

## Russian mortality trends for 1991-2001: analysis by cause and region

Tamara Men, Paul Brennan, Paolo Boffetta, David Zaridze

### Abstract

**Objectives** To investigate trends in Russian mortality for 1991-2001 with particular reference to trends since the Russian economic crisis in 1998 and to geographical differences within Russia.

**Design** Analysis of data obtained from the Russian State statistics committee for 1991-2001. All cause mortality was compared between seven federal regions. Comparison of cause specific rates was conducted for young (15-34 years) and middle aged adults (35-69 years). The number of Russian adults who died before age 70 in the period 1992-2001 and whose deaths were attributable to increased mortality was calculated.

**Main outcome measures** Age, sex, and cause specific mortality standardised to the world population.

**Results** Mortality increased substantially after the economic crisis in 1998, with life expectancy falling to 58.9 years among men and 71.8 years among women by 2001. Most of these fluctuations were due to changes in mortality from vascular disease and violent deaths (mainly suicides, homicides, unintentional poisoning, and traffic incidents) among young and middle aged adults. Trends were similar in all parts of Russia. An extra 2.5-3 million Russian adults died in middle age in the period 1992-2001 than would have been expected based on 1991 mortality.

**Conclusions** Russian mortality was already high in 1991 and has increased further in the subsequent decade. Fluctuations in mortality seem to correlate strongly with underlying economic and societal factors. On an individual level, alcohol consumption is strongly implicated in being at least partially responsible for many of these trends.

### Introduction

The huge fluctuations in Russian mortality during the 1990s have attracted much interest.<sup>1-3</sup> Although Russian adult mortality was relatively high in 1991 compared with levels in western Europe, it increased rapidly in the immediate period after the break up of the Soviet Union, with a more marked increase among men. Subsequent to this, a sharp improvement was observed in the period 1995-8. Analyses of these trends identified vascular diseases and external causes as being responsible for most of the changes and focused on the role of alcohol and socioeconomic

stress related to rapid economic changes.<sup>1-6</sup> Individual level information on possible aetiological factors is, however, limited.

Russia experienced a further economic crisis in 1998, including rapid devaluation of its currency and increases in poverty. This economic crisis coincided with a further increase in adult mortality in the three years up to 2001, with life expectancy falling to 58.9 among men and 71.8 among women, levels similar to the low points reached in 1994. The cause of this recent dramatic decrease in life expectancy is not known. We examined the disease specific trends during this period to clarify these unique patterns.

### Methods

We obtained data from the Russian State statistics committee, including deaths by cause, sex, five year age group, and calendar year together with corresponding population denominators. Causes of death in Russia were coded with the Soviet system of disease classification up to 1998, with each category corresponding to groups of items in ICD-9 (international classification of diseases, ninth revision).<sup>7</sup> From 1999, a new system based on the 10th revision (ICD-10) was introduced.<sup>8</sup> Table 1 shows the major groups of the Soviet and Russian classification systems and the corresponding ICD-9 and ICD-10 codes.

We analysed trends of total and cause specific mortality for 1991-2001 for Russia overall and for seven federal regions, five in European Russia (North Western, Central, Privolzhski, Southern, and Uralski) and two in Asian Russia (Siberian and Far Eastern). We excluded data on Chechenskaya and Ingushskaya republics from the Southern region because of war. All death rates were standardised to the world standard population.<sup>9</sup>

### Results

#### Mortality by age, sex, and cause

Age standardised mortality from all causes increased between 1998 and 2001 by 189/100 000 among men and 49/100 000 among women (table 2). Similar to the increase in mortality in 1991-4 and the decrease up to 1998, over 80% of the 1998-2001 increase was due to changes in those aged 35-69 years (middle age). However, an increase in mortality was also observed among younger adults, which is important given the lower

Institute of Carcinogenesis, Cancer Research Centre, Kashirskoye Shosse 24, 115478 Moscow, Russia  
 Tamara Men  
*scientist*  
 David Zaridze  
*director*  
 International Agency for Research on Cancer, 150 cours Albert-Thomas, 69008 Lyons, France  
 Paul Brennan  
*scientist*  
 Paolo Boffetta  
*unit chief*

Correspondence to: P Brennan  
 brennan@iarc.fr

bmj.com 2003;327:964

**Table 1** Causes of death used in analysis of change in mortality in Russia

Cause	Russian classification 1988-98	ICD-9	Russian classification 1999-2001	ICD-10
Infectious and parasitic diseases:	1-44	001-139	1-19,22-55	A00-A32,A35-A99,B00-B99
Tuberculosis	9-13	010-018	9-15	A15-A19
Cancer:	45-66	140-208	56-88	C00-C97
Lip, oral cavity, pharynx	45	140-149	56	C00-C14
Oesophagus	46	150	57	C15
Stomach	47	151	58	C16
Colon	49	153	60	C18
Rectum	50	154	61	C19-C21
Larynx	52	161	65	C32
Trachea, bronchus, lung	53	162	66	C33,C34
Breast	57	174	72	C50
Cervix	58	180	73	C53
Prostate	61	185	77	C61
Urinary tract	63	188,189.0	79-81	C64-C68
Leukaemia	65	204-208	87	C91-C95
Diseases of blood and blood forming organs	71,72	280-289	90-92	D50-D89
Endocrine, nutritional, metabolic diseases:	68-70	240-279	93-96	E00-E90
Diabetes mellitus	68	250	93	E10-E14
Mental and behaviour disorders:	73-77	290-319	97-103	F01-F99
Due to use of alcohol	73,75	291,303	97,98	F10
Diseases of nervous system and sense organs	78-83	320-389	104-111	G00-G98
Diseases of circulatory system:	84-102	390-459	115-147	I00-199
Rheumatic heart disease	84,85	390-398	115,116	I00-I02,I05-I09
Hypertensive disease	86-89	401-405	117-120	I10-I13,I15
Ischaemic heart disease	90-95	410-414	121-129	I20-I23,I24.1-9,I25.1-9
Cerebrovascular disease	98,99	430-438	133-141	I60-I69
Diseases of respiratory system:	20,103-114	034,460-519	148-164	J00-J99
Acute respiratory infections	103	460-466	148,155	J00-J01,J02.8-9,J20-J22
Pneumonia	105-107	480-483,485,486	151-153,154	J12-J16,J18
Chronic lower respiratory diseases	108-110	490-496	156-160	J40-J47
Lung diseases due to external agents	111	500-508	161	J60-J70
Suppurative and necrotic conditions of lower respiratory tract	112	510,513	163	J85,J86
Diseases of digestive system:	115-127	520-579	165-179	K00-K93
Alcohol liver diseases	122	571.0-571.3	173	K70
Non-alcoholic fibrosis and cirrhosis of liver	123	571.5-571.6	174	K74
Gastric and duodenal ulcer	115,116	531-533	165-167	K25-K27
Gastritis and duodenitis	117	535	168	K29
Diseases of appendix	118	540-543	169	K35-K38
Hernia	119	550-553	170	K40-K46
Non-infective enteritis and colitis	120	555-558	171	K50-K52
Intestinal obstruction	121	560	172	K56
Cholelithiasis and cholecystitis	124	574,575.0	176,177	K80,K81
Diseases of pancreas	126	577	178	K85,K86
Diseases of urinary system:	128-132	580-599	185-191	N00-N39
Urolithiasis	131	592,594	190	N20-N23
Pregnancy, childbirth, puerperium	135-141	630-676	21,194-205	A34,000-099
Perinatal conditions	151-157	764-779	206-216	P05-P96
Congenital anomalies	145-150	740-759	217-225	Q00-Q99
Symptom, senility, ill defined, unknown cause	158,159	780-799	226-228	R00-R99
All external causes:	160-175	E800-E999	239-255	V01-Y89
Transport incidents	160,161,162	E800-E807,E810-E848	239,240,241	V01-V99
Unintentional poisoning by alcohol	163	E860	247	X45
Other unintentional poisoning	164	E850-E858,E861-E869	248	X40-X44,X46-X49
Falls	166	E880-E888	242	W00-W19
Incidents caused by fire	167	E890-E899	246	X00-X09
Unintentional drowning	168	E910	243	W65-W74
Suicides	173	E950-E959	249	X60-X84
Homicides	174	E960-E969	250	X85-V09
Injury of undetermined intent	175	E980-E989	251	Y10-Y34

**Table 2** Contribution of deaths at different ages to change of standardised mortality rate in Russia (per 100 000)

Ages (years)	Mortality 1991	Change (%) 1991-4	Change (%) 1994-8	Change (%) 1998-2001
<b>Men</b>				
All ages	1 184	459 (100)	-323 (100)	189 (100)
0-14	213.7	0.9 (0.2)	-2 (0.7)	-1 (-0.5)
15-24	216.3	15 (3.2)	-2 (0.6)	3 (1.6)
25-34	316.1	35 (7.5)	-18 (5.6)	16 (8.5)
35-69	1 789	349 (75.9)	-237 (73.2)	152 (80.4)
≥70	10 430	60 (13.2)	-64 (19.9)	18 (9.5)
<b>Women</b>				
All ages	584.1	152 (100)	-98 (100)	49 (100)
0-14	146.8	3 (1.8)	-1 (1.0)	-1 (-2.2)
15-24	69.9	4 (2.3)	-0.1 (0.1)	1 (2.2)
25-34	96.9	7 (4.8)	-2 (2.4)	2 (4.4)
35-69	674.9	97 (63.8)	-69 (70.0)	40 (81.6)
≥70	70 492	42 (27.3)	-26 (26.5)	7 (14.2)

underlying mortality. We therefore restricted analysis of these trends to young and middle aged adults.

All cause mortality in the 15-34 age group in 2001 was similar to that observed in 1994 among both men and women, with the modest improvements in the years up to 1998 having been completely reversed (table 3). Most of the increase in the mortality trends in the period 1998-2001 could be explained by trends in deaths from external causes, the most important being, in order of magnitude, an increase in suicide, traffic incidents, homicide, unintentional poisoning by alcohol, and falls. Other notable features include a modest increase in men and women of death from circulatory disease as well as an increase in infectious diseases, the latter representing a constant increase over the period

1991-2001 that was due almost entirely to tuberculosis. Finally, mortality from cancer changed little over the 10 year period.

In middle aged adults (35-69 years) total mortality in 2001 was 21% higher for men and 15% higher for women than in 1998. The large increase between 1998 and 2001 seemed to be predominantly due to the same causes of death that were responsible for the previous increase between 1991 and 1994 and the subsequent decrease between 1994 and 1998—namely, diseases of the circulatory system and external causes. Of the former, the increase in mortality from cerebrovascular diseases during 1998-2001 was almost identical to the drop in mortality during 1994-8 among both men and women. The increase in mortality from ischaemic

**Table 3** Death rate by selected causes at age 35-69 years per 100 000 (standardised to world population)

Cause of death	Age 15-34 years								Age 35-69 years							
	Men				Women				Men				Women			
	1991	1994	1998	2001	1991	1994	1998	2001	1991	1994	1998	2001	1991	1994	1998	2001
All causes	298	457	392	454	82.1	117	109	124	1789	2814	2117	2566	674	959	756	873
Infectious diseases:																
All	6.5	11.2	15.9	21.6	2.1	3.1	4.3	5.6	34	64.2	58	74.1	4.6	9	7.2	10.7
Tuberculosis	5.2	9.2	13.2	17.5	1.1	1.7	2.9	3.6	30.4	55.5	53.9	68	2.5	4.6	5	7.6
All cancer	12.7	13.3	12.6	11.6	12.4	12.2	11.9	11.6	447	455	403	384	194	201	189	187
Circulatory system:																
All	20.6	38.4	30.7	35.9	7	11	8.9	11.2	734	1180	905	1121	305	452	354	417
Ischaemic disease	8.9	16.9	10.6	11.9	1.4	3.0	1.9	2.4	433.2	688.9	508.6	616.3	128.4	202	148	176
Cerebrovascular	3.6	5.1	4.4	5.1	2.1	2.4	2.1	2.6	204	302.4	256.9	300.7	123.6	167	145.7	159.7
Respiratory system:																
All	4.2	9.4	8.0	11.3	2.3	3.5	3.0	4.1	102	193	118	155	23.1	34.4	22.4	26.7
Pneumonia	2.1	6.0	5.1	8.8	0.9	1.8	1.6	2.9	15.6	60.9	37.9	77.1	3.6	10.3	6.8	13.4
Chronic diseases	1.0	1.2	1.0	0.9	0.8	0.9	0.6	0.5	60.2	88.6	59.1	63.8	14.5	17.2	11.7	10.8
Digestive system:																
All	4.6	9.9	7.8	11.7	1.8	3.3	2.8	4.3	60	106	84.1	107	24.8	43.6	33.3	46
Alcohol liver disease	0.1	0.4	0.4	1.5	0.0	0.1	0.1	0.7	0.9	5.2	4.0	13.6	0.2	1.7	1.3	5.8
Liver cirrhosis	0.9	2.4	1.9	3.0	0.5	1.1	1.0	1.4	22.0	43.8	31.7	38.1	9.5	21.1	15.0	20.5
External causes:																
All	229	341	287	320	40	64.3	61.9	67.9	336	657	446	567	73.4	146	95.9	121
Transport incidents	63.5	59.1	46.5	52.7	11.6	13.7	13.6	15.1	60.6	55.1	41.1	52	14.4	13.1	11.4	14.1
Alcohol poisoning	8.8	25.8	12.5	17.4	0.9	4.1	2.4	3.5	39.1	123.5	57.6	90.2	9.1	33.8	14.7	24.2
Other poisoning	8.0	14.1	22.0	25.7	2.5	4.0	4.7	5.8	22.1	33.6	27.6	31.4	4.8	7.7	5.8	6.5
Falls	5.2	6.8	4.5	9.1	0.9	1.4	1.1	2.4	10.2	16.9	9.5	25.7	1.9	3.2	1.9	4.4
Fire	3.1	4.5	3.7	5.4	0.8	1.3	1.0	1.6	7.2	15.6	12.6	20.7	2.0	4.0	3.1	4.8
Drowning	16.9	23.0	21.4	22.4	1.8	2.8	3.7	3.6	18.1	27.5	23.1	27.1	2.0	3.4	3.1	3.7
Suicide	41.2	68.3	62.0	72.9	7.0	10.1	8.9	10.2	67.2	114.9	88.3	96.8	13.9	17.6	13.8	13.3
Homicide	33.3	60.0	41.4	46.6	6.7	12.5	11.0	13.0	31.5	72.9	48.8	66.6	9.3	20.9	13.4	17.6
Other	49	79.4	73	77.8	7.8	14.4	15.5	12.7	80	197	137.4	156.5	16	42.3	28.7	32.4

heart disease during 1998-2001 was also dramatic, although it was smaller than the 1994-8 decrease.

The primary causes of death from external causes among men aged 35-69 years in 2001 were, in order of magnitude, suicide, unintentional poisoning by alcohol, homicide, and transport incidents. All numbers of deaths from these causes increased substantially in the period 1998-2001, although were all slightly lower than the peak reached in 1994. The largest absolute increase was for unintentional poisoning by alcohol, which increased from 57.6/100 000 in 1998 to 90.2/100 000 in 2001. Among women, the primary causes of death from external causes were unintentional poisoning by alcohol and homicide, both of which increased in the period 1998-2001, although to a far lesser degree than among men.

In 1998-2001 mortality from diseases of the respiratory system also increased, mainly due to an increase in death from pneumonia. Mortality from digestive diseases, mostly alcohol induced liver disease and cirrhosis, and from infectious diseases, mostly tuberculosis, increased moderately.

The one disease category that did not follow these trends was cancers, with moderate decreases among men and a constant rate among women during 1998-2001, after more substantial decreases in 1994-8. These decreasing trends among men were largely explained by decreases in mortality from lung cancer and stomach cancer.

### Mortality by region

When we compared all cause mortality between the seven different Russian regions, there were similar temporal trends (fig 1). High rates were consistently observed for the Siberian and Far Eastern regions, whereas the Southern region experienced a considerably lower rate. These temporal trends should be interpreted in the context of the health experience of countries in the same region, and we have included the mortality for Finland and the Czech Republic for comparative purposes (rates are not currently available for 2001 for either country). In 1991, mortality in Russian men was about 20% higher than in the Czech Republic, although mortality then decreased in the Czech Republic, resulting in an age standardised mortality in Russia in 2000 of 1484/100 000 that was 100% higher than that in the Czech Republic (733/100 000). The comparison with Finland, with which Russia shares a border, is also illustrative. Mortality also decreased in Finland over the period 1991-2001, although at a slower rate than in the Czech Republic, resulting in a lessening in the mortality gap between Finland and the Czech Republic and a large widening of the gap between Finland and Russia. In 2000, age standardised mortality in Russia was over twice as much as in Finland for men (1484 and 589/100 000 respectively) and women (678 and 333/100 000 respectively).

Finally, we calculated the numbers of extra premature adult deaths (that is, age 15-69 years) in the period 1992-2001 on the basis of two different scenarios: the number of premature adult deaths that would have occurred if mortality in 1992-2001 had stayed constant at the level of 1991, and if Russian mortality in the period 1992-2001 had decreased at a similar level to that seen in the Czech Republic, about 3% per year (fig 2). Of the 8 317 789 premature deaths in men and

the 3 699 717 premature deaths in women that occurred among adults aged 15-69, about 2 142 000 in men and 625 000 in women would have been avoided if mortality had stayed constant at 1991 levels. Furthermore, an additional 864 000 premature deaths in men and 402 000 premature deaths in women would have been prevented if Russian mortality had decreased as it did in the Czech Republic.

### Discussion

The increase in Russian mortality in 1998-2001 followed a cause specific pattern similar to that seen in the earlier increase in 1991-4 and decrease in 1995-8, with external causes and circulatory disease explaining the large proportion of these trends. The increase in mortality was most apparent among young and middle aged men, and similar changes in mortality were observed in all parts of Russia. The increase in mortality over the period 1992-2001 is likely to have led to 2.5-3 million extra deaths in young and middle aged Russian adults.

The reasons behind the trends in mortality between 1991 and 1998 have been discussed previously in detail.<sup>1-6</sup> In particular, the trends are unlikely to have been artefactual because of trends in data collection or underestimation of the Russian population,<sup>1,2</sup> especially given the relatively constant mortality for all neoplasms combined. Furthermore, even though Russian mortality may have been overestimated in the past decade due to a large number of new non-resident immigrants who are not counted in population estimates,<sup>10</sup> the strong consistency of these results across the Russian geographical regions would also argue strongly against an artefactual explanation due to population movement or misclassification.

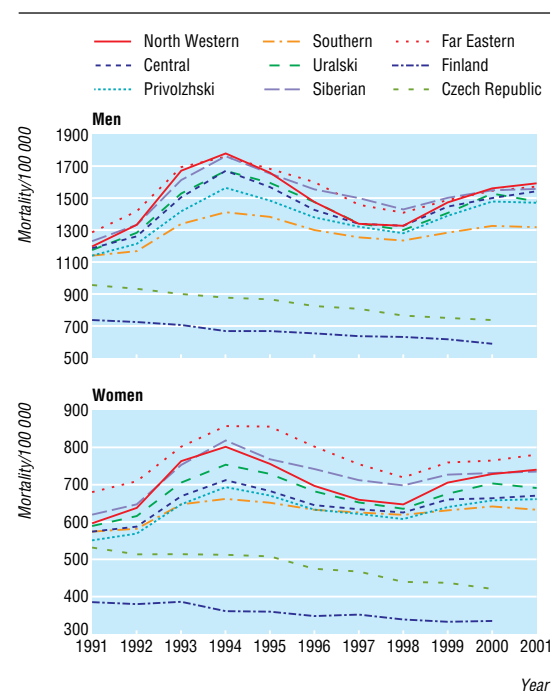
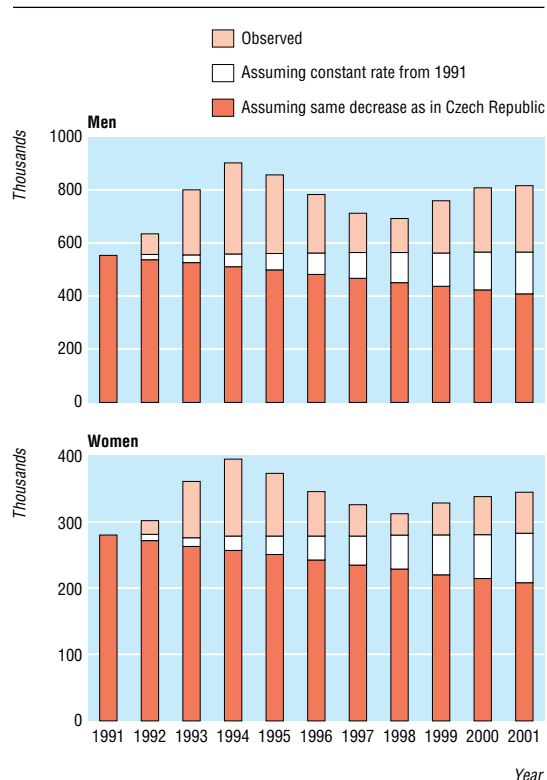


Fig 1 Age standardised mortality from all causes by region



**Fig 2** Observed and expected mortality in young and middle aged Russian adults 1991-2001. Data for men from 8 317 789 observed, 6 175 768 assuming constant rate from 1991, and 5 311 486 assuming same decrease as in Czech Republic. For women numbers were 3 699 717, 3 074 790, and 2 672 962

### The role of lifestyle factors

Attention has previously focused on the role of lifestyle factors associated with rapid economic change as possible causes of these mortality trends, in particular alcohol consumption and "socioeconomic stress" associated with having to survive in a challenging economic climate. The role of alcohol consumption in explaining a large part of the mortality trends would appear reasonable. The largest relative changes have been observed for those conditions that are directly related to alcohol—namely, unintentional poisoning by alcohol and liver cirrhosis. Poisoning by alcohol is likely to be a good measure of heavy (or binge) alcohol consumption in the population. Regarding liver cirrhosis, that short term trends can be influenced by recent changes in alcohol consumption may seem surprising given the chronic nature of the disease, although it is not without precedent. A similar phenomenon was reported in Paris during the German occupation of the second world war, when a shortage of alcohol in 1942 led to a large drop in mortality from liver cirrhosis in the following year.<sup>11</sup>

While changes in mortality from external causes were the main determinant for changes in overall mortality among young adults, trends in circulatory disease are primarily responsible for mortality trends in middle aged adults, in particular ischaemic heart disease and cerebrovascular disease. Regarding the latter, alcohol consumption strongly increases the risk of haemorrhagic stroke, although the association with ischaemic stroke is less clear.<sup>12</sup> One might therefore

predict that the overall trends are likely to be due to changes in haemorrhagic stroke. Regarding ischaemic heart disease, studies conducted among Western populations have consistently shown a protective effect for moderate alcohol consumption. However, in Russia heavy alcohol consumption and binge drinking are common, and the effects of binge drinking on lipids, coagulation and myocardial cells are probably different from the effects of regular drinking,<sup>13 14</sup> resulting in an association between ischaemic heart disease and binge drinking that may be the inverse of the association with moderate alcohol consumption. Furthermore, there is evidence that heavy alcohol consumption can cause sudden death due to arrhythmias and cardiomyopathies.<sup>5</sup> A possible association with binge drinking is also supported by an increase in cardiovascular mortality in Moscow during weekends,<sup>4</sup> similar to findings from Scotland.<sup>15</sup> The other disease categories that show substantial temporal variation include respiratory infections, in particular pneumonia, and also tuberculosis. Again, there is evidence for a link between alcohol consumption and mortality from these diseases,<sup>16</sup> possibly acting through an immunosuppressive effect of heavy alcohol consumption.

### Societal factors

Other proposed explanations for these rapid mortality changes include lifestyle and societal factors linked to general economic and political uncertainty.<sup>5</sup> The rapid transition from a state controlled communist society to a capitalist society, which started in 1991 with rapid relaxation of economic controls, was combined with much political and societal uncertainty and resulted in devaluation of the currency, hyperinflation, increasing inequality, and removal of most forms of job protection. After some general improvement in the period 1994-8, a second economic crisis occurred in

### What is already known on this topic

Adult mortality in Russia increased rapidly in the immediate period after the collapse of the former Soviet Union and fell rapidly in the period 1995-8

Vascular diseases and external causes were responsible for most of these changes, probably influenced by changes in alcohol consumption

Subsequent to the economic crisis in 1998, mortality increased again, with life expectancy falling to 58.9 among men and 71.8 among women by 2001

### What this study adds

The increase in mortality in 1998-2001 followed a similar cause specific pattern to the increase in 1991-4

Trends were similar in all parts of the Russian Federation

An estimated extra 2.5-3 million Russian adults died in middle age in the period 1992-2001 than would have been expected based on 1991 mortality



July-August 1998, which again resulted in further devaluation of the currency, an increase in inflation, and further political and economic uncertainty. Although the effect on mortality patterns seems to have been immediate, what remains to be identified is the exact role of rapid changes in alcohol consumption as opposed to other less clearly defined factors such as perceived lack of control over outside events, an increase in social stress, or a breakdown in trauma care.

### Prospects

The changes in Russian mortality in the 1990s are unprecedented in a modern industrialised country in peacetime, and analysis of the cause of these changes is fundamentally important to understand the link between rapid economic change and health and also to help prevent similar future changes in Russia and other countries in transition. While analyses of mortality trends can highlight the problem, they cannot explain the reason, and large prospective epidemiological studies in Russian populations with individual level data are clearly required. With regard to future mortality trends in Russia, it is clear that a period of constant economic stability is required. One sign of optimism is that while mortality increased between 2000 and 2001, among young adults overall mortality decreased, indicating that the most recent part of this story may have turned another corner.

Contributors: TM, PBr, PBo, and DZ designed the study. TM collected the data and conducted the analysis. PBr wrote the first draft of the manuscript, and TM, PBo, and DZ contributed to all editions of the manuscript. Figures were produced by G Ferro and TM. DZ is guarantor.

Funding: TM was partially funded by the INCO-Copernicus-2 programme of the European Commission (contract number ICA2-CT2001-10002).

Competing interests: None declared.

- 1 Leon DA, Chenet L, Shkolnikov VM, Zakharov S, Shapiro J, Rakhmanova G, et al. Huge variations in Russian mortality rates 1984-94: artefact, alcohol, or what? *Lancet* 1997;350:383-8.
- 2 Shkolnikov V, McKee M, Leon DA. Changes in life expectancy in Russia in the mid-1990s. *Lancet* 2001;357:917-21.
- 3 Mesle F. Mortality in Eastern Europe and the former Soviet Union: long term trends and recent upturns. Presented at IUSSP/MPIDR Workshop, June 19-21 2002. [www.demogr.mpg.de/Papers/workshops/020619\\_paper27.pdf](http://www.demogr.mpg.de/Papers/workshops/020619_paper27.pdf) (accessed 23 July 2003).
- 4 Chenet L, McKee M, Leon D, Shkolnikov V, Vassin S. Alcohol and cardiovascular mortality in Moscow: new evidence of a causal association. *J Epidemiol Community Health* 1998;52:772-4.
- 5 Britton A, McKee M. The relation between alcohol and cardiovascular disease in Eastern Europe: explaining the paradox. *J Epidemiol Community Health* 2000;54:328-32.
- 6 Walberg P, McKee M, Shkolnikov V, Chenet L, Leon D. Economic change, crime, and mortality crisis in Russia: regional analysis. *BMJ* 1998;317:312-8.
- 7 World Health Organization. *International classification of diseases, 1975 revision (ICD-9)*. Geneva: World Health Organization, 1977.
- 8 World Health Organization. *International classification of diseases and related health problems, tenth revision (ICD-10)*. Geneva: World Health Organization, 1992.
- 9 dos Santos Silva I. *Cancer epidemiology: principles and methods*. Lyons: International Agency for Research on Cancer, 1999.
- 10 Zbarskaya I. Methodology of the census: traditions and innovations. *Economica Rossyi: XXI Century* 2002;9 (Oct):12-20. (In Russian.)
- 11 Fillmore KM, Roizen R, Farrell M, Kerr W, Lemmens P. Wartime Paris, cirrhosis mortality, and the ceteris paribus assumption. *J Stud Alcohol* 2002;63:436-46.
- 12 Mazzaglia G, Britton AR, Altmann DR, Chenet L. Exploring the relationship between alcohol consumption and non-fatal or fatal stroke: a systematic review. *Addiction* 2001;96:1743-56.
- 13 McKee M, Shkolnikov V, Leon DA. Alcohol is implicated in the fluctuations in cardiovascular disease in Russia since the 1980s. *Ann Epidemiol* 2001;11:1-6.
- 14 McKee M, Britton A. The positive relationship between alcohol and heart disease in eastern Europe: potential physiological mechanisms. *J R Soc Med* 1998;91:402-7.
- 15 Evans C, Chalmers J, Capewell S, Redpath A, Finlayson A, Boyd J, et al. "I don't like Mondays"—day of week of coronary heart disease deaths in Scotland: study of routinely collected data. *BMJ* 2000;320:218-9.
- 16 Doll R, Peto R, Hall E, Wheatley K, Gray R. Mortality in relation to consumption of alcohol: 13 years' observations on male British doctors. *BMJ* 1994;309:911-8.

(Accepted 18 August 2003)