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Infant mortality trends in a region of Belarus, 1980–2000

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Abstract

Background: The Chernobyl disaster in 1986 and the breakup of the former Soviet Union (FSU) in 1991 challenged the public health infrastructure in the former Soviet republic of Belarus. Because infant mortality is regarded as a sensitive measure of the overall health of a population, patterns of neonatal and postneonatal deaths were examined within the Mogilev region of Belarus between 1980 and 2000.

Methods: Employing administrative death files, this study utilized a regional cohort design that included all infant deaths occurring among persons residing within the Mogilev oblast of Belarus between 1980 and 2000. Patterns of death and death rates were examined across 3 intervals: 1980–1985 (pre-Chernobyl), 1986–1991 (post-Chernobyl & pre-FSU breakup), and 1992–2000 (post-Chernobyl & post-FSU breakup).

Results: Annual infant mortality rates declined during the 1980s, increased during the early 1990s, and have remained stable thereafter. While infant mortality rates in Mogilev have decreased since the period 1980–1985 among both males and females, this decrement appears due to decreases in postneonatal mortality. Rates of postneonatal mortality in Mogilev have decreased since the period 1980–1985 among both males and females. Analyses of trends for infant mortality and neonatal mortality demonstrated continuous decreases between 1990, followed by a bell-shaped excess in the 1990's. Compared to rates of infant mortality for other countries, rates in the Mogilev region are generally higher than rates for the United States, but lower than rates in Russia. During the 1990s, rates for both neonatal and postneonatal mortality in Mogilev were two times the comparable rates for East and West Germany.

Conclusions: While neonatal mortality rates in Mogilev have remained stable, rates for postneonatal mortality have decreased among both males and females during the period examined. Infant mortality rates in the Mogilev region of Belarus remain elevated compared to rates for other western countries, but lower than rates in Russia. The public health infrastructure might attempt to assure that prenatal, maternal, and postnatal care is maximized.

Background

The public health infrastructure for the republic of Belarus has been challenged by two notable events occurring within the past two decades. In April 1986, the Chernobyl nuclear power station located in the northern region of Ukraine released large amounts of radioisotopes, including iodine, cesium, strontium, and plutonium, into the atmosphere. Areas receiving the most concentrated radioactive doses were regions of northern Ukraine, southern Belarus, and Russia's Bryansk region [1]. Studies assessing health effects from this event remain ongoing.

In August 1991, the Union of Soviet Socialist Republics (USSR) was dissolved and Belarus became an independent republic. The Belarussians, along with the other nations of the Former Soviet Union (FSU), were forced to respond to stresses related to the political and economic changes subsequent to the dissolution of the USSR. This political change brought about economic and social upheaval with consequences seen in the overall health status of populations in the former-USSR. In Russia, the average life expectancy of both men and women has been reduced to rates at or below those observed in the 1960's [2-4]. Increases have been noted for deaths due to infectious diseases, heart disease and trauma. In addition, maternal mortality and infant mortality rates began to climb, peaking between 1993 and 1994 [2,5,6].

Infant mortality is considered as a sensitive measure of the overall health of a population, although its precise interpretation has been debated [7]. This parameter is thought to reflect an interaction of economic, social, and environmental factors likely to influence the health status of the entire population [8]. Infant mortality rates in Russia reportedly remained essentially stable from the 1970s until the 1990s [2]. Upon the collapse of the USSR, rates began to rise in most republics of the FSU [9]. However, this observed increase may have been due in part to the implementation of an expanded definition of live births, which served to increase denominator figures; economic and social changes brought by the transition were also likely contributors [10].

In the present study, we examine infant mortality overall, as well as neonatal and postneonatal deaths, within the Mogilev region of Belarus between 1980 and 2000.

Methods

Population

The republic of Belarus borders Latvia and Lithuania on the northwest, Russia on the northeast and east, Ukraine to the south, and Poland on the west (see figure 1). Belarus includes a land area of about 80,000 square miles, comparable to the state of Kansas within the United States. Its current population is 10,335,000, distributed

throughout six regions, which are referred to as oblasts within Belarus.

As shown in figure 1, Mogilev Oblast lies in the eastern portion of the republic, with a total population of 1,208,600 persons; [11] about 30% of the population is classified as "rural". The region is heavily industrial and specializes in the refining of oil and chemicals, machine building, metalworking, and food production. Between 1980 and 2000 there was an average of 16,904 live births annually (range 19,642 during 1980 to 11,101 during 2000), accounting for 354,984 person-years of observation for infants in this region.

Source of mortality data

Death certificate information was obtained from the regional registration office in Mogilev. Belarussian administrative law mandates the registration of all deaths so that a death certificate can be issued. Information pertaining to all deaths in Belarus is kept in written logs. These written logs contain fields for name, date of birth, date of death, gender, area (rayon) of residence, location of death (home, hospital, other), completion of autopsy (yes/no) and cause of death. Records contained in these logs were copied for each calendar year included in the study. Following translation, text fields for immediate and contributory causes of deaths were coded to the ninth revision of the International Classification of Diseases (ICD-9) [12]. The entire database included 7,459 deaths among children ages 0-14 years, registered between 1980 and 2000. This report focuses on infant mortality, which accounted for 4672 total deaths.

Definition of infant deaths

Infant deaths included children dying prior to their first birthday (1-364 days of age). These deaths were further sub-divided into neonatal (1-28 days of age) and postneonatal (29-364 days).

Study design

This study utilized a regional cohort design that included all infant deaths occurring among persons residing within the Mogilev oblast between 1980 and 2000.

Analyses

The analytic file was restricted to deaths occurring among children who were residents of Mogilev oblast between 1980 and 2000 and who were less than 1 year of age at time of death. The 21-year period was sub-divided into 3 intervals based on historical events: 1980-1985 (pre-Chernobyl), 1986-1991 (post-Chernobyl & pre-FSU breakup) and 1992-2000 (post-Chernobyl & post-FSU breakup). Further analyses were structured as follows:



Figure 1
 Republic of Belarus, Oblast Regions & Major Cities.

Cause of mortality

Leading causes of infant deaths (overall and by gender) were examined for both neonatal and postneonatal deaths.

Infant death rates

Trends in annual death rates among all infants, neonates (1–28 days at death) and postneonates (29–364 days at death) were examined overall and by gender. Denominator data were based upon official birth enumerations for the Mogilev oblast. The Ministry of Health maintains birth enumerations for each of the six oblasts in Belarus. Average annual death rates were also examined across the specified time intervals: 1980–1985, 1986–1991 and 1992–2000. Rate ratios were calculated using the 1980–

1985 mortality rate as the baseline. While these data are population-based, 95% confidence intervals are included with rate ratios to provide an estimate of precision.

Further analysis of neonatal and postneonatal mortality was completed by comparing mortality rates in the Mogilev region to those in the United States and the Russian Federation. Infant mortality statistics for the United States and the Russian Federation were obtained from the National Center for Health Statistics [10,13]. Data from the Russian Federation was not complete for all years of analysis and not available by gender [10]. Rate ratios, with the Mogilev region serving as the comparison group, were calculated for the United States and the Russian Federation, along with 95% confidence intervals. Linear regres-

Table 1: Infant Deaths (<1 year of age) Mogilev Oblast, Belarus, 1980–2000, by cause & gender.

Males				Females			
Rank	Category (ICD)	#	%	Rank	Category (ICD)	#	%
1	pneumonia	341	12.3%	1	acute viral syndrome/influenza	234	12.4%
2	prematurity	327	11.8%	2	congenital heart defects	207	11.0%
3	acute viral syndrome/influenza	292	10.5%	3	pneumonia	195	10.4%
4	congenital heart defects	284	10.2%	4	prematurity	183	9.7%
5	asphyxia	164	5.9%	5	asphyxia	110	5.8%
6	cardiopulmonary insufficiency	152	5.5%	6	multiple congenital defects	97	5.2%
7	multiple congenital defects	146	5.2%	7	cardiopulmonary insufficiency	94	5.0%
	All other	1082	38.8%		All other	1244	40.5%
	Total	2788	100.0%		Total	1884	100.0%

sion was used to perform trend analyses of infant mortality rates over time. This model included an undisturbed exponential trend (i.e., $c1 * \exp(c2 * t)$) plus a bell-shaped excess $c3 / \exp(((1 - c4) / c5)^2)$.

Results

Causes of death

Between 1980 and 2000, there were 4672 infant deaths in the Mogilev region of Belarus; a majority of these deaths occurred among males (n = 2788, 59.6%). The major causes of infant deaths are shown in Table 1. For male infants, pneumonia (12.3%), prematurity (11.8%), acute viral syndrome/influenza (10.5%), congenital heart defects (10.2%), asphyxia (5.9%), cardiopulmonary insufficiency (5.2%) and multiple congenital defects (5.2%) represented leading causes of death. Among female infants, the leading causes of death were acute viral syndrome (12.4%), congenital heart defects (11.0%), pneumonia (10.4%), prematurity (9.7%), asphyxia (5.8%), multiple congenital defects (5.2%) and cardiopulmonary insufficiency (5.0%).

As shown in table 2, among neonates, prematurity, congenital heart defects, and pneumonia represented the top three causes of deaths for males and females. Postneonatal deaths most commonly resulted from acute viral syndrome/influenza, pneumonia, and congenital heart defects (Table 3).

Trends in annual death rates

Trends in infant, neonatal, and postneonatal mortality rates between 1980 and 2000 are illustrated in Figure 2. Infant death rates declined between 1981 and 1990, increased between 1991 and 1996, then remained stable. Less variation was noted for neonatal and postneonatal death rates, although the same general trend was noted.

Figure 3 shows trends in neonatal mortality rates by gender between 1980 and 2000. Neonatal mortality rates

among males generally exceeded rates for females; the shapes of the curves were comparable. A slight elevation among males was evident when trends in postneonatal mortality rates were examined by gender (figure 4). Postneonatal mortality rates declined during the 1980s, then increased slightly during the 1990s. Figure 5 presents the results of trend analyses for infant mortality and neonatal mortality which both demonstrated continuous decreases between 1990 followed by a bell-shaped excess rate in the 1990's ($p < 0.001$).

Patterns of deaths by time interval

Table 4 presents leading causes of neonatal and postneonatal deaths by time interval. Common causes of neonatal deaths generally included prematurity, congenital heart defects, asphyxia, and pneumonia across all time intervals; however, asphyxia did not rank among the most frequent causes of deaths between 1992 and 2000. Causes of postneonatal deaths, which generally included acute viral syndrome/influenza, cardiopulmonary insufficiency, congenital health defects and pneumonia, did not show marked variation by time interval.

Trends in death rates by time interval

Table 5 presents trends for infant, neonatal, and postneonatal mortality in Mogilev during the three time intervals. Compared to the 1980–1985 period, infant mortality rates among males declined significantly during the period 1986–1991 (RR = 0.68; 95% CI = 0.62–0.74) and during 1992–2000 (RR = 0.72, 95% CI 0.67–0.81).

Female infant mortality rates also experienced a significant decline during 1986–1991 (RR = 0.74; 95% CI = 0.66–0.83) and 1992–2000 (RR = 0.78; 95% CI = 0.70–0.87), compared to the base period of 1980–1985.

Male neonatal mortality rates experienced a decrease between 1986–1991 (RR = 0.78; 95% CI = 0.69–0.88);

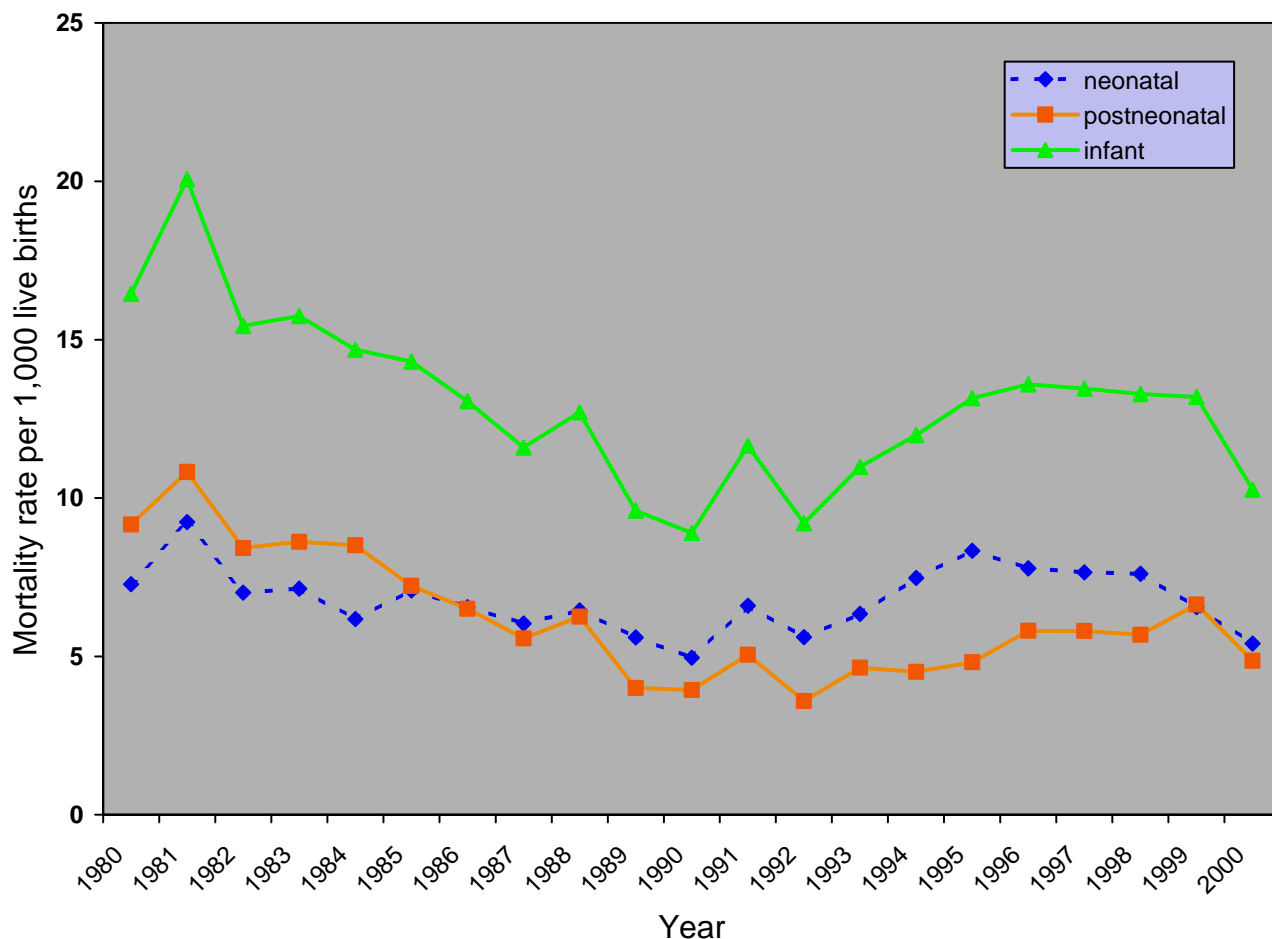


Figure 2 Infant (1 Year), Neonatal (0–28 days of age), and Postneonatal (29–364 days of age) Mortality Rates for Mogilev Oblast, Belarus, 1980–2000.

however, the rates for 1992–2000 did not differ from the rate observed during 1980–1985. Female neonatal mortality rates did not change significantly across the three time intervals.

Postneonatal mortality rates among males decreased significantly between 1986–1991 with a rate ratio of 0.59 (CI = 0.69–0.88) and a rate ratio of 0.56 (CI = 0.50–0.65) for 1992–2000 when compared to 1980–1985. Similar decreases were seen for postneonatal mortality among females (RR = 0.62; 95% CI = 0.53–0.72, during 1986–1991 and RR = 0.59; 95% CI = 0.50–0.68, during 1992–2000) (see Table 4).

Comparison with US & Russia

Table 6 compares infant, neonatal, and postneonatal mortality rates in Mogilev, the United States (US), and the Russian Federation across time intervals. From 1980 to 1985, infant mortality rates in Mogilev were significantly higher for both males (+50%) and females (+27%) when compared to the United States. Between 1986–1991, these rates became more similar (males, +20% and females, +10%), then diverged between 1992 and 2000 (males, +68%, females, +50%). Overall infant mortality rates in Mogilev were 25% to 36% lower than in Russia.

Neonatal mortality rates among males in Mogilev were significantly higher than US rates only during the period

Table 2: Neonatal Deaths (0–28 days of age) by major category, Mogilev Oblast, Belarus, 1980–2000, by cause & gender.

Males				Females			
Rank	Category (ICD)	#	%	Rank	Category (ICD)	#	%
1	prematurity	314	21.5%	1	prematurity	166	17.7%
2	congenital heart defects	154	10.6%	2	congenital heart defects	114	12.2%
3	pneumonia	149	10.2%	3	pneumonia	94	10.0%
4	asphyxia	112	7.7%	4	multiple congenital defects	78	8.3%
5	multiple congenital defects	102	7.0%	5	asphyxia	72	7.7%
6	birth trauma	69	4.7%	6	acute viral syndrome/ influenza	41	4.4%
	All other	563	38.5%		All other	373	39.8%
	Total	1463	100.0%		Total	938	100.0%

1992–2000 (+53%). Neonatal mortality rates among Mogilev females were 18% less than US rates during 1980–1985 but 26% more than US rates during 1992–2000. Neonatal mortality rates in Mogilev were 25% lower than in Russia during 1980–1985, with a steady decrease to 59% lower during the period 1992–2000.

During 1980–1985, postneonatal mortality rates in Mogilev were significantly higher for both males (+131%) and females (+117%) when compared to the United States. Between 1986–1991, these differences diminished somewhat but remained elevated (+49% in males, +45% in females). During 1992–2000, postneonatal mortality remained elevated (+99%) compared to US males, but did not differ from US rates among females. Postneonatal mortality rates in Mogilev were 22% to 32% lower than in Russia.

Discussion

As a result of a series of unique factors occurring during the last two decades, residents of Belarus were forced to contend with a variety of stresses deriving from environmental, economic and sociopolitical sources. As noted in this paper, it is likely that such stresses impacted the public health infrastructure with a negative effect on vulnerable sub-populations, including infants.

While infant mortality rates in Mogilev have decreased since the period 1980–1985 among both males and females, this decrement appears due to decreases in postneonatal mortality. Rates of postneonatal mortality in Mogilev have decreased since the period 1980–1985 among both males and females. Compared to rates of

infant mortality for other countries, rates in the Mogilev region are generally higher than rates for the United States, but lower than rates in Russia [10,13]. During the 1990s, rates for both neonatal and postneonatal mortality in Mogilev were two times higher than comparable rates for East and West Germany [14]. In general, there is a lack of readily accessible data preventing comparisons with other FSU republics. However, within Belarus, increased perinatal mortality in the Gomel region, adjacent to Mogilev, has been attributed to excess strontium exposures among pregnant women [15].

Although infant mortality rates as well as neonatal and postneonatal mortality rates either decreased or remained stable during the 1986 to 1991 time period, increases were noted for 1992–2000. One possible factor for this trend was the 1991 collapse of the Soviet Union, although additional factors are likely responsible.

Maternal health is associated with access to prenatal care, substance abuse, nutrition, anemia, and the presence of sexually transmitted disease among pregnant women, and each of these factors is known to contribute to deaths among infants. Appropriate care of newborns and infants, access to health care, and maternal education are also associated with neonatal survival [16]. According to these criteria, the factors most likely to have affected overall infant mortality and neonatal mortality rates in Mogilev were changes in lifestyle and the health care system resulting from the transformation to an independent republic, although the health care structure that existed as part of the Soviet Union has been largely retained.

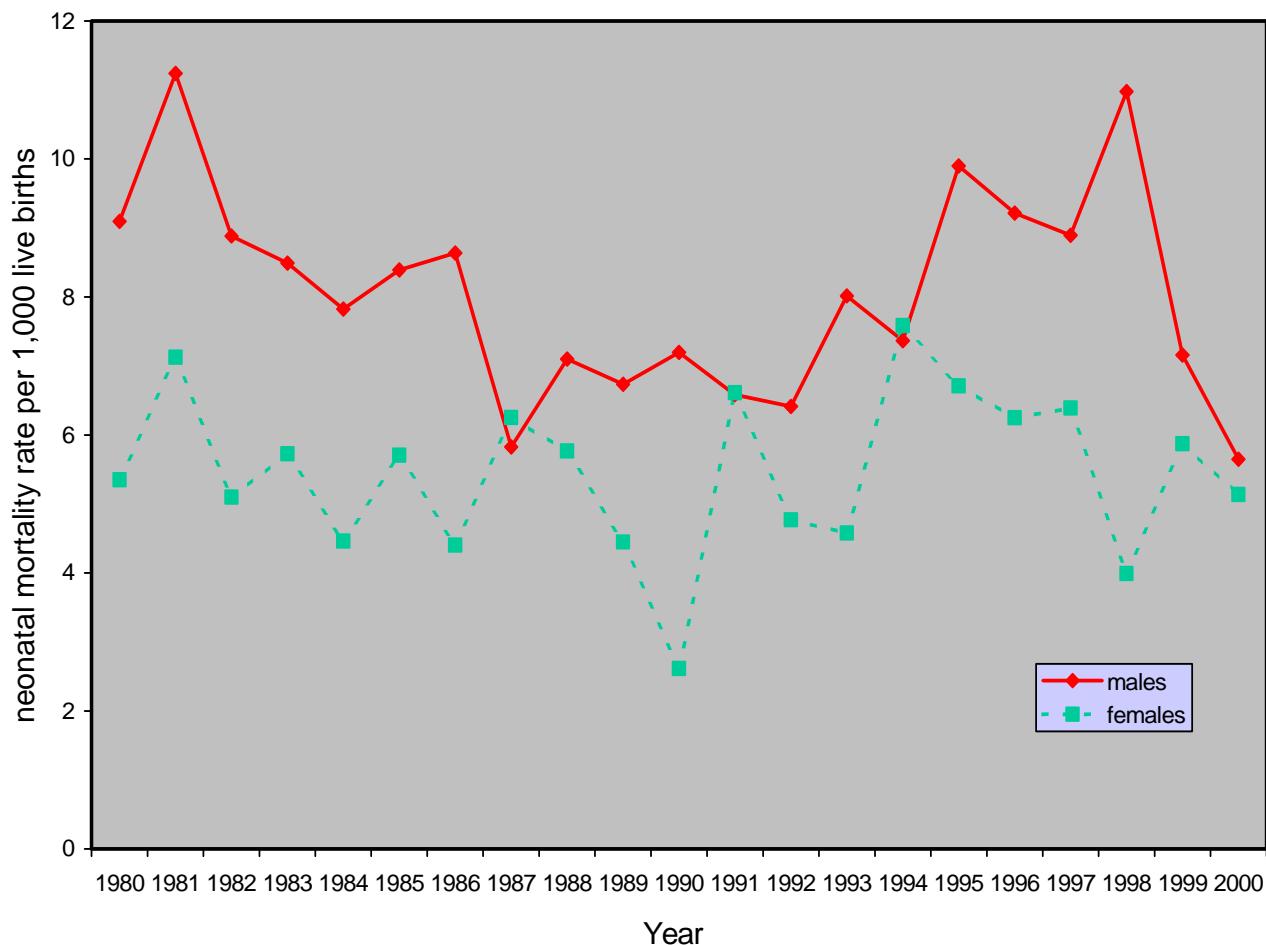


Figure 3
Neonatal (0–28 days of age) Mortality Rates per 1,000 live births in Mogilev Oblast, Belarus, 1980–2000.

In an analysis of mortality caused by preventable and treatable conditions, Andreev et al. (2003) provided an explanation for health consequences seen after the breakup of the Soviet Union. These authors reported an increase in deaths due to preventable conditions following 1991 [17] and attributed this to untimely and ineffective health care and changes in the quality of and access to health care.

Health resources became scarce after the 1991 collapse of the Soviet economy [18]. Wages of medical personnel were cut, resulting in lower morale, higher rates of absenteeism, and decreases in quality care. Medicines, vaccines, and medical instruments could not be afforded; medical facilities were also poorly maintained [5].

Changes in maternal lifestyle factors associated with birth outcomes could be linked with the collapse of Communism. Economic limitations may have prevented pregnant women from acquiring proper nutrition, including use of prenatal folic acid supplementation. Cigarette smoking has been linked to reduced infant birth weight, increased pre-term births, and increased infant mortality [19,20]. Psychosocial stress, associated with premature labor and neonatal death, [21] could also be considered as a partial explanation.

While neonatal deaths are generally associated with maternal care during pregnancy and delivery, postneonatal deaths are more reflective of socioenvironmental factors after birth [22]. In this study, little variation was

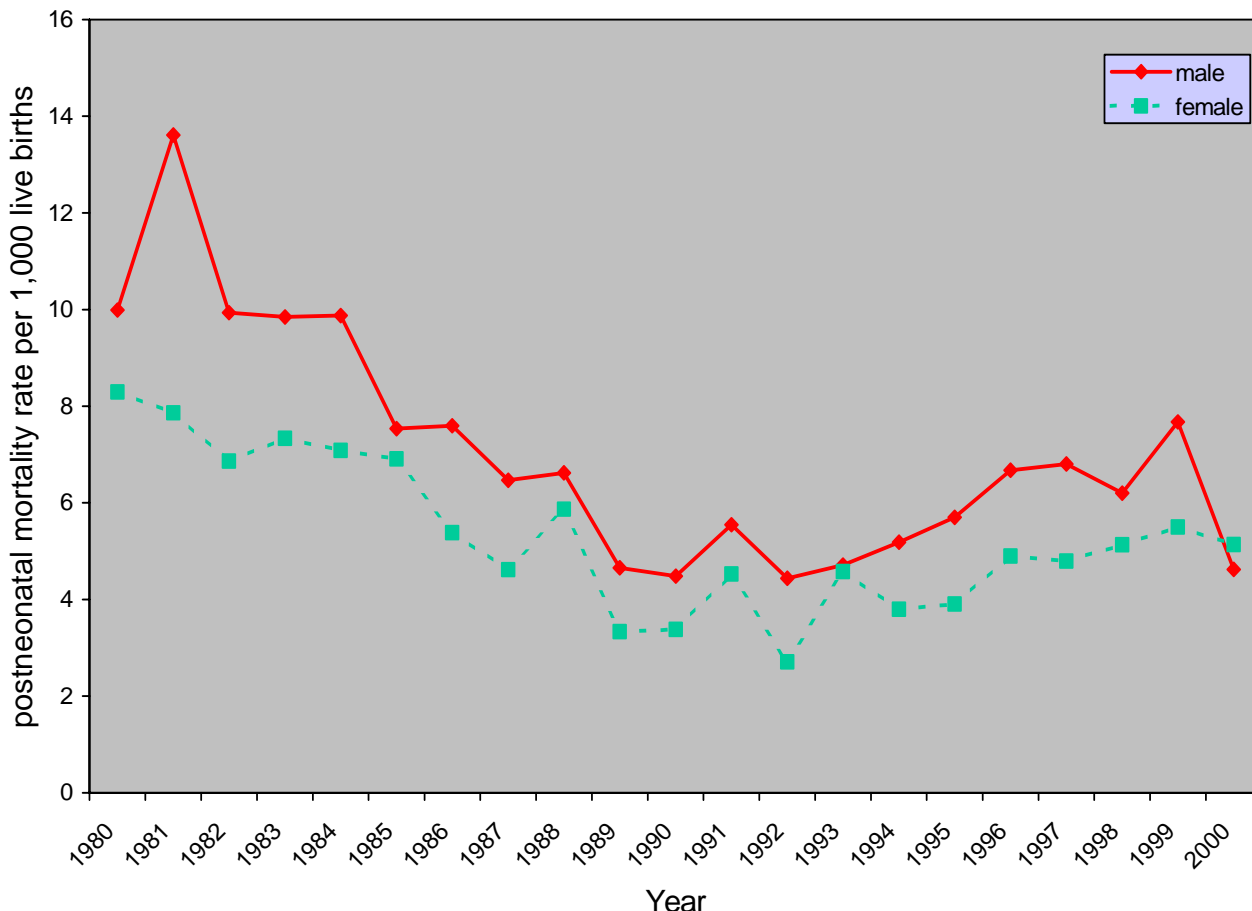


Figure 4
 Postneonatal (29–364 days of age) mortality rates per 1,000 live births in Mogilev Oblast, Belarus, 1980–2000.

noted for neonatal death rates while postneonatal death rates decreased between 1980–1985 and 1986–1991; between 1992–2000 these rates increased among males but continued to decrease among females. These data suggest that the political transition in 1991 may have impacted the public health infrastructure in Belarus and had a measurable detrimental effect on infant health. Postneonatal deaths from all conditions, excluding congenital anomalies, are considered to be preventable [23]. These conditions remained as leading causes of postneonatal mortality from 1992–2000.

The quality of data collected in the former Soviet Union has been evaluated by different authors at different periods of time. Most of the authors have concluded that the

population estimates and the death counts are fairly accurate, while morbidity data are difficult to obtain [24,25]. An assessment of the completeness and accuracy of international infant mortality data has been completed for information collected as part of the United Nations (UN) Statistical Division's Demographic Yearbook. Regions of the former Soviet Union, including Belarus and the Russian Federation, perceived their data as virtually complete, [26] although there was no verification of data collection.

An additional caveat in interpreting the results of this study is to be aware of international variation in infant mortality definitions. Infant mortality is generally defined as the number of infant deaths per 1,000 live births. However, the definition of a live birth is not consistent interna-

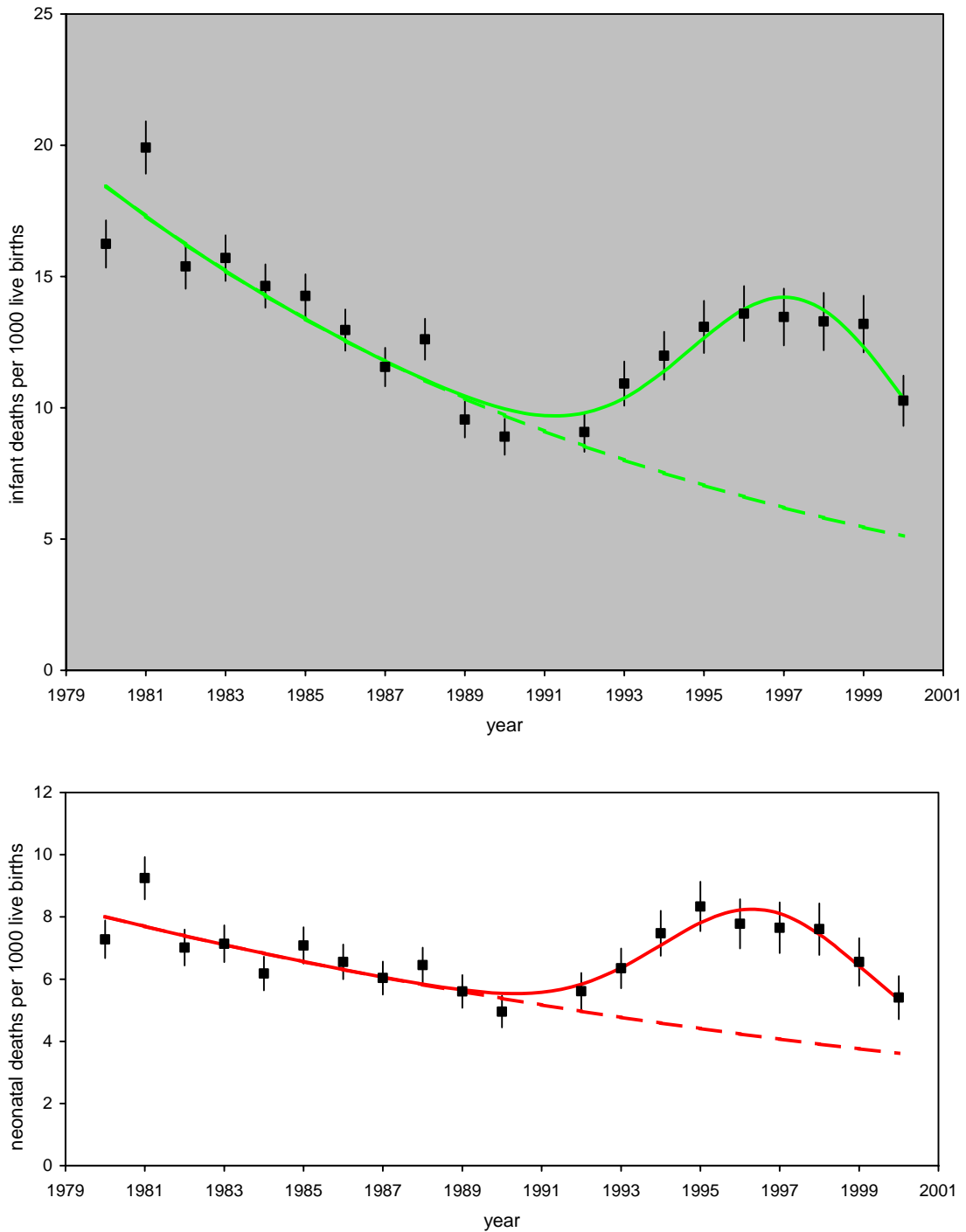


Figure 5
Trends in Infant and Neonatal Mortality in Mogilev Oblast, Belarus, 1980–2000, based on regression analyses (dashed line shows projected trend).

Table 3: Post-neonatal Deaths (29–364 days of age) Mogilev Oblast, Belarus, 1980–2000, by cause & gender.

Males				Females			
Rank	Category (ICD)	#	%	Rank	Category (ICD)	#	%
1	acute viral syndrome/influenza	243	18.6%	1	acute viral syndrome/influenza	192	20.5%
2	pneumonia	192	14.7%	2	pneumonia	101	10.8%
3	congenital heart defects	128	9.8%	3	congenital heart defects	93	9.9%
4	cardiopulmonary insufficiency	92	7.0%	4	cardiopulmonary insufficiency	61	6.5%
5	gastroenteritis	55	4.2%	5	gastroenteritis	46	4.9%
6	asphyxia	52	4.0%	6	asphyxia	38	4.1%
	All other	563	42.5%		All other	415	43.9%
	Total	1325	100.0%		Total	946	100.0%

Table 4: Leading Causes of Infant Mortality in Mogilev Oblast, Belarus, 1980–2000, by time period and age category.

1980–1985			1986–1991			1992–2000		
Cause	Num	%	Cause	Num	%	Cause	Num	%
Neonatal (0–28 days)								
1. prematurity	132	14.8%	premataturity	167	23.5%	premataturity	181	22.7%
2. pneumonia	121	13.6%	congenital heart defects	92	12.9%	congenital heart defects	102	12.8%
3. asphyxia	76	8.5%	asphyxia	63	8.9%	multiple congenital defects	78	9.8%
4. congenital heart defects	74	8.3%	pneumonia	59	8.3%	pneumonia	63	7.9%
5. acute viral syndrome/influenza	57	6.4%	multiple congenital defects	53	7.4%	cardiopulmonary insufficiency	61	7.6%
6. birth trauma	57	6.4%	intracranial hemorrhage/bleeding	37	5.2%	intracranial hemorrhage/bleeding	47	5.9%
Other	373	42.0%	Other	241	33.8%	Other	267	33.4%
Total	890	100.0%	Total	712	100.0%	Total	799	100.0%
Postneonatal (29–364 days)								
1. acute viral syndrome/influenza	232	21.9%	acute viral syndrome/influenza	129	21.0%	acute viral syndrome/influenza	74	12.8%
2. pneumonia	175	16.5%	congenital heart defects	70	11.4%	cardiopulmonary insufficiency	71	12.3%
3. congenital heart defects	82	7.8%	pneumonia	64	10.4%	congenital heart defects	69	11.9%
4. gastroenteritis	52	4.9%	cardiopulmonary insufficiency	48	7.8%	pneumonia	54	9.3%
5. sepsis	49	4.6%	asphyxia	27	4.4%	asphyxia	29	5.0%
6. meningococemia	34	3.2%	meningococemia	26	4.2%	upper airway obstruction	28	4.8%
Other	445	41.6%	Other	256	41.3%	Other	257	44.2%
Total	1069	100.0%	Total	620	100.0%	Total	582	100.0%

tionally. The World Health Organization definition of a live birth involves "the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy which, after such separation, breathes or shows any other evidence of life, such as beating of the heart, pulsation of the umbilical cord or definitive movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached." The Soviet Union adopted a less inclusive definition, excluding infants born before 28 weeks and those weighing less than 1000 grams, regardless of signs of life. Use of this definition continues in many republics of the former Soviet Union. Since a large proportion of the cases that would not be counted in Russia but would be counted in

the US would have died, they would contribute to both the numerator and denominator. However, given their relatively disproportionate contribution to the numerator, the exclusion of these cases would result in an *underestimation* of mortality rates. The presumed effect is an underestimation of infant mortality rates in these republics, projected as being between 20% and 25% below the actual rate [5,16,26,27]. Since 1994, infant mortality rates in Belarus have included infants born after 22 weeks and those weighing more than 500 grams.

Limitations of this study include the focus on a single geographic region rather than an entire country; however, we utilized existing data based on the mortality experience of

Table 5: All cause mortality rates per 1,000 and Rate Ratios among residents of Mogilev Oblast, Belarus, 1980–2000, Rate Ratios by Sex, Age at Death, and Time Period.

Age at death (Time Period)	Male			Female		
	Num+	Rate++	RR* (95% CI)**	Num+	Rate	RR* (95% CI)**
Infant (<1 Year)						
1980–1985	1189	19.08		770	12.94	
1986–1991	781	12.96	0.68 (0.62–0.74)	551	9.54	0.74 (0.66–0.83)
1992–2000	818	13.78	0.72 (0.67–0.81)	563	10.09	0.78 (0.70–0.87)
Neonatal (0–28 days)						
1980–1985	559	8.97		331	5.56	
1986–1991	423	7.02	0.78 (0.69–0.88)	289	5.01	0.90 (0.77–1.05)
1992–2000	481	8.10	0.90 (0.80–1.02)	318	5.70	1.03 (0.88–1.20)
Postneonatal (29–364 days)						
1980–1985	630	10.11		439	7.38	
1986–1991	358	5.94	0.59 (0.52–0.67)	262	4.54	0.62 (0.53–0.72)
1992–2000	337	5.68	0.56 (0.50–0.65)	245	4.39	0.59 (0.50–0.68)

+Num = number of deaths. ++mortality rate per 1,000 live births. *RR = rate ratio relative to 1980–1985 time period. **95% Confidence Interval.

Table 6: Infant, Neonatal, and Postneonatal Rates per 1,000 live births among residents of the Mogilev region of Belarus, the United States, and the Russian Federation, 1980–2000, by gender and time interval.

Time interval	1980–1985			1986–1991			1992–2000		
	Rate Mogilev	United States	Russian Federation	Rate Mogilev	United States	Russian Federation	Rate Mogilev	United States	Russian Federation
		RR* (95% CI)**	RR* (95% CI)**		RR* (95% CI)**	RR* (95% CI)**		RR* (95% CI)**	RR* (95% CI)**
Infant (<1 Year)									
All	16.08	1.41 (1.35–1.47)	0.75 (0.72–0.78)	11.29	1.16 (1.10–1.22)	0.64 (0.61–0.68)	11.99	1.60 (1.52–1.69)	0.64 (0.61–0.67)
Male	19.08	1.51 (1.43–1.69)	***	12.95	1.20 (1.19–1.29)	***	13.77	1.67 (1.56–1.79)	***
Female	12.94	1.28 (1.19–1.37)	***	9.54	1.11 (1.03–1.21)	***	10.08	1.54 (1.42–1.67)	***
Neonatal (0 to 28 days)									
All	7.31	0.96 (0.90–1.03)	0.72 (0.67–0.77)	6.03	0.98 (0.91–1.05)	0.55 (0.52–0.59)	6.94	1.41 (1.32–1.51)	0.41 (0.38–0.44)
Male	8.97	1.08 (1.00–1.17)	***	7.02	1.04 (0.95–1.14)	***	8.10	1.51 (1.38–1.65)	***
Female	5.56	0.82 (0.74–0.91)	***	5.01	0.91 (0.81–1.02)	***	5.70	1.27 (1.14–1.42)	***
Postneonatal (29–364 days)									
All	8.78	2.27 (2.09–2.47)	0.69 (0.65–0.73)	5.25	1.51 (1.35–1.68)	0.78 (0.72–0.84)	5.05	1.99 (1.77–2.23)	0.71 (0.65–0.77)
Male	10.11	2.34 (2.17–2.62)	***	5.94	1.52 (1.38–1.69)	***	5.68	1.98 (1.78–2.20)	***
Female	7.38	2.18 (1.99–2.39)	***	4.54	1.49 (1.32–1.68)	***	4.39	2.09 (1.96–21.24)	***

*RR = Rate Ratio relative to Mogilev mortality rate for time period. **95% Confidence Interval. ***Gender specific mortality figures not available for Russian Federation

a large population base. Data on causes of death were recorded from text field entries, then translated and coded to ICD categories. Although autopsies were not completed for all infant deaths, 88% of all infants, including 95% of neonates and 80% of postneonates received autopsies, which attests to the high quality of the data. Unfortunately, we did not have access to data on birth weight, gestational age, prenatal care, or maternal medical histories.

Conclusion

Although detailed historical public health data is difficult to locate for most FSU republics, this study included information on 21 years of infant mortality for a large geographic region of the FSU. Infant mortality reflects the interaction of several complex processes including prenatal, perinatal and postnatal care, maternal health, health care resources and the public health infrastructure. These findings document elevated rates of neonatal and postneonatal mortality in the Mogilev region of Belarus compared to rates in Europe and the US. Since most postneonatal deaths are potentially preventable, health planners might utilize this information to prioritize the allocation of public health resources to maximize prenatal care, including folic acid supplementation, adequate prenatal care, education of parents, as well as enhanced access to medical care.

Competing interests

None declared.

Authors' contributions

MCM, SPC, and LJZ were responsible for the study concept. LJZ, MCM, SL, and AMM participated in study design, data analysis and interpretation. MCM, SPC, and NK participated in data acquisition efforts. LJZ and MCM drafted the manuscript and, along with AMM and SL, provided critical review and input. All authors read and approved the final manuscript.

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