ABSTRACT

Objectives. To describe the essential features of the newly established Murmansk County Birth Registry (MCBR); make some preliminary comparisons of selected variables related to pregnancy and delivery in northern counties of the Nordic countries and in cities and towns of Murmansk County [Murmanskaja Oblast (MO)] and explore some research possibilities.

Study design. A registry-based cohort study.

Methods. The MCBR was established in 2005 and registration began on 1 January 2006. A registry form draws upon both hospital files and information from the mother. There are 54 major fields consisting primarily of tick-off boxes and International Classification of Diseases (ICD-10) codes. A quality control exercise was conducted in both 2006 and 2007.

Results. During 2006, 8,468 births were registered in the MO (coverage = 98.9%). The proportion of errors was below 1% in both years. Limiting the descriptive statistics to 2006, compared to counties of the Nordic counties in the Barents Region, the delivering women in the MO were younger and had fewer and lighter (mean of 3000 g) babies. The gestational age was somewhat shorter in the MO than in the Nordic counties and fewer babies had a birthweight above 4,500 g. The perinatal mortality corresponding to a gestational age (GA) of either 22 or 28 completed weeks was higher (p<0.02) in the MO than the Nordic counties in this study. In the MO, the birth rate does not balance the reported increase in death rate.

Conclusions. Our study concludes that a medical birth registry of satisfactory quality has been established for the world’s largest arctic population. (Int J Circumpolar Health 2008; 67(4):318-334)

Keywords: Birth registry, pregnancy outcomes, quality control, perinatal mortality, Barents Region
INTRODUCTION

Birth registries were created in several Nordic countries following the thalidomide disaster in Europe (1): Norway in 1967 (1), Denmark in 1968 (2), Sweden in 1973 (3) and Finland in 1987 (4). Since then, these registries have proven themselves useful not only for surveillance of pregnancies and deliveries but also for research purposes (1–4).

During the 1990s, Odland et al. commenced investigations of some pregnancy outcomes related to pollution, occupation and life-style factors in the Murmanskaja Oblast (MO) [i.e., Murmansk county, also referred to as the Kola Peninsula] and in the Arkhangelsk Region. The studies focused especially on toxic metals and adverse pregnancy outcomes (5–8) and, more specifically, on the effect of nickel exposure on women working in the nickel industry (9–17). It became apparent that in order to obtain sufficient sample sizes for statistical comparisons, larger cohorts needed to be defined. Work on a registry system was inaugurated in 1997 in the city of Monchegorsk, MO. This registry, called the Kola Birth Registry (KBR), was a detailed retrospective registry that used hospital files to construct a database (12). By 2003, over 25,000 births were registered that went back as far as 1973. Several articles have been published using this database together with personal exposure assessments (9–17) to examine the effects of occupational nickel exposure on pregnancy outcomes. The implementation and use of this research registry demonstrated the need for a medical birth registry for all the towns and cities of MO, and its planning was begun in 2005. The new registry was fully operational by 1 January 2006 and by March 2008 over 17,000 births had been registered.

The MO features the world’s largest population above the Arctic Circle. The Murmansk County Birth Registry (MCBR) covers the whole of the Kola Peninsula in north-west Russia with a population of 864,600 (in 2006), and constitutes a truly arctic registry since most of the MO’s 144,900 square kilometres is located above the Arctic Circle. The population density is 6 people per square kilometre and the biggest city is Murmansk with 321,000 inhabitants. Other sizeable cities in the region are Apatity, Severomorsk and Monchegorsk with 62,900, 54,100 and 50,100 inhabitants, respectively (18).

While the KBR in the city of Monchegorsk was only a research tool, the MCBR covering the entire oblast is a medical birth registry that can also be used for surveillance and standardization of related aspects of the health care system. The information is gathered in such a way as to be compatible with the medical birth registries in the Nordic countries, which comply with World Health Organization (WHO) guidelines, standards and recommendations. To carry out the international comparison of some of the outcome variables, areas similar to the MO in Finland, Sweden and Norway were chosen. The 3 counties in northern Norway selected were Nordland, Troms and Finnmark and belong to the Barents Region. Most of Nordland and both of the 2 other counties are located above the Arctic Circle. Combined, they consist of an area of 112,944 square kilometres (19) and have a population of 462,237 (20). The 2 selections from Sweden are the northernmost counties, namely, Västerbotten and Norrbotten, with a size of 154,311 square kilometres and with 509,467 inhabitants (21,22). The 4 Finnish counties in the comparisons are Lappi, Länsi-
Pohja, Kainuu and Pohjois-Pohjanmaa (total area of 154,850 square kilometres and 720,625 inhabitants) (23). The study area is depicted in Figure 1.

This article describes how the MCBR was set up, illustrates the quality of the data and the data collection (Quality Assurance/Quality Control [QA/QC]) and presents some selected pregnancy outcomes for 2006 for the Barents Region of Norway, Sweden, Finland and Russia. The birth registry data reported are limited to the year 2006, because the respective databases were not fully available for 2007 at the time of writing. We are aware of the limitations of the intrinsic scientific value of the regional comparisons made here, but recognize their importance for more in-depth future analyses and the generation of hypotheses. Lastly, the research potential of the MCBR is explored.

The MCBR is a cooperative effort between the University of Tromsø (UiT), Norway, and the Murmansk County Health Department, as well as all the delivery departments in the county.

Figure 1. Map of the study area.
MATERIAL AND METHODS

Planning and implementation
Planning for the new registry in the MO started in the early spring of 2005. During the summer, a registry form was designed using other Nordic registry forms as a model. An extensive user manual was prepared using ICD-10 codes to explain the nature of the variables requested on the form, which was also translated into Russian. The template of an Access database, originally designed for a Tanzanian epidemiological birth registry by Bergsjø et al. (24), was used to construct the MCBR; it was supplied by the Norwegian Medical Birth Registry, Bergen, Norway (MFR). By the late fall, preliminary testing had been completed and the official registering commenced on 1 January 2006. Further adjustments and improvements during 2006 and 2007 were based on 2 major quality control exercises and on group discussions during annual conferences involving all parties participating in the MCBR network.

The registry form
The form was created using the MFR as a model, but was adapted for the Russian information system of the perinatal period. It was first composed in English and then translated into Russian during several meetings and discussions between the UiTø, Russian medical specialists and professional translators. In the end, the form comprised 2 pages with 54 major fields mostly consisting of tick-off boxes and subfields for entering ICD-10 codes (the 2005/2006 version). Table I summarizes the major information items included and data registered in the MCBR.

Information flow
The information recorded on the registry form came from 4 sources: (1) the mothers’ medical history files; (2) the mothers’ obstetric journal; (3) the newborns’ delivery record; and (4) the mothers themselves during interviews conducted by a physician or midwife who also gathered the required information from the respective delivery department. Specific details are provided in Table I. After all the fields had been filled out, and after the mothers and children had been dismissed or transferred from the hospital, the forms were sent by courier to the Registry Office in the city of Murmansk. Depending on the size of the delivery department in question, this transfer was made monthly or bimonthly and records of the forms sent and received were kept in the hospitals and the Registry Office. The information was then entered into an Access database.

The database
The database was set up in English using Microsoft Office Access software, and it was subsequently translated into Russian. The design of the front-end database was made to look like the registry form and to be user friendly. The transfer of information was carried out by 2 persons. One individual read the information on the form received from the delivery departments, while the other entered the information into the database. There were 2 screens so that the “reader” could see what the other person actually entered. This is not a true double entry system, but served well as an effective QA measure (see below). A routine auditing scheme was put in place to ensure that the data from all the forms received were entered.
Table I. Summary of the registry form information.

**Personal information**

| Information on mother | Date of birth |
|-----------------------|---------------|
|                       | Date of last live birth |
|                       | Date of last abortion |
|                       | Ethnicity* |
|                       | Residence |
|                       | Did the mother move from another city during the last 12 months?* |
|                       | Civil status |
|                       | Education |
|                       | Mother’s occupation |
|                       | Mother’s workplace |

| Information on father | Age* |
|-----------------------|------|
|                       | Father’s occupation* |
|                       | Father’s workplace* |
|                       | Ethnicity* |

**Pregnancy and mother’s health**

| Previous pregnancies | Live/still births |
|-----------------------|-------------------|
|                       | Spontaneous abortions |
|                       | Induced abortions |

| Supplements/abuse | Supplement intake before/during pregnancy* |
|-------------------|---------------------------------------------|
|                   | Cigarette smoking before/during pregnancy* |
|                   | Drug/alcohol abuse |

**Disease**

| Disease before pregnancy |
|--------------------------|
| Disease during pregnancy |

**About the birth**

| The delivery | Neonatal presentation |
|--------------|-----------------------|
|              | Delivery type |
|              | Planned caesarean section? |
|              | Indication for surgery or induction |
|              | Complications during delivery |
|              | Anaesthesia |
|              | Placenta |
|              | Umbilical cord |
|              | Amniotic fluid |
|              | Post delivery maternal complications |

**About the child**

| Information on the newborn | Date/time of birth |
|----------------------------|--------------------|
|                            | Multiple delivery |
|                            | Sex |
|                            | Weight/length |
|                            | Head circumference |
|                            | Apgar score (1 and 5 minutes) |
|                            | Live/stillborn |
|                            | Child died at a later time or date |
|                            | Neonatal diagnosis |
|                            | Birth defects |
|                            | Discharge dates (mother and child) |
|                            | Transferred to other hospital |

*Information that was gathered by asking the mother directly.
**Organization**

The organizational and reporting chart for the MCBR is provided in Figure 2. It shows that the 3 main uses of the registry are to provide feedback to the MO Health Committee, to improve and standardize perinatal and maternal care and to facilitate cooperation with the University of Tromsø for research activities.

**Quality assurance**

Throughout the whole registry, network quality assurance measures were built in – from extensive training of personnel to providing detailed user manuals, ensuring secure routines for information flow, building in safety measures in the database entry-system to open communication channels. In addition to one-on-one training with each midwife/doctor responsible for filling out the forms in each of the hospitals, 3 workshops were arranged that included training seminars and discussion groups. As indicated, an instruction manual provided guidance for the completion of the registry form. In addition to the list of pertinent ICD-10 codes, disease descriptors were provided. The manual also clearly described the difference between wrong information, no information and missing information. The Access database entry system had several built-in quality assurance measures to avoid entries and measurements that were illogical. There were also methods for registering missing values during the process and for computing the intervening period between 2 dates to avoid errors. The most important measure, however, was the open-communication channel between the hospitals and the Registry Office. The register was small enough to implement the quality control measures described as well as resolve discrepancies through personal communication.

![Organizational and reporting chart of the MCBR](image-url)
Quality controls
Two quality control exercises have been carried out to date: one during the summer of 2006 and the second in the fall of 2007. They had 2 components: to check the information transfer from mothers and hospital files onto the registry form, and to verify the information transfer from the form into the database. A random-number generator picked out file numbers from the respective hospitals. The aim was to check a minimum of 30 files from each, or 10% if the hospitals had many deliveries. This goal was met for most of the delivery departments, but some of the files requested upon visits were missing due to other quality-control measures being conducted by health insurance companies or the County Health Department. In 2006, 6 fields from the registry form were evaluated: (1) the mother’s date of birth (date); (2) use of an upgraded maternity ward (yes/no); (3) delivery type (3 tick-off boxes); (4) complications during delivery (21 tick-off boxes and numerous ICD-10 codes); (5) weight of the newborn (integers); and (6) sex of the newborn (3 categories). These particular fields were chosen to test the accuracy and precision of different types of variables (described in the brackets above). All in all, 410 files were investigated in the hospitals. In 2007, 547 hospital files were checked. In both 2006 and 2007, 1,500 data entries (300 forms, 5 questions from each) were checked for information transfer errors to the database.

Privacy and confidentiality issues
The registration of pregnancies into the MCBR was made compulsory by the Murmansk County Health Department in the fall of 2005 to be effective from 1 January 2006. This requirement is not different from that in Norway. However, names of the women are not registered in order to protect privacy. People in the MO do not have personal identification numbers (social security numbers) like they do in some other countries. This made it challenging to identify women who might have had several deliveries. Efforts have been made to create personal codes in the registry for each woman based on other personal identifiers (e.g., birth dates), but this method is not fail proof. All files are locked up in safes in the Registry Office, and no person is allowed in the building without an invitation and without legal identification. Only 3 copies of the database exist: 1 on a laptop (also locked up in the office), 1 in a different city in the MO (as a backup) and 1 at the University of Tromsø (for research purposes). These copies of the database are all depersonalized and cannot be used to identify individuals. The legality of linking the registry in the future to other sources must be approved by the Federal Russian Health Department. Linking will be challenging, however, without social security numbers, but there is discussion about implementing them in Russia as well.

RESULTS
Statistics
The general baseline demographics for the MO were supplied by the Murmansk County Health Department and the summary statistics for the delivery outcomes are from the MCBR.

MCBR content details
Fifteen delivery departments in the MO participated in the registration of births, which extend from Pechenga in the north to Kandalaksha in the south. Only 14 hospitals are identified in Table II, but in January 2007 the
Severomorsk hospital, which had been under renovation, joined the registry. Delivering women from the Severomorsk area were all directed in 2006 to the hospitals in Murmansk. In 2006, there were 8,563 births in the MO (Murmansk County Health Department), a small decrease from the year before (8,590). The MCBR had 8,468 newborns (including 67 twins) registered for 2006 and this gives the register a coverage or completeness of 98.9%. For 2007, there were 8,834 newborns registered. Of the mothers, 93.4% considered themselves to be of Russian ethnicity and of the fathers, 93.5%. Table II shows that 52.5% of all deliveries took place in the 3 Murmansk hospitals, even though the population of the city (321,000) only constitutes 37.1% of the total population of the MO. The percent of errors decreased only slightly (0.89% to 0.84%) from 2006 to 2007, but the percentage of missing information decreased more substantially in the same period (from 1.10% to 0.15%) (Table III). In the central office, 300 forms and 5 questions from each were checked against the existing database and no mistakes were found in either year.

**Table II.** Distribution of deliveries among the delivery departments in the MO in 2006.

| Hospital name   | Number of deliveries (n) | (%) |
|-----------------|--------------------------|-----|
| Gadzievo        | 298                      | 3.5 |
| Sneznogorsk     | 291                      | 3.5 |
| Kola            | 329                      | 3.9 |
| Olenegorsk      | 366                      | 4.4 |
| Monchegorsk     | 592                      | 7.0 |
| Kovedor         | 185                      | 2.2 |
| Kirovsk         | 445                      | 5.3 |
| Apatity         | 592                      | 7.0 |
| Kandalaksha     | 541                      | 6.4 |
| Murmansk No. 1  | 1741                     | 20.7|
| Murmansk No. 2  | 1382                     | 16.5|
| Murmansk No. 3  | 1280                     | 15.2|
| Nikel           | 263                      | 3.1 |
| Zaozersk        | 96                       | 1.1 |
| **Total**       | **8,401**                | **100**|

**Table III.** Results of quality control activities in 2006 and 2007.

| Question # and entry | 2006 (410 files) | 2007 (547 files) |
|----------------------|------------------|------------------|
|                      | Missing (n)      | Mistakes (n)     | Missing (n) | Mistakes (n) |
| (5) Birth date of mother | 0               | 6               | 0            | 5             |
| (28) Upgrade of maternity ward | 9          | 7               | -            | -             |
| (30) Type of delivery | 9               | 2               | 2            | 2             |
| (33) Complications during delivery | 7         | 3               | 2            | 14            |
| (42) Sex of baby     | 2               | 2               | 0            | 0             |
| (43) Weight of baby  | 0               | 2               | 0            | 2             |
| **Percentage**       | 1.1%             | 0.89%           | 0.15%        | 0.84%         |

*This question has been removed from the registry form and also from the 2007 quality control.
† Question 28 was not evaluated during the 2007 quality control exercise.
DISCUSSION

The yearly number of newborns increased by about 700 in the MO between 2000 and 2006, while the total population decreased by 120,000. Even though the crude birth rates (CBRs) have risen considerably (from 8.2 to 9.7 per thousand) and the abortion rates have decreased (16%) in the same period, they cannot compensate for the migration away from the area and the high death rates (13.4 per thousand in 2005) (25). The situation for the MO is not unique, however, but appears to be less grim than for the rest of the Russian North as documented by Bogoyavlenskiy (26).

When considering the number of births registered in MCBR compared to the official number of births recorded by the Health Department in the MO, the completeness of 98.9% would seem adequate unless the missing files were absent because of a systematic error or inadvertent omission. In fact, it was possible to test this. When the official birth numbers were released for 2006 in the MO in April of 2007, they revealed that the initial completeness was only 97.5%. Efforts were made to locate these files, and an additional 120 files were subsequently identified and included in the register. The reasons for the missing records were accidental and coincidental, so there was no systematic error present. On the other hand, some of the lifestyle variables collected by asking the mother directly (such as smoking) would be underestimated in this group, as not all the mothers were contacted during their hospitalization. New protocols were created to avoid the same problem, but it is too early to conclude whether they have been successful.

The fact that the delivery department in Severomorsk was closed in 2006 contributed considerably to the elevated proportion of deliveries taking place in the Murmansk hospitals compared to the rest of the county. Another important aspect of this is that while the delivery departments in the smaller cities and towns of the Kola Peninsula are fully capable of handling most deliveries, complicated cases are often transferred to the larger hospitals simply because they have more expertise and modern facilities. The system works in such a way that all the smaller departments have been assigned partner hospitals in the closest larger city. This might be expected to impact the statistics on delivery complications. A new perinatal centre is under construction in Murmansk and, in the future, all cases with complications (found through screening) will be transferred there. Further, adverse delivery outcomes potentially related to environmental exposure to pollutants, for example, should not be directly compared between the hospitals in the future, but might better be stratified by the area of residence for the parents.

Several studies have considered what is achievable in the way of minimum error rates using double entry, and the numbers are around 7–10/10000 (27,28). These are related to keystrokes and the articles did not discuss the significance of such errors. The most pertinent question in relation to the MCBR is the presence of systematic errors. Büchele et al. (29) report a single data entry error proportion of between 0.2% and 2.1%, depending on whether the variable was plain text, open continuous or closed dichotomous. Both Büchele et al. and Day et al. (30) discuss the viability of reducing the error rates by using a double-entry system, which does however increase the cost of the
study by a factor of about 2.5. As already indicated, the MCBR uses a modified single-entry format. A completeness of 98.9% and an accuracy of 99.2% (for the variables included in the quality control) seem adequate. Since the data entry was performed simultaneously by 2 persons, it could be considered a double-checking system. The latter also revealed its usefulness by the reported data entry error rate of zero and the aforementioned ability to correct obvious errors through communication with the delivery clinics. One concern, though, is that both in 2006 and 2007 the majority of the reported errors were systematic. In 2006, question 28 in the questionnaire (Did the mother pay for an upgrade of the maternity ward?) accounted for over 50% of the mistakes. In the MO it is possible for a mother, for a small fee, to upgrade her maternity ward for more privacy. This upgrade could be made at any time during her stay in the hospital, but her hospital file only included information about the situation directly after the delivery. Subsequently, this question was deemed misleading and was removed from the form and thus not evaluated in the 2007 quality control. In 2007, another systematic error revealed itself in the form of a misunderstanding between the Russian diagnostic and the ICD-10 systems. Again, over half of the errors came down to one specific question and in only 2 hospitals. This time it concerned early membrane rupture before delivery. Whereas the form classified membrane rupture 12–24 hours before delivery as early, the Russian system defined “early” as 6 hours before delivery. These specific inconsistencies were the result of inadequate information flow to new or stand-in staff.

In terms of birth registries, it is difficult to conclude what error rates are tolerable, especially since there are so many different types of potential errors to be made. Cnattingius et al. (31) discuss in detail all the different types of mistakes that are common and classify (quality scores of 1–3) the types of variables susceptible to errors: specifically dates, numbers, check boxes and ICD codes. They also discuss the types of errors in the register. Missing data is of course preferable to wrong data, as long as they are classified as such and not used as a data point, for example 0. Great care was taken during the construction of the registry form and the database to clarify this aspect. The missing information in the MCBR was greatly reduced from 2006 to 2007 as a result of better follow-up routines. As stated above, mistakes in data entry into the computer database were not discovered at all during the 2 control exercises, but errors as a result of poor design and inaccurate use of the form and variableness in diagnostic practices were. One last type of error that we have not yet had the opportunity to turn our attention to is the mistakes in the basic medical records. These errors will, of course, be transferred to the registry database. Obviously, such systematic errors are of great concern, even in small numbers, especially when stratifying to look for differences or similarities. Fortunately, the little inaccuracies and missing data that exist tend to bias associations towards the null hypothesis, rather than to cause spurious associations as long as they occur in equal proportions in the groups to be compared (32). We should acknowledge that there likely exist additional errors (i.e., not uncovered by the quality-control inspections) in the register, and that these potential problems should be addressed later in a planned external quality-control exercise and during ongoing revisions.
NORDIC COMPARISONS OF SELECTED PREGNANCY AND PERINATAL STATISTICS

Statistical treatment
The proportions for the other Nordic counties were calculated using the Internet sites for the respective medical birth registries (33–35) and through direct communication with representatives from these organizations. All calculations using MCBR data were executed with SPSS. The significance testing of differences in perinatal mortality between the regions was done using binary logistic regression.

Pregnancy and perinatal statistics
CBRs in 2006 (2005 for Sweden) were 9.8/1000 (MO); 9.3/1000 (northern Sweden); 11.3/1000 (northern Finland); and 11.4/1000 (northern Norway).

Perusal of Table IVa reveals that the average age of the delivering women in the MO was lower than Norway, Sweden and Finland by 3.6, 3.7 and 3.3 years, respectively. The same pattern holds true for the average age of the women delivering their first child. Compared to the Nordic counties, fewer women had a parity of 3 in the MO and they had a somewhat lower body mass index (BMI) (Table IVa).

| Geographical area | Average age of mothers (years) | Average age at first delivery (years) | Percentage of mothers under 20 years | Percentage of mothers over 35 years | Parity (distribution) | BMI of mothers (estimated at the 1st antenatal visit) | Smoking at the end of pregnancy |
|-------------------|---------------------------------|---------------------------------------|--------------------------------------|-------------------------------------|------------------------|----------------------------------------------------|--------------------------------|
| Murmanskaja Oblast | 26.0                            | 23.7                                  | 9.8%                                 | 4.8%                                | 60.6% 32.9% 5.2%      | 23.2                                              | 15.7%                           |
| Norway           | 29.6                            | 26.8                                  | 4.2%                                 | 16.7%                               | 40.4% 34.0% 17.9%    | N.A.*                                             | 12.7%                           |
| Sweden           | 29.7                            | 27.6                                  | 1.8%                                 | 13.5%                               | 42.3% 36.1% 14.6%    | 24.9                                              | 4.3%                            |
| Finland          | 29.3                            | 26.8                                  | 3.3%                                 | 16.7%                               | 37.1% 29.6% 15.7%    | 25.1†                                              | 12.6%                           |

* Not available.
† Data from Sweden are from 2005.
‡ Calculated from pre-pregnancy weight.
§ Nordland, Troms and Finnmark counties
¶ Vasterbotten and Norrbotten counties
‖ Lappi, Länsi-Pohja, Kainuu and Pohjois-Pohjanmaa counties
proportion of women who reported cigarette smoking during pregnancy was similar in the MO, Norway and Finland, 15.7%, 12.7% and 12.6%, respectively, but considerably lower (4.3%) in Sweden (Table IVa). The average birthweight was between 179 g and 235 g lower in the MO than in the Nordic counties (Table IVb). Northern Norway stands out in relation to the proportion of babies with a birthweight less than 1,500 g (1.5%), and the MO had a considerably lower proportion of children with a birthweight higher than 4,500 g. The perinatal mortality at 28 weeks was different between MO and the 3 other regions (p<0.02).

At 22 weeks, the difference (between Norway and MO) was more substantial (Table IVb).

**Analysis and discussion**

In Tables IVa and IVb, most of the values reported are arithmetic averages which should not be influenced at all by the reported error rate, especially considering that illogical values are not accepted by the data entry program.

As already indicated, the average age of the mothers at the recorded births and at first delivery were lower in MO than in the Nordic counties. The same holds true for the average age at first delivery. This is important in rela-

| Table IVb. | Selected variables from the birth registries of the study area (concerning the child) for 2006. | Parameters concerning pregnancies, births and newborns |
|-----------|----------------------------------------|----------------------------------------------------|
| Geographical area | Number of births | Gestational age (weeks) | Average birth weight (g) | Proportion of children under 1500 g | Proportion of children over 4500 g | Perinatal mortality from 28 weeks (22 weeks)**†† |
| Murmanskaja Oblast | 8468 | 39.0* | 3320 | 1.0% | 0.8% | 8/1000 (14/1000)‡ |
| Norway (Nordland, Troms and Finnmark counties) | 5269 | 39.2 | 3515 | 1.5% | 3.6% | 5/1000 (6/1000) |
| Sweden (Västerbotten and Norrbotten counties)† | 4726 | 39.3 | 3567 | 0.7% | 4.4% | 4/1000 |
| Finland (Lappi, Länsi-Pohja, Kainuu and Pohjois-Pohjanmaa counties)§ | 8109 | 39.4 | 3499 | 0.8% | 3.0% | 5/1000 |

* Estimated by LMP, other countries estimated by ultrasound (if available).
† The numbers from Sweden and Finland only includes live births, but in Norway and the MO also stillbirths.
‡ The rate of 14/1000 includes stillbirths from gestational week 22** to 27+6 which took place in the delivery departments, as well as those that took place elsewhere in the hospital system thus not captured by the MCBR.
§ Data from Sweden are from 2005.
** Stillbirths and deaths day 0 through day 6+23.
†† Among all live births and stillbirths with GA 28+0 weeks or birth weight >= 1000 g or length >= 35 cm.
" Among all live births and stillbirths with GA 22+0 weeks or birth weight >= 425 g or length >= 25 cm.
The rates for the MO were different statistically (p<0.02) from the other 3 counties.
tion to the health of the delivering population as a whole. The Nordic countries have among the lowest perinatal mortality rates in the world (35). The next challenge for these countries will be to maintain this low perinatal mortality in spite of an ever-increasing age of the delivering population. The same concern has been raised in the United Kingdom (36).

Even though only 5.2% of the mothers in the MO reported to have had a third child compared to 14.6% in northern Sweden, the lowest CBR was observed for the latter. This means that either a lower proportion of women in the Swedish counties choose not to have children at all or the proportion of potential delivering women is lower in this area. Further, a comparison of the CBR does not yield a complete picture without inclusion of the respective death rates.

The report “Perinatal Mortality 2005: England, Wales, and Northern Ireland” (36) states that obesity (BMI > 30) is an independent risk factor for stillbirths or neonatal deaths. Although the average BMI of mothers is lower in the MO than in the Finnish and Swedish counties (not available from Norway), it seems that a more correct way to display this in the future would be to give the proportion of women with a BMI over 30. Of the delivering women in the MO in 2006, 6.9% had a BMI over 30. There is no available data for a direct comparison between these cohorts, but the Nordic countries have seen an increase in obesity for delivering women during the last decades. From 1990 until 2000, the proportion of obesity in Finland for women giving birth rose from 7.5% to 11.0% (37). In Sweden, the proportion was 11.6% in 2001 (38). With the continuous improvement of the Russian economy and the increase in availability of imported foods, it will be interesting to monitor this trend over the coming years.

The self-reporting of smoking in any population is likely to be underestimated, and especially so when dealing with the sensitive issue of smoking during pregnancy. The frequency of under-reporting will vary greatly depending on the type of survey and on the study base, from 1% (39) to over 15% (40). The real question is whether the frequency of under-reporting is the same in the respective areas included in this study. When looking at the percentage of mothers who smoked during pregnancy in the 3 hospitals in the city of Murmansk, it became clear that simply to ask the mother whether or not she was a smoker was not sufficient (also shown by Russel et al. [(41)]. These hospitals reported proportions of smokers (during pregnancy) from 6% to 14% and before pregnancy from 8.5% to 26.8%. The variation in the smoking proportion cannot be this large within the city; hence, we can conclude that smoking is under-reported in this study as well. The prevalence of maternal smoking has decreased in the Nordic countries since the early 1980s, except for Finland (42). Finland has had a steady proportion of about 15% (at the beginning of pregnancy) since the Finnish birth registry started this type of data collection in 1987. Interestingly, Odland et al. (5) reported a maternal smoking proportion of 23.6% in 1993–1994 (from the Arkhangelsk Region and from Nikel and Monchegorsk in the MO). In 2006, the proportions were 25.9% and 15.4% in Nikel and Monchegorsk, respectively. At least there does not seem to be a significant increase in the maternal smoking proportions in the MO, even though the availability and commercialization of tobacco products have risen in Russia during the same period. From Table IVa, it is evident that Sweden has been more...
successful in obtaining low maternal smoking prevalences than Finland, Norway and the MO. However, the 2 Swedish counties represented in this article have a higher prevalence of smokeless tobacco-use (especially “snus,” a moist powder tobacco consumed by placing it under the upper lip) than the national average for Sweden. About 4% of mothers in their first trimester used “snus” in these 2 counties in 2005. The same trends have been observed in Norway over the last years; as smoking decreases, the use of “snus” increases, especially among the younger generation.

The gestational age (GA) has been estimated differently in the MO compared to the Nordic counties, so a direct comparison may not be warranted. The last menstrual period (LMP) for estimating the GA was used in the MO and is known to overestimate the GA compared to ultrasound (43,44). Considering this, the GA in the MO still appears to be shorter than for the other counties. In estimating the GA for the MO, 744 cases were excluded because the women were unsure about the information including nine illogical values. If these excluded values were part of a group with longer GAs than the rest of the cohort, then the lower GA for the MO compared to the other countries could be an artefact. The MCBR will replace the LMP-based estimation of the GA with ultrasound technique in the near future.

Although earlier studies have shown a relationship between ethnicity and birthweight (45,46), the differences shown in Table IVb most likely reflect divergent socio-economic conditions. For example, the increase in birthweight in Norway over the last decades corresponds well with an improved standard of living (47).

The observed differences in perinatal mortality, although significant (p<0.02), seem lower than one might have expected. The reason for this is that the working definition of this endpoint in Russia has been “dead at birth or death during the first 7 days of life if the GA at delivery was 28 weeks or more” (12). Consequently, babies with a GA<28 weeks and not surviving those full 7 days were categorized as spontaneous abortions (16). This criteria differs from that recommended by the WHO for international comparisons, namely, a GA of 28 completed weeks, or birthweight ≥1000g, or length ≥35 cm (48). Therefore, the perinatal mortality as estimated by the new WHO criteria in the MCBR was expected to be higher than before because some deliveries that had previously been classified as spontaneous abortions would now be included in the perinatal mortality rates. When the perinatal mortality among all live births and stillbirths with a GA of 22 completed weeks or birthweight ≥425g or length ≥25 cm (data only available from Norway and the MO) were compared, the difference in rates between the regions increased substantially. It is a fact that Norway has more state-of-the-art equipment capable of dealing with extremely premature and low-weight babies. This difference should even itself out over the next years as more and more state funding and modern equipment find its way to the Russian delivery departments. The MCBR will monitor the effect of these as well as of other changes in the years to come.

Though interesting, regional comparisons of birth outcome information often does not have intrinsic scientific value, because it frequently is not possible to control for different biases and to adjust for confounders that exist between datasets. Since the MCBR has been developed

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to parallel the Nordic birth registries, direct comparisons by using the respective databases are facilitated in the future. If, for example, we assume that the similarity in design reduces collection bias to a minimum, the most important confounders would be controlled for in statistical analyses and modelling. Hopefully, valuable information can be harvested from such studies in the future. There are several scientists working with different hypotheses within the MCBR at present. Some of the areas that are being examined more closely are (1) birthweight distribution; (2) varicose disease during pregnancy; (3) the effect of local and city-specific pollution on the frequency or types of birth defects; (4) pre-eclampsia; and (5) associations of pregnancy outcomes with levels of persistent organic pollutants or toxic metals in tissues of mothers and their newborns.

MCBR summary statistics and related information will be made available on demand.

Conclusions
A medical birth registry of satisfactory quality has been established for the world’s largest arctic population which will aid clinicians, epidemiologists and health officials in improving and monitoring the quality of maternal and neonatal health care in the region. To date, the MO and Russia have allocated fewer resources towards perinatal care than the Nordic countries. However, the implementation of new Russia-wide health reforms is expected to improve the situation. The MCBR can be used in the MO to assess their impacts. Interesting new hypotheses can also be explored, information from which will be beneficial not only to mothers and children in Russia but also those living elsewhere.

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List of abbreviations

BMI – Body Mass Index
CBR – Crude Birth Rate
GA – Gestational Age
ICD - International Classification of Diseases
KBR – Kola Birth Registry
LMP – Last Menstrual Period
MCBR – Murmansk County Birth Registry
MFR – Norwegian Medical Birth Registry
MO – Murmanskaja Oblast
QA/QC – Quality Assurance/Quality Control
SPSS – Statistical Package for the Social Sciences
UiTø – University of Tromsø
WHO – World Health Association