INCORPORATED LEVELS OF CESIUM-137 IN PREGNANT WOMEN AND PREVALENCE RATES OF NEURAL TUBE DEFECTS AND MICROCEPHALY

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Chornobyl, Radiation, Neural Tube Defects, and Microcephaly

Abstract

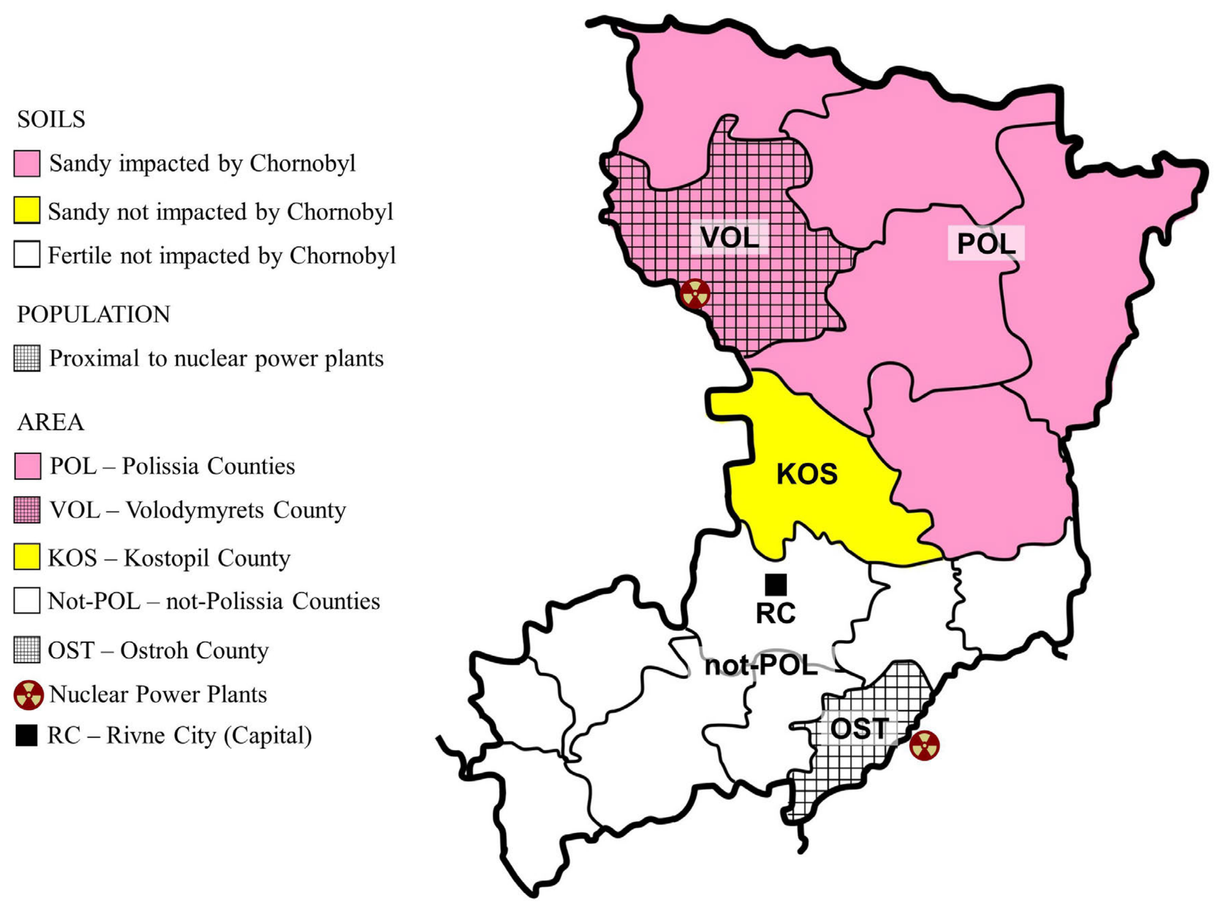
Introduction: Neural tube defects and microcephaly prevalence rates in the Rivne province of Ukraine, in particular in its Polissia region, are among the highest in Continental Europe. Polissia is impacted by Chornobyl ionizing radiation.

Methods: Determination of Whole Body Counts of incorporated cesium-137 obtained from 11,784 pregnant women residing in Rivne. Also investigated are the prevalence rates of neural tube defects and isolated microcephaly.

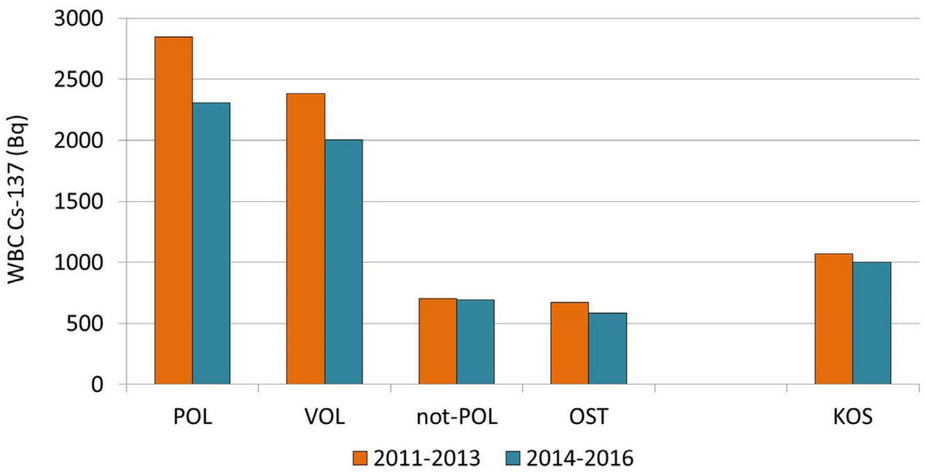
Results: Levels of incorporated Whole Body Counts of cesium-137 are significantly higher in Polissia (over 2,000 Bq) compared to not-Polissia (under 700 Bq). The prevalence rates of neural tube defects and isolated microcephaly are 20.77 and 1.47 in Polissia and 14.51 and 1.19 in not-Polissia, respectively. These prevalence rates exclude one county in Polissia and another in not-Polissia with populations proximal to nuclear power plants. In the Polissia county the neural tube defects and microcephaly prevalence rates are 24.69 and 3.32 and in the not-Polissia are 23.99 and 5.64. However, the Whole Body Counts of cesium-137 in both counties did not differ from those in Polissia and not-Polissia respectively.

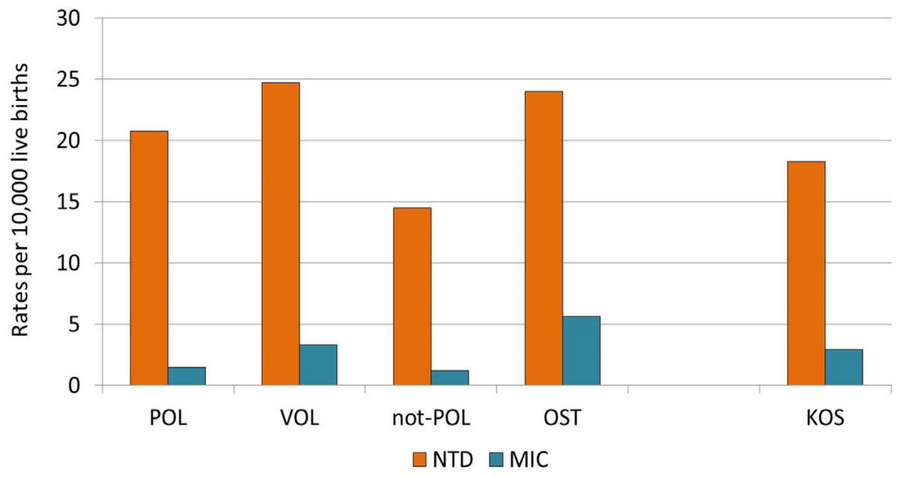
Conclusions: This descriptive epidemiologic investigation demonstrates a likely causal association of chronic low dose radiation exposures with teratogenic impacts. The associations in two counties suggest that in addition to cesium-137, other radionuclides may augment teratogenic impact. The reported observations provide a basis for further cause-effect investigations.

Rivne Province and Polissia soils impacted by Chornobyl ionizing radiation

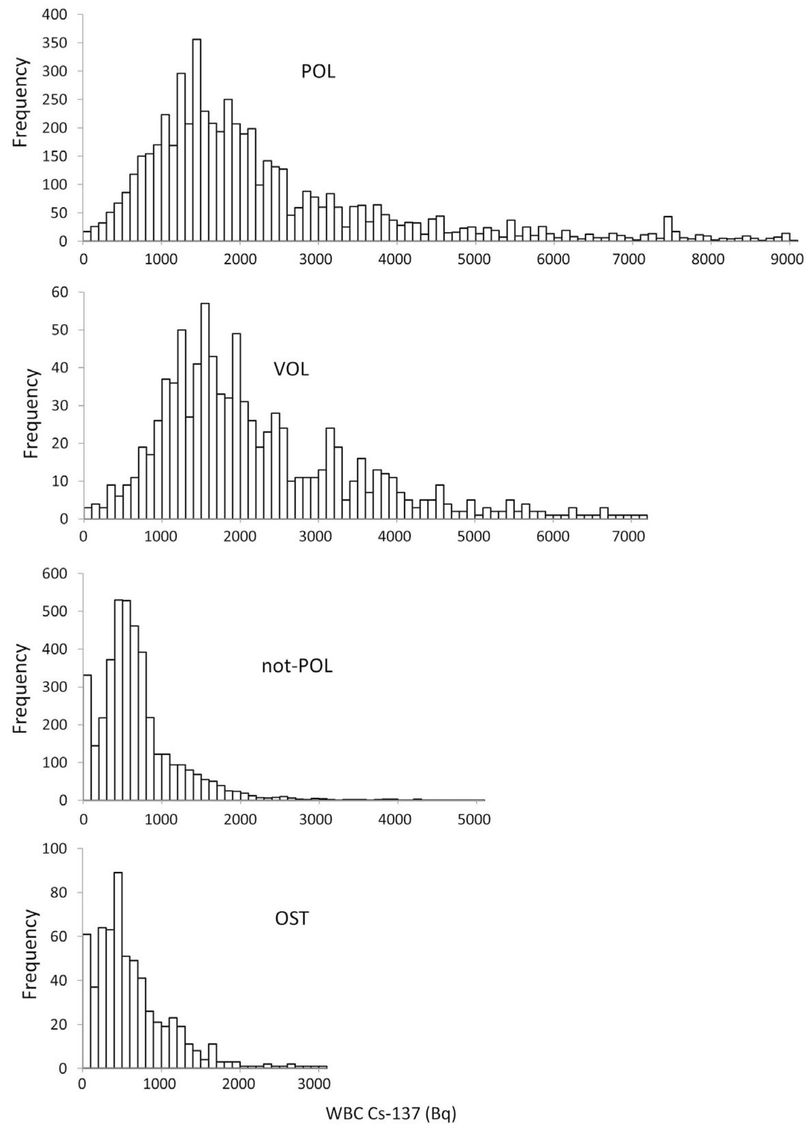


WBC Cs-137 levels recorded during two time periods (top) and 2000–2015 prevalence rates of neural tube defects (NTD) and microcephaly (MIC) (bottom)

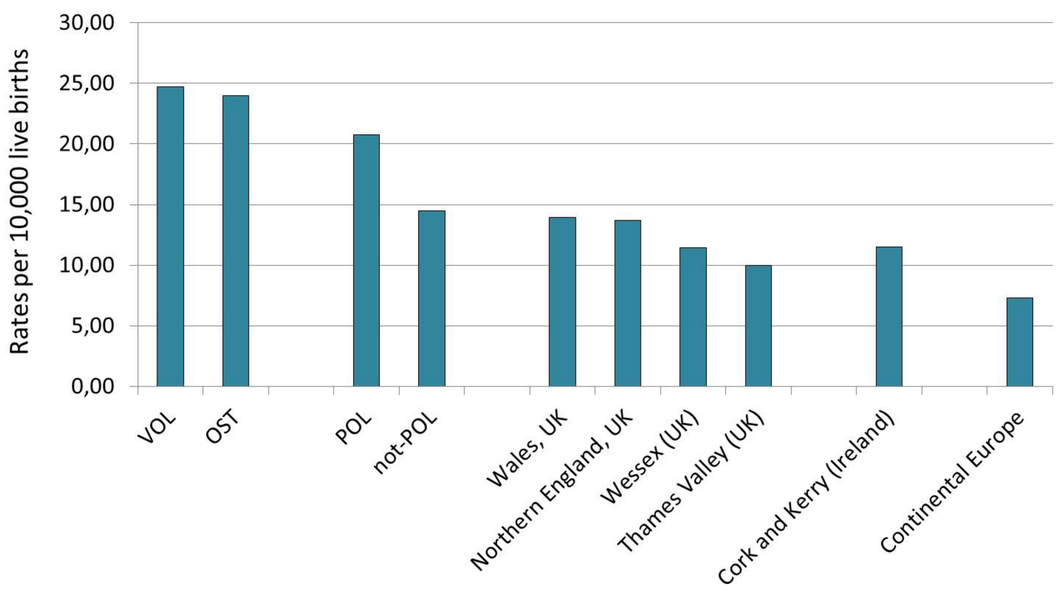




Distribution of Cs-137 whole body count (WBC Cs-137) frequencies recorded during the period 2011–2016 from women residing in Polissia (POL), Volodymyrets County (VOL), not-Polissia (not-POL) and Ostroh County (OST) in 100 Bq wide intervals



Neural Tube Defects (NTD) prevalence rates during the 2000–2015 period in Europe



- Whole body counts (WBC) of cesium-137 (Cs-137) incorporated by pregnant women are persistently elevated in areas impacted by Chornobyl radiation.
- Neural tube defects (NTD) and isolated microcephaly rates are statistically significantly higher in areas impacted by Chornobyl radiation when compared to other areas of the province.
- In two counties, each proximal to a nuclear power plant (NPP), the rates of NTD and isolated microcephaly are the highest irrespective of WBC levels of Cs-137. We suspect that if this fact reflects impacts of emissions from the adjoining NPPs, the most likely nuclide is tritium (H3) because it is known that waters emitted by these NPPs contained elevated levels of this nuclide.
- Our investigations demonstrate a statistically significant and persistent association between high WBC Cs-137 levels and elevated population rates of congenital anomalies. However, the descriptive epidemiologic nature of this study design does not allow for assertions of cause-effect.
- **We conclude that there is a strong basis to recommend further investigations by our team with partnerships with international research teams to further define the impacts of chronic low dose radiation ongoing exposures on large populations in Ukraine.**