

ORIGINAL ARTICLE

The Kola Birth Registry and perinatal mortality in Mončegorsk, Russia

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Background. A population-based birth registry has been set up for the Arctic town of Mončegorsk in north-western Russia. In this investigation, the quality and the content of the registry are assessed and the perinatal mortality (PM) rates in the period 1973–97 estimated.

Material and method. Enrollment in the Kola Birth Registry (KBR) involved the retrospective inclusion of all births with at least 28 weeks of gestation in Mončegorsk in the period 1973–97. The data in the registry were assessed for data entry errors, completeness of data and population coverage. The annual PM rates were estimated for live- and stillborns with at least 28 weeks of gestation.

Results. The KBR contains detailed information about the newborn, delivery, pregnancy and mother for 21 214 births by women from Mončegorsk, covering at least 96% of all the births by the population in the period studied. No records were missing data for gender and birth date of the newborn, and more than 99.9% of the records contained data about gestational age and birthweight. Data concerning the mothers' employment were missing in 0.4% of the records. The annual PM rate fell from more than 20 to less than 10 deaths per 1000 births during this period.

Conclusion. The KBR provides an extensive data source useful for case-control and register-based prospective studies, and constitutes the first such compilation in Russia. The homogeneity of the population in Mončegorsk makes it advantageous for epidemiological investigations. The PM rate in Mončegorsk was lower than the overall rate in Russia.

Key words: fetal death; pregnancy outcome; registries; vital statistics; Russia

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The Kola Birth Registry (KBR) in Mončegorsk in the Kola Peninsula of Russia (Fig. 1) was initiated in 1997 in response to a report in 1994

by Chashschin et al. about a possible increase in spontaneous abortions and structural malformations among infants of occupationally exposed female nickel workers (1). The purpose of the registry was to provide an integrated and comprehensive access to the different data sources for reproductive and developmental outcomes. The registry's objective was to include all live births, as well as stillbirths from 28 weeks of pregnancy, delivered in Mončegorsk since 1973. By May 2002, a total of 22 155 births were registered in the KBR.

Official statistics and investigations indicate that the rates of low birthweight (BW), low newborn body mass index, perinatal, neonatal and

Abbreviations:

KBR: Kola Birth Registry; KRLOH: Kola Research Laboratory for Occupational Health; PM: perinatal mortality; UiT: Universitetet i Tromsø; GA: gestational age; BW: birthweight; ICD: International Classification of Disease; WHO: World Health Organization; UNICEF: United Nation Children's Fund; MO: Murmanskaja oblast' or Kola Peninsula; NIPERA: Nickel Producers Environmental Research Association; WSIB: Ontario Workplace Safety and Insurance Board; FIGO: Federation International de Gynecologie et Obstetrique.

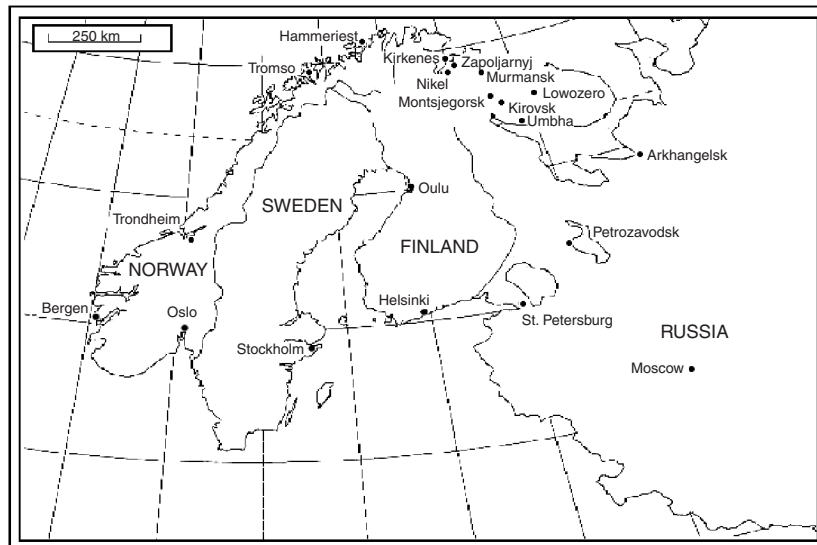


Fig. 1. Northern Europe.

infant mortality have been higher in Russia than in most other East European countries (2–6). The official perinatal mortality (PM) rate estimates in Russia were 14.7 or 15.8 per 1000 births in 1995 depending on the source, down from 17.8 in 1985 (2,6). The rate was 2.7/1000 births higher in urban than in rural areas (7). The overall rate in 1995 was more than twice that found in the Nordic countries, and also higher than in most of the neighboring European countries (Estonia 11.1; Lithuania 9.0; Ukraine 11.9; Romania 12.5; Moldavia 16.1; Bulgaria 11.8) (2,5,6; R. Gaidelyte, pers. commun., Lithuanian Health Information Centre, Vilnius, 2002; A. Lauk, pers. commun., Statistical Office of Estonia, 2002). Within Russia the regional PM varied from 12.0 (Kola Peninsula) to 29.2 per 1000 births (Ingusjetia) in 1995. According to official statistics of the Russian Federation, maternal pregnancy complications explained 31.7% of the perinatal deaths with an established cause in 1998, while maternal health conditions unrelated to pregnancy accounted for 23.4% (2).

Mončegorsk is located in the industrial corridor in the central part of Murmansk County (Murmanskaja Oblast', MO), which is the administrative unit of the Kola Peninsula (Fig. 1). Most of MO is located north of the Polar circle, bordering Norway and Finland to the west and fronting the Barents Sea to the north. The mean population in the year 2000 was 974 000 people. The largest employer in Mončegorsk has been the Severonikel nickel refinery, where 12 835 (41.9% women) of the 66 212 inhabitants worked in 1995. The mean population of the town in 2000 was 62 767 (52% women). The population grew from 46 230 inhabitants in 1970 to 52 509 in 1979 and

peaked at 72 800 in 1991. However, in 1992 the trend reversed and the population decreased 13.8% by 2000. The decline in growth in both Mončegorsk and MO since 1992 was primarily due to a net migration out of the region, but was aided by both an increased death rate and a decreased birth rate (8–10; VM Dorofeev, pers. commun., St Petersburg Medical Information and Analytical Center, Russia, 2002). The industrial activities in MO and Mončegorsk have been described previously (11).

The KBR provides an insight into the pregnancy health and outcome of an urban population living in an industrial setting under arctic conditions. The extensive amount of data registered about the mother, the pregnancy, the delivery and the newborn can become a valuable tool for an assessment of associations between maternal and pregnancy factors and pregnancy outcome, and for addressing the impact of occupation and occupational exposure in the nickel industry on maternal and newborn health. The present investigation aimed to assess the quality and content of the KBR, describe the pregnancy history of the population registered in the KBR, and use the data in the registry to describe the PM history in Mončegorsk for the period 1973–97. PM rates are associated with the quality of obstetric and early neonatal health care, as well as with maternal and fetal factors (12,13).

Material and method

Maternal and newborn care in Mončegorsk

A birth-planning and reproductive health center was opened in Mončegorsk in 1996, involving

volunteers. Since 1997, the obstetric and gynecology level-2 polyclinic in Mončegorsk has participated in the World Health Organization (WHO)/United Nation Children's Fund (UNICEF) Children Friendly Hospital program. In 2001 the department was certified by the WHO and the Russian Ministry of Health. In 1998 the Female Reproductive Health program was developed, and in 2000 the Safe Maternity Municipal Program and the Pregnant Women Care Improvement project were started. Mončegorsk is also participating in the midwife and medical staff exchange between MO and the county Finnmark in Norway (A. Vojtov, pers. commun., Obstetric and Gynaecological Polyclinic, Mončegorsk, 2002). In 1995 the delivery department implemented instant breast contact for the newborn, as well as costaying. The practice of swaddling the newborn is used in Mončegorsk. Ultrasound came into use in the late 1980s, and from the early 1990s almost every woman has received an ultrasound on the occasion of her first visit to the gynecologist – if she did not object. Ultrasound dating from then on was used together with Naegele's rule to establish gestational age (A. Vojtov, pers. commun., 2002).

Nowadays, women are dismissed from the clinic 3–4 days after delivery. Until 1997 they stayed in the clinic for at least 7–10 days after delivery. Very few deliveries occurred at home or outside the clinic (A. Vojtov, pers. commun., 2002). The gynecology and delivery clinic in Mončegorsk is considered to hold a high standard in terms of both equipment and staff compared to general Russian conditions.

The prenatal care in Russia is covered by basic medical insurance and is free. All pregnant women are recommended to visit a gynecologist before 12 weeks of pregnancy. As an encouragement, and by law promulgated on 16 November 1990, women receive one minimum monthly wage as a bonus when going on maternity leave if they consult a gynecologist before 12 weeks of pregnancy. Seventy-nine percent of all first visits by pregnant women at the gynecologic clinic in Mončegorsk occurred before 12 completed weeks of pregnancy. On the first visit, the gravida is referred to the appropriate specialist and within 10 days she sees the gynecologist again. She receives a new appointment at 20–24 weeks of pregnancy and sometimes also at about 34–36 weeks. A woman having heavy or risk-related work should be transferred to another task at the workplace as soon as she has visited a gynecologist and it has been established that she is pregnant. Her salary continues during this period (A. Vojtov, pers. commun., 2002).

By law, a pregnant woman was obliged to leave work after week 30 of gestation. She then received 100% of her wage for the next 140 days. Subsequently, she may have up to 3 years maternity leave with reduced pay. During the first 1.5 years, the pay depended on her wage, while for the rest of the leave she received an equal, but smaller, amount. Since the early 1990s women received no pay during the last 1.5 years of a 3-year maternity leave, but child benefits begin 1.5 years after delivery. Women carrying plural fetuses or residing in the countryside are issued with an additional 2 weeks of maternity leave by leaving work after week 28. Prior to 1991 the law was slightly different: a woman was obliged to leave work after the 32nd week of pregnancy and received 100% of her wages until 56 days after delivery (72 days if twins or complications occurred). To encourage childbearing, the central government introduced a law in the beginning of 2002 that awards each woman an additional 5000 roubles when she goes on maternity leave (roughly equalling four times the monthly minimum wage at the time) (A. Vojtov, pers. commun., 2002).

Until 12 weeks of pregnancy the woman can choose to have an abortion. From the 13th to the 22nd week, she may have an abortion if she has valid social reasons. Two gynecologists and the hospital lawyer together decide whether the social reasons claimed by the pregnant woman are sufficient. In Soviet times, induced abortions occurred relatively frequently (1.4 per delivery in the country as a whole in 1985) (2), but were very seldom allowed beyond the 12th week of pregnancy. The opportunity to abort for social reasons was introduced by law in 1991. In 1996 the law was liberalized to contain 13 specified reasons valid for a social abortion (see Table I) (14). In practice this law leaves room for almost all women to have an abortion up to the 22nd week of gestation if desired. However, a new but more stringent law is expected to be passed in 2003. Induced abortion for medical/clinical reasons can occur at any time during the pregnancy (A. Vojtov, pers. commun., 2002). Thirty-six abortions per 1000 live births were carried out due to social reasons in MO in 1999 (10). According to the statistics of the delivery clinic, the ratio of induced abortions to deliveries in Mončegorsk decreased from 1.96 : 1 in 1984 to 1 : 1 in 1995, but then the ratio increased to 1.4 : 1 in 1997. The ratio of induced abortion to deliveries in Russia as a whole was 1.5 : 1 in 1995, which was equivalent to 55 induced abortions per 1000 women of fertile age (2). There was an increased demand for abortions and a subsequent fall in number of

Table I. List of social indications for induced interruption of pregnancy (14)

1	The husband has a personal handicap of group 1–2
2	The husband died during the pregnancy
3	The woman or her husband is residing in a place with removed liberties
4	The woman or her husband is unemployed
5	The presence of a court decision about removal of natural parental rights
6	The woman is not in a marriage
7	The marriage is dissolved during the pregnancy
8	The pregnancy is a result of a rape
9	The absence of a home in a specific residence
10	The woman is holding a status as a refugee or forced migrant
11	The woman already has three or more children
12	The presence of a handicapped child in the family
13	The family income per member is less than the established minimum wage in the tax region

births after the devaluation of the rouble in August 1998 (A. Vojtov, pers. commun., 2002).

Very preterm newborns [gestational age (GA) <28 weeks, BW <1000 g or birth length <35 cm] have to survive for 7 days before they are defined as liveborn in Russia. If death occurs before classification, they are counted and noted as spontaneous abortions. Stillborns with a GA below 28 weeks were also classified as spontaneous abortions – regardless of weight and length. In 1993, Russia adopted the international convention about children's rights. This included the general WHO definition of a live birth, which is based on four signs of life (4, 15). Until 1993, the practice was that at least one out of the following three signs had to be present for the newborn to be alive: heart beat, breathing, and/or screaming (A. Vojtov, pers. commun., 2002). The law that was implemented on January 1, 1993 also stated that medical documentation is to be filed for all newborns weighing more than 500 g (alternatively 22 weeks of gestation or more), and that all still-born fetuses of such a weight shall undergo pathological examination (15).

The Kola Birth Registry

The registration in the KBR has involved the retrospective inclusion of all births in the town of Mončegorsk since 1973. The aim was to register all live births, as well as stillbirths from 28 weeks of pregnancy. However, spontaneous abortions that occurred at the birth clinic before 28 weeks were also registered. By May 2002 all births from 1973 through 1997, a total of 22 155, were registered. Since 1999 all diagnoses were registered in the KBR using the International Classification of Disease (ICD)-10 system, and the diagnoses in all records from previous registration have been updated from ICD-9 to ICD-10 codes. The sources of the information in the KBR and the regulations and practices concerning

record keeping of deliveries are described elsewhere (11).

The computerized registry was constructed and is administered by the Kola Research Laboratory for Occupational Health (KRLOH) in co-operation with the University of Tromsø (UiT), Norway. The KRLOH is described elsewhere (11). The KBR database was set up using the Epi-Info version 6 (16). The data entry procedure involved two of the staff at the KRLOH who sat by the computer together while entering data from the journals. This permitted crosschecks between them to ensure the accuracy of the data read and entered. In addition, the leader of the KRLOH KBR team (Talykova) performed random checks by comparing the data in the source and the registry.

Currently the KBR is being updated to include all deliveries from the period after 1997. On completion of this task, it will be transferred from the KRLOH to the obstetric department at the hospital in Mončegorsk to facilitate the addition of all births on an ongoing basis.

Quality and content assessment

In November 2001, two researchers from the UiT (Odland and Vaktiskjold) were invited to the KRLOH to assess the quality of the data entry in the KBR. The researchers were given full access to the original paper-based records from the gynecologic polyclinic and the delivery department. Records ($n = 119$) were selected randomly and five numerical entries were checked against the data registered electronically in the database of the birth registry. The specific items checked were: date of last menstruation; birth date of infant; bodyweight; body length; and Apgar score at birth. These data were read aloud from the hospital journals by a person from the data entry staff and checked in the database record by one of the Norwegian researchers.

The UiT received a complete copy of the KBR database in May 2002, which was used to carry out an assessment of the content and quality of the registered data and the completeness of the registry. The latter was assessed by a comparison of the annual number of births registered in the KBR with the official number of births in Mončegorsk. The quality was further verified by looking at distributions of data; the proportions of missing values; the presence of nonlogical values; and the coherence between data in overlapping fields in each record.

Population

The population in the present investigation comprised births in the period 1973–97 by women who were registered as residents in Mončegorsk at the time of a pregnancy. The township of residency can be identified through a special code in the KBR. Every woman is assigned an identification number so that records by the same mother can be linked. Each record contains the number of previous live births, stillbirths, induced and spontaneous abortions, respectively. These data were used to assess whether the registered delivery was nulliparous or not. The abortion history of the population was estimated from the data concerning the most recent delivery record of each woman.

Perinatal mortality

The PM was investigated by use of the registered data for birth date, GA, stillbirth, and early neonatal mortality registered for women residing in Mončegorsk at the time of the pregnancy. Perinatal death was defined as dead at birth or death during the first 7 days of life if the GA at delivery was 28 weeks or more. If information about the GA was missing, the birth was included if the BW was ≥ 1000 g. The PM rate was defined as the number of perinatal deaths divided by the number of dead plus liveborn with a GA at delivery of at least 28 weeks. The analyses were carried using SAS statistical software 6 V, version 8e (SAS Institute Inc., Cary, NC, USA, 1999).

The set-up of the KBR and its use for epidemiological investigations was approved by the Norwegian data inspectorate and the regional health administration in MO.

Results

Data entry

A total of six data entry errors (1.0%) were found in six different records. No errors were found in

the data for birth date, while one error was found for date of last menstruation, bodyweight and body length, respectively. The remaining three errors were uncertainty concerning the recorded Apgar score. This uncertainty occurred in instances when only one Apgar test was recorded in the written journal and it was not clear how it should be recorded (1 min vs. the 5 min Apgar assessment). Although these three data entries have been noted as potential errors, the actual values were correctly entered and the scores might have been entered in the correct field of the two field choices. Hence, the data entry error rate was 0.5% (± 0.04). A low data entry error rate was also confirmed by the small number of nonlogical values found in a data distribution assessment of each descriptor registered in the database.

Missing data

In instances where one or two of the three main sources of information were missing it was noted in a separate field in the registry. This concerned 2.0% of the records. Among these were 51 women (0.2% of all records) who were not medically observed during the pregnancy, and consequently these records only contain information recorded at the time of the delivery and about the newborn. However, some of the most pertinent information, such as GA and BW, was recorded in more than one of the sources and could therefore be retrieved for the KBR even in cases where the primary source was missing. When descriptive, morphometric or outcome information was missing in the source journals, an indication using a numeric or a character value was made in the field in the KBR. The proportion of records in the KBR that was missing information exceeds 5% for six of the registered descriptors. Three of these descriptors contained data about the father: age (29.0% missing), employer (10.3%) and occupation (14.8%). The missing information occurred mainly in the oldest delivery records in the registry. In terms of information about the mother, 7.3% of the records did not contain her height and 8.4% were missing her weight. Measurement of the newborn's chest circumference was not carried out routinely and 63.5% of the records were missing information. On the other hand, there were no missing data for gender and birth date of the newborn, and more than 99.9% of the records contained data about GA and BW. The height at birth was missing in 0.2% of the records. Data concerning the type of employment and employer of the mother were missing in 0.4% of the records.

Missing records

Based on a comparison with official annual birth statistics for Mončegorsk, a total of 500–800 deliveries from the period 1973–97 do not appear to have been registered in the KBR. The missing journals mainly concern deliveries in 1973, 1984, 1987 and 1989 (Fig. 2). An annual distribution of date-of-birth of the newborn showed that whole months of journals were missing from these years.

Data content

Each record in the KBR contains more than 200 fields of information about the mother; her birth history and occupation; the pregnancy; delivery; and the newborn. The name, age, occupation and employer of the father are also registered. The registry also contains morphometric data for the mother and the newborn; Apgar scores; and maternal medication use, smoking, alcohol abuse, hemoglobin values, blood pressure, diabetes and infections (see Table II). Some of the fields are overlapping, which means that the information in one field is also included in another field. For instance, infections during pregnancy are registered in the fields concerning such specific conditions, as well as in those containing ICD-10 codes for all diseases during pregnancy. There is also a yes/no field connected to conditions that are further described with an ICD-10 code if the condition was present. For each field for an ICD-10 code, there is a field where the disease or condition is also registered with a word descriptor. ICD-10 codes are registered concerning the delivering woman's medical history, previous adverse pregnancy outcomes, illnesses during pregnancy, pregnancy and deliv-

ery complications, fetal disorders and death, congenital malformations and childhood neoplasm. The KBR does not contain the mother's birth date, but each woman is given a unique code in the registry.

Population

Of the registered records, 21 214 (95.8%) were concerning women residing in Mončegorsk, corresponding to 15 923 different individuals. The remaining number of deliveries registered were by women from other areas within (1.1%) and outside (3.1%) the MO who have delivered in Mončegorsk. There were 11 329 women who were registered with one record of delivery in the time period. Among these, 4773 women had experienced at least one previous delivery ($GA \geq 28$ weeks). There were 4594 women registered with more than one record of delivery, of which 3842 of their nulliparae deliveries were recorded. The total number of registered deliveries includes 348 records of twins and six records of triplets. Fifty-three percent of the registered deliveries involve births where the nickel plant employs one or both of the parents, while 23% of the women were employed at the nickel plant at the time of delivery. The registered population had on average experienced 0.20 spontaneous abortions and 1.07 induced abortions, and 1.8 stillbirths per live birth by the end of 1997. The 7556 women (47%) who had had a previous induced abortion had experienced on average 2.2 induced abortions. Of the recorded deliveries, 21 124 (99.6%) occurred at a recorded GA of at least 28 weeks. In addition, there were seven deliveries where the recorded BW was ≥ 1000 g, but without a recorded GA. The average age of

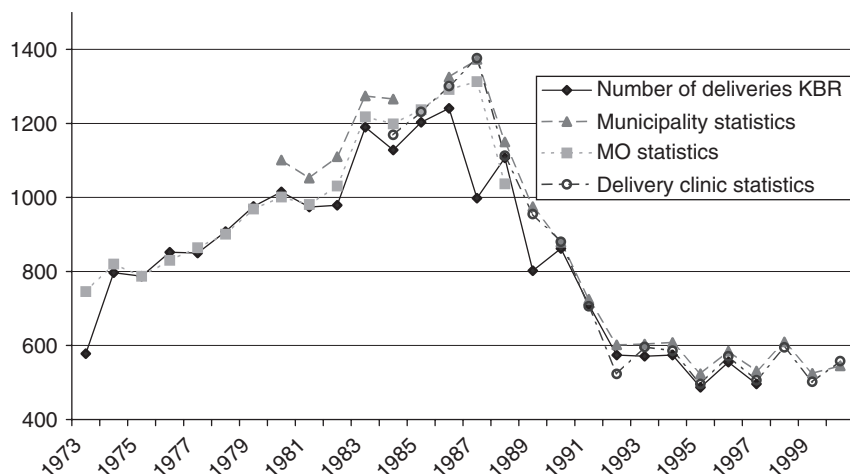


Fig. 2. Annual number of deliveries in Mončegorsk registered in the KBR vs. three sources of official numbers of births.

Table II. Data registered in the Kola Birth Registry

Mother • Town/city of residence • Individual code • Name • Age • Employer • Occupation • Address • Marital status • Height • Weight • Rh+ or Rh- • Rh antibodies titer • Gestational age at first visit to gynecologist • Medical history of mother and family (ICD-10: Z00-Z90) • Medical history of mother unrelated to pregnancy (ICD-10: E, D, N and I codes) • Presence of maternal diabetes, endocrine or metabolic disorders in medical history (ICD-10: E00-E90) • Use of antibiotics/hormonal medication during pregnancy • Presence of disorders or diseases causing pelvis deformation (yes/no) • Presence of diabetes mellitus, gestational diabetes or glucosuria during pregnancy in medical history • Smoking during pregnancy (yes/no) • Alcohol abuse during pregnancy (yes/on) • Infections before/during pregnancy • Incomplete mother-child information • Reasons for missing data • Presence of congenital or rheumatic heart disease in medical history (ICD-10: Q20-Q28) • Number of pregnancies experienced • Existence of multiple pregnancies during previous deliveries or other discrepancies between delivery numbers and pregnancy outcomes (yes/no) • Number of live births experienced, including term of delivery and subsequent mortality • Number of stillbirths experienced, including term of delivery • Number of induced abortions experienced • Number of spontaneous abortions experienced, including gestational age • Other pregnancy outcomes experienced (ICD-10:O00-O02, O04.91) • Weight of previous newborn • Time since previous birth • Time since previous pregnancy • Adverse outcomes ordered by parity	Newborn • Plural births • Birth date • Gender • Height • Head circumference • Chest circumference • Birthweight • Apgar scores at 1 and 5 min • Dead/alive • Gestational age • Date of last menses • Presence of asphyxia • Presence of hypoxia • Disorders related to pregnancy duration and fetal growth (ICD-10: P05-P08) • Conditions that arose during perinatal time (ICD-10: P010-P096) • Neoplasms • Malformations
	Gestation/Fetus • Ultrasound and fetal findings • Pathological weight gain during pregnancy • Presence of nausea during pregnancy • Illnesses during pregnancy by ICD codes • Miscarriage risk, and term of risk • Presence of anemia, and the hemoglobin concentration • Complications during delivery (ICD-10: P010-P096) • Presence of edema, proteinuria and hypertensive disorders in pregnancy (ICD-10: O10-O16), including term, codes and measured values • Other complications of pregnancy (ICD-10: O20-O29; O46-O47, R88, R82.8) • Maternal care related to the fetus and amniotic cavity and possible delivery complications (ICD-10: O30-O48)
	Father • Name • Age • Employer • Occupation • Address, if different than the delivering woman's

the pregnant women was 25.3 years; the youngest was 13 and the oldest 46 years old (Table III).

Perinatal mortality

A total of 391 perinatal deaths were recorded, which amounted to an overall PM rate of 18.5/1000 births. The annual rate varied from 5.4/1000 in 1996 to 38.2/1000 in 1987. The rate showed a decreasing tendency between 1973 and 1985. Subsequently, the rate peaked above 21/1000 for the next 3 years, before it dropped and decreased between 1989 and 1997 (Fig. 3). A trend analysis revealed that the PM decreased annually by 0.43

deaths/1000 births (± 0.38 , 95% CL) in the period 1973-97.

Discussion

The low proportion of records with missing values of weight, height, GA and gender of the newborn indicates that the recording of data in the hospital delivery department journals was performed systematically. The proportion of birth records where the BW and GA of the newborn was specified is 99.97 and 99.93%, respectively, which is comparable to the equivalent proportions registered in the Medical Birth

Table III. Characteristics of population

Average maternal age (in years)	25.3	
Total number of registered births	21 214	
GA $\geq$ 28 weeks	21 124	99.58%
GA missing	7	0.03%
GA < 28 weeks	83	0.39%
Nulliparae deliveries*	10 398	49.2%
Multiparae deliveries*	10 733	50.8%
Average gestational age (weeks)	39.4	
Total number of registered women	15 923	
With one delivery registered in the KBR	11 329	71.1%
With more than one delivery registered in the KBR	4594	28.9%
Average number of registered deliveries per woman	1.3	
Average number of deliveries experienced per woman	1.8	
Total number of spontaneous abortions experienced	3256	
Average number of spontaneous abortions in population	0.2	
Number of women having had a spontaneous abortion	2493	15.7%
Average number of spontaneous abortions	1.3	
Total number of induced abortions experienced	17 028	
Average number of induced abortions in population	1.07	
Number of women having had an induced abortion	7556	47.4%
Average number of induced abortions	2.25	

*Based on number of deliveries with GA $\geq$ 28 weeks.

Registry of Norway (99.90 and 90.93%) (17), as well as to the registration in the national data files of the United States (99.8 and 95.8%) (18).

The study that investigated the feasibility of setting up a birth registry in MO found less than 1% data errors in the initial part of the registry concerning Mončegorsk (11). The present investigation of data entry included a higher number of records and a data entry error rate of 0.5% was found. A rate of such a magnitude is acceptable for estimations and inferences concerning morphometric and descriptive data. The impact of entry error on such future uses is usually minimal

as long as the entry error is randomly and normally distributed. Nevertheless, an error rate of the magnitude found may impact interpretations concerning very rare conditions or outcomes. On the other hand, data entry errors concerning ICD-10 codes in the KBR can be checked, overcome and diminished as the registry contains a field adjacent to each ICD-10 code field where the condition is also spelled out using the words in the source journal.

The explanations for the differences in annual number of deliveries in Mončegorsk between the official statistics and the number of deliveries in

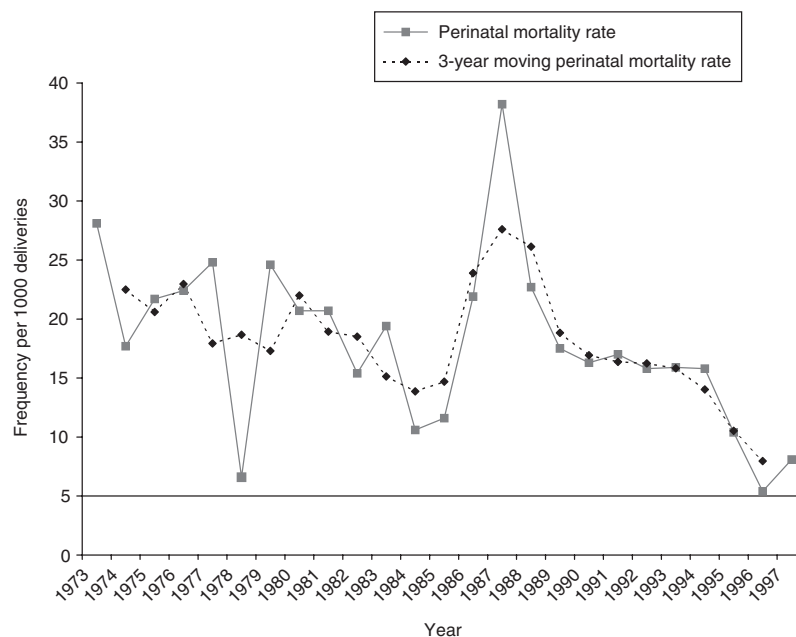


Fig. 3. Annual perinatal mortality per 1000 deliveries in Mončegorsk.

the KBR can be several. The annual number of births registered in the KBR and depicted in Fig. 2 only includes registered births by women who are inhabitants of Mončegorsk. The statistics of the local birth clinic includes all deliveries that occurred at the clinic, including deliveries by women residing elsewhere, and did not include deliveries that occurred outside the clinic – for instance at home. The municipal and MO statistics may or may not include the deliveries mentioned above, and may also include women from Mončegorsk who gave birth elsewhere in MO or in the country. Besides the discrepancies in birth frequency for the four mentioned years (1973, 1984, 1987, 1989), the KBR appears to be fairly exhaustive for the remaining years in the period 1973–97. Efforts are in progress to locate the missing journals from the mentioned years, and 180 of them have been found. Some of the missing journals are known to have been spoiled in a water spill that occurred in the early 1990s, while some of the others might have been lost in a past fire (A. Vojtov, pers. commun., 2002). The search for missing records showed that whole months of journals were missing from some years, which indicates that journals have vanished or were destroyed in bundles rather than individual journal copies disappearing. The missing files from 1973 concern the period January–March of that year. Hence, if these are not located it can be concluded that the KBR contains data about deliveries in Mončegorsk from March 1973, and the missing records from the beginning of that year would no longer be a part of the gravida or newborn population registered in the KBR. In the PM pattern depicted in Fig. 3, the rates of the years with missing journals fall in line with the trend. Interestingly, the highest annual rate found was in 1987, which is one of the four years in which some of the journals were missing. Consequently, there are no apparent indications that the missing journals bias the rate estimates of the years in question. However, because whole months of journals were missing, the rate estimates could be biased for these years if there was a seasonal factor that influenced the PM.

Out of the 11 329 women registered with one record of delivery, 6556 were nulliparae, while 3842 of the 4594 women with more than one record of birth had their first delivery in the time frame of registration in the KBR. Thus, the KBR contains records of 10 398 nulliparae births with 28 weeks of gestation. This means that 5525 (34.7%) of the registered women had their first birth while residing elsewhere and/or the first birth occurred before 1973, or some of them had a previous delivery that is among the missing

journals. Mončegorsk experienced a relatively large immigration during the 1980s and a large proportion of the new arriving inhabitants were probably young families with children. The registered population had by the time of their most recent delivery gone through 1.07 induced abortions on average, which amounts to 0.8 induced abortions per delivery. However, in terms of the actual rate of induced abortions, it must be kept in mind that the KBR does not reveal induced abortions in the period by women who never delivered or moved before their first delivery. It can also be assumed that the population registered in the KBR had induced abortions in the period later than their last delivery. The official rate for the Soviet Union in 1985 was 1.4 induced abortions/delivery, and for Russia in 1995 the rate was 1.5 (8). According to the polyclinic figures for Mončegorsk, the rate fell from 1.9 in 1984 to almost 1.0 per delivery in the mid-1990s (A. Vojtov, pers. commun., 2002).

Russian regulations are that maternal birth dates are confidential and thus the KBR does not contain this information. Linking multiple delivery records to the same birth mother was achieved by considering the full name, supplemented by secondary information including address, age at delivery, and name of father. This permitted the assignment of a unique code to each woman. At the time of writing this task was not fully completed, which means that the reported number of different women recorded in the birth registry is a slight overestimation. As a consequence, the number of women for whom one birth is registered will necessarily decrease; conversely the number with more than one birth will concomitantly increase.

The estimated PM rates in Mončegorsk since 1989 are similar to the official rates for MO as a whole. The rates in MO were 18.2/1000 in 1989 and 9.2/1000 in 1997 (7) compared with 17.5/1000 and 8.1/1000 in Mončegorsk in the same years. The official rate for Russia in 1997 was 15.0/1000 (2). However, how the population at risk is defined in the official national figures is not given. The rate in Fig. 3 shows that the annual PM rates in Mončegorsk fluctuated notably from year to year in the period from 1973 to 1989. The official rates for Mončegorsk in the period 1988–92 obtained from the MO regional health care department confirm the magnitude of the rates based on the KBR, except for 1990 when the official rate was 21.3 compared to the KBR-based rate of 16.3/1000 births (I.V. Kovaljov, pers. commun., The Regional Health Care Department of Murmanskaja oblast', 1994). The population at risk is defined differently in the

official rates, as they are supposed to include women who are registered as inhabitants of Mončegorsk but giving birth elsewhere in the country. The relatively small annual pregnant population is most likely to be the main explanation of the fluctuations from year to year. A conversion of the rates to 3-year moving averages in order to remove some of the random annual fluctuations in outcomes clarified the trends, but the rate still fluctuated slightly from year to year until 1989. However, in the following years there was a decreasing trend with small fluctuations. Perhaps the latter reflects a more standardized perinatal care in emergency situations than in previous years. During the course of the 25 years of data, the achievements in Mončegorsk in terms of decreasing PM was almost comparable to the achievements in Norway, but the mortality still remained 2–5 deaths/1000 births higher. The rate in Norway decreased by about 10 deaths per 1000 births (19), while the trend analysis in this study showed a decrease of $(10.4 \pm 9.1)/1000$ in Mončegorsk over the whole period. However, care should be exercised when comparing PM rates of populations that are likely to have different GA and BW distributions (18,20–23).

The elevated mortality rates during the years 1986–88 deserve some attention. Random variation does not seem appropriate as the sole explanation. The number of births during these years was 20–30% higher than that a few years earlier, and more than twice the annual numbers born in the mid-1990s. The high influx of deliveries might have strained the capacity and thereby affected the quality of the maternal and newborn care at the clinic. During these years the gynecologic polyclinic also carried out about 1.5 induced abortions for every delivery (A. Vojtov, pers. commun., 2002). Consequently, the explanation, or a part of it, could be unknown factors within the community and/or the polyclinic. The magnitude of the estimated rate for 1988 (22.7/1000) was confirmed by the official rate for Mončegorsk (22.0/1000) (I.V. Kovaljov, pers. commun., 1994). (The official rates for 1986 and 1987 were not requested for comparison.)

In investigations using the data in the KBR, it is important to be aware of the mentioned differences in the definition of a live birth in use in Russia/Soviet Union. A correction for the differences is needed when official infant mortality rates in Russia/Soviet Union are compared to rates elsewhere. This means that deliveries that occurred before 28 weeks of pregnancy and for which the newborn died within the first 7 days of life are not necessarily included in the KBR.

Thus, the KBR cannot be used to assess spontaneous abortions or other outcomes that occurred before 28 weeks of pregnancy. However, this factor should not have influenced the PM rates in this investigation as only the deliveries after at least 28 weeks of gestation were included in the population at risk. The seven births that were included based solely on BW contributed only in the denominator as they all survived beyond the seventh day of life. However, it is important to be aware that the retrospective data about the mother concerning her previous deliveries might have been influenced if she had a newborn delivered before 28 weeks of pregnancy and who subsequently died during the first 7 days of life. In such a case, it was likely to be recorded as a previous spontaneous abortion and not as a live birth. In the current investigation, these data were only used in some of the population estimates in Table III, and in these instances would thus contribute to a slight inflation of the spontaneous abortion figures and likewise to a reduction in the delivery figures compared to the standard definition.

BW has been promoted by the WHO as the key criterion to be used in estimations of stillbirth and PM rates (24–27). BW is a more objective measurement than GA, but BW is biologically dependent on both the GA and the appropriateness of the fetal growth rate. In terms of choosing a BW or a GA cut-off value for estimates of adverse outcomes, the latter appears preferable (28,29). In estimations using the KBR, the recorded GA should be used as the value of 28 weeks of gestation has been used as the cut-off value in the definition of a stillbirth in the recording at the birth clinic. Thus, a stillborn fetus with a $BW \geq 1000$ g and an estimated $GA < 28$ weeks is considered an abortion and a birth record is consequently not filed. Hence, using FIGO rates would result in an underestimation of the PM rates in Mončegorsk based on this organization's definition (25). In the determination of GA by the gynecologist, an overestimation would inflate PM rates that are defined solely on the GA, and vice versa.

Forty-five of the newborns included in the estimation of PM rates had a BW below 1000 g. Of these, 30 had a GA of 28 weeks and 15 had a GA greater than 28 weeks. In addition, there were 25 with both a GA of 28 weeks and a $BW \geq 1000$ g. Conversely, for 15 registered deliveries that were not included, the BW was ≥ 1000 g, but the GA was below 28 weeks. Nine of the latter did not survive beyond the first week, and of these seven were delivered before 1993. The above figures indicate a limitation in using the established GA

as the sole factor for inclusion of borderline births in the population for PM statistics.

The data in the KBR reveal that a total of 17 deliveries occurred at the birth clinic after 24–27 weeks of gestation in the period 1993–97. All of these were born alive, but 15 died during the first week of life. The proportion of births with a GA of 24–27 weeks, and occurring at the birth clinic, was 0.63% for the period. The annual proportion of births in Norway with a GA of 24–27 weeks varied between 0.3 and 0.4% (19).

The plan is to use the KBR in quality control of medical practices and as a monitoring and research tool. The registry represents a defined population and provides an extensive nonselected data source useful for both case-control and register-based prospective studies concerning outcomes, including structural malformations, of pregnancies that were terminated after 28 weeks of gestation. The population in Mončegorsk has been very homogeneous in terms of ethnicity, socioeconomic status and living conditions, which makes it an advantageous population for epidemiological investigations. In addition, the maternal and newborn care has been highly standardized because all institutional births have taken place in the same delivery department.

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