

THE PREVALENCE OF SELECTED PREGNANCY OUTCOME RISK FACTORS IN THE LIFE-STYLE AND MEDICAL HISTORY OF THE DELIVERING POPULATION IN NORTH-WESTERN RUSSIA

ABSTRACT

Objectives. A population-based birth registry has been set up for the Arctic town of Mončegorsk in north-western Russia. This investigation describes the health status of the delivering population, including pregnancy history and the prevalence of obesity, infections, smoking and alcohol abuse during the pregnancy period. An overview of the occupations of the delivering population is also presented.

Methods. The birth registry contains detailed and verified information about the newborn, delivery, pregnancy and the mother for 21 214 births by women from Mončegorsk in the period 1973-97.

Results. Of the delivering women, 15.7 % had experienced one or more spontaneous abortions, and 47.4 % had at least one induced abortion. More than 9 % had suffered pelvic inflammatory disease (PID) in their past. The local nickel company employed 9016 (42.5 %) of the delivering women; of these 17% worked in production areas with exposures to compounds of nickel, among other hazards, and 38% are judged to have had possible, or probable, exposure of this type.

Conclusion. Compared with the delivering population in Norway, that in Mončegorsk was younger and had a lower prevalence of obesity, diabetes and heavy smoking. The most worrisome findings were the high prevalence of a history of abortion and PID. A relatively high proportion of the women worked in physically demanding, or/and nickel-exposed occupations. (*Int J Circumpolar Health* 2004; 63: 39-60)

Key words: Kola Peninsula; nickel; maternal health; abortion; infection; registries

Vaktskjold Arild¹
Paulsen Erna Elise¹
Talykova Ljudmila²
Nieboer Evert^{1,3}
Odland Jon Øyvind¹

¹Institutt for samfunnsmedisin,
Universitetet i Tromsø,
Tromsø, Norway.

²Kola Research Laboratory
for Occupational Health/,
Kirovsk, Russia

³McMaster University,
Hamilton ON, Canada

INTRODUCTION

Official statistics and investigations indicate that the rates of low birth weight (LBW), low newborn body mass index, as well as perinatal, neonatal and infant mortality, have been higher in Russia than in most other Eastern-European countries (1-5).

Russia has wide environmental, climatic and socio-economic differences between the various regions and towns within the country, which creates relatively large health status differences between sub-populations. The nation-wide mortality rate for women in the age group 20 – 39 increased from 4.6/1000 in 1985 to 5.7 in 1998. The overall perinatal mortality rate in 1995 was 14.7 per 1000 births (5), being 2.7/1000 births higher in urban than in rural areas (6). The perinatal mortality in Russia in 1995 was lowest in the Kola Peninsula (KP), with 12.0 per 1000 births, while the highest rate of 29.2 occurred in Ingusjetia (7). In an investigation of perinatal mortality in Mončegorsk, located in the KP, we found that the rate was 10.4 deaths per 1000 births in 1995, which was about fifty percent lower than 20 years earlier (8). The rate was 2-5 deaths per 1000 births higher than in the Nordic countries, but similar to the rates found in most of the other European countries neighbouring Russia (1,4,5,8). According to the official statistics of the Russian Federation, maternal health conditions unrelated to pregnancy explained 24.7 % of early-neonatal deaths, 22.2 % of stillbirths, and 23.4 % of perinatal deaths (7).

The population in the township of Mončegorsk has been exposed to large emissions of sulphur dioxide, dust, nickel and copper from the local nickel refinery (9). Maternal and infant urinary-nickel levels were significantly higher in Mončegorsk than in Norwegian populations and residents of the Russian city of Arkhangelsk, which is located 400 km south-east of Mončegorsk (10). The main employer in the town has been the refinery, where those working in nickel production have been exposed to elevated levels of nickel compounds and other industrial chemicals and hazards (11). A substantial proportion of the workers at the refinery have been women (8,12).

The newly established Kola Birth Registry (KBR), which is the only registry of its kind in Russia, now provides verified data that can be used to assess the health of the newborn and pregnant population of Mončegorsk. The registry includes extensive data about the mother,

pregnancy, delivery and the newborn (8). The KBR thereby provides insight to the reproductive health of an urban population living under both industrial and arctic conditions.

Our aim in this investigation is to describe the health status of the delivering population in Mončegorsk for the period 1973 –1997 by describing their pregnancy history and pertinent medical history, as well as the prevalence of obesity, infections, smoking and alcohol abuse during the pregnancy period. We also examine closely the distribution of occupations of the delivering population, and the proportion that was potentially exposed to compounds of nickel and of other metals at work.

MATERIALS AND METHODS

The township of Mončegorsk in northwest Russia is located north of the Polar circle at 68°N-33°E. In 1995, the population of Mončegorsk was 66 200, of which 52.0 % were women. Since the disintegration of the Soviet Union in the early 1990s, the size of the population has decreased by more than 10 000. This decrease has been mainly due to emigration, but the natural growth has also been negative. The natural decrease in both Mončegorsk and in the KP as a whole since 1992 can be attributed to both an increased death rate and a decreased birth rate (13,14). The nickel refinery employed 12 835 (41.9 % women) of the inhabitants in 1995. The refinery runs 24 hours a day and has three work-shifts.

The source of the data in this investigation is the KBR. The KBR includes extensive data about more than 98 % of all live births, as well as stillbirths of at least 28 weeks of gestation, in the period March 1973 through 1997 by women residing in Mončegorsk (8). Data concerning spontaneous abortions (SA) occurring at the clinic after 22 - 27 weeks of gestation were also included in the KBR. A total of 21 214 deliveries by women residing in the township before becoming pregnant have been registered, corresponding to 15 923 different individuals (8). The definitions of a live birth, stillbirth and SA employed in this study, along with a comprehensive account of the history, content and data quality of the KBR, have been described previously (8). Careful verification of the KBR database has shown a low data entry error rate and an acceptable level of missing records and data (8) (see also the Discussion).

The data registered in the KBR were obtained from the medical, delivery and gynaecological records of the delivering women (8). The height and weight information were recorded pre-delivery. The information about the medical history includes certain infectious diseases during the period from 2-3 months before pregnancy until 12 weeks of gestation (for brevity, this time frame from here on is referred to as the "pregnancy period"). The presence of infections was registered categorically (yes/no) in a common field, along with the corresponding ICD-10 codes. Influenza during the first twelve weeks of pregnancy was also recorded. All pregnant women in Mončegorsk are tested for gonorrhoea and syphilis (Wassermann test) on their first visit to the gynaecologist, and they are retested during the 24th and the 36-38th weeks of pregnancy. Other infections are tested for if suspected, or upon request. Testing for chlamydia was available from the mid-80s. The information recorded about smoking during pregnancy was yes or no, based on what the gynaecologist observed, or heard from the visiting pregnant woman. In addition, the appropriate ICD-10 was code registered in the KBR. Similarly, if there were obvious signs of alcohol abuse this was recorded by the gynaecologist and was registered in the same fashion. Obesity in the medical history of the mother was specified with an ICD-10 code. Pre-gestational or gestational diabetes mellitus, or glycosuria during pregnancy were also noted categorically and each condition was registered with the appropriate ICD-10 code. The information in the KBR about the delivering woman's occupation and employer was obtained from the gynaecological records. The gynaecologist requests this information at the first visit, or it is asked for at the delivery clinic if the mother had not visited a gynaecologist. The information is registered by a numeric code, as well as with an accurate word descriptor. Twenty-nine different employer codes and 16 different job codes were used in the registration.

The prenatal care in Russia is covered by basic health-care insurance and is without service fees. All pregnant women are advised to visit a gynaecologist before 12 weeks of pregnancy. Women having heavy or risk-related work are supposed to be transferred to another task at their workplace as soon as the pregnancy has been confirmed (Vojtov, person communication 2002). By law, the pregnant women are obliged to leave work after 30 weeks of pregnancy. Until and including week 12 of gestation, a woman can choose to have an abortion. Since 1991, induced abortion has been allowed from the 13th to

the 22nd week, providing there are valid social reasons for it. The maternal care and maternal benefits, as well as the regulations for induced abortion in Russia, were described previously in some detail (8).

The University of Tromsø's regional research ethics board, the Norwegian data inspectorate and the regional health administration of the Murmanskaja Oblast' approved the setting up of the KBR and its use for epidemiological investigations.

RESULTS

The pregnancy and delivery history of the study population is summarised in Table I. The registered individuals had, on average, a total of 1.8 deliveries and 3.0 pregnancies; whereof 1.3 are described in the KBR. 15.7% of the women had experienced one or more SA and 47.4 % had had at least one induced abortion, with an average of 2.25 induced abortions.

Table I. Pregnancy and delivery history of the population.

Information Item	Number	Proportion (%)
Total number of births registered	21 214	
Nulliparae deliveries ^a	10 398	49.2
Multiparae deliveries ^a	10 733	50.8
Average number of deliveries at delivery per registrant ^{a,b}	1.7	
Average number of pregnancies at delivery per registrant ^b	2.8	
Total number of registered women	15 923	
Average total number of deliveries experienced/registered woman ^{a,c}	1.8	
Average total number of pregnancies experienced/registered woman ^c	3.0	
Total number of spontaneous abortions experienced	3 256	
Average number of spontaneous abortions in population	0.2	
Number of women having had a spontaneous abortion	2 493	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 deliveries by women with a past induced abortion	8 667	40.9
Number of women with a past induced abortion	7 556	47.4
Average number of induced abortions	2.25	
Mean time interval since previous delivery, years	5.4	
Time interval <18 months		9.3
Mean time interval since previous pregnancy, years	2.4	

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

^b The unit of observation is the delivering woman at delivery.

^c The unit of observation is each individual woman at her last registered delivery.

The average delivering woman was 25.3 years old (Table II), had been pregnant 2.8 times and had delivered 1.7 times at the time of delivery. The mean time between deliveries was 5.4 years and between pregnancies 2.4 years. Nine percent of the registered deliveries occurred within 1.5 years of the woman's previous delivery and 1.6 % of the delivering population had reported infertility problems in their past.

Table II. Characteristics of the study population (N=21 214).

	Number with information (% missing)	Mean	SD	Range	Proportion (%)
Mean maternal age, years	21212 (0.01)	25.3	5.1	13-46	
Mean height, cm	19705 (7.1) ^a	161.5	5.8	140-188	
Mean weight at delivery, kg	19473 (8.2) ^a	73.1 ^b	11.0	36-148	
Mean body mass index at delivery	19188 (9.6)	28.0	3.9	14.1-68.5	
Mean gestational age at first visit to gynaecologist, weeks	20997 (1.0)	14.6	7.6	4-42	
Economically employed	21150 (0.3)				92.0
Employed by the nickel refinery	9016				42.5

^a Information is missing when the delivery occurred at home, on the way to the clinic, or urgently at the clinic.

^b The weight recorded at the clinic right before delivery.

Ninety-two percent of the women giving birth were economically employed at the onset of the pregnancy. The nickel refinery company employed 9016 of the delivering women (46.3% of all employed). Of these, 17% worked in production areas with exposures to nickel, related metals and other industrial hazards (11); 38% are judged to have had possible, or probable, exposure of this type; and 45% had jobs outside the nickel refinery complex with no industrial exposures (see footnotes to Table III). The employment overview is presented in Table III, which also shows that a large proportion of the women worked in retail, schools and public offices (18%), medical services (7.8%) and in construction enterprises (5.0%).

Table III. Employment of the delivering women.

EMPLOYMENT	Number	Proportion (%)
Production in the nickel refinery ^a	1529	7.2
Other work at the nickel refinery complex ^b	3464	16.3
Nickel company employees working outside the refinery complex ^c	4023	19.0
Public offices, schools, clerks, retail	3825	18.0
Chemical enterprises	242	1.1
Other factories	152	0.7
Mines or geological exploration	121	0.6
Food and service enterprises	1398	6.6
Hospitals, pharmacists	1664	7.8
Water, electricity and gas supply	550	2.6
Agriculture and timber	332	1.6
Construction	1055	5.0
Transport	323	1.5
Textile and clothing industry	779	3.7
Housewife/unemployed	1693	8.0
No information about employment	64	0.3
Total	21214	100.0

^a Includes matte separation, roasting and smelting, anode casting, nickel-carbonyl purification and electro-refining of metals (mostly nickel and copper)

^b Includes maintenance, transport, administration, repairs, technical control, construction, sulfuric acid production and canteens at the plant.

^c Housing, sanatorium, child care, shops and canteens outside the plant area.

In Table IV, the delivering population is grouped according to the type of work. It shows that more than 20 % had occupations that were considered physically demanding.

Table IV. Work details of the delivering population.

OCCUPATION/EXPOSURES	Number	Proportion (%)
Operators, machinists, drivers	1851	8.7
Manual labour	827	3.9
Occupations considered physically detrimental	287	1.4
Chemicals, gas, paints, laboratory	1792	8.3
Machine and equipment service	1399	6.6
Light industry and service work considered physically light	2271	10.7
Cleaning, gardening, waiting and other service occupations considered physically demanding	4308	20.3
Office, clerk	5454	25.7
Periodical work in departments with harmful exposures	1254	5.9
Business, police, or unknown	78	0.4
Not economically employed	1693	8.0
Total	21 214	100.0

The prevalence of the selected maternal risk factors is presented in Table V. Of the delivering women, 5.8% were older than 34 and 2 % were over 37 years. The overall proportion of deliveries by women younger than 18 years was 1.9 %, but this increased in the 1990s. The time trends for selected age categories and obesity are depicted in Figure 1. 5.6 % of the delivering women were diagnosed as obese prior to pregnancy. The mean body mass index (BMI) at delivery was 28.0 kg/m² (Table II), and 10.6 % had a BMI at delivery above 32.6 kg/m², 26.6 % were above 29.6 kg/m², while 24.7 % were below 24.7 kg/m². The cut-off value of 32.6 kg/m² corresponds to the BMI for a woman with a pre-pregnancy BMI of 30.0, a weight gain during pregnancy of 6.8 kg, and a height of 1.61 metres. The other two cut-off points mentioned above correspond to women with pre-pregnancy BMIs of 25.0 or 20.0 kg/m², respectively, with a weight gain of 12 kg and a height of 1.61 metres.

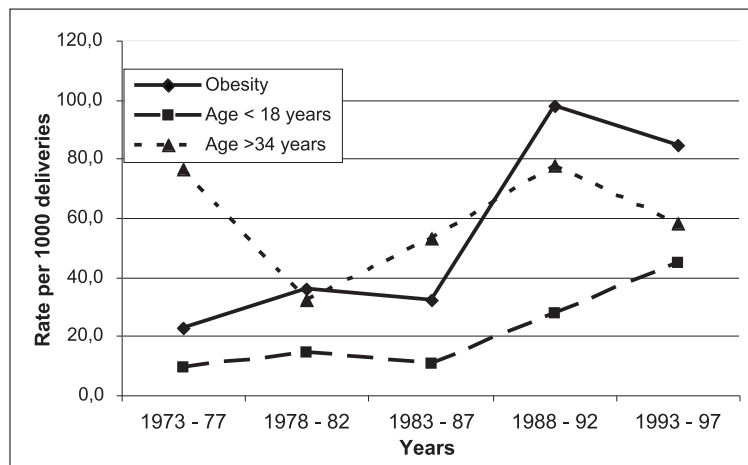


Figure 1. Frequencies of obesity, and of low and high maternal age in the delivering population in Montsčegorsk 1973 – 97

0.5 % of the delivering women were recorded as alcohol abusers and 0.7 % as smokers during pregnancy (see Table V). Thirty-nine percent of the smokers were also recorded as drinkers, while 54 % of drinkers were smokers. Twenty-five women (0.1%) who delivered had a history of pre-gestational diabetes mellitus, while 390 women were diagnosed with glycosuria and 5 women developed diabetes mellitus during pregnancy. The ICD-10 code was not recorded in 26 of the noted cases of diabetes, or glycosuria during pregnancy. In total, 2.1 % had diabetes mellitus that developed pre-gestationally or gestationally, or had glycosuria.

Table V. The presence of maternal risk factors (N=21 214).

Risk Factors	Number with Information (% missing)	Proportion diagnosed (%)
Obesity (E66.9)	21214 (0.00)	5.6
Tobacco smoking during pregnancy (Z72.0)	21212 (0.01)	0.7
Alcohol abuse during pregnancy (Z72.1)	21212 (0.01)	0.5
Infectious disease during pregnancy	20953 (1.23)	3.0
Pre-gestational, or gestational diabetes mellitus, or glycosuria during pregnancy (O24.4, O24.9, E14, R81)	21212 (0.01)	2.1
Congenital malformations of the circulatory system, or rheumatic heart disease (ICD-10: Q20-Q28, I05-I09)	21004 (0.99)	1.2
Maternal age >34 years		5.8
Maternal age <18 years		1.9

Table VI summarizes the disease experience of the delivering population in their pre-pregnancy past. 1.4 % had had acute rheumatic fever (ICD: I00 - I02), while 1.1 % had experienced chronic rheumatic heart diseases (ICD: I05 - I09). About 1 % had been diagnosed with essential (primary) hypertension (ICD-I10) and an equivalent proportion had had a reading of elevated blood pressure without diagnosis of hypertension. There had been 2016 diagnoses of diseases of the urinary system (ICD: N00 – N39) and 5721 diagnoses of diseases of the female genital system (ICD: N60 – N98). Unspecified non-toxic goitre was the only disorder of the thyroid gland diagnosed, a disorder that 3.9 % had experienced.

In terms of past infections, also presented in Table VI, salpingitis/oophoritis and unspecified viral hepatitis were the most widespread in the investigated population. Close to 7 % had been infected with hepatitis, and more than 9 % had been diagnosed with salpingitis/oophoritis. 0.5 % had a record of respiratory tuberculosis in their past.

Table VII presents the prevalence of infectious diseases during the "pregnancy period". The burden of both viral hepatitis and gonorrhoea was 2.8 per 1000 deliveries, and 0.6 % had had gonorrhoea in their past. The prevalence of viral hepatitis and gonorrhoea during the "pregnancy period" decreased over the period 1973 – 1997. The most prevalent of the investigated infections during the "pregnancy period" was urogenital trichomoniasis (UT) (1.8 %). The prevalence was slightly higher in the nineties than earlier. There were 2 to 10 cases of rubella, parotitisvirus, toxoplasmosis and chlamydial lymphogranuloma, respectively.

Table VI. The pre-pregnancy disease experience of the delivering population.

ICD-10 code	Disease	Number	Proportion (%)
A15	Respiratory tuberculosis, bacteriologically and histologically confirmed	101	0.47
A53	Other and unspecified syphilis	20	0.10
A54	Gonococcal infection	126	0.59
A56	Other sexually transmitted chlamydial diseases	13	0.06
A59.0	Urogenital trichomoniasis	330	1.56
A63	Other predominantly sexually transmitted diseases	14	0.1
B19	Unspecified viral hepatitis	1448	6.8
B58.9	Toxoplasmosis, unspecified	4	0.0
B91	Sequelae of poliomyelitis	26	0.1
D25	Leiomyoma of uterus	142	0.7
D27	Benign neoplasm of ovary	413	2.0
D50	Iron deficiency anaemia	96	0.5
E04.9	Non-toxic goitre, unspecified	817	3.9
E14	Unspecified diabetes mellitus	25	0.1
E28.2 & 9	Polycystic ovarian syndrome, ovarian dysfunction	328	1.6
E66.9	Obesity, unspecified	1188	5.6
E80.4	Gilbert's syndrome	11	0.1
F48.0	Neurasthenia	19	0.1
G40	Epilepsy	53	0.3
I00	Rheumatic fever without mention of heart involvement	280	1.3
I02, I05, I06	Rheumatic chorea, mitral or aortic valve diseases	179	0.8
I09.9	Rheumatic heart disease, unspecified	59	0.3
I10	Essential (primary) hypertension	243	1.2
I51.5	Myocardial degeneration	111	0.5
I83	Varicose veins of lower extremities	116	0.6
I95.9	Hypotension, unspecified	42	0.2
N11.9	Chronic tubulo-interstitial nephritis, unspecified	1532	7.2
N20.0	Calculus of kidney and ureter	98	0.5
N20.0, N28.8	Calculus, or other specified disorders of kidney and ureter	192	0.9
N30.9	Cystitis, unspecified	194	0.9
N60.9	Benign mammary dysplasia, unspecified	194	0.9
N70.0 & 1	Chronic, or acute salpingitis and oophoritis	1947	9.2
N71.9	Inflammatory disease of uterus, unspecified	149	0.7
N72	Inflammatory disease of cervix uteri	24	0.1
N75.0 & 8	Cyst, or other diseases of Bartholin's gland	37	0.2
N83.6	Haematosalpinx	52	0.3
N84	Polyp of female genital tract	24	0.1
N86	Erosion and ectropion of cervix uteri	2963	14.0
N97	Female infertility	331	1.6
R03.0	Elevated blood-pressure reading, without diagnosis of hypertension	248	1.2

Table VII. The presence of selected infectious diseases during the period from 2-3 months prior to pregnancy to 12 weeks of pregnancy.

Infection (ICD-10 code registered)	Number	Prevalence/1000 deliveries
Gonococcal infection (A54)	56	2.7
Chlamydial lymphogranuloma (A55)	2	0.1
Urogenital trichomoniasis (A59.0)	384	18.3
Rubella (German measles) (B06)	10 ^a	0.5
Viral hepatitis, unspecified (B19)	59	2.8
Mumps, parotitisvirus (B26)	9	0.4
Toxoplasmosis (B58.9)	4	0.2
Influenza, virus not identified (J11) ^b	135	6.4
Infection present, but not specified	5	

^a An additional 3 had contact with/exposure to rubella (Z20.4)

^b During the first 12 weeks of pregnancy.

DISCUSSION

The focus of the present study was to describe the health status of the delivering population in Mončegorsk during the period 1973–1997, with delivery as the unit of observation. Thus, in the description of past disease and infection experiences, each woman may have contributed more than once to the frequency if she had more than one recorded delivery in the KBR and had delivered more than once after the diagnosis in question. The discrepancy between the number of deliveries by women of Mončegorsk and the number of records in the KBR means that 5 525 (34.7%) of the registered women had their first birth while residing elsewhere, or/and that their first birth was before 1973.

Occupation

Economically active women have been found to be at higher risk for adverse birth outcomes than women who are not economically active (15,16), although non-strenuous occupations have not been associated with adverse outcomes (17). A meta-analysis (18) revealed that physically demanding work, prolonged standing, shift work, and a high cumulative work-fatigue score are associated with pre-term birth. Ninety-two percent of the delivering population in Mončegorsk were employed, which is high compared with women in central Norway, where 77.3 % in the 20-49 age group were employed in 1995-97. About one-third of the latter population reported having an occupation

that involved much lifting or walking, or that was physically demanding (19). The Russian national hygiene standards of 1996 consider night-shift work to be a non-permissible load on the female organism. However, this regulation is not enforced. Instead the Russian sanitary-epidemiological control centres enforce the Russian labour code, which only prohibits women with infants to work night shifts (20).

Table III shows that 1529 (7.2%) of the delivering women were employed in nickel production, which are sectors where the workers are exposed to hazards (11). An additional 16.3% had possible, or probable, exposures of this type. Whether such exposure may cause reproductive toxicity (21) has not yet been formally established. A reproductive concern is plausible, since nickel does cross the placental barrier (22,23). Animal studies suggest that nickel is toxic to the foetal-placental unit and to the newborn (24,25). Foetal haemorrhages and haematomas, as well as malformations at birth, including ocular, skeletal and neuronal effects, have been reported in rodents, but assessments concerning the reproductive health and fertility of humans are not available (26,27). The dosages, speciation and routes of administration in the animal studies cannot be readily extrapolated to the human exposure situation, so the experiments have limited use for predicting the effect of exposure on humans (28). The Health Council of the Netherlands (26) reviewed studies published over the period 1966-2000 concerning adverse effects of nickel with respect to fertility, development and lactation in humans and/or animals. Based solely on hazard identification, they classified soluble nickel salts as substances which cause concern for human fertility and which, in terms of foetal development, should be regarded as if they cause developmental toxicity in humans (26). Metallic nickel and water-insoluble nickel compounds were not classifiable, because of a lack of appropriate data. Pregnancy outcome and semen quality studies of Mončegorsk nickel workers are in progress.

Abortion

Women of the delivering population had, by the time of their most recent delivery, experienced an average of 1.07 induced abortions, which amounts to 0.8 induced abortions per delivery. Women with induced abortions had had an average of 2.3 induced pregnancy terminations. The effects of induced abortions on a woman's general health and subsequent reproductive health are difficult to assess and, therefore, are

poorly understood. A meta-analysis has suggested that induced abortion increases the risk of pre-term birth and placenta previa in subsequent pregnancies, but did not provide support for a higher risk of SA, or sub-fertility (29). Some studies have found an association between ectopic pregnancy and previous induced abortion (29,30).

Despite the high number of abortions and the implications of an abortion, one should also keep in mind that the women included in the present investigation all had a delivery after their reported abortions. Forty-one percent of the deliveries during the period 1973 – 97 were by women with an induced abortion in their past. In terms of the actual rate of induced abortion in Mončegorsk, the KBR does not reveal those by women who never delivered, or who had moved prior to their first delivery. One can also assume that the population registered in the KBR have had induced abortions after their last delivery. However, the induced abortion rate has decreased. Figures obtained from the polyclinic in Mončegorsk show that the ratio of induced abortion per delivery dropped from 1.9 in 1984, to almost 1.0 in the mid-1990s (Fig.2) (Vojtov, pers.comm. 2002). The official rate for the Soviet Union in 1985 was 1.4 induced abortions per delivery, and for Russia the rate was 1.5 in 1995 (31). In the United States the ratio has been reported to be 0.35 (29). The decreased induced abortion rate in Mončegorsk does not appear to subsequently impact the proportion of deliveries by women with a previous induced abortion. The explanation could be that induced abortion is mainly decreasing among women who already had the desired number of children before their induced abortion (Fig.2).

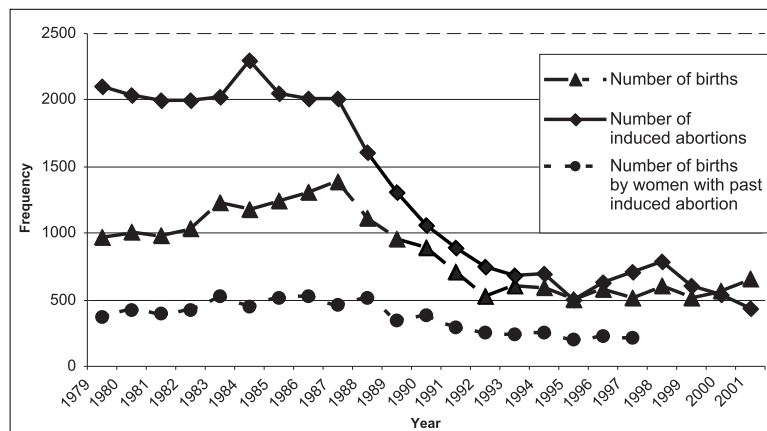


Figure 2. Annual number of births, induced abortions and deliveries by women with a past induced abortion in Mončegorsk during the period 1979 - 2001. The figures for the years 1998 – 2001 were obtained from the polyclinic in Mončegorsk

Age

In the 1990s, the proportion of deliveries in Mončegorsk by women younger than 18 was almost ten-fold the proportion in Norway (0.5%), but the proportion of births by women older than 34 was less than half that in Norway in 1998 (13.6 %) (32). Compared with women in the age group 18-34, pregnant women in the age group above 34 are at increased risk of complications during pregnancy, including LBW, pre-term delivery, stillbirth, foetal death, Caesarean section, postpartum haemorrhage, placenta previa, breech presentation and operative vaginal delivery (33,34). Births by mothers in the age group 13-17 have been found to be at higher risk of LBW, premature delivery and SGA compared with deliveries by women in the age group 20-24 (35). The estimated age of the mother at delivery was subject to a slight underestimation in our study since the analysis is based on the age in years recorded during pregnancy, and not on the exact time difference between the date of delivery and the date of birth of the mother. The mother's date of birth was not registered in the KBR due to Russian regulations. The recorded maternal age approximates the maternal age at conception rather than the age at delivery, since the majority visit the gynaecologist by 12 weeks of pregnancy (median=12.0). Hence, the estimated proportions of deliveries by women younger than 18 and older than 34 are slight over- and under-estimations, respectively.

Maternal weight

The definition of obesity employed in Mončegorsk was based on a rather uncommon method. Fifty kg was considered the upper limit of normal weight for a 150-cm tall person; 60 kg when 160 cm; and so on. If the weight was $\geq 20\%$ above this height guideline, the mother was diagnosed with obesity grade 1. Classification was done by the gynaecologist, or obtained from the medical journal. Compared with the formal BMI method, the protocol used allows a slightly higher BMI at the cut-off limits for taller persons. The upper cut-off BMI levels for normal weight using the Russian approach fall in the range 23.0 – 24.0 for most women, while the cut-off levels for obesity would have been 28.1 rather than 30 for the average delivering woman of 161 cm height. 5.6 % of the delivering women were recorded as having been obese prior to pregnancy, but the proportion increased to above 8 % in the

1990s (Fig.1). However, considering that past obesity does not necessarily mean present obesity, the estimated percentages are likely to be slight over-estimations of the prevalence at onset of pregnancy. The average Norwegian woman has had a substantial increase in BMI. In the mid-eighties, 3.8 % of women in the age group 20-29 in central Norway were obese ($\text{BMI} \geq 30.0$) and, 10 years later, the proportion had increased to 10.5 % (36). Thus, the proportion with a $\text{BMI} \geq 30.0$ in that age group was then actually higher in the non-pregnant Norwegian population than in the pregnant population of Mončegorsk.

The optimal range of weight gain during pregnancy depends on the woman's pre-pregnancy weight, but all optimal ranges are within the range 12 – 18.2 kg (37). The recommended minimum weight gain is 6.8 kg for normal weight women (37). A pre-pregnancy BMI above 25 kg/m^2 has been found to be associated with an increased risk of still-birth. The risks of gestational diabetes and hypertensive disorders of pregnancy are also elevated among women who are overweight prior to pregnancy (38,39). Obese women (pre-pregnancy $\text{BMI} \geq 30.0$ kg/m^2) have been found to have an increased pregnancy risk of late foetal death, perinatal mortality, and congenital abnormalities, but are less likely to deliver an infant that is small for its gestational age (38,40). Women with a low pre-pregnancy BMI appear to be at higher risk of suspected intra-uterine asphyxia (41).

Pre- or early pregnancy maternal weight was not recorded in the pregnancy journals in Mončegorsk. Hence, neither the individual pre-pregnancy BMI, nor the change in BMI during pregnancy, can be estimated based on the data in the KBR. However, considering the estimated mean height of 161 cm and the average BMI at delivery of 28.0 kg/m^2 , a minimal mean weight gain of 6.8 kg would mean an average pre-pregnancy BMI of 25.6. If the mean weight gain was 12.0 kg, the corresponding pre-pregnancy mean BMI would have been 23.6 kg/m^2 . In a study involving cohorts from Norway and the KP, the mean BMIs at delivery were 27.1 and 26.8 kg/m^2 , respectively (42). The findings in the present investigation support the findings in other studies showing that the BMI in the general female population in north-western Russia was lower than in Norway (19,42,43).

The observations that only 5.6 % were diagnosed as obese, and that a mere 10.6 % had a BMI at delivery above 32.6 kg/m^2 , indicate that the prevalence of pre-pregnancy obesity in the delivering population in Mončegorsk was very low compared with cohorts of gravidæ in the

United States and France (38). The distribution of BMI at delivery in the present study indicates that the proportion of the delivering women at increased risk of a non-favourable pregnancy outcome due to a low pre-pregnancy BMI might have been larger than the proportion at risk due to pre-pregnancy obesity. In the evaluation of the mean BMI at delivery, one should keep in mind that the data also includes pre-term deliveries and therefore is an underestimation of the mean maternal BMI at full term. About 8 % of the records did not contain the data needed to calculate the BMI. These data are mostly missing for women that delivered outside the clinic, or had an urgent delivery there.

Smoking

In the present investigation, 0.7 % of the delivering women were recorded as smokers during pregnancy. The noted smokers were most likely relatively heavy smokers, since only high cigarette use ("abuse") was likely to be noted by analogy to alcohol consumption (see below). Looking at the trend, the prevalence of smoking in the delivering population in Mončegorsk increased steadily over time. In the period 1993-97, the proportion of obvious smokers reached 1.6 %. This proportion is comparable to the finding in a cohort of delivering women in the western part of the KP, where 23.2 % were smokers but 2.7 % reported smoking more than 10 cigarettes per day (2). Nevertheless, the finding in the present investigation is probably an under-estimation, since the pregnant women were not queried about smoking habits.

Alcohol

Maternal alcohol abuse during pregnancy may cause serious birth defects, have a life-long physical impact, and impair the foetus mentally (44). Foetal alcohol syndrome is a leading cause of preventable birth defects in the United States (45). Consumption of alcohol during pregnancy, especially during the first trimester, has also been found to be associated with increased risks of pre-term delivery, SA and still-birth (44,46-48). There have been few investigations mapping the prevalence of regular alcohol abuse, or consumption during pregnancy. Under-reporting of alcohol consumption by subjects is a chronic difficulty associated with this sensitive topic (49). In an investigation in the KP in which a questionnaire was administered through an inter-

view by the midwife/gynaecologist, 36 % of the pregnant women refused to answer the question about alcohol (42).

In the present study, about 0.5 % of the delivering population were recorded as alcohol abusers. For the same reason as for smoking, this figure is most likely an under-estimation. The relatively high co-occurrence rate of both smoking and alcohol abuse (39 and 54 %, respectively) in this material suggests that women having one of these two habits during pregnancy were likely to also have had the other habit. However, the method of how the data about smoking and alcohol abuse were obtained might bias towards a recording of co-occurrence. Observing/obtaining one piece of information about risk behaviour might more easily lead to, or be connected to, openness about additional risk behaviour information.

Diabetes

Pre-gestational maternal diabetes mellitus is associated with a less favourable pregnancy outcome for both the mother and the infant, compared with non-diabetic pregnancies (50,51). The overall experience of pre- or gestational diabetes mellitus (unspecified) in the delivering population in Mončegorsk was 1.4 per 1000 deliveries. The prevalence of diabetes in the pregnant population in Norway has risen sharply over the last decades, from 1.8 per 1000 births in 1977, to 12.8 in 1998 (32,52). The Medical Birth Registry (MBR) of Norway interpreted the increase to be mainly due to an increasing number of diabetic women, choosing to go through a pregnancy because of improved risk management. Also, more women are now being diagnosed with gestational diabetes in Norway than before (52). In the age group 20-49 Norwegian females, 0.7 % reported having or having had diabetes (19), while only 0.1 % of the delivering population in Mončegorsk had a past experience of diabetes mellitus.

Infections

Studies have estimated perinatal infections to cause of 2-3 % of all congenital anomalies (53). Thus, the recognition of pertinent infections is an important part of prenatal care. Prior sexually transmitted diseases have been associated with an increased risk of ectopic pregnancy (30). Testing for syphilis and gonorrhoea was carried out on all pregnant women in Mončegorsk, while testing for the other infectious diseases

included in this investigation was carried out only if the infection was suspected, or requested and paid for by the pregnant woman. Thus, the estimated prevalence of the latter infections during the "pregnancy period" likely constitutes an under-estimation. The distribution of the infections over time revealed that the recorded cases were not due to an epidemic at one point in time. UT and influenza during the first 12 weeks of pregnancy appeared to be the predominant investigated infection. Vaginitis due to *Trichomonas vaginalis* is also recognised as one of the most common of sexually transmitted diseases (54). Some studies have suggested that UT may be associated with increased risks of pregnancy loss before 22 weeks, LBW, PPRM, pre-term birth, as well as pre-term birth of a LBW infant (55,56). A possible increased risk of pregnancy loss due to UT cannot be investigated using the KBR, since SA before the 28th week of gestation were not systematically recorded. The frequency of gonorrhoea was less than four cases annually during the period 1987-97.

The proportion having had viral hepatitis in their medical history (6.8 %) was comparable to the proportion found in an investigation in Arkhangelsk, where 10.1 % of the women below 40 years of age are reported as having had hepatitis and/or cirrhosis (43). The possible implications of a viral hepatitis infection during pregnancy vary depending on the type of virus (57). However, this was not specified in the data sources for the KBR. The incidence of hepatitis of all types has risen sharply in the KP during the most recent years (58).

More than 9 % of the delivering women had been diagnosed with salpingitis and/or oophoritis in their past. These terms and diagnoses fall under the term of pelvic inflammatory disease (PID). A previous PID has been found to be associated with an increased risk of ectopic pregnancy (30) and infertility (59). In the United States, PID afflicts more than one million women each year. The risk factors linked to PID include infections connected to abortions, age at first intercourse, intercourse without a condom, multiple sex partners, use of an intra-uterine device (IUD) and sexually transmitted diseases (60,61). In an investigation in the U.S. among users of copper IUDs, 3.4 % had PID (61). The relatively high proportion of the delivering women in Mončegorsk having had PID might be explained by the high rate of induced abortion, extensive use of the spiral IUD, and the equipment and techniques used for termination of pregnancy. In a feasibility study of female nickel workers and a control population, 52 % of res-

pondents acknowledged the use spiral IUDs (27). The high proportion having a past diagnosis of tubulo-interstitial nephritis suggests that pyelonephritis is also recorded under this diagnosis.

Validity/reliability

The data registered in the KBR were extracted from medical, delivery, or gynaecological records (8,27). The forms used for recording during Soviet times and later in Russia were standardised, and the recording, as well as the registration, have been recognised as thorough and diligent. In Mončegorsk, there is only one hospital, one delivery clinic and one gynaecological polyclinic, and the latter provides the only gynaecological services available in the township. The services, recording and routines were thus highly standardised, and each type of record was archived in one place. In the KBR, both the written diagnosis given in the records and the ICD-10 code classification have been registered in separate fields, which enables verification of the noted ICD-10 codes (8,12,27). The validity of the latter, however, would be affected for diagnoses that, traditionally, have not been clear-cut to establish. Over-estimations of the prevalence, or incidence, of the factors assessed in this study are unlikely, but the prevalences of smoking, alcohol abuse and infections other than syphilis and gonorrhoea are most likely under-estimations. The same can be said about the reported number of previous spontaneous abortions, because it is unlikely that all mini-abortions were recorded.

Summary

A relatively low, but increasing, proportion of the population in Mončegorsk gave birth while in the elevated risk groups in terms of high age. The proportion of heavy smokers in the population of delivering women also appeared to be lower in Mončegorsk than, for example, in Norway. We also judge the prevalence of pre-pregnancy obesity and diabetes and the incidence of gestational diabetes to be relatively low. The most worrisome findings in this investigation were the high prevalences of a history of SA, induced abortion and PID. The high occurrences suggest the possibility of negative health impacts that may have influenced the lives of many women. More than 90 % of women were economically employed at the onset of pregnancy,

and a high proportion worked in physically demanding or/and occupations with potential hazards. Although legislation was in place to ensure that the pregnant women in such occupations were temporarily transferred to another job, the transfer could only be enforced after a gynaecologist had established the pregnancy. Considering that the mean gestational age at the first visit to the gynaecologist was 14 weeks, occupational exposures and strain might have impacted the pregnancy health and outcome.

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Arild Vaktskjold
 Institutt for samfunnsmedisin
 University of Tromsø
 N-9037 Tromsø
 Norway
 Email: arild.vaktskjold@ism.uit.no