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Exposure to ionizing radiation resulting from the Chernobyl fallout and childhood cardiac arrhythmia: a population based study (EPICE Program)

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CONTEXT

- On 26 April 1986, the worst industrial accident that release environmental ionizing radiation occurred at the Chernobyl nuclear power plant in the former Soviet Union.
- About 5 million individuals at the time of the accident, including around 1.2 million children and adolescents were exposed.
- The radioactive plume was composed of a mixture of radionuclides among which ¹³¹I and ¹³⁷Cs.
- The childhood thyroid cancer epidemic is now widely recognised as a major consequence of the Chernobyl accident.
- Relating to the non-cancer effects, some scientists put forward various symptoms on exposed children including especially chronic gastrointestinal pathology, asthenia, apathy, and cardiovascular symptoms, such as unstable blood pressure, sinus arrhythmia, repolarisation and conduction abnormalities.

METHODS

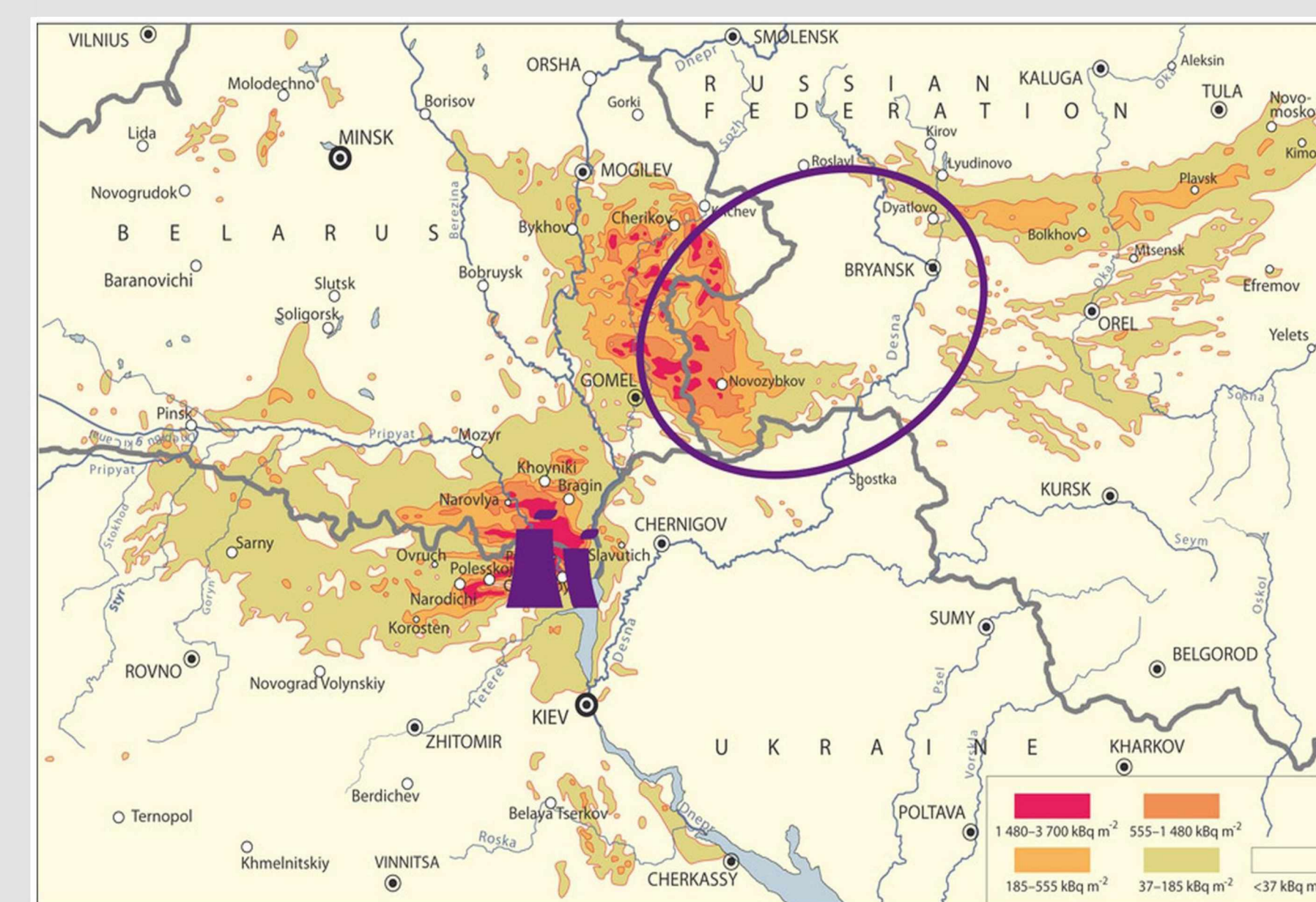
- Cross-sectionnal study: 17 697 volunteer children aged from 2 to 18 years
- Location of the study: Bryansk region (Russian Federation) on contaminated (CT) and non-contaminated territories (NCT)
- Administrative and medical questionnaire
- Several medical examinations: whole-body ¹³⁷Cs activity, echocardiogram, echocardiography
- Further medical tests for some children: a 24-hour Holter monitoring and blood test



What is the prevalence of cardiac arrhythmias in Bryansk oblast (CT vs NCT)?

Is ¹³⁷Cs an associated factor in the occurrence of cardiac arrhythmias?

→ Multivariate logistic regression model (SAS software V.9.2)

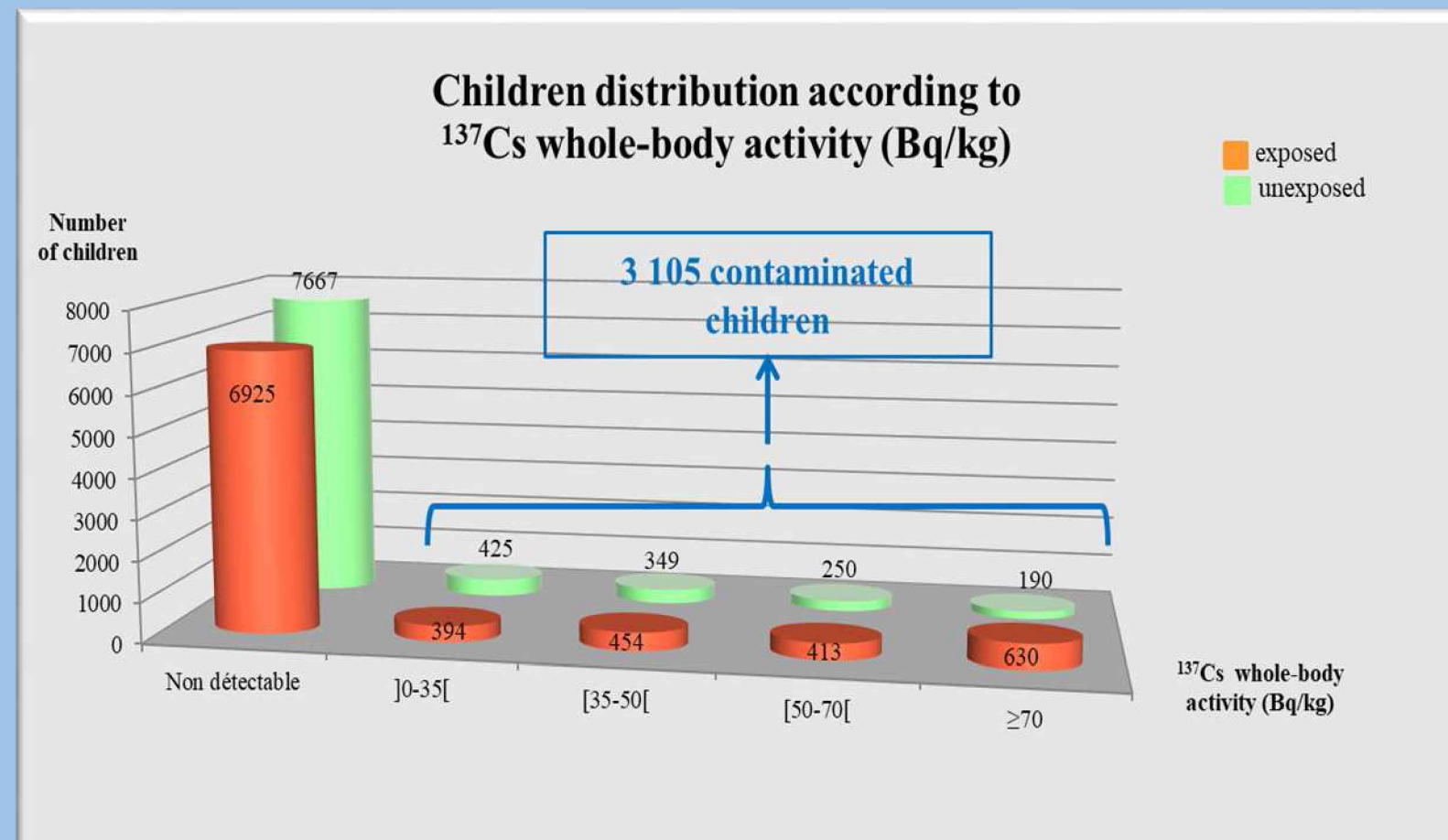


Caesium-137 soil deposition (UNSCEAR)

RESULTS

Cardiac rhythm disorders
Cardiac conduction disorders

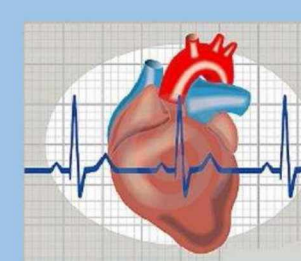
2 526 children with cardiac arrhythmia



COMMITTED EFFECTIVE DOSE

3 081 children < 1 mSv/year
24 children ≥ 1 mSv/year (max = 5,77 mSv/year)

Question 1
Cardiac arrhythmia prevalence over the period 2009-2013?



TERRITORIES		WITH CARDIAC ARRHYTHMIA(S)	
		CONTAMINATED	HEALTHY
TERRITORIES	CONTAMINATED	1 172	7 644
	CONTROLLED	1 354	7 527
¹³⁷ Cs WHOLE-BODY BURDEN	POSITIVE	449	2 656
	NOT DETECTABLE	2 077	12 515

According to the territory

$P_{\text{exposed}} = 13.3\%$; $P_{\text{unexposed}} = 15.2\%$

→ Prevalence ratio (PR) = $P_{\text{exp}}/P_{\text{unexp}} = 0.87$ [95%_{IC} = 0.84 – 0.90]

According to the ¹³⁷Cs whole-body burden

$P_{\text{exposed}} = 14.5\%$; $P_{\text{unexposed}} = 14.2\%$

→ Prevalence ratio (PR) = $P_{\text{exp}}/P_{\text{unexp}} = 1.02$ [95%_{IC} = 0.97 – 1.07]

Question 2
Is ¹³⁷Cs an associated factor?

	OR	[95% CI]	P-VALUE
TERRITORY (1)			
CONTROLLED	1		
CONTAMINATED	0.90	[0.81 – 1.00]	0.06
¹³⁷ Cs WHOLE-BODY ACTIVITY (Bq/kg) (2)			
NOT DETECTABLE	1		
]0 – 35[1.07	[0.89 – 1.29]	
[35 – 50[1.00	[0.81 – 1.23]	
[50 – 70[1.04	[0.82 – 1.31]	
≥ 70	0.96	[0.77 – 1.20]	0.97

(1) adjustment for gender, age, drug intake, BMI and ¹³⁷Cs whole-body burden

(2) adjustment for gender, age, drug intake, BMI and territory

CONCLUSION

- Estimated prevalence of cardiac arrhythmias over the period 2009-2013
 - Statistically significant differences according to the territory (lower prevalence in the contaminated territories)
 - No statistically significant differences according to ¹³⁷Cs whole-body burden (contaminated children vs children with ¹³⁷Cs contamination not detectable)
- No evidence of an association between the presence of cardiac arrhythmia and the territory or ¹³⁷Cs whole-body burden
 - ¹³⁷Cs is not an associated factor in the frame of the study
- Children (with cardiac arrhythmia(s)) care
 - Followed up and outpatient care by cardiologists, pediatricians
 - 26 children redirected to Moscow for consultation and care
 - 220 children were taken care of in institutions in the region (oblast) including 6 children who were operated in emergency (2 with pacemaker)

RELEVANT PUBLICATIONS

- J. R. Jourdain, G. Landon, E. Clero, V. Doroshchenko, A. Silenok, I. Kurnosova, A. Butsenin, I. Denjoy, D. Franck, J. P. Heuze, and P. Gourmelon, Is Exposure to Ionising Radiation Associated with Childhood Cardiac Arrhythmia in the Russian Territories Contaminated by the Chernobyl Fallout? A Cross-Sectional Population-Based Study, *BMJ Open*, 8 (2018).
- United Nations Scientific Committee on the Effects of Atomic Radiation, Sources and Effects of Ionizing Radiation, Unsclear 2008, Report to the General Assembly with Scientific Annexes. Volume II - Scientific Annexes C, D and E, (New York 2011), p. 179 p.
- E. Cardis, and M. Hatch, The Chernobyl Accident - an Epidemiological Perspective, *Clinical Oncology*, 23 (2011), 251-60.
- Yablokov A.V., Nesterenko V.B., and Nesterenko A.V., Consequences of the Chernobyl Catastrophe for Public Health and the Environment 23 Years Later, ed. by Annals of the New York Academy of Sciences (Boston: Blackwell Publishing, 2009), pp. 318-26