Paper accepted for presentation at
The 2010 Annual Meeting of the Population Association of America

April 15-17, 2010
Dallas, TX

Session 121 "Ethnicity, Health and Mortality in Russia and Former Soviet Republics"

Ethnic Differentials of Mortality in Russia and the Role of Socio-economic Conditions

Natalia Gavrilova*, Alla Ivanova**, Victoria Semyonova**, Leonid Gavrilov*

Center on Aging, NORC and the University of Chicago, Chicago*
Institute of Public Health and Social Development, Moscow, Russia**

Abstract

Ethnic Russians in Russia traditionally have higher mortality at working ages compared to many other ethnic groups. We analyzed mortality in 78 Russian territories according to percentage of ethnic Russians reported by the last 2002 census. Higher proportion of ethnic Russians in total population is positively correlated with mortality at adult ages in a particular region. Multivariate analysis showed that this finding is robust and it is still observed when controlled for the effects of other important explanatory variables: alcohol consumption, socio-economic factors, migration rate, divorce rate and workforce education. Although the proportion of Russians is a significant predictor of total mortality at working ages, it does not affect external mortality and is not correlated with alcohol consumption.

Background

Ethnic Russians in the Former Soviet Union had higher mortality at working ages compared to many other ethnic groups. For example, study by Andreev and colleagues (1992) showed that in 1989 ethnic Russians had the lowest life expectancy compared to many other ethnic groups. In national republics of the Former Soviet Union, the Russians also had lower life expectancy than the "status" or "title" ethnicity (Andreev *et al.* 1992). After the publication of this first study on ethnic mortality Russia and many countries of the Former Soviet Union experienced a significant upsurge of mortality, which was well documented in the scientific literature (Chen *et al.* 1996; Shkolnikov *et al.* 1998; Anderson 2002; Ivanova *et al.* 2002; Shkolnikov *et al.* 2004; Brainerd & Cutler 2005). However data on the recent developments in ethnic mortality in the countries of the Former Soviet Union are scarce. Absence of ethnicity information in the current official death certificates significantly hampers studies of ethnic mortality in Russia.

The first study of ethnic differences in mortality in the Former Soviet Union was conducted in 1992 and was based on the 1989 census (Andreev *et al.* 1992) Table 1 shows mortality data for 18 ethnic groups. According to this data, Russians, Ukrainians and Belarusians (1st group) as well as Lithuanians, Latvians and Estonians have relatively low child mortality, high male adult mortality and significantly lower female mortality (high sex differential in mortality). Similar patterns are observed for Russians living in other republics of the Former Soviet Union. Central Asian ethnic groups (2nd group) are characterized by relatively low male adult mortality and relatively high (compared to the 1st group) mortality of women and children. Mortality patterns of Tatars and Germans in the Former Soviet Union are close to the first group.

In order to understand the causes of the observed ethnic differentials it helps to consider the historical background. More than a century ago, calculations based on the 1897 census produced the following interesting results. According to this data, Latvians had the maximal life expectancy and the minimal infant mortality at that time. Russians had quite the opposite pattern. Differences between Latvians and Russians were equal to 16-17 years for life expectancy, and more than two-fold differences for infant mortality (Novoselsky 1916). These differences were related not only to the living conditions but also to religion and cultural traditions. For example, difference in life expectancy between Orthodox Christians and Jews was 15-19 years in favor of Jews, with infant mortality ratio estimated as 2.5 to 1. Similar differences were observed between Orthodox Christians and Muslims. Novoselsky explains high infant mortality of Orthodox Christians (mainly Russians) by a tradition to give infants bread and other food as a supplement to breastfeeding (Novoselsky 1916). Researcher

explained higher mortality of Russian adults by higher involvement of Russians in hard labor at factories in urban areas. This data show that socio-economic and cultural differences played significant role in the ethnic differentials in mortality and their role is still important.

Table 1. Main characteristics of mortality in the Former USSR in 1988-1989

Ethnicity	Men			Women		
	Life expectancy, years	Probability of death in the age interval (per 1000)		Life expectancy, years	Probability of death in the age interval (per 1000)	
		0-14 yr	15-59yr		0-14yr	15-59yr
Lithuanians	67.3	21.4	266.8	76.6	17.1	103.8
Latvians	65.9	25.6	276.7	75.5	16.8	111.4
Belarusians	66.3	25.9	274.9	75.8	17.5	105.7
Russians	64.6	28.9	298.0	74.6	20.3	111.6
Ukrainians	66.4	27.5	261.3	74.9	19.6	107.8
Estonians	66.0	29.3	266.3	75.1	20.0	106.4
Tatars	65.5	35.2	276.7	75.6	24.5	108.7
Jews	70.1	24.1	170.2	73.7	19.5	114.4
Germans	66.2	36.3	248.0	74.6	26.2	107.4
Georgians	68.6	31.5	211.0	75.9	23.7	90.8
Moldavians	65.1	42.3	272.1	71.2	31.9	169.0
Kazakhs	63.6	60.4	238.5	72.5	47.0	151.4
Armenians	65.5	58.3	237.7	69.6	55.1	175.4
Azeri	66.4	58.8	221.2	74.4	50.5	110.5
Kyrgyz	65.1	74.2	239.2	71.9	61.0	149.4
Uzbeks	66.8	73.7	199.9	71.9	60.0	139.8
Turkmen	62.1	100.2	247.7	67.7	82.5	166.7
Tajiks	68.8	78.0	157.9	73.3	66.3	123.3

An additional argument in support of this view comes from information on infant mortality for “title” ethnicities and Russians living in the same republics of the Former USSR in 1989 (Figure 1). In republics with low levels of infant mortality Russians had levels of infant mortality, which were closer to the levels of “title” ethnicity than to the levels of Russians in Russia. For other republics the pattern was quite the opposite: Russians in Latvia and Estonia were closer to Latvians and Estonians while Russians in Tajikistan were closer to Russians in Russia than to Tajiks (Andreev *et al.* 1992).

Studies of ethnic mortality in the countries of the Former Soviet Union after 1991 showed higher mortality of ethnic Russians at working ages compared to the “title”

ethnicity. For example, study of ethnic mortality in Estonia found that in the period 1989 - 2000, ethnic differences in life expectancy between Russians and Estonians increased from 0.4 years to 6.1 years among men and from 0.6 years to 3.5 years among women (Leinsalu *et al.* 2004). In 2000, Russians in Estonia had a higher mortality than Estonians in all age groups and for almost all selected causes of death. The largest differences were found for some alcohol related causes of death, especially in 2000. Authors concluded that political and economic upheaval, increasing poverty, and alcohol consumption can be considered the main underlying causes of the widening ethnic mortality gap (Leinsalu *et al.* 2004).

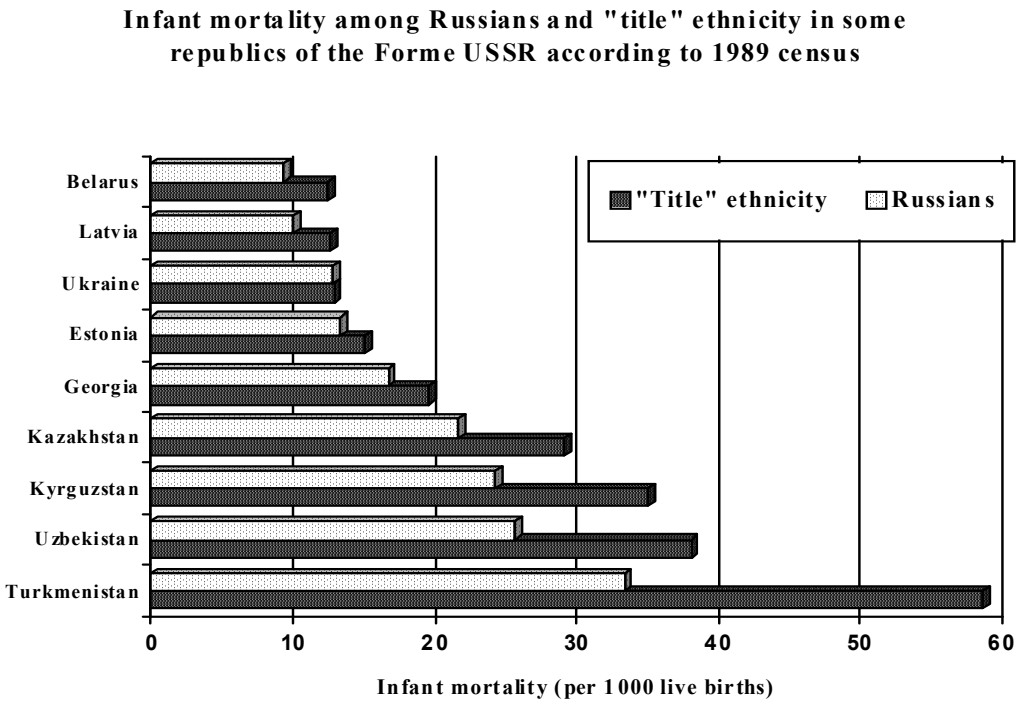

Figure 1. Infant mortality among Russians and "title" ethnicity in some republics of the Former USSR according to 1989 census. Source: Andreev et al., 1992.

Study of ethnic differentials in Kyrgyzstan also demonstrated that ethnic Russians (men in particular) have higher mortality compared to Central Asian ethnic groups (Guillot *et al.* 2007). As it was found earlier in Estonia, ethnic differences in life expectancy in Kyrgyzstan also increased after the independence (Guillot *et al.* 2007). Control for socio-economic factors (education, urban/rural residence) decreased, but did not eliminate these ethnic differences (Guillot *et al.* 2007). Study of cause-of-death

mortality in Kyrgyzstan also found that the highest ethnic differentials in mortality are observed for causes related to alcohol (Guillot *et al.* 2007).

Earlier study by Brainerd found a strong correlation between proportion of ethnic Russians in population and mortality in the countries of the Former Soviet Union (Brainerd 1998).

Taking into account this information, we may expect that ethnic Russians in the Russian Federation also have higher mortality compared to many other ethnic groups. Census is a traditional source of data on ethnicity, which makes possible to estimate ethnic differentials in family composition and fertility. For mortality analysis researchers need simultaneous analysis of census data and current vital statistics. Opportunity to study ethnic differences in mortality in Russia appeared only when information about ethnicity was included into official death certificate. In the USSR this happened only in 1979 and data were analyzed for the first time in conjunction with 1989 census. However, starting with 1997 (when a new law about vital statistics has been adopted) ethnicity was excluded from the official (ZAGS) death certificates in Russia and hence from the official mortality statistics. This information still remains in the medical death certificate, which are used for the ZAGS death certificate issuance. Hence the study of ethnic mortality in Russia is possible now on the basis of sample medical certificate data from particular regions. Unfortunately now a significant proportion of medical death certificates does not have information about ethnicity.

Despite the absence of data on ethnicity in the official death certificates it is still possible to study ethnic differences in mortality indirectly, by using information about proportion of ethnic Russians in population. Thus, we studied data on ethnic composition (taken from 2002 census) and mortality at working ages in different regions of Russia controlling for a number of socio-economic factors.

Data

In this study we analyzed mortality at working age (15-59 years) in 78 Russian regions in 2003. Information on the percentage of ethnic Russians was taken from the last 2002 census (Federal State Statistics Service of Russia 2004). Information on socio-economic characteristics of regions and regional mortality was taken from the official yearbooks (Federal State Statistics Service of Russia 2006) and from the Rosstat Central Database of Statistical Data available online (http://www.gks.ru/dbscripts/Cbsd/DBInet.cgi). Table 2 lists the measures for each of the dependent and independent variables used in this analysis, together with the mean and standard deviation for each.

Table 2. Measures Used for Independent and Dependent Variables: Russia, 2003.

Variable	Measure	Mean	Standard Deviation
Mortality, men	Deaths per 100,000 men of working age (15-59 years) in 2003	470.0	71.7
Mortality, women	Deaths per 100,000 women of working age (15-59years) in 2003	181.3	46.0
Russians	Proportion of ethnic Russians, 2002 census	77.9	22.3
Alcohol consumption	Deaths per 100,000 persons of working age due to alcohol poisoning	51.2	34.8
Relative deprivation	Gini coefficient of income inequality	0.36	0.04
GRP	Gross regional product per capita, rubles	64,135.1	49,090.7
Income	Mean monthly income per capita, rubles	4,376.3	2,396.7
Unemployment	Percentage of active labor force unemployed	9.5	4.0
Poverty	Proportion of population living below the official subsistence level	28.3	8.6
Price Index	Ratio (in %) of prices in current year compared to the previous year	112.7	2.1
Education	Proportion of workforce with university or college education	21.3	4.7
Divorce rate	Number of divorces per 1000 population	5.5	1.3
Migration rate	Net migration rate	-11.9	53.8
Sex ratio	Number of women per 1000 men	1,144.7	58.5
Urbanicity	Percent of urban population	69.6	12.6

Mortality at working age. Previous studies showed that the main changes in mortality during the transition period in Russia occurred predominantly at working ages. Study of ethnic mortality in Kyrgyzstan also demonstrated that mortality disadvantage of

Russians compared to Central Asians is observed for working ages while infant mortality is always lower among ethnic Russians (Guillot *et al.* 2007). We used data on mortality at age 15-59 years in 2003 per 100,000 population of working age. Mortality of men and women was studied separately

Proportion of ethnic Russians in population. Study by Brainerd (Brainerd 1998) showed that proportion of Russians in population may be a significant factor of mortality. Thus we may expect that this proportion could also be a significant factor of regional differences in mortality in Russia. This variable is the main variable of interest in our study. Strong dependence of ethnic differences in mortality on alcohol consumption (Leinsalu *et al.* 2004; Guillot *et al.* 2007) may indicate that the effect of Russian ethnicity on mortality should become lower when alcohol consumption is included in the analysis.

Alcohol consumption. Alcohol consumption is often measured through the official retail sales of alcohol products. However this information does not take into account homemade alcohol (samogon) and consumption of so-called alcohol surrogates (polishing liquids, pharmaceutical tinctures, etc.), which are consumed by marginalized groups of Russian society(Lang *et al.* 2006; Pomerleau *et al.* 2008; Tomkins *et al.* 2008). Many experts on Russian mortality consider mortality from acute poisoning by alcohol the most reliable proxy measure of alcohol consumption (Shkolnikov *et al.* 2001; Pridemore 2002). For these reasons we used the death rate from acute poisoning by alcohol at working ages (per 100,000 working population) as a proxy for the regional aggregate level of alcohol consumption at working ages.

Other demographic and socio-economic data.
We included several demographic and socioeconomic variables in the models to control for the effects of social factors on mortality.

Gini coefficient is a measure of deviation of the actual distribution of income in population from uniform distribution. Gini coefficient varies from 0 to 1 and the higher its level the higher population inequality according to the income.

Gross regional product (GRP) per capita in rubles per year. This is a general measure of regional economic activity characterizing production of goods and services in current prices per total population of region.

Mean monthly income per capita is measured as annual income (including income of businessmen, salaries, social payments, bank deposit payments, etc.) per month per midyear population.

Poverty is measured as a proportion of persons with income below the official subsistence level (in %) in total population.

Unemployment level (in percent) is measured according to the International Labor Organization methodology. This measure is determined as a ratio (in percent) of unemployed population in particular age group to the number of economically active population (population at working age) of the same age group.

Proportion of urban population. Distribution according to urban or rural residence is made on the basis of the place of residence. Urban residents are those who live in settlements that are officially considered as urban. All other places are considered as rural.

Proportion of women per 1000 men.

Divorce rate per 1000 population may be used as a measure of family disruption.

Migration rate is based on the net number of in-migrants and out-migrants per midyear population.

Proportion of persons with university or college education (in %) among employed population.

Consumer price index is estimated as a ratio (in %) of prices for goods and services in current year compared to the previous year and is a measure of inflation.

Methods

Our study is a cross-sectional study of the 78 Russian regions using 2003 data (2002 for proportion of Russians). Analysis of local vital statistics in Ingush and Chechen Republics revealed that coverage of death registration there is not particularly reliable, therefore these regions are not included in the analysis.

We used ordinary least squares regression to estimate the cross-sectional effects of the proportion of ethnic Russians in population on regional working age mortality, controlling for the socio-economic factors outlined above. Taking into account that the dependent variable (mortality rate) cannot be negative in any circumstances, a log transformation of this variable was made. We found that there is a strong collinearity between monthly income per capita and GRP per capita. Further analysis of variance inflation factors (VIF) revealed very high VIF value for the income variable, so this variable was removed from the analyses, as recommended (Rabe-Hesketh & Everitt 2007).

Thus the initial equation to be estimated is as follows (analyses were conducted separately for men and women):

Ln (Mortality rate$_{15\text{-}59}$) = α + β1 (gini) + β2 (grp)+β3 (migration) + β4 (russians) + β5 (poverty) + β6 (divorce) + β7 (sex ratio) + β8 (unemployment) + β9 (urban) + β10 (alcohol) + β11 (education) + β12 (price index)

In the process of model estimation and analysis it was found that there are several statistically significant interactions between variables, which were different for men and women. The strongest interaction was observed for alcohol proxy and unemployment (both for men and women).

Results

Figure 2 shows the log of male working age mortality rates plotted against the proportion of ethnic Russians in population. The Pearson correlation coefficient between the two is 0.51 ($p<0.001$). Figure 3 shows the dependence between log of female mortality at working ages and proportion of Russians. The Pearson correlation coefficient between these variables is lower: 0.33 ($p<0.005$). Both correlation coefficients are statistically significant.

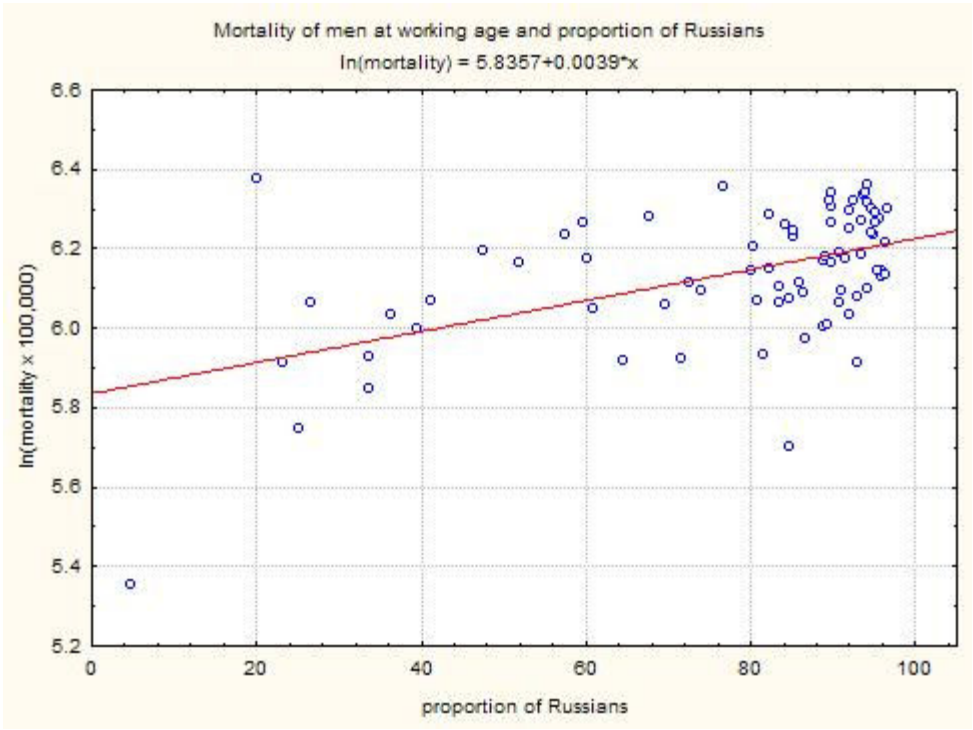

Figure 2. Scatterplot of the log of the regional mortality at working age for men and proportion of ethnic Russians.

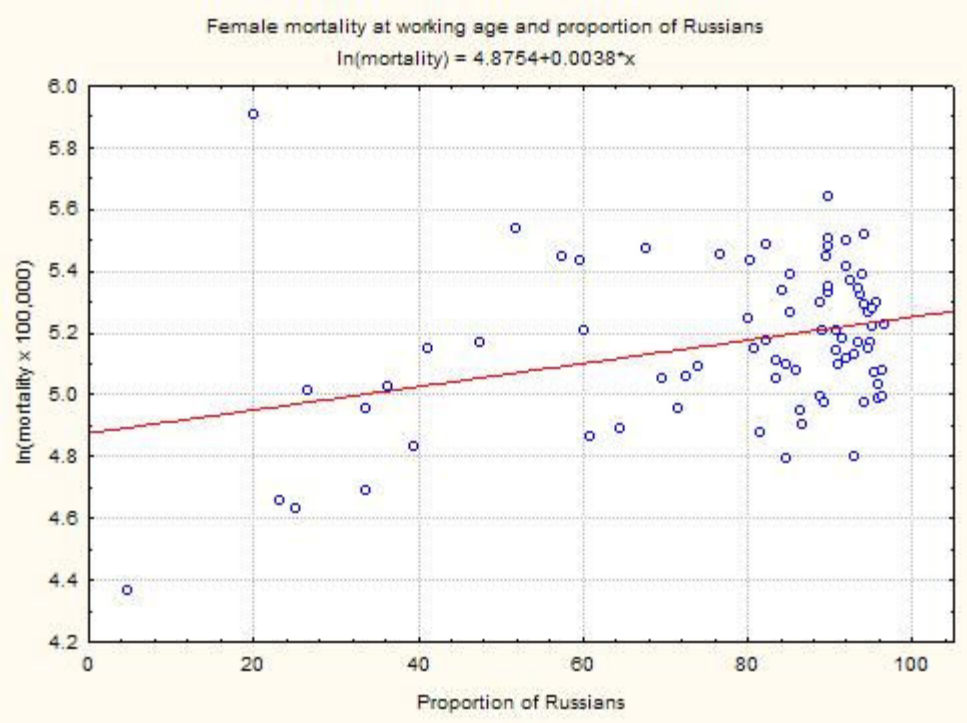

Figure 3. Scatterplot of the log of the regional mortality at working age for women and proportion of ethnic Russians.

Data on Figure 2 and 3 referred to bivariate analyses on the effects of proportion of Russians on adult mortality. To explore the net effects of the proportion of Russians on adult mortality, the multivariate analysis was conducted. Tables 3-4 present the results of multivariate model estimation for men and women. Model 1 includes all variables. Model 2 includes additional interaction variables. Model 3 is the most parsimonious model, which includes only statistically significant variables.

Note that in all models proportion of Russians remain a significant independent predictor of mortality at working age for both men and women even after controlling for socio-economic variables and alcohol consumption. One possible explanation of the observed phenomenon (robustness of the effect of the proportion of Russians) is high mortality of ethnic Russians from cardiovascular diseases found in previous studies (Guillot *et al.* 2007). In this case socio-economic variables and alcohol may not capture factors related to possibly different response to stress of ethnic Russians.

We found also that alcohol is a statistically significant predictor of mortality only in interaction with unemployment (Table 3). Other statistically significant predictors of male mortality were price index, proportion of urban population (increasing mortality), as well as migration rate and proportion of highly educated workforce (decreasing mortality). With

exception of alcohol and unemployment, other interactions are not easy to interpret.

Table 3. Results of Model Estimation for Regional Male Mortality Rates at Working Age Regressed on proportion of Russians, Alcohol Consumption and Socio-Economic Variables: Russia 2003.

Variable	Model 1	Model 2	Model 3
Constant	4.4779 (<0.001)	1.0174 (0.531)	0.2331 (0.877)
Russians	**0.0017 (0.040)**	**0.0018 (0.006)**	**0.0018 (0.007)**
Alcohol	**0.0022 (<0.001)**	-0.0013 (0.071)	-0.0013 (0.072)
Gini	-0.7318 (0.077)	-0.4265 (0.282)	
GRP	-3.5e-07 (0.400)	**0.000003 (0.001)**	**0.000003 (0.001)**
Poverty	0.0012 (0.495)	0.0020 (0.167)	
Unemployment	-0.0042 (0.305)	0.2407 (0.117)	**0.3175 (0.032)**
Price Index	**0.0146 (0.020)**	**0.0368 (0.007)**	**0.0435 (0.001)**
Urban	**0.0036 (0.005)**	**0.0125 (0.001)**	**0.3175 (0.032)**
Migration	-0.0002 (0.464)	**-0.0022 (<0.001)**	**-0.0022 (<0.001)**
Divorce	0.0093 (0.541)	**0.1252 (0.007)**	**0.1235 (0.008)**
Sex ratio	-0.0001 (0.728)	0.00001 (0.968)	
Education	**-0.0057 (0.039)**	**0.0085 (0.046)**	**0.0088 (0.023)**
Unemployment x Alcohol		**0.0004 (<0.001)**	**0.0004 (<0.001)**
Migration x Alcohol		**0.00004 (0.003)**	**0.00003 (0.003)**
Urban x Divorce		**-0.0018 (0.004)**	**-0.0017 (0.005)**
Priceind x Unemployment		-0.0024 (0.087)	**-0.0031 (0.022)**
GRP x Education		**-1.32e-07 (0.001)**	**-1.39e-07 (<0.001)**
Adjusted R^2	0.68	0.82	0.82

Note: Numbers in parentheses are P values.

Table 4. Results of Model Estimation for Regional Female Mortality Rates at Working Age Regressed on proportion of Russians, Alcohol Consumption and Socio-Economic Variables: Russia 2003.

Variable	Model 1	Model 2	Model 3
Constant	**2.7595 (0.029)**	**-67.9466 (0.034)**	**-70.4679 (0.022)**
Russians	**0.0024 (0.049)**	**0.0034 (0.001)**	**0.0025 (0.003)**
Alcohol	**0.0040 (<0.001)**	-0.0020 (0.067)	-0.0016 (0.112)
Gini	-0.456 (0.464)	-0.896 (0.102)	-0.8534 (0.078)
GRP	-1.40e-07 (0.824)	4.82e-07 (0.348)	
Poverty	0.0036 (0.179)	0.0015 (0.488)	
Unemployment	0.0022 (0.726)	**-0.0235 (0.001)**	**-0.0217 (0.001)**
Price Index	**0.0298 (0.002)**	**1.2875 (0.023)**	**1.3316 (0.015)**
Urban	**0.0061 (0.002)**	**0.0056 (0.001)**	**0.0052 (0.001)**
Migration	-0.00001 (0.973)	0.0056 (0.201)	0.0036 (0.361)
Divorce	-0.0055 (0.810)	-0.0304 (0.116)	
Sex ratio	**-0.0014 (0.005)**	**-0.0012 (0.002)**	**-0.0012 (<0.001)**
Education	-0.0062 (0.141)	-0.0023 (0.498)	
Unemployment x Alcohol		**0.0005 (<0.001)**	**0.0005 (<0.001)**
Migration x Alcohol		**0.00005 (0.003)**	**0.00005 (0.002)**
Migration x Urban		**0.00007 (0.006)**	**0.00008 (0.002)**
Migration x Gini		**-0.0375 (0.002)**	**-0.0332 (0.002)**
Priceind x Priceind		**-0.0056 (0.025)**	**-0.0058 (0.016)**
Adjusted R^2	0.67	0.81	0.81

Note: Numbers in parentheses are P values.

For women significant predictors of mortality with negative effect were proportion of

Russians, interaction of alcohol with unemployment, price index and proportion of urban population. A significant predictor of female mortality with positive influence (decreasing mortality) was an excess of women over men in a given population (Table 4). These findings suggest that complex socio-economic factors affect mortality at working age in Russia in addition to the ethnicity.

At the same time it was shown that alcohol-related mortality is higher among ethnic Russians compared to Central Asian ethnic groups and Estonians (Leinsalu *et al.* 2004; Guillot *et al.* 2007). In this case one may expect that proportion of ethnic Russians in region should be correlated with a proxy for alcohol consumption. Also, external causes of death (like injuries or homicide) should strongly depend on the proportion of Russians in region when alcohol is removed from the equation.

Table 5 shows adjusted (partial) correlation coefficients of the proportion of Russians with other important socio-economic variables and alcohol. Note that correlation of Russians with alcohol is not statistically significant, although it positive. Much more significant is correlation of Russians with divorce rate, which supports the existing hypothesis that stress may be a factor of mortality crisis in Russia (Shkolnikov *et al.* 1998).

Table 5. Adjusted (partial) correlation coefficients of the proportion of Russians in population with other variables.

Variable	Correlation coefficient	p-value
Alcohol	0.21	0.082
Gini	0.14	0.252
GRP	**-0.26***	**0.036**
Unemployment	-0.16	0.194
Urban	0.16	0.180
Price Index	0.09	0.482
Poverty	-0.03	0.797
Migration	**0.25***	**0.043**
Divorce	**0.55*****	**<0.001**
Sex ratio	0.15	0.234
Education	-0.006	0.962

Also note that more ethnic Russians live in economically depressed regions with low GRP. These data do not support a hypothesis that higher proportion of Russians is associated with more drinking in a particular region.

We also conducted a regression analysis for several external causes of death (used as outcome variables in a log scale): homicide, suicide and all injuries combined. In all three cases alcohol consumption was a strong predictor variable for these external causes of death while proportion of Russians was not a statistically significant predictor. Table 6 shows results of such calculations for logarithm of male homicide mortality at working age used as a dependent variable.

Table 6. Results of Model Estimation for Regional Male Homicide Rates at Working Age Regressed on proportion of Russians, Alcohol Consumption and Socio-Economic Variables: Russia 2003.

Variable	Model 1	Model 2	Model 3
Constant	1.0719 (0.788)	4.0233 (0.246)	5.6363 (0.071)
Russians	0.0054 (0.167)	0.0018 (0.599)	0.0031 (0.305)
Alcohol		**0.0080 (<0.001)**	-0.0053 (0.122)
Gini	1.3202 (0.514)	2.2863 (0.190)	0.2184 (0.892)
GRP	-2.06e-07 (0.916)	-1.26e-06 (0.458)	-3.98e-07 (0.793)
Unemployment	0.0221 (0.275)	0.0205 (0.237)	-0.0325 (0.101)
Price Index	0.0490 (0.102)	0.0173 (0.509)	0.0088 (0.705)
Urban	**0.0117 (0.053)**	**0.0128 (0.015)**	**0.01103 (0.018)**
Migration	-0.0010 (0.502)	0.0004 (0.772)	-0.0007 (0.561)
Divorce	-0.0944 (0.197)	-0.0114 (0.859)	-0.0265 (0.643)
Sex ratio	-0.0025 (0.095)	**-0.0031 (0.020)**	**-0.0024 (0.044)**
Education	**-0.0483 (<0.001)**	**-0.0326 (0.007)**	**-0.0346 (0.001)**
Unemployment x Alcohol			**0.0011 (<0.001)**
Adjusted R^2	0.23	0.44	0.56

Note: Numbers in parentheses are P values.

Results in Table 6 demonstrate that proportion of urban population as well as interaction of alcohol consumption with unemployment have significant effect on increasing homicide mortality while female excess in population and educated workforce decrease homicide mortality.

The role of alcohol in mortality from external causes of death in Russia was shown by many studies before (McKee *et al.* 2001; Pridemore 2002). When alcohol variable was removed from our set of variables, the proportion of Russians still remained to be a non-significant predictor for homicide mortality (Table 6). Table 6 shows results of the regression analysis for homicide mortality at working age. Note that educated workforce is the best explanatory variable for homicide mortality, leading to decreased homicide mortality rates.

Discussion and Conclusions

Our study supports previous findings that ethnic Russians have higher mortality compared to many other ethnic groups. However, a common explanation of this phenomenon through a higher propensity of Russians to drink strong liquors is probably too simplistic. Our study shows that many socio-economic factors affect mortality in different regions of Russia and factors related to stress may provide better explanation to the observed ethnic mortality differentials.

We need to admit that our study has several limitations. First of all, this is a cross-sectional study that shows associations but does not prove cause and effect relationship. Also the level of aggregation in our study data does not permit to find specific pathways through which ethnic Russians show elevated mortality compared to other ethnic groups. The results, however, are consistent with the existing literature about higher mortality of ethnic Russians compared to many other ethnic groups. The observed ethnic differences need to be studied in a particular socio-economic context. Although we observe a correlation between the proportion of ethnic Russians and mortality, it may be interesting to consider some marked exceptions. First of all, in some cases a high proportion of Russians in population may be consistent with low mortality. For example, Moscow city has almost 85 percent of ethnic Russians in population, yet it shows relatively high life expectancy (for Russia) due to better living standards and infrastructure: 66.1 years for men and 75.7 years for women. Our study of individual death certificates showed that the resident population of Moscow (without migrants) demonstrates even better life expectancy, which is close to life expectancy observed in European countries. One possible explanation of this phenomenon is the fact that Moscow city has one of the most educated workforce in the country. The opposite example is related to the mortality in Tyva. This region has one of the lowest life expectancy in Russia (51.2 years for men and 62.5 years for women) and low proportion of ethnic Russians (20%). Studies showed that some ethnic groups in Russia (indigenous nations of Russian North and Siberia in particular) have exceptionally high mortality. A similar phenomenon is observed in the United States for American Indians. Thus, it would be incorrect to consider a relatively high mortality of adult Russians

as a general phenomenon related to heavy drinking.

Higher proportion of ethnic Russians in total population is positively correlated with mortality at adult ages in a particular region. Multivariate analysis showed that this finding is robust and it is still observed when controlled for the effects of other important explanatory variables: alcohol consumption, socio-economic factors, migration rate, divorce rate and workforce education. Although the proportion of Russians is a significant predictor of total mortality at working ages, it does not affect external mortality and is not correlated with alcohol consumption.

References

Anderson BA (2002). Russia faces depopulation? Dynamics of population decline. *Population and Environment*. **23**, 437-464.

Andreev E, Dobrovolskaya VM , Shaburov KY (1992). Ethnic differentiation of mortality. *Sociologic Studies [In Russian]*. **7**, 43-49.

Brainerd E (1998). Market reform and mortality in transition economies. *World Dev*. **26**, 2013-2027.

Brainerd E , Cutler DM (2005). Autopsy on an empire: Understanding mortality in Russia and the former Soviet Union. *J Econ Perspect*. **19**, 107-130.

Chen LC, Wittgenstein F , McKeon E (1996). The upsurge of mortality in Russia: Causes and policy implications. *Popul Dev Rev*. **22**, 517-530.

Federal State Statistics Service of Russia (2004). *Results of All-Russia population census-2002. Vol. 4, Book 1. National composition, knowledge of languages and citizenship.* Moskva: I&P Center "Statistics of Russia".

Federal State Statistics Service of Russia (2006). *Regions of Russia. Socio-economic Indicators - 2005.* Moscow: Rosstat.

Guillot M, Gavrilova NS , Pudrovska T (2007). Explaining the "Russian Mortality Paradox". In *Annual Meeting of the Population Association of America*ed^eds). New York.

Ivanova AE, Semyonova VG, Gavrilova NS, Evdokushkina GN, Gavrilov LA , Demchenko TA (2002). Mortality patterns of the Russian population in the 1990s and potential for mortality decline: dynamics and prognosis. [In Russian]. *Disease Prevention and Health Promotion*. **3**, 9-19.

Lang K, Vali M, Szucs S, Adany R , McKee M (2006). The composition of surrogate and illegal alcohol products in Estonia. *Alcohol Alcohol.* **41**, 446-450.

Leinsalu M, Vagero D , Kunst AE (2004). Increasing ethnic differences in mortality in Estonia after the collapse of the Soviet Union. *J Epidemiol Commun H*. **58**, 583-589.

McKee M, Shkolnikov V , Leon DA (2001). Alcohol is implicated in the fluctuations in cardiovascular disease in Russia since the 1980s. *Ann Epidemiol*. **11**, 1-6.

Novoselsky SA (1916). Review of the most important data on demography and health statistics of Russia. In *Calendar for physicians for year 1916. Part II.*). St. Petersburg, pp. 66-67.

Pomerleau J, Mckee M, Rose R, Haerpfer CW, Rotman D , Tumanov S (2008). Hazardous alcohol drinking in the former soviet union: a cross-sectional study of eight countries. *Alcohol Alcohol.* **43**, 351-359.

Pridemore WA (2002). Vodka and violence: Alcohol consumption and homicide rates in Russia. *Am J Public Health*. **92**, 1921-1930.

Rabe-Hesketh S , Everitt BS (2007). *A Handbook of Statistical Analyses Using Stata.* Boca Raton, FL: Taylor & Francis.

Shkolnikov L, McKee M , Leon DA (2001). Changes in life expectancy in Russia in the mid-1990s. *Lancet*. **357**, 917-921.

Shkolnikov VM, Andreev EM, Leon DA, McKee M, Mesle F , Vallin J (2004). Mortality reversal in Russia: the story so far. *Hygiea Internationalis*. **4**, 29-80.

Shkolnikov VM, Cornia GAA, Leon DA , Mesle F (1998). Causes of the Russian mortality crisis: Evidence and interpretations. *World Dev*. **26**, 1995-2011.

Tomkins S, Allen E, Savenko O, McCambridge J, Saburova L, Kiryanov N, Oralov A, Gil A, Leon DA, Mckee M , Elbourne D (2008). The HIM (Health for Izhevsk men) trial protocol. *Bmc Health Services Research*. **8**, -.