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THE ESTIMATION OF PREVALENCE AND STRUCTURE OF BIRTH DEFECTS IN ARKHANGELSK REGION IN 2012-2014: ARKHANGELSK COUNTY BIRTH REGISTRY DATA

ABSTRACT

Introduction

Birth defects (BD) are an important medical and social issue as they represent one of the most important causes of infant mortality and childhood disability. Constant epidemiological surveillance is a core issue in primary prevention of this pathology. The aim of this study was to assess prevalence of birth defects based on population birth registry data.

Materials and methods

The Arkhangelsk County Birth Registry was used in this retrospective cohort study. Database included information on all births at gestational age 22 and more weeks registered in Arkhangelsk County in 2012-2014. Data on variety of perinatal exposures, pregnancy and delivery complications as well as neonatal diseases were available for detail analysis.

Results

In 2012-2014, 1870 various birth defects in 1718 newborns were registered in Arkhangelsk County. The total prevalence of BD was 39,9 for 1000 newborns, and the prevalence after exclusion of co-called minor anomalies was 28,6 per 1000 newborns, that significantly higher than the Federal monitoring data for Arkhangelsk region. The most frequent groups of BD were congenital anomalies of circulatory system, congenital malformations and deformations of the musculoskeletal system as well as congenital anomalies of the urinary system.

When calculating the prevalence of BD that are subject of mandatory registration in Russia, it was found that their prevalence in the Arkhangelsk County was 6,4 per 1000 newborns in 2012-2014.

Conclusion

The total prevalence of birth defects, as assessed by the Arkhangelsk County birth registry, was higher than reported by the Federal monitoring. It can be assumed that this population-based tool allows to estimate the total prevalence of congenital anomalies more completely compared to the current Federal monitoring.

Keywords: birth defects, prevalence, surveillance, population-based medical birth registry.

INTRODUCTION

Congenital malformations (CM) are the direct cause of a significant number of infant deaths, they can lead to disability and can decrease quality of life [19]. In 2015, CM were diagnosed in 130,451 children of the first year of life, they became the cause of disability in 93,788 children. Moreover, it has been reported that CM had been directly connected with 2707 cases of infant deaths in the Russian Federation (RF) in 2015 [6].

According to World Health Organization (WHO) General Assembly's resolution, one of the main action for CM prevention is establishing of an effective national and international surveillance system. At the same time, adequate monitoring of CM should provide an opportunity to determine temporal trends in the prevalence of CM, to identify clusters of CM, to allow en evaluation of both population prenatal screening and preventive programs, and to provide sufficient data for any epidemiological studies of their risk factors [19].

International monitoring systems as a tool for systematic epidemiological surveillance of CM exist in the world from the middle of the last century. The most famous are the International Clearinghouse for Birth Defects Surveillance and Research (ICBDMS), that collects and organizes data from more than 30 regional registers from America, Asia and Europe, and report the prevalence of the most severe and easily visualized 39 forms of CM [12], and the European Registry Network for Epidemiological Surveillance for congenital anomalies (EUROCAT). The later covers almost a third of newborns in the European Union and collects data on more than 80 forms of CM [11].

Definitions of the terms used in the world practice are following: birth defects and congenital anomalies are identical terms and they represent structural and functional developmental abnormalities that present at birth [19]. According to EUROCAT guidelines minor anomalies are a diverse group of isolated anomalies with «insignificant structural, functional or cosmetic effects». They are not considered by EUROCAT when calculating the prevalence of CM [9].

The existing system of monitoring

of the CM in the RF differs from the international registers by the number of anomalies considered and age limits for reporting defects. Twenty-one forms of CM as well as multiple CM are mandatory for reporting, and data collection is organized by medical organizations at regional level [2]. In every case of newborn with CM, information on maternal age, address and parity, as well as sex and birth weight of the child are collected. The total prevalence of all forms of CM is also a subject of surveillance, however, the absence of unified criteria for registration leads to high variation of this indicator between regions of the RF. Thus, the total prevalence of CM in Russia varied from 9.8 per 1000 births in the Stavropol County to 75.4 per 1000 births in Severnaja Osetia-Alania in 2012, with an average All-Russian prevalence of 24.9 [2].

Incomplete registration of cases, the lack of individual data on prenatal risk factors, as well as limited opportunities for temporal analysis requires some changes in the existing monitoring system, which would allow to identify the factors that affect BD occurrence.

Population-based medical birth registries provide possibility for epidemiological surveillance of CM and investigation of their risk factors and allow data collection on both adverse perinatal outcomes and fetal exposures during intrauterine development [13; 14]. An implementation of prospective data collection on CM with medical birth registers reduces the likelihood of selection and information biases [4, 5].

The aim of this study was to investigate prevalence of CM using data of the Arkhangelsk County Birth Registry (ACBR) in 2012-2014 with an assessment of the total prevalence of CM at birth, a proportional distribution of different groups of CM, and birth prevalence of nosological forms that are mandatory for reporting in the RF.

Maternal and methods

The ACBR includes data on all pregnancy outcomes with gestation age of 22 weeks or more. It was implemented in 2012 by the Arkhangelsk Medical Analytic Center with the support of the Northern State Medical University (Arkhangelsk), Norwegian Institute of Public Health (Oslo) and the Arctic University of Norway (Tromsø). The registry contains information about the parents (age, place of residence and occupation); maternal health and lifestyle (smoking before and during pregnancy, signs of alcohol abuse, use of medication during pregnancy, chronic diseases before pregnancy); previous pregnancies and their outcomes, complications of current pregnancy; results of prenatal screening. In addition, the ACBR contains information on deliveries itself, their complications and outcomes. Data on newborns includes status at birth (live or stillborn), Apgar score, anthropometric data, as well as the pathology diagnosed during first days of life, including CM. The ACBR is regulated by the Order of the Ministry of Health care of Arkhangelsk County. The database of the registry is created by using registration forms which are filled in by employees of obstetric departments extracting data from primary medical records [5].

We conducted a retrospective cohort study [7] using data of the ACBR for 2012-2014. It is impossible to include all cases of early spontaneous pregnancy terminations in the analysis and several authors recommend using prevalence at a specified point of time (for example, at birth) as a valid measure of CM's occurrence [15]. Thus, we calculated the prevalence of CM at birth.

Data on 43327 births and 43446 births (livebirth and stillborn) were registered in the ACBR between 01.01.2012 and 21.12.2014. There were 365 cases with missed or incorrect information on the presence or absence of CM and 76 cases had no information on the status at birth. The analysis of CM's prevalence was carried out with a stratification by blocks of anomalies according to the International Classification of Diseases, the 10th revision (ICD-10). The prevalence of defects, which are mandatory for reporting in the RF was also calculated. The newborns with more than one CM diagnosis were included in the analysis only as newborns with multiple defects as their diagnoses were not coded as Q89.7 ("multiple congenital malformations, not elsewhere classified"). These newborns were not included for any specific defects they had. However, all diagnosed malformations in the newborn were used for analysis stratified by group of defects. In addition, the prevalence of CM was recalculated after exclusion of minor anomalies according EUROCAT recommendations [10]. The statistical analysis was done using SPSS 23.0 software package. All rates are presented per 1000 births (livebirth and stillborn) with 95% confidence intervals (CI), calculated by Wild's method [1].

Results and discussion

43,446 live births and stillborn were recorded in the ACBR in 2012-2014. There were 1,718 newborns with 1870 different forms of CM among them. Thus, the prevalence of CM at birth was 39.9 per 1000 births (95% CI = 39.0-40.9). Fourteen (0.8%) were stillborn and 11 (0.6%) died during the first 168 hours of life out of those with CM. The most prevalent groups of defects were the malformations of the kidney and the urinary tract, malformations of the nervous system, the genital tract malformations, malformations of the circulatory system, as well as defects of the musculoskeletal system (Table 1). After excluding minor anomalies according to EUROCAT guidelines [most of them were minor anomalies of the circulatory system (n = 260), the musculoskeletal system (n = 147) and the nervous system (n = 137)] the total prevalence decreased to 28.9 per 1000 births (95% CI = 28.1-29.7). The most prevalent minor anomalies were following: a patient or persistent foramen ovale (Q 21.1), a single cerebral cyst (Q 04.6), congenital metatarsus (primus) varus (Q 66.2). The total prevalence of CM, that are mandatory for registration in the RF was 6.4 per 1000 births (n = 274). Among this group of CM, the most prevalent were hypospadias, clefts lips and/or palate and multiple CMs (Table 2).

Our assessment of CM's prevalence in Arkhangelsk County is the second attempt to apply the medical birth registry for investigation of CM epidemiology. Similar analysis was carried out earlier in Murmansk County [17]. Our data on the total prevalence of CMs were significantly higher in comparison with results of the Federal monitoring for Arkhangelsk County in 2006-2012. (10.1 per 1000 births) [2]. On the one hand, it can be explained by more complete registration of perinatal diagnoses made by the birth registry. On the other hand, we cannot exclude possible overdiagnosis of CM in the early neonatal period.

Data on the total prevalence are similar with international estimates. According to the EUROCAT, the prevalence of CM below 20.0 cases per 1000 births may indicate incomplete detection or poor registration of CM [15]. The prevalence of CM in Arkhangelsk County, calculated after the exclusion of minor anomalies, was higher than EUROCAT data in 2012-2014 (28.9 / 1000 vs. 2 5.8 / 1000). However, the later included pregnancy terminations of about 20% [10], which were not considered in our analysis. In the term of CM structure according to ICD-10 blocks, our data are comparable with the European ones, apart from the significantly higher prevalence of genital defects (4.3 / 1000 vs 2.2 / 1000), malformations of the urinary system (6.3 / 1000 vs. 3, 4/1000),

Table 1

Prevalence of congenital malformations at birth in 2012-2014: data of the Arkhangelsk County Birth Registry (per 1000 births)

Group of congenital malformations according to ICD-10	Total prevalence		Prevalence excluding minor anomalies	
	N	Prevalence (95%CI)	N	Prevalence (95%CI)
Congenital malformations of the nervous system	217	5,0 (4,4-5,7)	80	1,9 (1,5-2,3)
Congenital malformations of eye, ear, face and neck	32	0,7 (0,5-1,0)	24	0,6 (0,4-0,8)
Congenital malformations of the circulatory system	544	12,6 (11,6-13,6)	284	6,6 (5,9-7,4)
Congenital malformations of the respiratory system	24	0,6 (0,4-0.8)	14	0,3 (0,2-0,5)
Cleft lip and cleft palate	70	1,6 (1,3-2,0)	70	1,6 (1,3-2,0)
Other congenital malformations of the digestive system	76	1,7 (1,4-2,1)	57	1,3 (1,0-1,7)
Congenital malformations of genital organs	195	4,5 (3,9-5,2)	184	4,3 (3,6-4,9)
Congenital malformations of the urinary system	277	6,4 (5,7-7,3)	270	6,3 (5,6-7,1)
Congenital malformations and deformations of the musculoskeletal system	306	7,1 (6,3-7,9)	159	3,7 (3,1-4,3)
Other congenital malformations, excluding multiple	79	1,8 (1,4-2,3)	51	1,2 (0,9-1,5)
Chromosomal abnormalities, not elsewhere classified	50	1,2 (0,9-1,5)	50	1,2 (0,9-1,5)

Table 2

Prevalence of congenital anomalies that are mandatory for reporting in the Russian Federation in 2012-2014 (per 1000 birth)

Form of anomaly	N	Prevalence, per 1000 birth (95% CI)
Anencephaly	–	-
Spina bifida	18	0,41 (0,31-0,51)
Encephalocele	1	0,02 (0,00-0,04)
Congenital hydrocephalus	29	0,67 (0,55-0,79)
Anophthalmos, microophthalmos	-	-
Anotia, microtia,	3	0,07 (0,03-0,11)
Transposition of large vessels	1	0,02 (0,00-0,04)
Hypoplastic left heart	4	0,09 (0,04-0,13)
Cleft palate	34	0,78 (0,65-0,91)
Cleft lip with or without cleft palate	28	0,64 (0,52-0,76)
Oesophageal atresia	8	0,18 (0,12-0,24)
Ano-rectal atresia	6	0,14 (0,08-0,20)
Hypospadias	64	1,47 (1,29-1,65)
Renal agenesis or disgenesis	-	-
Epispadias	2	0,05 (0,02-0,08)
Urine bladder exstrophy	-	-
Reducing limb malformations	12	0,28 (0,20-0,36)
Diaphragmatic hernia	2	0,05 (0,02-0,08)
Omphalocele	2	0,05 (0,02-0,08)
Gastroschisis	2	0,05 (0,02-0,08)
Down Syndrome	9	0,21 (0,14-0,28)
Multiple congenital anomalies	46	1,06 (0,90-1,22)
Total	273	6,40 (6,01-6,79)

and significantly lower prevalence of chromosomal abnormalities (1.2 / 1000 versus 4.2 / 1000) in Arkhangelsk County [10]. The described differences can be explained by the possible overdiagnosis of some forms, such as hypospadias and hydronephrosis at the neonatal stage and, conversely, insufficient prenatal and delayed postnatal diagnosis of chromosomal abnormalities or their incorrect classification by ICD-10 blocks. Compared with the study conducted in Monchegorsk (Murmansk region) [18], we can mention more complete detection of cardiovascular defects in the Arkhangelsk County; a likely reason for this is an improvement in ultrasound diagnostics over time (Monchegorsk study is dated 2006 - 2011).

A comparison of our results with other available data from population-based birth registries, shows that the total prevalence of CM in 2011 varied from 52.8 per 1,000 births in Finland to 27.4 per 1000 births and 22.2 per 1000 births in Norway and Sweden, respectively [10, 12, 13]. These differences can be explained by the different time limit for CM registration. For example, it is of 1 year in Finland, while only diagnoses made during the stay of newborns in maternity hospitals are included in the registries in Sweden and Norway [14].

A significant proportion of minor anomalies in the proportional distribution of CM (33.5%) must be emphasized, that is comparable with the results obtained in Monchegorsk. In this study, minor anomalies the cardiovascular system (patient or persistent foramen ovale, additional chords of left ventricular, hypoplasia of umbilical artery) accounted for more than 40% in the structure of all minor anomalies. High frequency of minor heart and vascular anomalies in Arkhangelsk County was demonstrated earlier [3], that, in our opinion, can be associated with high quality of diagnostics, sonographic in particular. The prevalence of malformations which are mandatory for registration in the RF was lower than available data from the Federal monitoring for 2012 (6.40 per 1000 births, compared to 7.07, respectively) [2]. However, statistical comparison of these indicators is impossible due to absence of data on the absolute number of newborns with CM, recorded by the Federal monitoring. Despite the differences in the prevalence of each nosology, the frequency of most forms of CM corresponds with all-Russian data. It was established that the prevalence of such forms of CM as congenital hydrocephalus, cleft palate and hypospadias in Arkhangelsk region is higher than in the RF, however, the prevalence of Down syndrome in Arkhangelsk region was significantly lower than Federal monitoring data.

Use of population-based medical birth registry is one of the method for CM surveillance. Implementation of methodology like in the international registries with the registration of the all CM provides an opportunity for international comparisons. The main advantage of such approach is the possibility of individual link between

exposure and outcome for each child, while the researchers always know exact denominator for the calculation of intensive indicators. As Demikova et al have already reported, inaccuracy in the denominator assessment (or the total number of births in some of regions) is one of the main causes of artificial variation of prevalence in territories of the RF [2].

99.6% of the total number of births in Arkhangelsk County in the study period registered in the ACBR [5], that minimizes the probability of a selection biases. At the same time there are some limitations that can affect the prevalence rates in our study. The main possible limitations of our study pertain to incomplete data on CM and early limit of diagnosing: only diagnoses made in the maternity houses were considered, which could be a reason for underestimation. Both restrictions are likely to lead to an underestimation of the true prevalence rate.

Conclusion

The total prevalence of CM in Arkhangelsk region according to EUROCAT methodology was 28.6 per 1000 births. Cardiovascular anomalies were the most common group in the structure of CM, that is comparable with EUROCAT data and indicates a sufficient detection of CM at birth. The population-based birth registry allows to perform accurate estimation of the total prevalence of CM, especially the prevalence of CM that are not mandatory for monitoring.

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