of industrial production was the possible factor in the end of the period apart from the beginning. This evidence would be explained by highest male mortality level in oil-extracting Mangystau and Kyzylorda regions for both age groups. The positive relation of the volume of industrial production with child and old age male mortality would be the possible environmental effect of industrial production on health of population. The high exposure to pollution in infant and child ages is likely to result in deaths by acute respiratory infections and maternal exposure to air pollution during pregnancy (Dejmek et al., 1999). It is also well established that the elderly (>65 years) are at higher risk of acute mortality effects of air pollution compared to younger age groups (Fischer et al., 2003).

Table 27e − Correlations between mortality indicators and the canonical variables of explanatory indicators, 2007-2008, males

	Explanatory1	**Explanatory2**	**Explanatory3**	**Explanatory4**
q5	*0.6605*	-0.2405	-0.4026	0.3018
q20	0.3405	*0.6510*	-0.3304	-0.2983
q65	0.2396	*0.9066*	0.0767	0.0317
q85	*0.8866*	0.4151	0.0102	0.0379

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 27f − Correlations between explanatory indicators and the canonical variables of mortality indicators, 2007-2008, males

	Mortality1	**Mortality2**	**Mortality3**	**Mortality4**
HIGHEDU	*-0.6479*	-0.5583	0.2224	0
INDPROD	*0.5616*	-0.1932	-0.1338	-0.2109
DIV	-0.3552	0.4317	0.5696	-0.0406
GRP	0.0131	-0.3960	0.0538	-0.2104
TFR	0.5284	*-0.7082*	-0.2356	0.0951
UNEMP	0.2431	-0.4493	0.2011	-0.0472
POVERTY	*0.7851*	-0.3468	-0.0056	-0.0853
RUSSIAN	-0.4305	*0.6716*	0.2927	0.1015

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

In the period 2007-2008 young and adult age male mortality had the same factors as it was observed for the beginning. This evidence indicated that male mortality level was above national in northern, central, and eastern regions with higher proportion of Russian population. It is worth to note that some regions of these parts even slightly decreased the level.

Table 28a − Canonical correlation coefficients, 2007-2008, females

	Canonical Correlation	**Adjusted Canonical Correlation**	**Approximate Standard Error**	**Squared Canonical Correlation**
1	*0.9662*	0.9410	0.0171	0.9336
2	*0.9292*	0.8982	0.0353	0.8634
3	0.7600	0.6317	0.1091	0.5776
4	0.6488	0.6209	0.1495	0.4210

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 28b − Decomposition of canonical variables, 2007-2008, females

Eigenvalue	**Difference**	**Proportion**	**Cumulative**	**Likelihood Ratio**	**Approx. F Value**	**Num DF**	**Den DF**	**Pr > F**
14.06	7.75	*0.6257*	0.6257	0.0022	2.17	32	16	0.0499
6.32	4.95	*0.2811*	0.9068	0.0334	1.61	21	15	0.1751
1.37	0.64	0.0608	0.9677	0.2446	1.02	12	12	0.4852
0.73		0.0323	1.0000	0.5790	1.02	5	7	0.4731

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

For female mortality by age groups in 2007-2008 the canonical correlation of first canonical variable of mortality and explanatory indicators was 0.9662 while the second canonical variable had the value 0.9292, and these values indicated the fairly strong association between indicators (see Table 28a). The table of PCA (Principal Component Analysis) type decomposition of the canonical variables showed that the first canonical variables accounted for 62.57% of data variability and the approximate F test shows the significant value (p = 0.0499). The second canonical variables accounted for 28.11% of the data variability with the value p= 0.1751. The share of other two canonical variables was near zero. Thus, only the first two canonical variables had any potential meaning (see Table 28b).

Table 28c − Correlations between mortality indicators and their canonical variables, 2007-2008, females

	Mortality1	**Mortality2**	**Mortality3**	**Mortality4**
q5	*0.4931*	0.3060	-0.2170	0.7849
q20	*0.6004*	0.2742	-0.5733	-0.4854
q65	-0.2155	*0.9130*	-0.2971	-0.1780
q85	0.5746	*0.8128*	-0.0411	0.0859

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 28d −Correlations between explanatory indicators and their canonical variables, 2007-2008, females

	Explanatory1	**Explanatory2**	**Explanatory3**	**Explanatory4**
HIGHEDU	-0.2779	*-0.8702*	0.3637	0.0781
INDPROD	*0.6255*	0.0002	0.2649	-0.2929
DIV	*-0.7515*	0.0777	0.5346	-0.2441
GRP	0.2345	*-0.5074*	0.5040	-0.2526
TFR	*0.8531*	-0.1980	-0.0413	0.4453
UNEMP	0.4048	-0.1661	0.5547	-0.0418
POVERTY	*0.6741*	0.3815	0.3468	0.1568
RUSSIAN	*-0.9264*	0.3102	0.1440	-0.0873

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Table 28e − Correlations between mortality indicators and the canonical variables of explanatory indicators, 2007-2008, females

	Explanatory1	Explanatory2	Explanatory3	Explanatory4
q5	*0.4765*	0.2843	-0.1649	0.5093
q20	*0.5801*	0.2548	-0.4357	-0.315
q65	-0.2082	*0.8484*	-0.2258	-0.1155
q85	0.5552	*0.7553*	-0.0312	0.0557

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The table of relationships between the attributes and their respective canonical variable demonstrated that MORTALITY1 is highly correlated with mortality indicators $_5q_0$, $_{15}q_5$, and EXPLANATORY1 is related to the volume of industrial production, divorce rate, total fertility rate, poverty, and the proportion of Russian population. MORTALITY2 is highly correlated with $_{45}q_{20}$ and $_{20}q_{65}$ while EXPLANATORY2 is related to the highest educational attainment and Gross regional product (see Tables 28c and 28d).

The cross correlation tables of the original mortality variables and explanatory canonical variables indicated that mortality indicators $_5q_0$, $_{15}q_5$ are highly correlated with the explanatory canonical variable EXPLANATORY1. This variable was mainly related to poverty, total fertility rate, divorce rate, the proportion of Russian population, and the volume of industrial production. Mortality indicators $_{20}q_{45}$ and $_{20}q_{65}$ were highly correlated with the explanatory canonical variable EXPLANATORY2. This variable was mainly related to the highest educational attainment and the gross regional product (see Tables 28e and 28f).

Table 28f − Correlations between explanatory indicators and the canonical variables of mortality indicators, 2007-2008, females

	Mortality1	Mortality2	Mortality3	Mortality4
HIGHEDU	-0.2685	*-0.8086*	0.2765	0.0507
INDPROD	*0.6044*	0.0002	0.2013	-0.1901
DIV	*-0.7261*	0.0722	0.4063	-0.1584
GRP	0.2265	*-0.4715*	0.3830	-0.1639
TFR	*0.8243*	-0.1840	-0.0314	0.2889
UNEMP	0.3911	-0.1543	0.4216	-0.0271
POVERTY	0.6514	0.3545	0.2636	0.1017
RUSSIAN	*-0.8951*	0.2882	0.1094	-0.0566

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

The higher female mortality in age groups 0-4. 5-19, the higher volume of industrial production, the higher total fertility rate, the lower divorce rate, the lower proportion of Russian population and the higher level of poverty the regions can perform (note that INDPROD, TFR, and POVERTY are positively while RUSSIAN and DIV are negatively correlated with EXPLANATORY1). The higher female mortality in age groups 20-64 and 65-84, the lower proportion of population with highest educational attainment and the lower gross regional product the regions can perform (note that HIGHEDU and GRP are negatively correlated with EXPLANATORY2).

The evidence indicated that child and young age female mortality was higher mainly in the regions with the lowest proportion of Russian population, accordingly with higher fertility, lower divorce rate, and with higher proportion of poor population and higher volume of industrial production. This relation identified the highest child female mortality level in South Kazakhstan and Kyzylorda regions with the highest incidence of poverty, highest level of fertility, and the high volume of industrial production in Kyzylorda region. Despite the fact that female mortality level in age group 5-19 was very low in the country (7.6 per 1,000) and the regional differentiation was not as high as in other age groups (between 4.0 per 1,000 in Almaty city and 9.0 per 1,000 in Atyrau region). The oil-extracting region Atyrau had the highest level of female mortality in the observed age group.

In the end of the period female mortality in age group 20-64 and 65-84 had the negative association with highest educational attainment and gross regional product. The evidence would be explained by the fact that in these age groups female mortality was lowest in Astana and Almaty cities. The cities apart from other regions have several advantages. Firstly, the cities had the highest proportion of population with highest educational attainment. Secondly, the cities had the highest gross regional product and the lowest proportion of poor population which are very important for women's health status. Thirdly, the cities had the highest number of physicians and higher access to healthcare compared to other regions which included rural areas where access to healthcare is in lower level (Thompson, 2003).

In the observed period male mortality level in age groups 0-4 and 65-84 was related to the same explanatory variables as it was observed in the period 1999-2000 except the volume of industrial production which identified the highest level of mortality in oil extracting Kyzylorda and Mangystau regions. Male mortality level in age groups 5-19 and 20-64 was related to the same indicators compared to 1999-2000 except the proportion of highly educated population which determined the lowest male mortality in these age groups in Astana and Almaty cities apart from 1999-2000. Female mortality level in age groups 0-4, 5-19 and 20-64, 65-84 were related to different variables apart from the period 1999-2000. In age groups 0-4 and 5-19 female mortality level was highest in South Kazakhstan, Kyzylorda, and Atyrau regions which had the lowest proportion of Russian population, above national incidence of poverty, and the high volume of industrial production. In age groups 20-64 and 65-84 the lowest level of female mortality in Astana and Almaty cities indicated the level to have the positive relation with proportion of highly educated population and gross regional product.

13.3 Main findings

1. *In what way the selected socio-economic and demographic indicators were related to regional mortality differentiation in the periods 1999-2000 and 2007-2008?*

2. In the period 1999-2000 regional differentiation of overall mortality level for both sexes was positively related to gross regional product as and indicator of living standard, and negatively related to the volume of industrial production as an indicator of possible environmental degradation and the occupation of population in unhealthy working conditions in industrial and oil-extracting regions, and the crude divorce rate.

   In the observed period regional male mortality differentiation in age groups 0-4 and 65-84 was positively related to total fertility rate, poverty incidence, and negatively related to proportion of population with highest educational attainment. Regional male mortality differentiation in age groups 5-19 and 20-64 was positively related to proportion of Russian population. Regional female mortality differentiation in all observed age groups was positively related to total fertility rate, poverty incidence, the volume of oil production, and negatively related to proportion of Russian population and proportion of population with highest educational attainment.

   In the period 2007-2008 regional differentiation of overall mortality level for both sexes was positively related to proportion of highly educated population. Overall male mortality differentiation was also negatively related to divorce level.

   Regional male mortality differentiation in age groups 0-4 and 65-84 was positively related to the volume of industrial production and poverty incidence, and negatively related to proportion of highly educated population.

   In age groups 5-19 and 20-64 the differentiation was positively related to proportion of Russian population, and negatively related to fertility level. Regional female mortality differentiation in age groups 0-4 and 5-19 was positively related to the volume of industrial production, fertility level, and poverty incidence, and negatively related to proportion of Russian population and divorce level. In age groups 20-64 and 65-84 the differentiation was negatively related to proportion of highly educated population and the gross regional product.

Chapter 14

Conclusion

14.1 Limitation of thesis

The thesis examined the regional mortality differentiation in the period 1999-2008 accentuating on the periods 1999-2000 and 2007-2008 and the changes between two periods. The thesis also has attempted to assess the importance of selected socio-economic and demographic factors in regional mortality differences in the beginning as well as the end of the observed period. The work was not without limitation. The limitation concerned mainly the unavailability of some variables which would perform the possible factors of regional mortality differentiation. We used the volume of industrial production as an indicator of economic prosperity explaining its positive relation with mortality as the possible effect of environmental degradation and the employment of higher proportion of population in unhealthy and working conditions in industrial and oil-extracting regions. However, it is not the best indicator which would perform the ecological situation of the regions. It was used by the author because available the emission of gas and hard air pollutants could not determine the pollution level of industrial regions when it was calculated per sq km. Astana and Almaty cities as the areas with lowest size of territory had the highest size of emissions compared to other regions despite their nonindustrial character. It is well documented that industrial Karagandy, Pavlodar, East Kazakhstan, and oil extracting Atyrau and Mangystau regions had the unfavourable ecological situation.

The second limitation was the unavailability of important lifestyle indicators as alcohol consumption and smoking in regional level if one takes into account that these indicators are responsible for 70-80% of death causes.

The third limitation was that the country has the ecological catastrophic zones such as the area of Aral Sea, Semipalatinsk nuclear polygon, Caspian Sea, Balkhash Lake. But we could not show their ecological situation with the appropriate indicators for analyses. We have to underline that the mortality at least for one of both sexes in adjacent regions of these ecological zones was high (Kyzylorda, East Kazakhstan, Karagandy, Mangystau regions).

14.2 Summary of results

The thesis reveals that regions of Kazakhstan are not homogeneous. The socio-economic, ecological, ethnical differences of regions explained the regional mortality inequalities.

1. *Regional mortality variation increased for both sexes with the bigger increase for males in the period 1999-2008.*

   The hypothesis is confirmed. Regional variation of overall mortality level increased for both sexes in the period 2007-2008 compared to 1999-2000. However, the increase was bigger for males in comparison with females. This extension was influenced by regional mortality variation increase in age groups 20-64 and 65-84 for both sexes. In age groups 0-4 and 5-19 the variation decreased between two periods.

2. *Mortality level improved for both sexes in all regions with the bigger improvement in the regions with the most favourable socio-economic conditions.*

   The hypothesis is confirmed for females. Because overall mortality level for males decreased slightly in northern regions North Kazakhstan, Kostanai, central regions Akmola, Karagandy, and southern region Almaty. Among all regions Astana and Almaty cities were considered to be the municipal cities with the most favourable socio-economic conditions. The biggest decrease of mortality level for both sexes was observed in these cities. In the observed period oil extracting western regions Atyrau, Mangystau, Aktobe, West Kazakhstan also improved mortality level for both sexes more than other part regions which would be related to growth of socio-economic importance of oil extracting regions.

3. *A. Mortality improvement in productive age groups (20-64) for both sexes contributed the most to the change in life expectancy at birth in the regions with the most favourable socio-economic conditions.*

   The hypothesis is confirmed for males. Male mortality improvement in age groups 15-59 in Almaty city, 45-59 in Astana city assessed the biggest contribution to male life expectancy at birth increase in the regions. In these regions female mortality improvement contributed the most in age groups 60-74 and 75+. In oil extracting western regions male mortality improvement in age group 45-59 and female mortality improvement in age groups 60-74 and 75+ contributed the most to life expectancy at birth increase.

   B. Mortality increase in productive age groups (20-64) for both sexes contributed the most to the change in life expectancy at birth in other regions. The hypothesis is confirmed. Mortality increase in age group 30-44 contributed the most to life expectancy at birth changes for both sexes in all northern, central, eastern regions, and southern regions Almaty and Zhambyl. Kyzylorda region observed the biggest contribution for males apart from females. However, among the regions with comparatively rapid socio-economic development the increase of male mortality in Aktobe, and female mortality in West Kazakhstan regions in the observed age group contributed negatively to life expectancy at birth increase.

4. *A. Mortality improvement from circulatory system diseases contributed the most to the change in life expectancy at birth in the regions with the most favourable socio-economic conditions.*
   The hypothesis is confirmed for females. In municipal cities female mortality improvement from circulatory system diseases mostly in age groups 60-74 and 75+ assessed the biggest contribution to female life expectancy at birth increase. For males mortality improvement from external causes assessed the bigger contribution than circulatory system diseases. Among oil-extracting western regions circulatory system diseases contributed the most to male life expectancy at birth increase in West Kazakhstan while external cause contributed the most in Aktobe and Mangystau regions. In oil extracting western regions female mortality improvement from circulatory system diseases contributed the most to female life expectancy at birth increase mostly in age groups 45-75+.
   B. Mortality increase from circulatory system diseases contributed the most to life expectancy at birth changes in other regions. The hypothesis is confirmed for males. Male mortality increase from circulatory system diseases contributed the most to male life expectancy at birth changes in northern regions, central Karagandy, eastern East Kazakhstan, and southern Almaty regions. Female mortality improvement from circulatory system diseases contributed the most in North Kazakhstan, Akmola, and Almaty regions.
5. *Between the periods 1999-2000 and 2007-2008 inequality in age at death decreased in the regions where expectation of life increased while it increased in the regions where expectation of life decreased*.
   The hypothesis is not confirmed. Because in one regions the increase of expectation of life coincided with the decrease of inequality in age at death while in other regions the increase of expectation of life coincided with the increase of inequality in age at death. The last evidence was explained by researchers as an “expansion” of death to advanced ages and also to difficulties in further reduction of mortality at young and middle adult ages (Shkolnikov et al., 2003).
6. *A. Fertility level is positively associated with infant and child mortality*.
   The hypothesis is confirmed. In the periods 1999-2000 and 2007-2008 regional mortality differentiation in age group 0-4 for both sexes was positively related to fertility level. The evidence demonstrated the higher level of infant and child mortality in regions with higher fertility level in both periods. They were South Kazakhstan, Kyzylorda, Zhambyl, Atyrau, Mangystau regions. Moreover, South Kazakhstan region increased the level between two periods apart from other ones. This positive relation is explained by the effect of variables as birth order, mother’s age, or the length of previous birth interval linked to fertility levels to higher risk of dying of infants and children (Taucher, 1989). The positive relation was found mainly in developing countries with higher level of fertility. Our results of analysis supported these findings (Zakir and Wunnava, 1999, Rutstein, 2005, Uddin and Hossain, 2008, Cabrera, 1980, Kembo and Ginneken, 2009).

B. Divorce level is positively associated with mortality.

The hypothesis is confirmed for overall mortality level but not confirmed for female regional mortality differentiation in age groups 0-4 and 5-19 in the period 2007-2008. In this period the divorce level was highly positively correlated with the proportion of Russian population. The regions with higher proportion of Russian population and divorce level observed the lower level of mortality in the observed age groups. Regional mortality differentiation for both sexes was positively related to divorce level in the period 1999-2000. In 2007-2008 the indicator was significant for males. Regional differentiation in divorce level within country would be determined by the level of urbanisation as well as cultural differences (Valkonen et al., 2008, Mortelmans et al., 2009). In Kazakhstan both features were determined. In both periods the higher level of regional male mortality differentiation in northern, central, and eastern regions and lower level in southern part regions was partly explained by regional differences in divorce level. The results of our analysis supported the findings in other countries (Spijker, 2009, Chuang and Huang, 2007, Spijker, 2004).

C. Highest educational attainment is negatively associated with mortality. The hypothesis is confirmed. In the period 1999-2000 regional male mortality differentiation in age groups 0-4 and 65-84 and female mortality differentiation in all age groups were negatively related to the proportion of highly educated population. In the period 2007-2008 overall mortality level for males and females, male mortality level in age groups 0-4 and 65-84, female mortality level in age groups 20-64 and 65-84 were negatively related to highest educational attainment of population. This negative relation mainly concerns the lowest level of mortality in Astana and Almaty cities. In Kazakhstan the proportion of highly educated population was not only social but also the economic indicator. Their highest concentration in municipal cities determines the favourable environment in the cities. In the period 2007-2008 their proportion increased in oil extracting Atyrau and Mangystau regions determining their rapid socio-economic development. Our results supported the evidences observed in Lithuania, Slovakia and Czech Republic (Kalediene and Petrauskiene, 2000, Rosicova et al., 2009, Spijker, 2009).

D. The proportion of Russian population is positively associated with male mortality in productive age groups. The hypothesis is confirmed. Regional male mortality differentiation in age groups 5-19 and 20-64 was positively associated with the proportion of Russian population in the period 1999-2000 as well as 2007-2008. The positive relation was explained by above national level of male mortality in northern, central, and eastern regions with higher proportion of Russian population in both periods. Our result supported the finding observed in the country in earlier period (1995-2001) (Becker and Urzhumova, 2005). Apart from C.Becker and D.Urzhumova we can not determine this evidence only as “The Slavic male mortality disadvantage in prime adult age” because we have no available data for ethnical differences of mortality level in each region. Therefore, it would be concluded that northern, central, and eastern part regions with higher proportion of Russian population indicated the “Russian pattern of mortality” (Mukhtarova, 2010).

E. The poverty incidence was positively associated with mortality.
The hypothesis is not confirmed for overall male mortality level in the period 1999-2000 which was explained by below national level of male mortality in southern regions with high scale of poverty. Regional male mortality differentiation in age groups 0-4 and 65-84 in both periods, regional female mortality differentiation in all age groups in the period 1999-2000, in age groups 0-4 and 5-19 in the period 2007-2008 were positively associated with poverty scale. It is mostly documented that poverty is one of contributors of high infant mortality (Gortmaker, 1979, Beenstock and Sturdy, 1990). The result of analysis also confirmed these findings indicating the positive relation with mortality level in age groups 0-4 for both sexes in both periods. The relation of indicator with the other age groups would be explained in combination with other factors.
F. The gross regional product is negatively associated with mortality. The hypothesis is confirmed. Regional differentiation of overall mortality level for both sexes in the period 1999-2000, female mortality level in age groups 20-64 and 65-84 in the period 2007-2008 was negatively associated with gross regional product. The gross regional product as a measurement of average income per capita indicated the level of living standard of regions. Our result confirmed the evidence observed in Greece (Papastergiou et al., 2008).
G. Unemployment rate is positively associated with mortality. The indicator was not significant in the result of our analysis. One of main reasons of this evidence would be the low regional variation of unemployment rate in the period 2007-2008.
H. The volume of industrial production is positively associated with mortality. The hypothesis is confirmed. Regional differentiation of overall mortality level for both sexes, female mortality level in all age groups in the period 1999-2000, male mortality level in age groups 0-4 and 65-84, female mortality level in age groups 0-4 and 5-19 were positively associated with the volume of industrial production. This variable was determined as the indicator of economic prosperity. However, its positive relation with mortality level would explain the environmental degradation in industrial and oil extracting regions. In the period 1999-2000 it was positively associated with overall mortality level for both sexes determining the higher mortality level in industrial and oil-extracting regions. However, in the period 2007-2008 it was significant only for child and old age groups. This evidence was explained by the improvement of overall mortality level in oil extracting regions in the period 2007-2008 compared to 1999-2000. Despite the decrease of mortality level in child age group the level was kept as higher in the regions in the end of the period. The result of our analysis supported the evidence observed in the country in the period 1995-2001 (Becker and Urzhumova, 2005).

One conclusion can be drawn from the results of analyses employed in the thesis is that regional mortality variation increased in the country during the examined decade with the further decrease of mortality level in municipal cities, comparatively bigger improvement in western oil extracting regions and the stagnation in the regions of other parts. In the beginning as well as the end of the observed period regional mortality differences were related to socio-economic and demographic inequalities across regions.

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APPENDICES

Appendix 1 – Crude death rate per 1,000, 1999-2008

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
Northern regions	**23.1**	**23.8**	**25.0**	**25.8**	**25.6**
North Kazakhstan	24.7	26.1	26.9	27.5	27.3
Kostanai region	23.3	23.3	25.2	25.9	26.1
Pavlodar region	21.2	21.9	23.0	24.0	23.3
Central regions	**23.7**	**24.7**	**26.1**	**26.4**	**25.8**
Akmola region	23.4	24.7	26.0	26.6	25.5
Karagandy region	23.9	24.6	26.1	26.2	26.0
Eastern region	**24.6**	**24.4**	**25.5**	**26.5**	**26.0**
East Kazakhstan	24.6	24.4	25.5	26.5	26.0
Western regions	**18.5**	**19.0**	**18.5**	**18.1**	**17.5**
West Kazakhstan	21.1	22.0	21.7	21.1	21.1
Aktobe region	19.5	20.3	19.8	19.3	18.3
Atyrau region	18.1	17.9	17.5	17.0	16.4
Mangystau region	15.1	16.0	15.0	15.0	14.1
Southern regions	**16.0**	**15.9**	**16.2**	**16.5**	**16.3**
South Kazakhstan	13.7	13.9	14.0	14.1	14.1
Kyzylorda region	14.9	15.0	14.6	15.3	14.9
Zhambyl region	17.4	17.2	17.6	17.5	17.3
Almaty region	17.9	17.7	18.7	19.2	18.8
Municipal cites	**18.4**	**17.3**	**17.5**	**17.0**	**14.9**
Almaty	21.3	21.0	22.0	20.6	18.3
Astana	15.5	13.6	13.0	13.3	11.4
Republic of Kazakhstan	19.9	20.0	20.6	20.7	20.0

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 2a – Infant male mortality rate per 1,000, 1999-2008

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
Northern regions	**25.1**	**21.5**	**16.7**	**15.7**	**19.3**
North Kazakhstan	20.6	17.2	15.5	14.4	20.5
Kostanai region	23.9	19.5	16.7	16.5	19.6
Pavlodar region	30.6	28.0	17.9	16.3	17.9
Central regions	**23.4**	**18.9**	**14.4**	**13.6**	**16.9**
Akmola region	23.7	17.3	14.1	14.9	17.0
Karagandy region	23.2	20.6	14.7	12.2	16.8
Eastern region	**22.8**	**23.8**	**18.9**	**19.0**	**20.5**
East Kazakhstan	22.8	23.8	18.9	19.0	20.5
Western regions	**24.3**	**23.0**	**18.5**	**16.6**	**20.1**
West Kazakhstan	20.0	17.7	17.1	15.3	17.3
Aktobe region	21.7	22.7	19.0	17.1	18.4
Atyrau region	22.8	22.8	16.5	13.3	21.3
Mangystau region	32.6	28.6	21.2	20.6	23.4
Southern regions	**22.8**	**21.6**	**17.8**	**18.2**	**20.9**
South Kazakhstan	22.6	20.8	17.3	17.2	25.4
Kyzylorda region	25.2	28.2	22.6	27.2	24.0
Zhambyl region	27.6	23.3	18.2	15.9	20.4
Almaty region	15.9	14.0	13.2	12.6	13.8
Municipal cites	**16.7**	**19.1**	**15.6**	**13.6**	**15.7**
Almaty	16.6	18.5	17.0	14.3	18.0
Astana	16.8	19.6	14.1	12.9	13.4
Republic of Kazakhstan	**22.5**	**20.9**	**17.0**	**16.2**	**19.9**

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 2b – Infant female mortality rate per 1,000, 1999-2008

	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008
Northern regions	**18.4**	**15.9**	**13.7**	**11.5**	**14.7**
North Kazakhstan	14.5	12.5	13.2	11.4	15.7
Kostanai region	19.2	15.9	13.9	11.6	14.5
Pavlodar region	21.5	19.2	13.9	11.6	14.0
Central regions	**17.2**	**14.1**	**11.1**	**9.7**	**13.6**
Akmola region	16.9	12.9	10.9	9.8	12.6
Karagandy region	17.4	15.3	11.4	9.7	14.6
Eastern region	**17.2**	**15.4**	**14.6**	**15.6**	**17.0**
East Kazakhstan	17.2	15.4	14.6	15.6	17.0
Western regions	**19.4**	**17.0**	**13.8**	**12.2**	**14.1**
West Kazakhstan	16.1	16.0	12.7	12.7	13.1
Aktobe region	19.2	16.7	15.3	11.7	14.5
Atyrau region	16.7	16.7	13.3	10.2	13.7
Mangystau region	25.6	18.7	14.1	14.2	15.1
Southern regions	**16.3**	**15.5**	**13.5**	**14.1**	**16.5**
South Kazakhstan	15.4	16.1	12.1	14.9	19.2
Kyzylorda region	19.3	21.0	18.3	18.9	20.1
Zhambyl region	17.7	16.3	12.9	13.3	16.6
Almaty region	13.0	8.5	10.7	9.1	10.2
Municipal cites	**13.7**	**13.3**	**10.5**	**11.2**	**12.6**
Almaty	11.9	13.1	10.5	11.4	14.6
Astana	15.6	13.5	10.6	11.1	10.6
Republic of Kazakhstan	**16.6**	**15.2**	**12.7**	**12.7**	**15.4**

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 3 – List of ICD-10 codes

Chapter	Blocks	Title
I	**A00-B99**	Certain infectious and parasitic diseases
II	**C00-D48**	Neoplasms
III	**D50-D89**	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
IV	**E00-E90**	Endocrine, nutritional and metabolic diseases
V	**F00-F99**	Mental and behavioural disorders
VI	**G00-G99**	Diseases of the nervous system
VII	**H00-H59**	Diseases of the eye and adnexa
VIII	**H60-H95**	Diseases of the ear and mastoid process
IX	**I00-I99**	Diseases of the circulatory system
X	**J00-J99**	Diseases of the respiratory system
XI	**K00-K93**	Diseases of the digestive system
XII	**L00-L99**	Diseases of the skin and subcutaneous tissue
XIII	**M00-M99**	Diseases of the musculoskeletal system and connective tissue
XIV	**N00-N99**	Diseases of the genitourinary system
XV	**O00-O99**	Pregnancy, childbirth and the puerperium
XVI	**P00-P96**	Certain conditions originating in the perinatal period
XVII	**Q00-Q99**	Congenital malformations, deformations and chromosomal abnormalities
XVIII	**R00-R99**	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
XX	**V01-Y98**	External causes of morbidity and mortality

Source: *WHO (2007)*

Appendix 4 – Forms of legal and medical death certificates for infant deaths

Запись акта о смерти

АХАЖ органының мөртаңбасы
Штамп орагана ЗАГС
Stamp of ZAGS

ҚАЙТЫС БОЛУ ТУРАЛЫ АКТ ЖАЗБАСЫ

ЗАПИСЬ АКТА О СМЕРТИ № _

LEGAL DEATH CERTIFICATE

Дата/Date

1.Тегі Фамилия/Surname	
2.Аты Имя/Name	3.Әкесінің аты Отчество/Middle name
4.Жынысы Пол/Sex	5.Ұлты Национальность/Nationality
6.Қайтыс болған күні Дата смерти/Date of death	
7. Қайтыс болған жері: Место смерти	Қаласы (ауылы) Город (селение)/Town (village) Ауданы/Район/District Облысы/Область/Region Республикасы/Республика/Republic
8.Қайтыс болган себебі Причина смерти/Cause of death	
9. Туған күні және жері: Место и дата рождения Date and place of birth	Қаласы (ауылы)/ Город селение Town (village) Ауданы/Район/District Облысы/Область/Region Республикасы/Республика/Republic Толык жасы/Исполнилось лет/Complete age Бір жаска толмаган балаларга 0 толган 12 кунін керсету Для детей моложе одного года 0 месяцев и 12 дней указать To show the month and days for children younger

	than 1 year сонымен бірге анасының нешінші баласы 1 также какой ребенок по счету у матери және анасының толық жасы/и возраст матери, лет Order of birth and the age of mother
10.Тұрақты мекені	Қаласы (ауылы) Город (селение)/Town (village) Ауданы/Район/District Облысы/Область/Region Республикасы/Республика/Republic Көшесі/улица/street Үйі/дом/house Пәтері/квартира/flat ____жылдан туракты турады/Постоянно проживал с/ Permit residence from____
11.Отбасы жағдайы: Семейное положение: Marital status:	
12. Кім болып қайда істейді (егер жұмыс істемейтін болса, қалай күн көргенін көрсету керек) Где и кем работает (если не работает, то указать источникd средств существования, а для пенсионеров – также прежнее место работы) Place and	
13. Білімі Образование Education	
14. Қайтыс болганын дәлелдейтін құжат Документы, подтверждающие факт смерти Confirmation documents of death fact	
15. Өтініш берушінің тегі, аты, әкесінің аты, мекен-жайы және қолы Фамилия, имя, отчество, адрес заявителя и его подпись Surname, name, middle name, address of applicant and his signature	
16.Куәлік берілді Выдано свидетельство Certificate	
17. Белгілер үшін Для отметок For notices	
Бір жаска толмаған баланың қайтыс болуы туралы актідегі 5,10,12,13 ,бағаналар анасына қатысты мәліметтер дәрігерлік куәліктін негізінде толтырылады В акте о смерти ребенка моложе 1 года, графы 5,10,12,13 заполняются в отношении матери на основании врачебного свидетельства (фельдшерской справки) о смерти In certificate of infant death columns 5, 10, 12, 13 are filled by mother in the basis of medical certificate	

М.О. АХАЖ бөлімінін бастығы Іс жургізуші

М.П.   Начальник отдела ЗАГС   Делопроизводитель

               Chief of ZAGS   Chief clerk

Қайтыс болғаны туралы дәрігерлік куәлік

Medical death certificate

(АХАЖ органдарында тіркеу үшін беріледі)   СЕРИЯ ________№______

(The document is given to register in ZAGS)   SERIE__________№______

1.Тегі, аты, әкесінің аты/Surname, name, middle name_______________________________

2. Жынысы ер-1, әйел-2/Sex male – 1, female -2

3. Туған уақыты, күні ___________айы______________жылы_________

Date of birth, day_____________month____________year___________

4. Қайтыс болған уақыты, күні ___ айы______________жылы_________

Date of death, day___month_________year_________

5. 7 күннен -1 айға дейінгі жаста қайтыс болған балалар үшін; айы-күні жеткен -1, айы-куні жетпеген-2

For infants dead from 7 days to 1 month; premature birth – 2

6. 7 күннен-1айға дейінгі жаста қайтыс болған балалар үшін; туған кездегі салмагы__грамм өмір сурген айы___және күні____2, анасының баласы-3, анасының жасы-4

For infants dead from 7 days to 1 month; birth weight___gramm, lived month____and day___2, order of birth -3, age of mother-4

7. Тұрақты-мекен жайы/permit residence:_________________________

Облысы/респ.маңызы бар қала/Region/municipal city_________________

Ауданы/обл.маңызы бар қала/District/regional city_________________

Елді-мекені/village_________

Көшесі/Street___________,үйі/house ______,пәтері/flat______

8. Кайтыс болган жері/Place of death:

Облысы/респ.маңызы бар қала/Region/municipal city _____________

Ауданы/обл.маңызы бар қала/District/regional city ______________

Елді-мекені/village _________

Көшесі/Street___________,үйі/house ______,пәтері/flat______

9. Қайтыс болды стационарда-1, үйде-2, баска жерде-3

Dead in hospital-1, home-2, in other place-3

10.Ұлты/Nationality_________

11. Отбасы жағдайы: некеге тұрған-1, некеге тұрмаған -2, жесір -3, ажыраскан -4, белгісіз-5.

Marital status: married-1, single-2, widow-3, divorced-4, unknown-5

12. Білімі: жоғары-1, аяқталмаған жоғары-2, арнаулы орта-3, жалпы орта-4, аякталмаған орта -5,бастауыш-6, белгісіз-7.

Education: high-1, incomplete high-2, vocational-3, secondary-4, incomplete secondary-5, elementary-6, unknown-7.

13. Жұмыс орны және лауазымы/Place of work and position_________________________

14. Кайтыс болу себебі: ауру-1, ондірістегі тыс бақытсыз жағдай-2, ондірістен тыс бақытсыз жағдай-3, өлтірілген-4, өзін-озі өлтірген-5, аныкталмады-6.

Cause of death: disease-1, industrial accident-2, nonindustrial accident-3, homicide-4, suicide-5, unknown-6.

15. Бақытсыз жағдайда қайтыс болғанда улану немесе жарақаттану

Poisoning or injuring in accidental death

1) уақыты: күні_________айы________жылы__________

Date: day_____month________year________

2) өндірістен тыс бақытсыз жағдайдағы жарақат түрі: тұрмыстық-1, жол-көліктен басқа, көшеде болган-2, жол-көлік -3, мектепте болган-4, спорттық-5, басқа да-6.

In nonindustrial accident: domestic-1, nontraffic-2, traffic-3, in school-4, sport-5, other-6

3) жарақаттанған немесе уланған кездегі уақыт және жағдай _____________

Date and conditions of poisoning and injuring_______________

16. Қайтыс болу себебін анықтаған: тек өлімді аныктаған дәрігер-1,емдеуші дәрігер-2, фельдшер-3, патологанатом- 4, сот медициналык сарапшы -5.

Who defined the cause of death: physician who defined death-1, doctor in charge of case-2, doctor's assistant-3, pathologist-4, forensic medical examiner-5.

17. Мен/I am____

(тегі, аты, әкесінің аты)

(surname, name, middle name)

(лауазымы)

(position)

Мәйітті тексеру-1, медициналық құжаттама жазбасы -2, бұрынғы тексеру-3, ашу-4, негізінде өлімге әкеп соктырған паталогиялык процестің (жағдайдың) салдарын аныктап, мынадай себебін белгіледім.

In the basis of examination of body-1, medical document-2, history of diseases-3, autopsy-4 defined the cause of death

18. Қайтыс болу себебі/Cause of death

1.Аурудын,басталуы,аяқталуы/the beginning and the end of disease

А)____

(тікелей өлімге әкелген ауру немесе жағдай)

(the direct condition or disease led to death)

Б)____

(тікелей себептердің туындауына әкеліп соқтырған паталогиялық жагдай)

(the pathologic condition led to cause of death)

В) ____

(өлімнің негізгі себебі соңынан корсетіледі)

(the main cause of death is shown in the end)

Г) ____

(жарақаттану және улану негізіндегі сыртқы себептер)

(external causes in the basis of poisoning and injuring)

2. Өлімге себепші болатын, бірак аурумен немесе паталогиялык жағдаймен байланысты емес оған әкелетін баска да маңызды жағдайлар.

The cause of death not related to diseases and pathologic conditions

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19. Ана өлімі болған жағдайда жүктілік аяқталганнан, босанғаннан (жүктілікке, салмақ салуға байланысты қандайда бір себептерден, бірак бақытсыз жағдай немесе аяқ астынан болған жағдайлар емес) кейінгі 42 күннің ішінде-1; жүктілік аякталғаннан, босанғаннан (тікелей акушерлік себептен немесе соган байланысты жанама себептен) кейінгі 43-365 күннің ішінде-2.

In case of maternal death (the causes of death related to pregnancy not to external accidents) within 42 days after childbirth-1; (obstetric or other indirect causes) within 43-365 days after childbirth-2

20. Куәлікті берген денсаулық сақтау ұйымының атауы, оның-мекен-жайы
The name of medical organisation who gave the certificate, its address

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21. Куәлік берген медицина қызметкерінің тегі, аты, әкесінің аты, лауазымы

The surname, name, middle name, position of medical employee who gave the certificate

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Денсаулық сақтау ұйымының немесе жеке медициналык практикамен айналысатын жеке тұлғаның мөрі.

Куәлік берген медицина кызметкерінін колы
____

The stamp of medical organisation

Signature of medical employee

қайтыс болған 1 жастағы бала үшін анасының қатысуымен толтырылады

For infant deaths application is filled with participation of mother

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Appendix 5 – The operationalisation of explanatory variables

Variables	Abbreviation	Operationalisation
Highest educational attainment	HIGHEDU	The proportion of population with high and incomplete high education, per 1,000 persons
Russian population	RUSSIAN	The proportion of Russian population, percentage
Unemployment rate	UNEMP	The unemployment rate, percentage
Poverty	POVERTY	The proportion of population with income below subsistence minimum, percentage
The number of doctors	DOC	The number of doctors, per 100,000 persons
Nominal wage	WAGE	The average monthly nominal wage, dollar per employee
Nominal income	INCOME	The average nominal income, dollar per capita
Gross regional product	GRP	Gross regional product, dollar per capita
Industrial production	INDPROD	The volume of industrial production, dollar per capita
Urban population	URBAN	The proportion of urban population, in percentage
Secondary sector	SEC	The proportion of employees employed in secondary sector, in percentage
Total Fertility Rate	TFR	Total fertility rate
Crude Divorce Rate	DIV	Crude Divorce rate, per 1,000 persons

Appendix 6a – Correlation matrix of explanatory variables, 1999-2000

Pearson Correlation Coefficients. N = 16
Prob > |r| under H0: Rho=0

	HIGHEDU	INDPROD	DIV	GRP	DOC	INCOME	UNEMP	TFR	POVERTY	WAGE	RUSSIAN	SEC	URBAN
HIGHEDU	1.0000	-0.0883	0.5716	0.4629	0.8912	0.4795	-0.1001	-0.3552	-0.3615	0.3060	0.2334	0.1882	0.7712
		0.7450	0.0207	0.0710	<.0001	0.0602	0.7122	0.1769	0.1689	0.2490	0.3842	0.4851	0.0005
INDPROD		1.0000	0.0548	0.7902	0.0018	0.7304	0.3522	0.3457	0.4191	0.8593	-0.3886	0.6355	0.2047
			0.8404	0.0003	0.9947	0.0013	0.1809	0.1897	0.1061	<.0001	0.1368	0.0082	0.4470
DIV			1.0000	0.4572	0.6644	0.5418	-0.2314	-0.6359	-0.5373	0.3881	0.6326	0.5632	0.7335
				0.0750	0.0050	0.0302	0.3886	0.0081	0.0319	0.1375	0.0085	0.0231	0.0012
GRP				1.0000	0.5519	0.9740	0.1240	-0.1068	-0.0388	0.9556	-0.0361	0.7179	0.6514
					0.0267	<.0001	0.6472	0.6938	0.8866	<.0001	0.8943	0.0017	0.0063
DOC					1.0000	0.6185	-0.2110	-0.4569	-0.5028	0.4523	0.2789	0.4553	0.8999
						0.0107	0.4328	0.0752	0.0471	0.0786	0.2955	0.0763	<.0001
INCOME						1.0000	0.0542	-0.1742	-0.0841	0.9632	0.0214	0.7734	0.7339
							0.8419	0.5189	0.7568	<.0001	0.9373	0.0004	0.0012
UNEMP							1.0000	0.4713	0.6000	0.1265	-0.4653	0.1688	0.0091
								0.0653	0.0140	0.6407	0.0693	0.5320	0.9734
TFR								1.0000	0.8874	0.0206	-0.8737	-0.2077	-0.3820
									<.0001	0.9395	<.0001	0.4401	0.1442
POVERTY									1.0000	0.0974	-0.8217	-0.0710	-0.3159
										0.7196	<.0001	0.7938	0.2333
WAGE										1.0000	-0.1781	0.7663	0.5962
											0.5093	0.0005	0.0148
RUSSIAN											1.0000	0.1022	0.2393
												0.7065	0.3720
SEC												1.0000	0.7221
													0.0016
URBAN													1.0000

Appendix 6b – Correlation matrix of explanatory variables, 2007-2008

Pearson Correlation Coefficients. N = 16
Prob > |r| under H0: Rho=0

	HIGHEDU	INDPROD	DIV	GRP	DOC	INCOME	UNEMP	TFR	POVERTY	WAGE	RUSSIAN	SEC	URBAN
HIGHEDU	1.0000	-0.0619	0.2998	0.5677	0.9108	0.7380	0.2764	-0.0223	-0.3199	0.6319	0.0244	0.3461	0.8608
		0.8200	0.2593	0.0218	<.0001	0.0011	0.3002	0.9346	0.2271	0.0086	0.9284	0.1891	<.0001
INDPROD		1.0000	-0.1749	0.7543	-0.0895	0.5798	0.2596	0.4387	0.4689	0.7167	-0.5021	0.7435	-0.0472
			0.5171	0.0007	0.7416	0.0186	0.3316	0.0891	0.0669	0.0018	0.0475	0.0010	0.8624
DIV			1.0000	0.1703	0.4583	0.2818	-0.0970	-0.7984	-0.4320	0.1208	0.8226	0.3016	0.6217
				0.5283	0.0742	0.2903	0.7209	0.0002	0.0948	0.6560	<.0001	0.2564	0.0101
GRP				1.0000	0.4984	0.9628	0.3373	0.1996	0.0977	0.9845	-0.2572	0.8038	0.5205
					0.0494	<.0001	0.2013	0.4585	0.7189	<.0001	0.3363	0.0002	0.0387
DOC					1.0000	0.6467	0.2074	-0.1281	-0.3681	0.5444	0.1228	0.3975	0.9278
						0.0068	0.4409	0.6364	0.1607	0.0292	0.6506	0.1273	<.0001
INCOME						1.0000	0.3359	0.1197	0.0035	0.9737	-0.1329	0.7589	0.6688
							0.2035	0.6588	0.9896	<.0001	0.6237	0.0007	0.0046
UNEMP							1.0000	0.3034	0.4103	0.3421	-0.3137	0.1450	0.1358
								0.2534	0.1145	0.1947	0.2367	0.5921	0.6161
TFR								1.0000	0.6325	0.2828	-0.9150	0.1766	-0.2675
									0.0086	0.2886	<.0001	0.5130	0.3166
POVERTY									1.0000	0.1418	-0.5135	0.1563	-0.4702
										0.6003	0.0419	0.5633	0.0661
WAGE										1.0000	-0.3137	0.7932	0.5400
											0.2367	0.0002	0.0308
RUSSIAN											1.0000	-0.1462	0.3016
												0.5889	0.2563
SEC												1.0000	0.5298
													0.0348
URBAN													1.0000

Appendix 7a – Proportion of death causes, in percentage, 1999, males

Age group	I	II	III	IV	V	VI	VII	VIII	IX	X
0	*8*	*0*	0	0	0	1	1	0	*2*	*27*
1 - 4	*13*	*4*	1	1	0	2	4	0	*2*	*30*
5 - 9	*5*	*10*	0	1	1	3	8	0	*4*	*11*
10 - 14	*4*	*8*	1	0	2	3	4	0	*4*	*5*
15 - 19	*6*	*5*	0	0	1	3	3	0	*6*	*3*
20 - 24	*11*	*3*	0	0	1	2	1	0	*7*	*3*
25 - 29	*15*	*3*	0	1	1	1	0	0	*10*	*3*
30 - 34	*13*	*4*	0	1	1	1	1	0	*14*	*3*
35 - 39	*12*	*5*	0	1	1	1	0	0	*21*	*3*
40 - 44	*11*	*8*	0	1	1	1	0	0	*29*	*5*
45 - 49	*9*	*12*	0	1	1	1	0	0	*35*	*5*
50 - 54	*6*	*16*	0	1	1	0	0	0	*40*	*6*
55 - 59	*4*	*20*	0	1	1	0	0	0	*45*	*7*
60 - 64	*3*	*21*	0	1	0	0	0	0	*50*	*8*
65 - 69	*2*	*20*	0	1	0	0	0	0	*54*	*10*
70 - 74	*1*	*18*	0	1	0	0	0	0	*59*	*10*
75 - 79	*1*	*14*	0	1	0	0	0	0	*66*	*10*
80 - 84	*0*	*9*	0	0	0	0	0	0	*71*	*9*
85+	*0*	*5*	0	0	0	0	0	0	*75*	*8*
Total	*5*	*13*	0	1	0	1	0	0	*42*	*8*

Appendix 7a – Proportion of death causes, in percentage, 1999, males (continue)

Age group	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XX
0	*1*	0	0	0	0	35	17	2	*5*
1 - 4	*1*	0	0	1	0	0	9	2	*30*
5 - 9	*2*	0	0	2	0	0	5	3	*45*
10 - 14	*2*	1	1	2	0	0	3	4	*59*
15 - 19	*1*	0	0	2	0	0	1	4	*64*
20 - 24	*2*	0	0	2	0	0	0	3	*65*
25 - 29	*3*	0	0	2	0	0	0	3	*57*
30 - 34	*4*	0	0	2	0	0	0	4	*52*
35 - 39	*4*	0	0	2	0	0	0	4	*45*
40 - 44	*5*	0	0	2	0	0	0	3	*34*
45 - 49	*6*	0	0	1	0	0	0	3	*26*
50 - 54	*5*	0	0	1	0	0	0	3	*20*
55 - 59	*5*	0	0	1	0	0	0	2	*12*
60 - 64	*5*	0	0	1	0	0	0	2	*8*
65 - 69	*4*	0	0	1	0	0	0	1	*6*
70 - 74	*4*	0	0	1	0	0	0	2	*4*
75 - 79	*3*	0	0	1	0	0	0	2	*2*
80 - 84	*2*	0	0	1	0	0	0	5	*2*
85+	*1*	0	0	1	0	0	0	8	*1*
Total	*4*	0	0	1	0	1	1	3	*19*

Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 7b – Proportion of death causes, in percentage, 1999, females

Age group	I	II	III	IV	V	VI	VII	VIII	IX	X
0	*9*	*0*	0	0	0	1	1	0	*2*	*28*
1 - 4	*15*	*3*	0	0	0	3	6	0	*2*	*31*
5 - 9	*8*	*13*	1	1	2	3	9	0	*4*	*10*
10 - 14	*3*	*14*	1	4	1	3	8	0	*7*	*10*
15 - 19	*7*	*8*	0	1	1	3	4	0	*7*	*5*
20 - 24	*12*	*6*	0	1	1	4	2	0	*11*	*6*
25 - 29	*16*	*9*	0	2	1	3	2	0	*12*	*4*
30 - 34	*14*	*12*	1	1	1	3	1	0	*17*	*6*
35 - 39	*9*	*18*	0	2	1	3	1	0	*22*	*5*
40 - 44	*7*	*23*	0	1	1	1	1	0	*27*	*4*
45 - 49	*4*	*25*	0	2	1	1	0	0	*35*	*4*
50 - 54	*2*	*26*	0	2	1	1	0	0	*43*	*4*
55 - 59	*3*	*23*	0	3	0	0	0	0	*49*	*4*
60 - 64	*1*	*21*	0	4	0	0	0	0	*54*	*5*
65 - 69	*1*	*18*	0	3	0	0	0	0	*62*	*5*
70 - 74	*1*	*16*	0	2	0	0	0	0	*68*	*5*
75 - 79	*0*	*11*	0	2	0	0	0	0	*74*	*6*
80 - 84	*0*	*6*	0	1	0	0	0	0	*77*	*5*
85+	*0*	*3*	0	0	0	0	0	0	*80*	*4*
Total	*2*	*13*	0	2	0	0	0	0	*59*	*6*

Appendix 7b – Proportion of death causes, in percentage, 1999, females (continue)

Age group	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XX
0	*1*	0	0	0	0	31	18	3	*5*
1 - 4	*1*	0	0	1	0	0	8	4	*26*
5 - 9	*3*	0	0	3	0	0	5	2	*36*
10 - 14	*2*	0	1	3	0	0	3	2	*37*
15 - 19	*3*	2	1	4	1	0	2	2	*48*
20 - 24	*3*	0	1	4	3	0	1	4	*40*
25 - 29	*4*	0	1	5	3	0	0	3	*34*
30 - 34	*4*	0	1	6	2	0	0	2	*30*
35 - 39	*5*	0	0	4	2	0	0	3	*24*
40 - 44	*6*	0	1	4	0	0	0	2	*20*
45 - 49	*6*	0	0	3	0	0	0	2	*15*
50 - 54	*5*	0	0	3	0	0	0	2	*11*
55 - 59	*5*	0	0	2	0	0	0	2	*8*
60 - 64	*6*	0	0	2	0	0	0	1	*6*
65 - 69	*4*	0	0	2	0	0	0	1	*4*
70 - 74	*3*	0	0	1	0	0	0	1	*2*
75 - 79	*3*	0	0	1	0	0	0	3	*2*
80 - 84	*1*	0	0	0	0	0	0	7	*1*
85+	*1*	0	0	0	0	0	0	10	*1*
Total	*3*	0	0	1	0	1	1	4	*7*

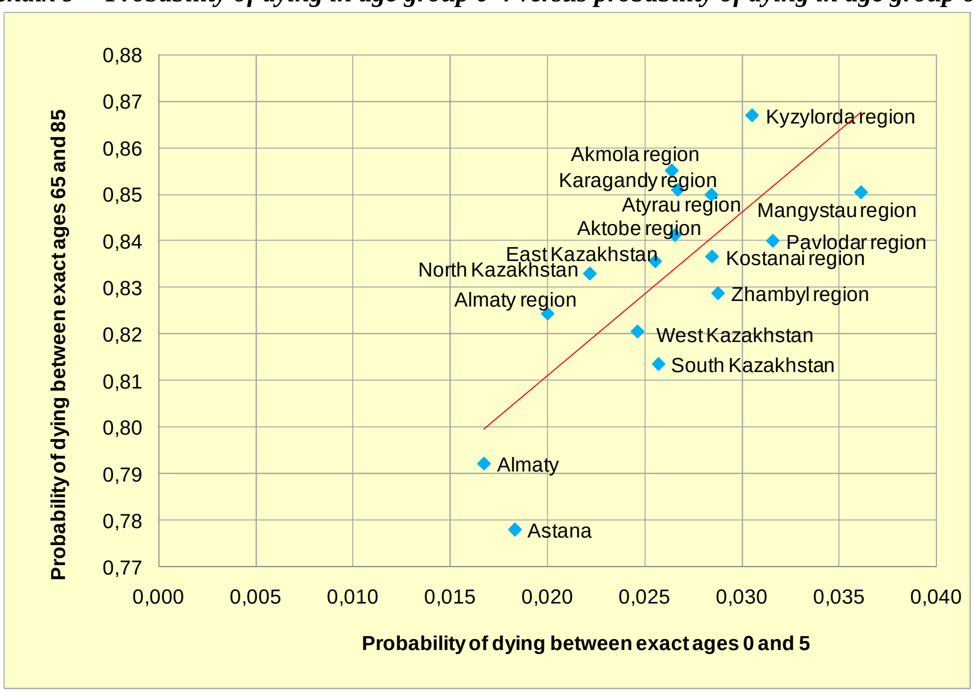
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 8 – Rotated component matrix of probability of dying in five year age groups

Rotated Factor Pattern			
	Factor1	**Factor2**	**Factor3**
q_0	-0.1477	*0.7616*	0.2089
$_4q_1$	-0.1602	*0.5977*	0.6589
$_5q_5$	0.0270	0.2939	*0.8311*
$_5q_{10}$	0.3029	0.2860	*0.7823*
$_5q_{15}$	0.5210	0.3271	*0.6308*
$_5q_{20}$	*0.6966*	0.3319	0.4596
$_5q_{25}$	*0.9367*	0.1466	0.0958
$_5q_{30}$	*0.8952*	-0.0543	-0.0825
$_5q_{35}$	*0.9565*	0.0066	0.0143
$_5q_{40}$	*0.9712*	0.0588	0.0831
$_5q_{45}$	*0.9053*	0.2100	0.2233
$_5q_{50}$	*0.8323*	0.2959	0.2403
$_5q_{55}$	*0.7745*	0.4491	0.2320
$_5q_{60}$	*0.7643*	0.5279	0.2631
$_5q_{65}$	0.4974	*0.7586*	0.2924
$_5q_{70}$	0.3681	*0.8624*	0.3006
$_5q_{75}$	0.2812	*0.8679*	0.2593
$_5q_{80}$	0.2110	*0.8764*	0.2435

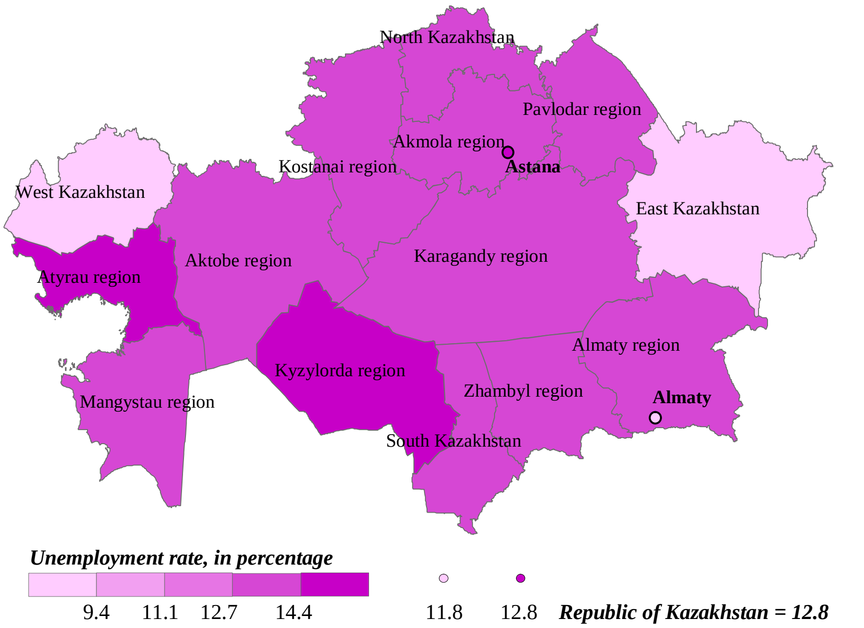
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 9 − Probability of dying in age group 0-4 versus probability of dying in age group 65-84



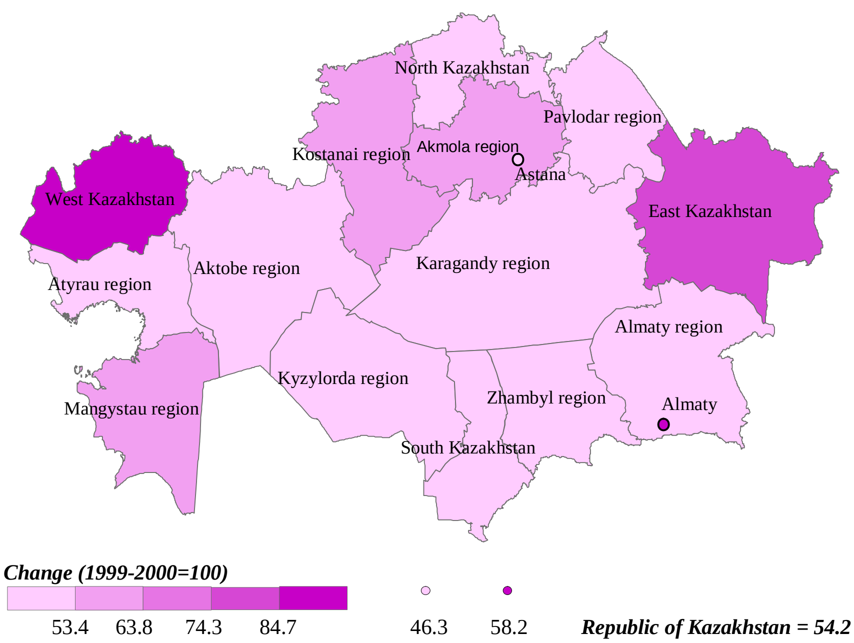
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 10a – Unemployment rate, in percentage, 1999-2000

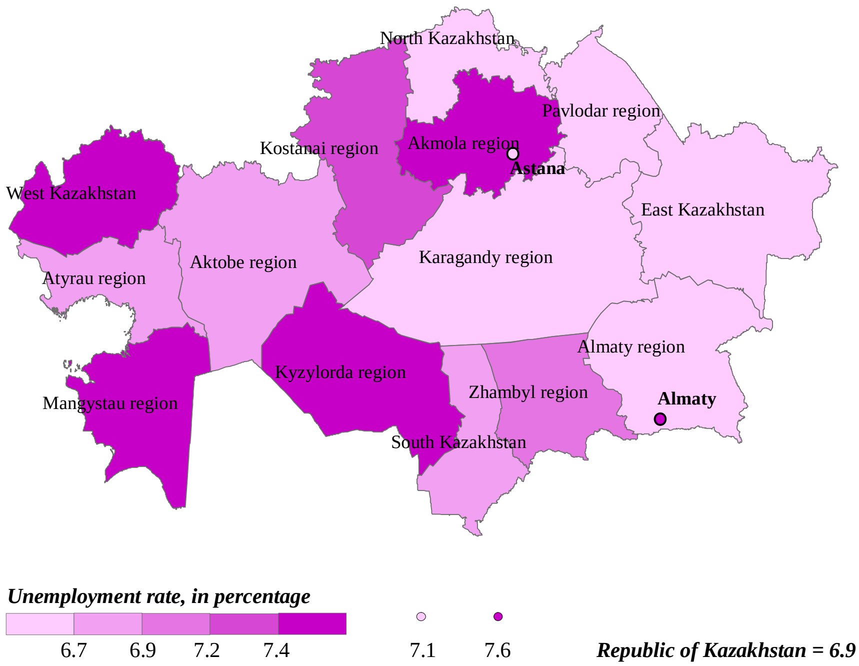


Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 10b – Change in unemployment rate between the periods 1999-2000 and 2007-2008, index (1999-2000=100)

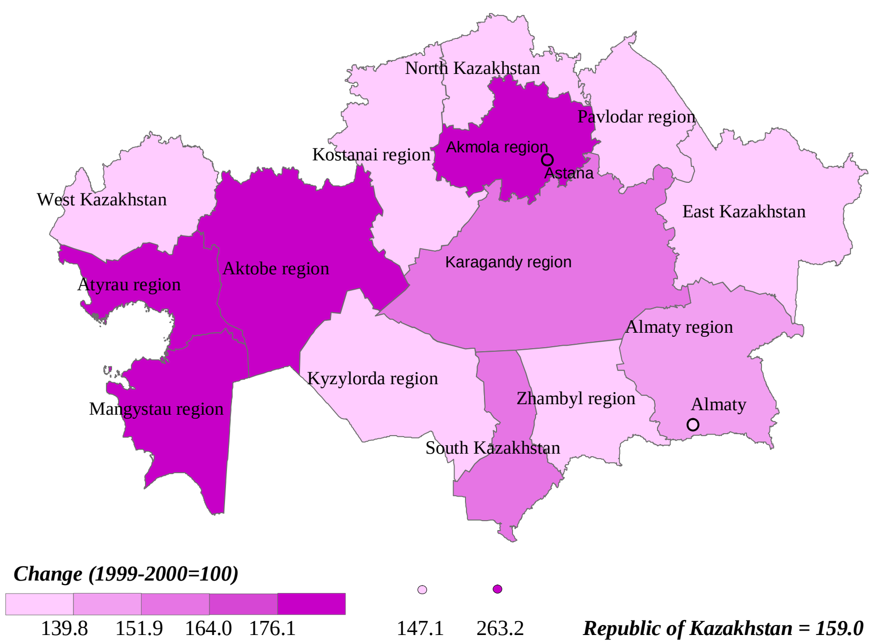


Appendix 10c – Unemployment rate, in percentage, 2007-2008



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 11 – Change in proportion of population with the highest educational attainment between the periods 1999-2000 and 2007-2008, index (1999-2000=100)



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 12a – Age-standardised death rates for selected main causes of death, 1999-2000, males

	I	II	IX	X	XI	XX	Other
0-4	*56*	7	11	*166*	6	61	289
5-19	4	6	5	5	2	*60*	16
20-64	91	*205*	*547*	87	72	*344*	96
65-84	93	*1349*	*5209*	*844*	250	289	404

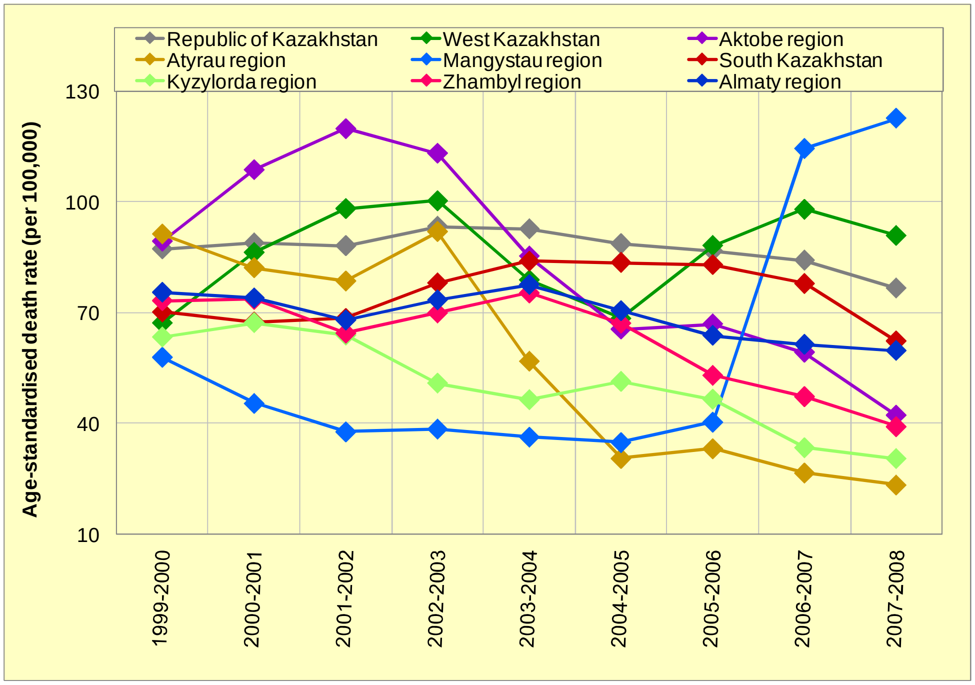
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 12b – Age-standardised death rates for selected main causes of death, 1999-2000, females

	I	II	IX	X	XI	XX	Other
0-4	*46*	4	9	*131*	4	50	214
5-19	3	5	3	4	2	22	12
20-64	21	*118*	*225*	25	31	*72*	52
65-84	26	*648*	*3641*	274	153	107	306

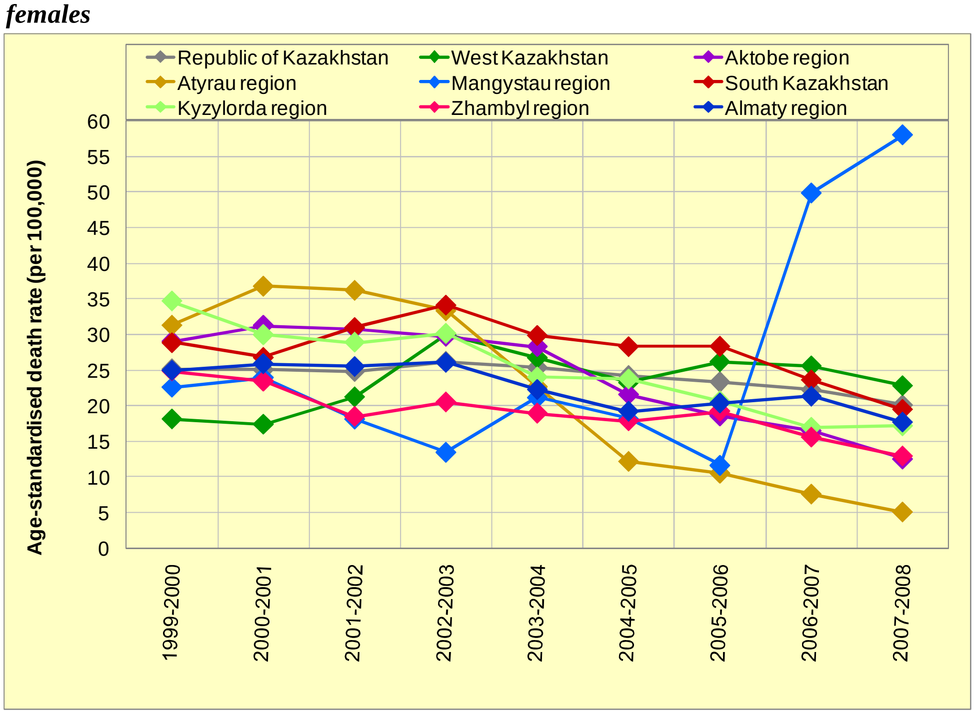
Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 13a – Diseases of the respiratory system in age group 20-64, 1999-2008, the second group of regions, males



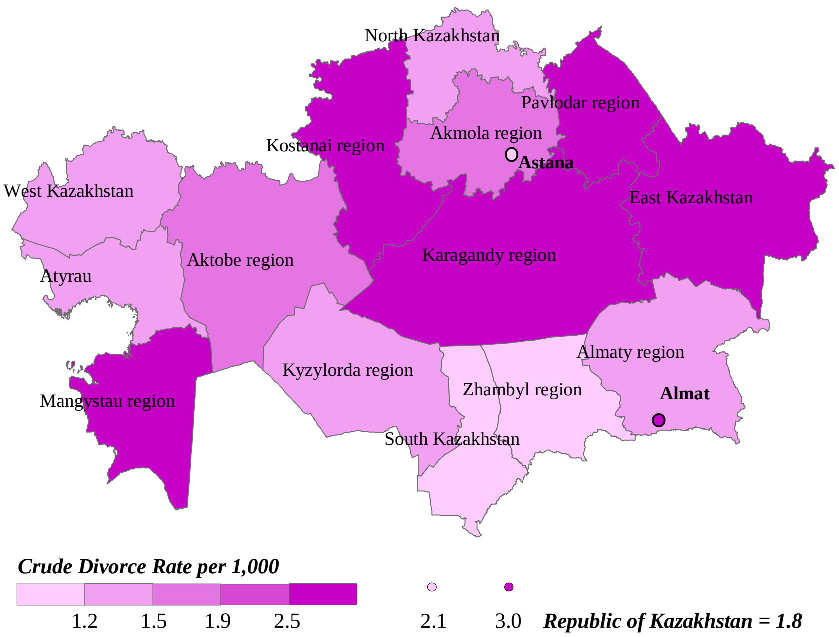
***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 13b – Diseases of the respiratory system in age group 20-64, 1999-2008, the second group of regions, females



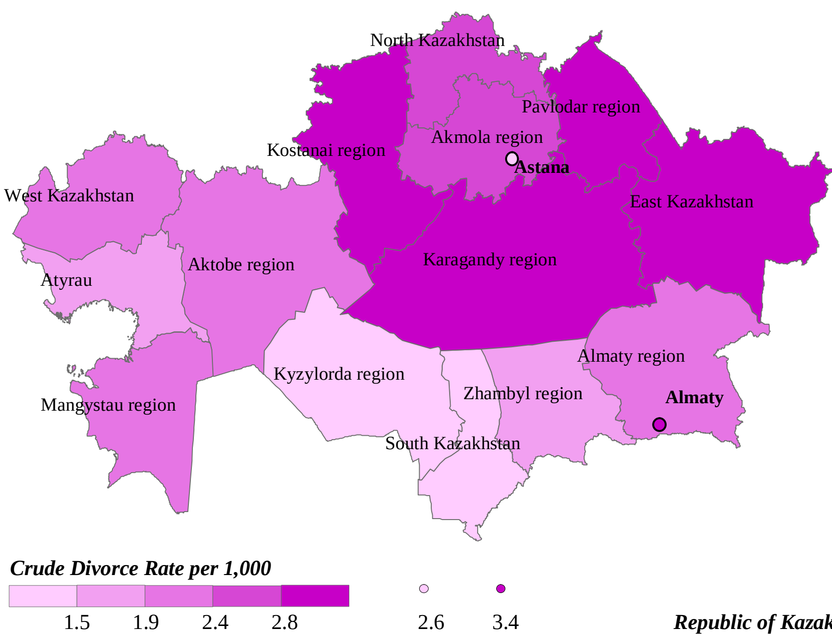
***Source:** Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 14a – Crude Divorce Rate, 1999-2000, per 1,000



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*

Appendix 14b – Crude Divorce Rate, 2007-2008, per 1,000



Source: *Author's calculations based on the data from the Agency of Statistics of the Republic of Kazakhstan*