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Malformations in a Chornobyl-Impacted Region

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Pediatrics published online Mar 22, 2010;
DOI: 10.1542/peds.2009-2219

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WHAT'S KNOWN ON THIS SUBJECT: No other population-based birth defects surveillance data applying international standards concerning rates in Ukraine are known. Furthermore, no other reports on chronic low-dose ionizing radiation exposure population effects related to Chornobyl expressed as malformations are known.

WHAT THIS STUDY ADDS: Population-based rates of NTDs and other malformations in Ukraine that may reflect composite impacts of low-dose radiation, folate deficiencies, and prenatal alcohol teratogenesis are provided. This study provides a baseline for prospective investigations.

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KEY WORDS
alcohol, anencephaly, Chernobyl, Chornobyl, conjoined twin, fetal alcohol syndrome, folate, gender, ionizing, malformation, microcephaly, microphthalmia, monozygotic, neural tube defects, nutrition, omphalocele, radiation, sex, spina bifida, teratoma, twin, Ukraine

ABBREVIATIONS
NTD—neural tube defect
EUROCAT—European Surveillance of Congenital Anomalies Organization
OR—odds ratio
CI—confidence interval
ABCC—Atomic Bomb Casualty Commission

www.pediatrics.org/cgi/doi/10.1542/peds.2009-2219

doi:10.1542/peds.2009-2219

Accepted for publication Nov 19, 2009

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: *The author has indicated he has no financial relationships relevant to this article to disclose.*

abstract

OBJECTIVE: One of the populations most exposed to chronic low-dose radiation from Chornobyl (Chernobyl in Russian) lives in Polissia, the region representing the northern half of Rivne Province (Oblast) in Ukraine. Here the patterns and population rates of malformations are reported and possible etiologic factors and regional contrasts are explored.

PATIENTS AND METHODS: Malformations, as defined by international standards, noted among all 96 438 births in Rivne between 2000 and 2006, were analyzed statistically. Contrasts of rates in Polissia compared with the rest of Rivne also were investigated.

RESULTS: The overall rate of neural tube defects in Rivne is among the highest in Europe (22.2 per 10 000 live births). The rates of conjoined twins and teratomas also seem to be elevated. In Polissia, the overall rates of neural tube defects are even higher (27.0 vs 18.3, respectively; odds ratio: 1.46 [95% confidence interval: 1.13–1.93]), and the rates of microcephaly and microphthalmia may also be elevated.

CONCLUSIONS: The malformation patterns observed suggest early disruptions of blastogenesis, manifesting as alterations of body axes, twinning, duplications, laterality, and midline formation. The results are sufficiently compelling to justify continuing and expanding this investigation of malformations in chronic low-dose radiation-impacted regions of Ukraine. *Pediatrics* 2010;125:e836–e843

FIGURE 1
Outline of Ukraine, its provinces (Oblasts), and its waterways and coastlines.

In 1999, a Ukrainian population-based malformations surveillance system was established in Rivne and other provinces.[1] The Rivne Province is located nearly 250 km west of the Chornobyl atomic power plants, and its northern half is a region known as Polissia. The Chornobyl explosion and fire started on April 26, 1986, and caused ionizing radiation-contamination across northwestern Ukraine. In Rivne, all Polissia counties (raions) were officially designated as significantly impacted (Fig 1). In addition, the Polissian radiation-contaminated soils have one of the highest known transfer rates of Cs^{137} from soil to the food chain known in Ukraine.[2] Recent radiation surveys confirmed that ingestion of Cs^{137}-contaminated foods, in particular milk and related products, is the main source of radiation exposures.[3] Since recorded history, Polissia has been inhabited by "Polishchuks" (forest dwellers), whose culture has characteristics in common with those of other isolated populations. Most Polishchuks inhabit small villages and primarily subsist on homegrown vegetables, animal products, home-produced milk, and dietary supplements gathered in nearby forests (from wild berries and wild mushrooms, as well as by hunting and fishing). Polissia also extends to adjoining provinces in Ukraine and Belarus.

The current investigation was prompted by persisting public concerns about the impact of Chornobyl-related chronic radiation exposure on pregnancy outcomes and lack of population-based malformations data collected according to international standards. After 2 years of malformations monitoring, rates of neural tube defects (NTDs) including anencephaly, iniencephaly, rachischisis, spina bifida, and encephaloceles in Northwestern Ukraine (Volyn and Rivne provinces) were noted to be elevated.[4] In addition, recurrent births of conjoined-twin sets were noted in Rivne, with none in 2 adjoining provinces (Volyn and Khmelnytsky).

The goal of this report is to present population rates of selected malformations noted during a 7-year period of standardized data collection and to compare and contrast these rates in the Polissian and non-Polissian regions of the Rivne Province. The specific malformations selected for comparison were NTDs; malformations related to twinning including conjoined twins, teratomas, and also microcephaly; and microphthalmia, all of which are malformations that may be due to prenatal exposure to ionizing radiation and the last two (microcephaly and microphthalmia) can also be due to prenatal exposure to alcohol.[5]

PATIENTS AND METHODS

In this report, the following conventions apply: "Rivne," unless specified otherwise, means Rivne Province, the capital of which is likewise named

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