Demographic consequence of mortality reversal in Russia

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Abstract

The topic of this paper is a demographic consequence of mortality growth in Russia, which continues in the country from the mid-1960s. For this purpose the hypothetical model of population dynamics was created provided that there was not turn of mortality dynamics since 1965 and the process developed as in the western countries. The model shows that human losses in period 1966-2003 due to mortality increase were about 17 million people. Comparison with last population projection for Russia shows that in 2051 the losses could grow up to 27 million. The sex structure of Russia's population is significantly distorted due to the record gender gap in life expectancy. It is very likely that this circumstance conduces to additional female fertility decline. The version of the model based on male fertility rates shoes that number of birth in 1965-2003 would be by 1.3 million more than the actual number.

1. Introduction

As it is well known, during almost 40 years life expectancy in Russia decreased. This process started in the mid-1960s and interrupted only by a short-lived improvement in 1985-1987, coinciding with Gorbachev's wide-ranging anti-alcohol campaign (Shkolnikov *et al.*, 2004; Meslé *et al.*, 2003). The general life expectancy decrease for period 1965-2003 is 6.0 years for males and 1.4 years for females. After 1991 the significant fluctuations of life expectancy were observed and eventually life expectancy decreased from 1991 to 2003 by 4.9 years for males and by 2.4 years for females. All this decrease is a result of adult mortality growth.

In this paper we have undertaken an attempt to estimate demographic consequence of this mortality growth and its possible effect to the future of Russia's population. This topic seems to us important; because many Russian scientists tend to underestimate influence of mortality growth on the dynamics of population size and are afraid mainly of fertility decrease. We also tried to estimate possible influence of mortality growth on fertility decrease in Russia.

At the beginning we consider evident consequences of mortality growth, further possible methods for estimation of demographic losses of Russia due to mortality growth and finally presented the result of our estimation.

2. Mortality growth in Russia and its evident consequences

In 1965 the life expectancy of males (65.0) in Russia was practically the same as in Japan in 1958 or in the USA and major developed European countries in the early-1950s. The life expectancy of females (73,6) was even higher than in the USA (the level of 1972) and practically the same as in Japan or in the 15 old members of the European Union (EU-15) overall: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom[1] (Figure 1). The year 1965 was a turning-point in the mortality dynamics of Russia's population. Contrary to the developed countries life expectancy in Russia began to decrease and this process continued with some fluctuations all consecutive years. Table 1 shows the contributions of different ages to life expectancy decline in Russia. The main mortality increase was concentrated in ages 15-64. As a result life expectancy at age 15 declined for males by 7.6 years and for females by 2.8. However the level of mortality at ages 0-14 slowly declined all periods after 1965 except the short interval from 1972 to 1976.

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[1] All used indicators for EU-15, Japan and the USA were calculated by the author on the basis of WHO Mortality Data base. The indicators for Russia are the result of the author's calculation based on the official vital statistics data.

Due to more rapid increase of adult male mortality the gender gap in life expectancy at birth has exceeded 13 years, i.e. it was at a level, which is about twice as mach as it was in the developed world and by about 5 years higher than it was in Russia in the 1960s.

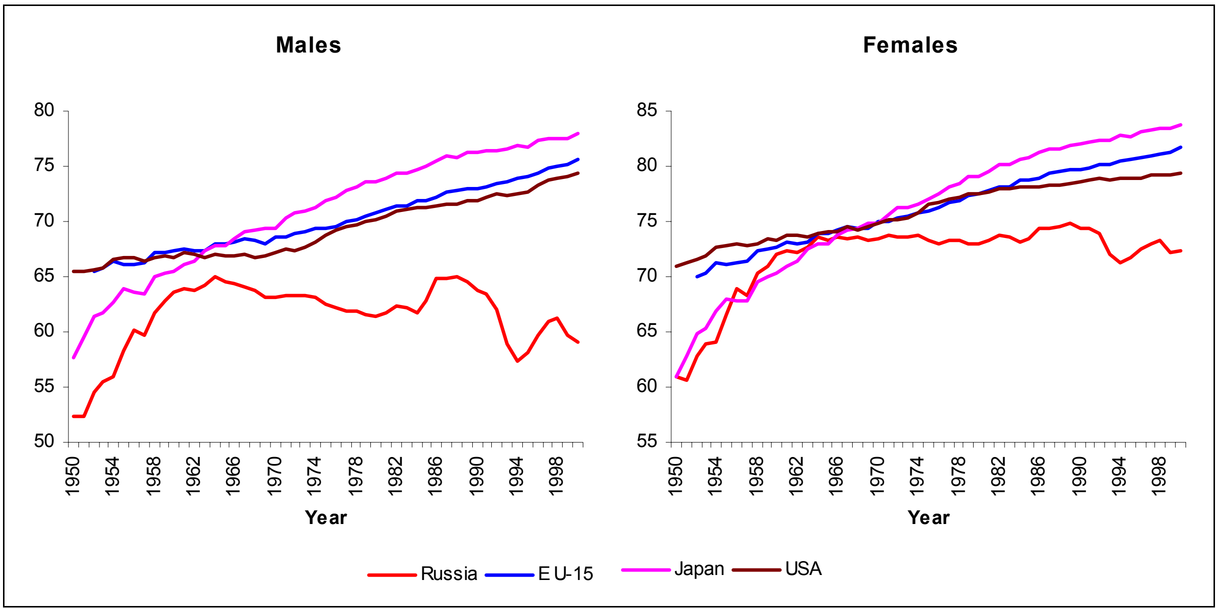

Figure 1. Life expectancy at birth in Russia, EU-15, Japan and the USA after 1950

Table 1. Decomposition of life expectancy changes in Russia in 1965-2003 by age groups

	Males	Females
Total	-5.99	-1.36
0-14	1.25	1.17
15-64	-6.33	-2.06
65+	-0.91	-0.47

It is useful to remind that up to the mid-1980s any indicators of mortality in Russia were not published except crude death rates. Thus increase of the crude death rates was really the first evident consequence of mortality growth started in the mid-1960s (Figure 2). Certainly a crude death rate is not adequate measure of mortality level. However based on this indicator Bourgeois-Pichat (1985) showed amplification of the east-west gap in life expectancy. During the last 40 years relative number of deaths in Russia increased by 2.2 times.

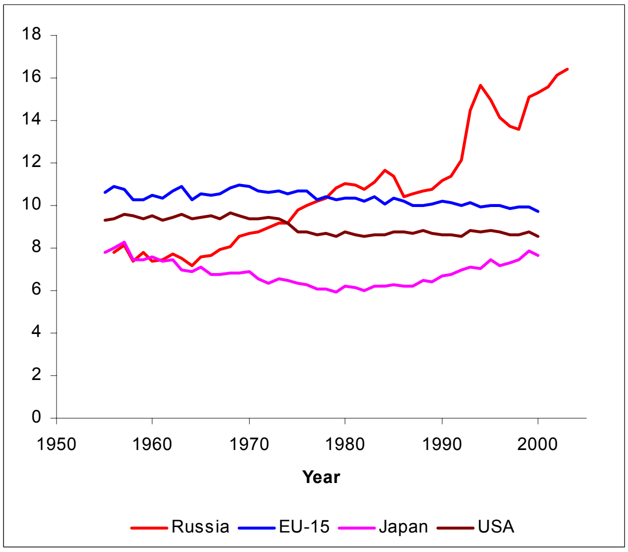

Figure 2. Crude death rate in Russia, EU-15, Japan and the USA after 1955 per 1000

According the last All-Russian population census (Results of the All-Russia population census, 2002) the sex ratio in Russia decreased after the 1989 census (Table 2) that is a direct consequence of the gender gap in mortality. In Europe the close sex ratio was observed only in Belarus (884) and Ukraine (860). In Germany even in 1950 sex ratio was larger than in modern Russia (882).

Table 2. The sex ratio of Russia's population according censuses and in some developed countries (last available data)

Year of census	Number of men per 1000 women
1926	903
1939	892
1959	805
1970	838
1979	852
1989	877
2002	872

Country	Year	Number of men per 1000 women
USA	2000	963
Germany	2001	955
United Kingdom	2002	954
France	2000	944
Poland	2002	939
Italy	2001	938
Russia	2002	877
Ukraine	2002	860

The gender gap in life expectancy conduced to instability of marriage and extremely high proportion of the widows in the female population. For example percent of widows in Russia at ages 30-44 is 3.7 times is more than in USA (Table 3). It is necessary to note that percent of never married women is similar, for example at ages 60+ in the USA it is 4.4 and in Russia – 4.3 percent.

Table 3. Percent of widowed in Russia (2002) and USA (2000) population

Age	Males		Females	
	Russia	USA	Russia	USA
20-24	0,0	0,2	0,3	0,2
25-29	0.1	0.2	1.1	0.3
30-34	0.3	0.3	2.2	0.6
35-44	0.9	0.5	4.8	1.3
45-54	2.4	1.0	11.1	3.7
55-64	7.0	2.8	28.0	11.9
65+	19.5	13.9	59.1	45.3

Source: 2000 Census of Population and Housing, Summary Population and Housing Characteristics, U.S. Census Bureau, Washington, DC, 2002. Results of the All-Russia population census 2002. Vol. 2. Age-sex structure and marital status. Moscow. 2004. (In Russian)

One more consequence of high mortality is low proportion of population at ages 65 and over. According the 2002 Census it is 13 percent. This value for EU-15 is about 16 percent, i.e. the difference is not too significant, but in some regions of Russia with extremely high mortality this proportion is unexpected low. For example in Republic of Tuva where life expectancy at birth for both sexes was in 2002 53.7 percent of people at ages 65+ was 4.4 and in Koryak autonomous district it was 4.2 (life expectancy was 56.3 in 2002)
The list of evident consequences may be continued but each of them and they together do not permit feel the degree of the demographic ravage of Russia in the second part of the XX century.

2. How to estimate the demographic losses of Russia due to mortality growth?
There are no fabricated methods for estimation of losses due to fluctuation or growth of mortality levels. In the study of the demographic history of Russia for estimation of losses due to the famines and the Second World War we compared actual population dynamics with the result of hypothetical calculation under condition normal fluent changes of the mortality, fertility and migration (Andreev et al., 1992, 1994). In all these situations the possible levels of mortality, fertility are more or less obvious because we know the actual patterns of these processes before and after the catastrophe. Is it

correct to use the same approach in case of 40 years period of mortality growth? And what is "normal fluent" mortality dynamics in this case?

It is possible to calculate the hypothetical population dynamics provided that age-sex-specific mortality rates in 1966-2003 are the same as in 1965. But this model ignores not only mortality growth but also decline of mortality at some ages. The more reasonable approach is to eliminate increase of age specific mortality indicators and to save all positive changes. In this case hypothetical life expectancy at birth for males in 2003 would be 67 years and for female - 76 years. It means that average annual life expectancy growth will be less than 0.05 years per 1 year for both sexes together versus 0.22 years per 1 year in the group of 17 countries including the EU members before May 2004, Japan and the USA (17 countries).

In the 1960s life expectancy at birth in Russia for both sexes together was enough close to this indicator in the 17 countries. The Russia's life expectancy in 1965 was practically the same as in the 17 countries in 1960 (Figure 3, left panel). We supposed for our further calculation that the regular mortality trend for Russia preserves these 5 years lag during all period up to 2003 (Figure 3, right panel).

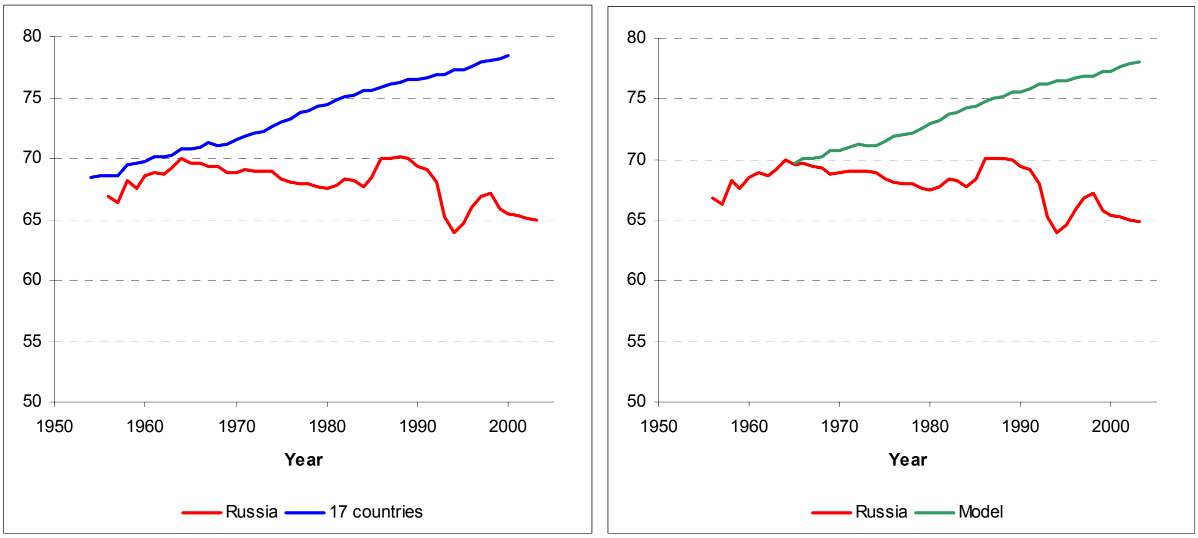

Figure 3. Life expectancy at birth for both sexes in Russia and in the 17 countries (left panel) and in Russia and in the hypothetical population (left panel) (year)

Does the mortality model chosen for an estimation of losses seem to be unlikely? The experience of the Central European countries shows possibility of this scenario. In the mid-1960s, in majority of these countries a long period of stagnation or regression in life expectancy began. But in the 1990s situation in these countries resumed a positive trend. In Poland, the Czech Republic and Slovakia stable life expectancy growth started in the early-1990s (Vallin *et al.*, 2001), in Bulgaria and Rumania it started only in the late-1990s. From our point of view this turning was not a result of great achievement in economics or in health care system but a change of an attitude to health problems in the governments and societies. We are sure, that in Russia in the 1960s there was an objective opportunity to avoid mortality growth.

3. Data and methods

The hypothetical population by age and sex was calculated by cohort-component method. All calculations were made for single years of age. Female age-specific fertility rates were used and we supposed that they coincide with registered by vital statistics. It was also supposed that the numbers of migrants by age and sex left at the same level as in the current population estimation for considered period. However we had to adjust all parameters of the model because at usual accuracy and so long period of calculation the difference between calculation data and the actual population size became significant at the end of period even if we took actual mortality rates.

Age-sex specific death rates for the 17 countries for period 1961-1999 were calculated basing on the WHO Mortality Database (2004). These data permit to calculate only an abridged life table. The death rates for single-year age groups were obtained with standard interpolation methods. We also used the death rates by main groups of causes of death.

As we showed the sex structure of Russia's population is significantly distorted due to the gender gap in life expectancy. Thus it is possible to suppose that this gender gap leaded to additional female fertility decrease. To estimate possible influence of this additional decrease on population dynamics we have tried to repeat our calculations basing on male fertility rates. Unfortunately Russia has data concerning birth by age of father only for marital birth and only for period before 1987. Thus for this purpose we have admitted two assumptions. First, non-marital births are distributed by age of the father as marital births. Second, the form of male fertility curve did not change after 1987. Using the second assumption and factual number of births we estimated male age-specific fertility rates for period after 1987. Certainly both these assumptions are rather crude but a series of experiments has shown that their influence on the final result is not great.

Finally we tried to estimate possible effect of mortality reversal on the future Russia's population and compared the last population projections for Russia with the population projection for the hypothetical population.

For this purpose we calculated the population projection on the base of the medium variant of the scenarios developed in the 2002 by the Centre of Demography and Human Ecology (CDHE) Russian Academy of Science (Population of Russia, 2001). The projection for the hypothetical population used the medium variant of the CDHE's scenarios of female fertility and migration and the UN mortality scenario for Western Europe according to the 2002 revisions of the United Nations World Population Projections (UN, 2003). We also have tried to estimate the future population of Russia in case when the growth of the adult mortality will proceed with the same speed as during the last 40 years (Low variant). Finally we tried to estimate possible population dynamics in case of fast mortality decrease (High variant). This high scenario supposes that during next several years life expectancy will enlarge as in the period of anti-alcohol campaign. Further female life expectancy will grow with the same speed as in the 17 countries in the 1970s-1980s and gender gap in life expectancy at the end of period will be 6 years. The high and low projections were calculated under the same assumption according fertility and migration as in the medium scenario of CDHE.

Standard cohort-component method of projection with migration was used.

4. Demographic losses of Russia due to mortality growth

If we assume that after 1965 the age-sex specific mortality rates in Russia change in the same manner as in the 17 countries since 1961 and other components of demographic dynamics (fertility and migration) remain at the actual level, then the total number of deaths for 1966-2003 would be less then actual by 16.8 million (Table 4) or 27 percent of actual number of deaths. The excessive male deaths are 35 percent of all male deaths or 65 percent of all the excessive deaths. The excessive male deaths at ages 15-64 are 55 percent of the all excessive male deaths.

The number of birth in the hypothetical population in the period 1966-2003 is by 290 thousands more than actual number, thus the number of deaths in the hypothetical population includes also 4 thousand additional deaths of this additional newborn that formally must include to the human losses but this value does not influence on the result.

Table 4. Actual number of deaths in Russia and in the hypothetical population in 1966-2003 (millions)

Age	Males and females			Males			Females		
	Actual	Hypothetical	Difference	Actual	Hypothetical	Difference	Actual	Hypothetical	Difference
Total	62.2	45.5	16.8	31.3	20.3	11.0	30.9	25.1	5.8
0-14	2.3	1.5	0.8	1.4	0.9	0.5	0.9	0.6	0.3
15-64	24.4	12.7	11.7	17.1	7.9	9.3	7.3	4.9	2.4
65+	35.5	31.2	4.3	12.8	11.6	1.2	22.7	19.6	3.1

The main losses connected with diseases of the circulatory system and external causes (Table 5). It is necessary to note that actual numbers of deaths from neoplasms for females and from group "other diseases" for both sexes is lower than the hypothetical ones.

Table 5. Distribution of deaths by causes in Russia and in the hypothetical population in 1966-2003 (millions)

Causes	Males			Females		
	Actual	Hypothetical	Difference	Actual	Hypothetical	Difference
All causes	31.3	20.3	11.0	30.9	25.1	5.8
Infectious and parasitic diseases	0.8	0.3	0.5	0.3	0.3	0.0
Neoplasms	5.1	4.8	0.3	4.6	5.3	-0.7
Circulatory diseases	13.6	8.1	5.5	20.4	12.0	8.3
Ischemic heart diseases	7.4	4.0	3.4	9.5	4.6	4.9
Cerebrovascular diseases	4.2	1.9	2.4	8.1	3.7	4.4
Respiratory diseases	2.4	1.7	0.8	1.7	1.9	-0.2
All other diseases	2.4	3.4	-1.0	2.0	4.5	-2.5
Injury and poisoning	6.9	2.0	4.9	2.0	1.1	0.8
Suicide	1.4	0.5	1.0	0.4	0.2	0.1
Homicide	0.6	0.1	0.5	0.2	0.0	0.2

If there are no these losses then the present population of Russia could be by 17.1 million more than the actual population including about 290 thousands children which were not born due to deaths of the potential mothers (Table 6).

Table 6. Actual population of Russia and hypothetical population at the beginning of 2004 (millions)

Age	Males and females			Males			Females		
	Actual	Hypothetical	Difference	Actual	Hypothetical	Difference	Actual	Hypothetical	Difference
Total	144.3	161.4	-17.1	67.1	78.2	-11.1	77.2	83.1	-5.9
0-14	22.8	23.2	-0.5	11.7	11.9	-0.3	11.1	11.3	-0.2
15-64	102.3	109.9	-7.6	49.2	55.3	-6.1	53.0	54.6	-1.6
65+	19.3	28.2	-9.0	6.2	11.0	-4.8	13.1	17.2	-4.2

Due to high mortality Russia lost in 1966-2003 about 227 millions person-years of life, of them 120 million person-years of life at ages 15-64. This is 3 percent of actual number of person-years of life in working ages. Men lost 155 million person-years of life and of them 100 million person-years of life at age 15-64. However it is necessary also to note that the age dependency ratio in the hypothetical population is significantly higher than in present Russia: 468 per 1000 vs. 411.

Now in Russia the retirement age for men is 60 and for women it is 55. According to the modern norm the working population includes men at ages 16-59 and women at ages 16-54. Thus actual retirement ratio equals 325 per 1000. The same ratio in the hypothetical population in 2004 is 418. From this point of view mortality decline is not economically effective. However it is clear that mortality decrease and health improvement can permit to increase the retirement age. The ratio of population at age 65+ to the number of persons at age 16-64 in the hypothetical population in 2004 is 263 per 1000.

The age of majority of parents is between 18 and 44 years. The actual sex ratio at this age interval is 988 beside hypothetical ratio is 1030 males per 1000 females. It is very likely that actual population sex structure conduces to female fertility decline. If we assume that male fertility remains at the actual level then the number of births in 1966-2003 will be by 1.6 million or 2 percent more than the actual number and by 1.3 millions more than in hypothetical population based on female fertility rates.

Actually Russia's population decrease started in the mid-1990s. The hypothetical population grows up to 2004. Our projection for the hypothetical population showed that population decrease will start after 2011 (Figure 4). According to the medium variant of the CDHE projection human losses due to mortality reversal would grow up to 27 million in 2051. According this projection in the 2051 population of Russia will be by 29 millions less than the hypothetical population.

Let's note that the medium variant of population projection of the CDHE is enough optimistic from point of view of future mortality dynamics (Andreev et al, 2003). It supposes that life expectancy will increase up to 2050 on 6.8 years for males and on 5.8 for female. If we suppose that mortality trend of 1965-2003 will remain up to the end of projection period then life expectancy will decrease up to 2050 by 4.0 years for males and by 1.3 for females. According to this low scenario the population of Russia will be by 13 million less than according to the medium scenario and on 42 million less than the hypothetical population. The difference between the extremely optimistic high variant and the projection for the hypothetical population is 16 million in 2051. Thus the demographic losses of Russia by our estimation will be in interval from 16 to 42 million at 2051. Only the high variant forecasts approach to the hypothetical population.

Decrease of the population size is not a unique negative consequence of long-term deterioration of life expectancy. According to the low scenario sex ratio in Russia population will be 744 males per 1000 females in 2051 beside 872 in 2002 and at ages 15-64 it will be 829 males per 1000 females beside 931 in 2002. It is probably that this disproportion will probably lead to new fertility decline in the future and have other social consequences.

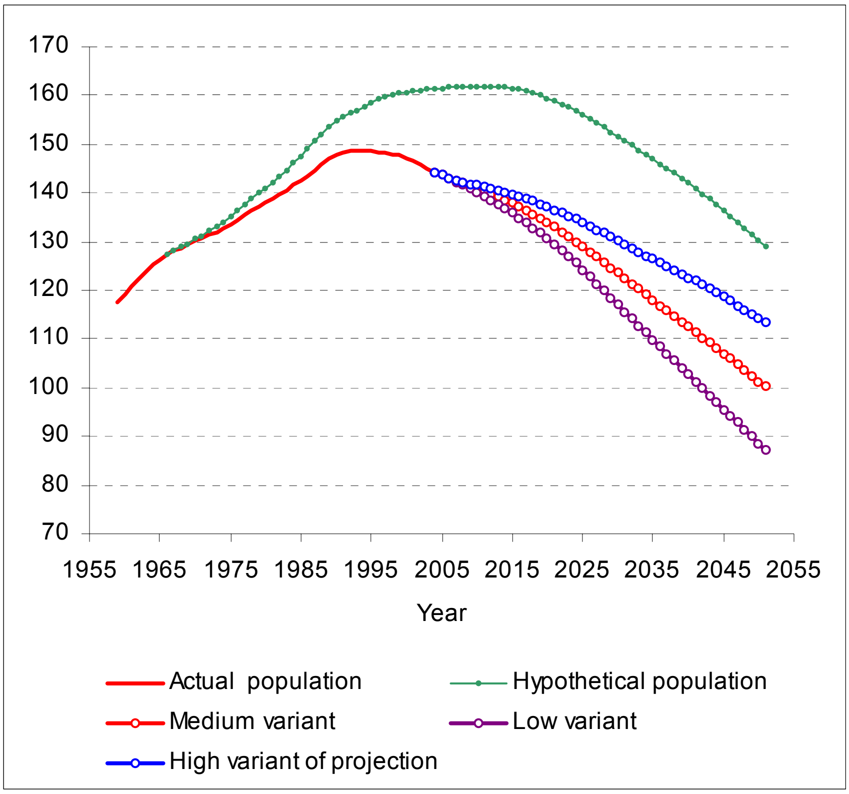

Figure 4. Actual and hypothetical population of Russia and three variants of actual population projection up to 2050 (millions)

4. Conclusion

It is known that total fertility below 2.1 children per woman has a consequence in the long-term perspective a negative natural increase. In case of Russia and some other post-Soviet countries this process was accelerated by significant decrease of life expectancy. The human loses of Russia due to adverse mortality and health trends in 1966-2003 were about 17 million people.

By the majority of estimations the human losses of the USSR in the Second World War were about 27 million people (Timasheff, 1948, Andreev et al, 1992). It seems to us that the losses of the Russian Federation were about half of this figure. Thus the human loses of Russia in the period 1966-2003 are comparable with the losses in the Second World War.

By our opinion the method used for estimation the human losses due to long-term deterioration of life expectancy may be effectively used in order to attract the attention of governments and societies to the health problems in the countries where the mortality situation is worsening.

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