FREQUENCY OF DICENTRICS IN UKRAINIAN CHILDREN AND ADOLESCENTS FROM PARENTS EXPOSED TO RADIATION FALL-OUT AFTER THE CHERNOBYL ACCIDENT

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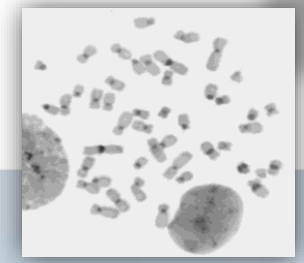

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WHY?

After the Chernobyl accident...

- More than 1.8 million people still inhabit the contaminated territories.
- 502,377 children, residents of Ukraine, were born in families where the parents have been exposed to ionizing radiation.

Countries from EU offer hosting programs for Ukranian children

juntos por la vida fundación

Non-Government Organization which has a program of hosting Ukranian children with families from Valencia (Spain).

- Our biodosimetry laboratory reviewed the literature in order to obtain more information on the level of human hazard due to such accidental exposure:
  - Various cytogenetic studies reported an increased frequency of chromosomal aberrations in children from contaminated areas (Padovani *et al.* 1997; Barale *et al.* 1998).
  - WHO found in a report (2006) a complete lack of analytical studies (Stepanova et al. 2008).

One proven way to obtain information related to the absorbed radiation dose is to quantify the cytogenetic effects.

OBJECTIVES

To assess whether the children living in the areas contaminated by the Chernobyl accident are exposed to ionizing radiation...

NGO (Spain)

Biodosimetry laboratory (Hospital La Fe, Spain)

Started a collaboration program to assess the radiation dose absorbed by children living near Chernobyl as well as the health and nutritional status.

- The aim of this study was to carry out a **cytogenetic analysis of 55 Ukrainian children and adolescents** living in the **Chernobyl** area and whose parents were exposed to ionizing radiation due to the nuclear accident.

- For this purpose we carried out a **dicentric chromosome assay** to elucidate a possible exposure to radiation from different contaminated sources.

MATERIAL AND METHODS

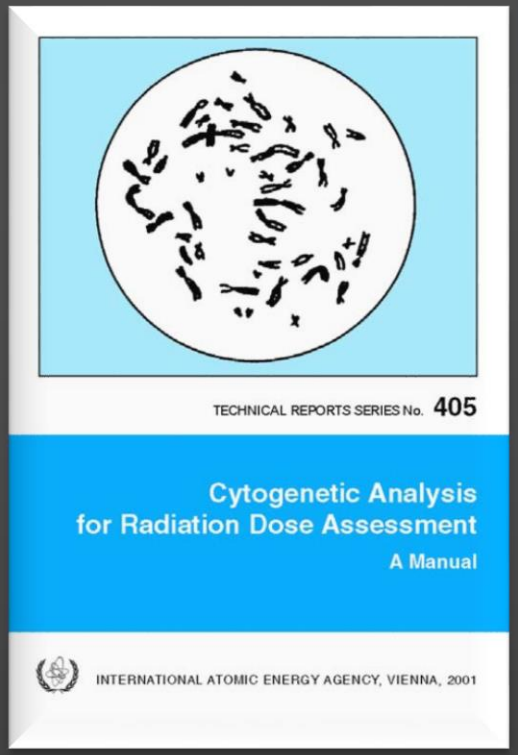
Biological dosimetry, based on the analysis of solid stained dicentric chromosomes, has been used since the mid-1960s.

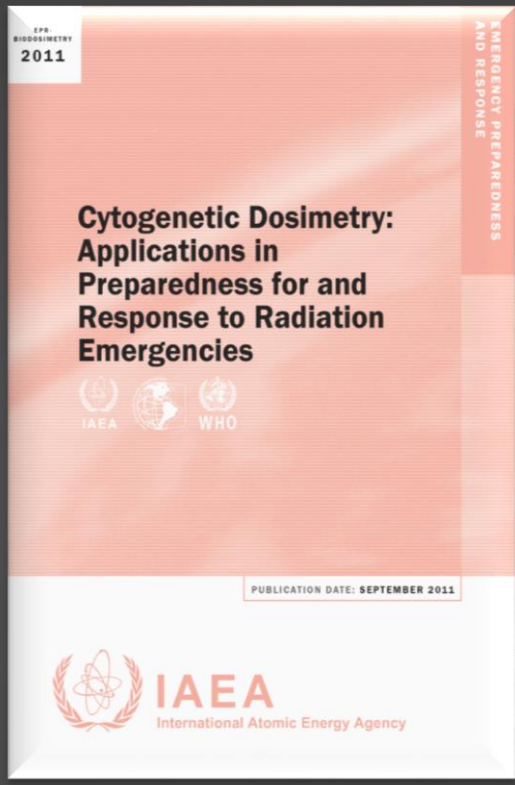
For many years the dicentric assay using blood lymphocytes was the only method of biological dosimetry available, and still today is the technique most frequently used (IAEA 2011) to monitor individual acute doses down to about 0.1 Gy.

Part of the study took place in the Ukraine (2008),

- Some of the health studies
- Nutritional tests
- The collection of blood samples

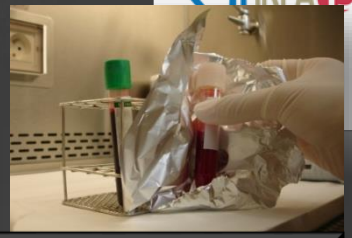
But the procedures shown on the next slide were conducted in Spain.





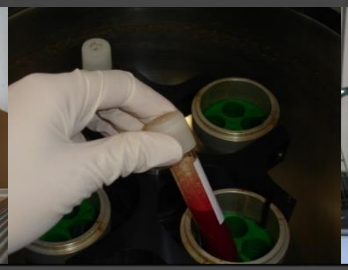
MATERIAL and METHODS

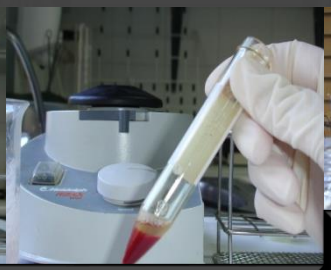


CULTURE

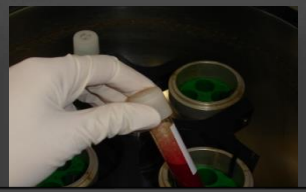
INCUBATION

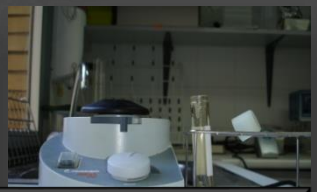





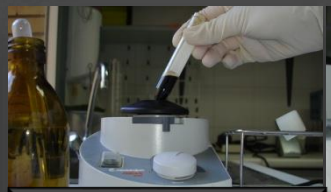
EXTRACTION

HYPOTONIC SOLUTION

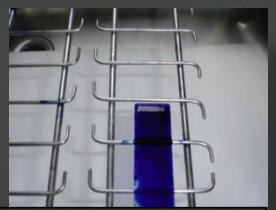


HYPOTONIC SOLUTION

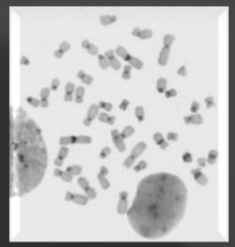



FIXATION

SLIDES

STAIN



22/06/2008: We arrived back in Spain at 2 am and until 10 am, I was culturing 30 blood samples.

4 tubes for 48 hours and 2 for 72 hours. In total 180 cutures!!. (*RENEB*)

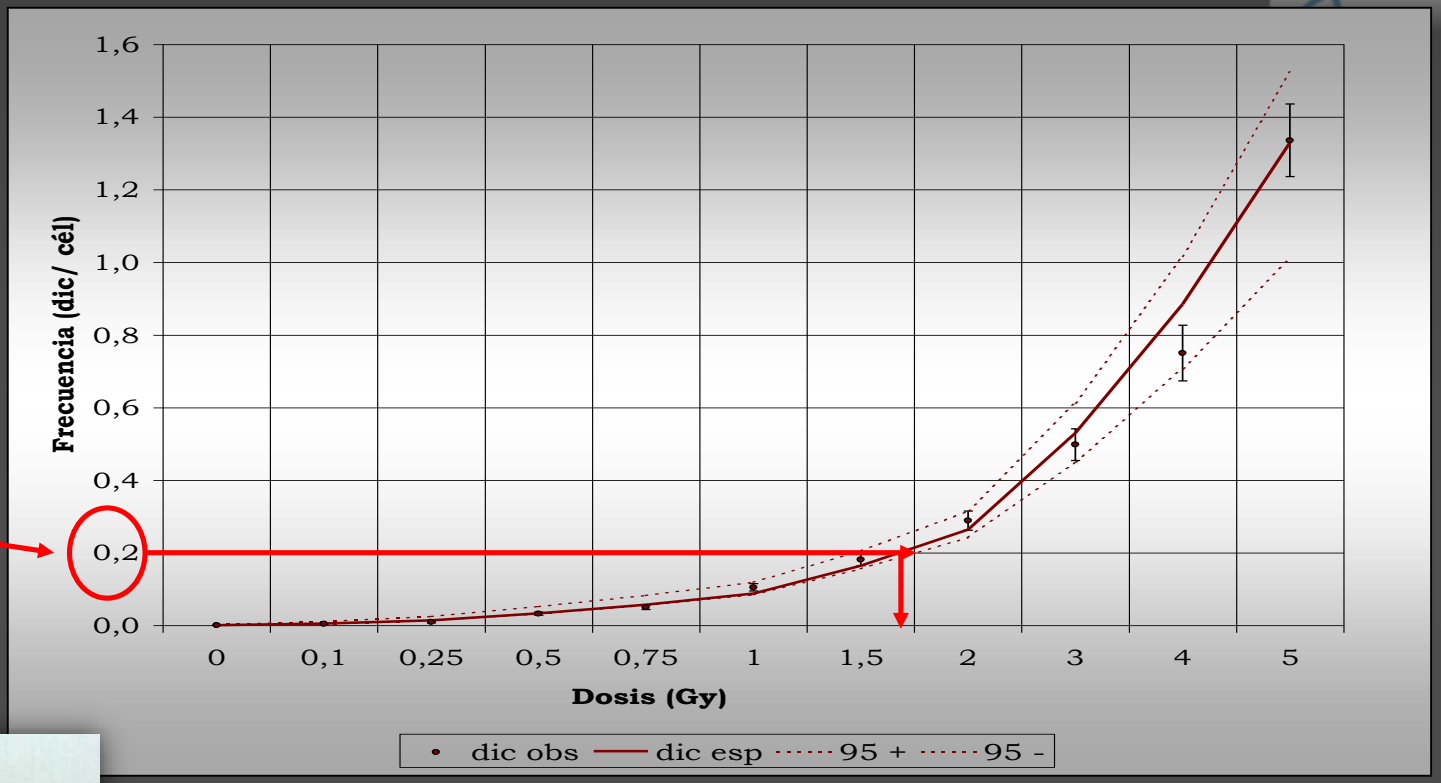
Dose - response curve. Biodosimetry

For dose estimation, the coefficients of the curve are (Montoro *et al.* 2005)

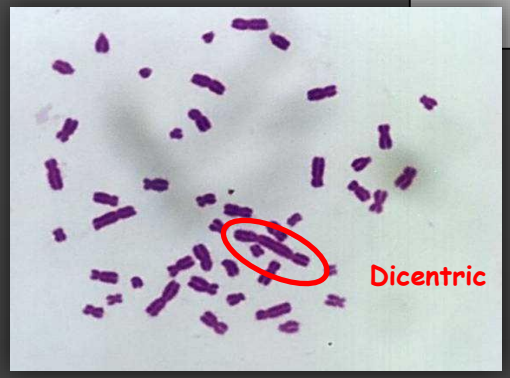
Frequency (Ydic)

200 dicentrics/ 1000 metaphases

Y=0.2



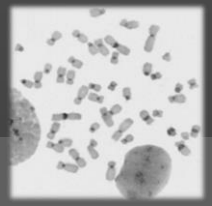
Estimated dose: 1.7 (1.56-1.85) Gy



Coefficients	Values	T-student	P-value
C	$(0.07\pm0.06)10^{-2}$	1.16	-
α	$(4.13\pm0.58)10^{-2}$	7.10	< 0.01
β	$(4.44\pm0.33)10^{-2}$	13.34	< 0.01

RESULTS

- 55 Ukranian children and adolescents (29 boys and 26 girls)
- Mean age: 11.0±4.7 years
- Metaphases scored: 53477.
- A mean dicentrics frequency of 0.0007 (0.7 dicentrics per 1000 cells) (around 0.0005 to 0.0010 of dicentrics fixed as a background level by the IAEA (2011).
- The collective dose calculated was 0 (0-0.044) Gy, this dose was below the detection limit.



Origin	Sex	Age (Mean±SD[a])	Incidence[b]	Y_{dic} ± SE[c]
Irpin	M	13.56 ± 4.82	4/9	0.0020 ± 0.0014[d] (2/4)
				0.0010 ± 0.0010[d] (2/4)
	F	10 ± 2.12	2/5	0.0010 ± 0.0010[d] (2/2)
Ivankiv	M	15.11 ± 5.51	5/9	0.0010 ± 0.0010[d] (3/5)
				0.0015 ± 0.0011[d] (1/5)
				0.0019 ± 0.0014[d] (1/5)
	F	15 ± 6.12	8/11	0.0010 ± 0.0010[d] (7/8)
				0.0016 ± 0.0010[d] (1/8)
Fenevichi	M	9.75 ± 3.10	1/4	0.0020 ± 0.0014[d] (1/1)
	F		-	-
Slavutych	M	15 ± 6.24	1/3	0.0010 ± 0.0010[d] (1/1)
	F	11.57 ± 2.64	3/7	0.0010 ± 0.0010[d] (2/3)
				0.0013 ± 0.0009[d] (1/3)
Hornostajpil	M	11 ± 0.00	2/4	0.0010 ± 0.0010[d] (1/2)
				0.0020 ± 0.0014[d] (1/2)
	F	10 ± 0.00	1/2	0.0020 ± 0.0014[d] (1/1)
Chernobyl	M	-	-	-
	F	9 ± 0.00	-	-
Mean		11.0 ± 4.7	27/55	0.0007 ± 0.0001

a Standard deviation
b Incidence (subjects with dicentrics/total subjects in this row)
c Standard error
d Incidence (subjects with this value of Ydicentrics/ subjects with dicentrics in this row)

RESULTS

- The highest frequency value of dicentrics was 0.002 and only obtained from Irpin, Fenevychi and Hornostajpil.
- These cities are close to the Kiev Reservoir that receives water from the Pripyat river (which passes through the zone around the Chernobyl reactor).
- Nowadays, this area has radionuclide contamination which is referenced in the literature related to fish and water.

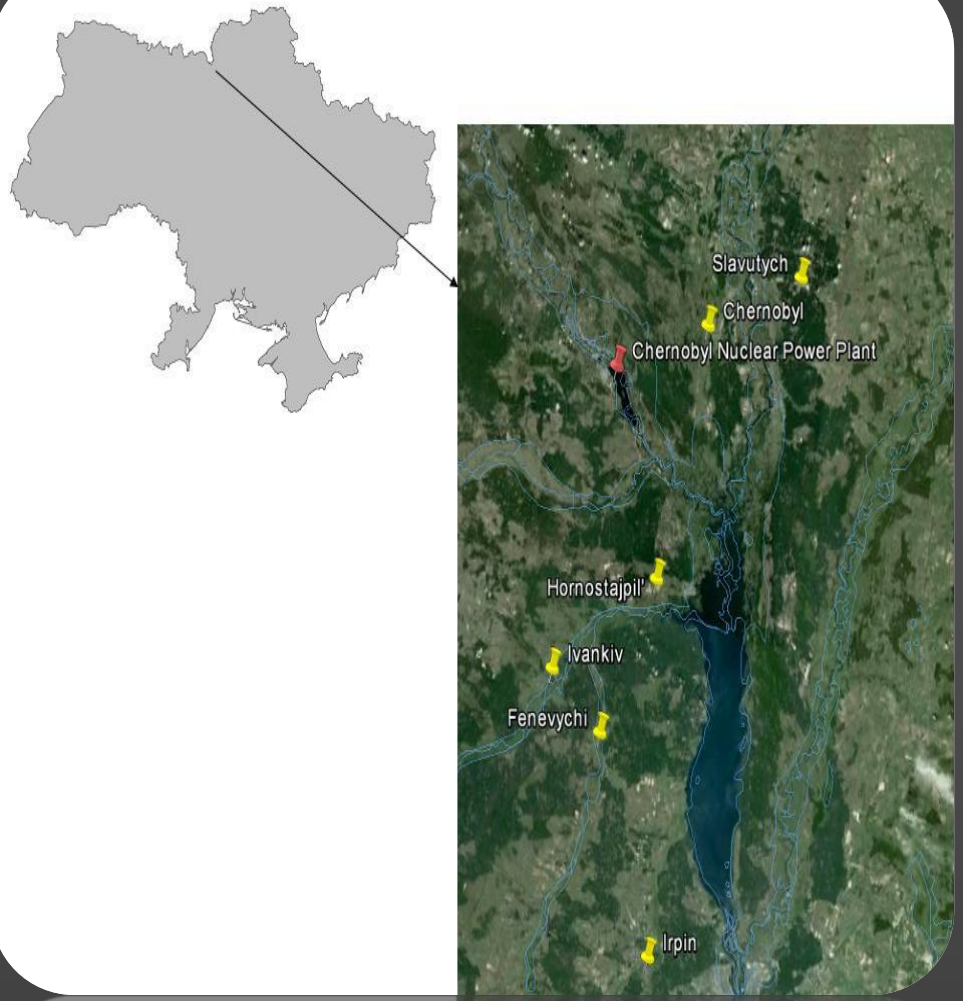
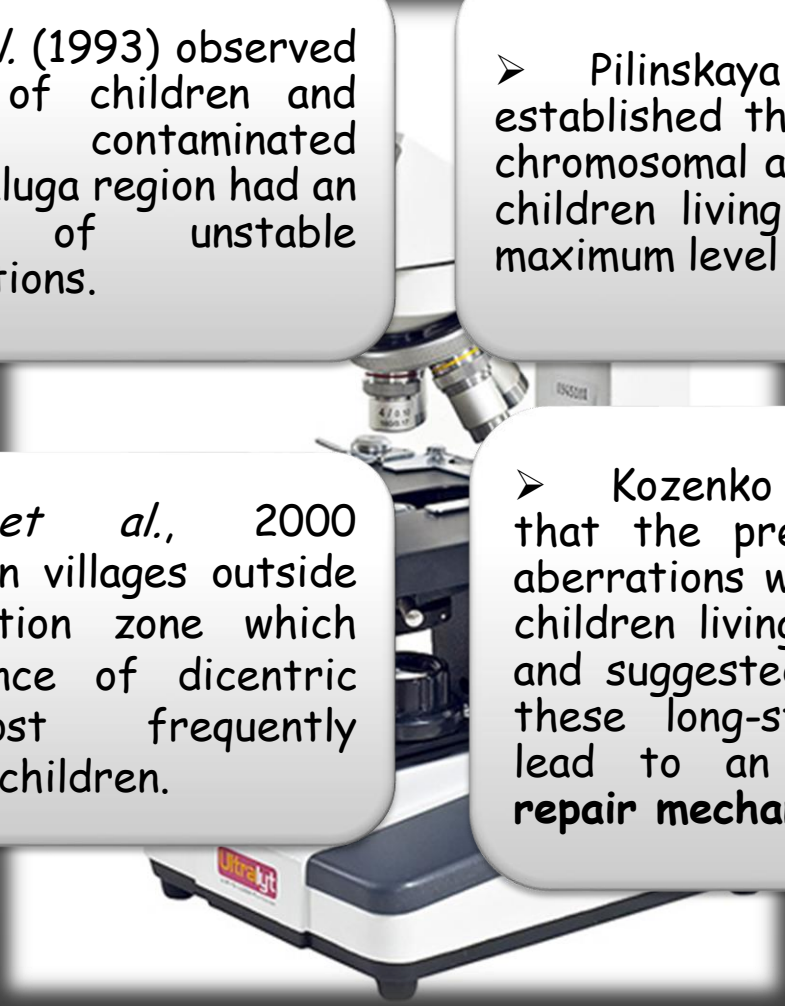


Figure 1. Location of the studied subjects.

Results from other laboratories

- Sevan'kaev *et al.* (1993) observed that the 30-60% of children and teenagers from contaminated territories of the Kaluga region had an increased level of unstable chromosomal aberrations.

- Pilinskaya *et al.* (1994) established that the highest level of chromosomal aberrations was found in children living within an area with a maximum level of exposure.



- Mikhalevich *et al.*, 2000 evaluated children in villages outside the 30-km evacuation zone which showed the presence of dicentric chromosomes most frequently recorded in younger children.

- Kozenko *et al.* (2010) observed that the presence of chromosomal aberrations was increased by 53% in children living in contaminated areas and suggested that the presence of these long-standing changes might lead to an **impaired chromosome repair mechanism.**

Results from other laboratories

- Fucic *et al.* (2008) reviewed that repeated measurements of chromosomal aberrations within a 4-year-period, revealed a 53% increased average level of genome damage as measured by the chromosomal aberration assay.

- Cytogenetic studies, up to 10 years after the accident, showed that even the areas which were considered as unpolluted were actually contaminated with radionuclides at levels that are capable of increasing and accumulating stable genome damage in children leading to long-term adverse health effects.

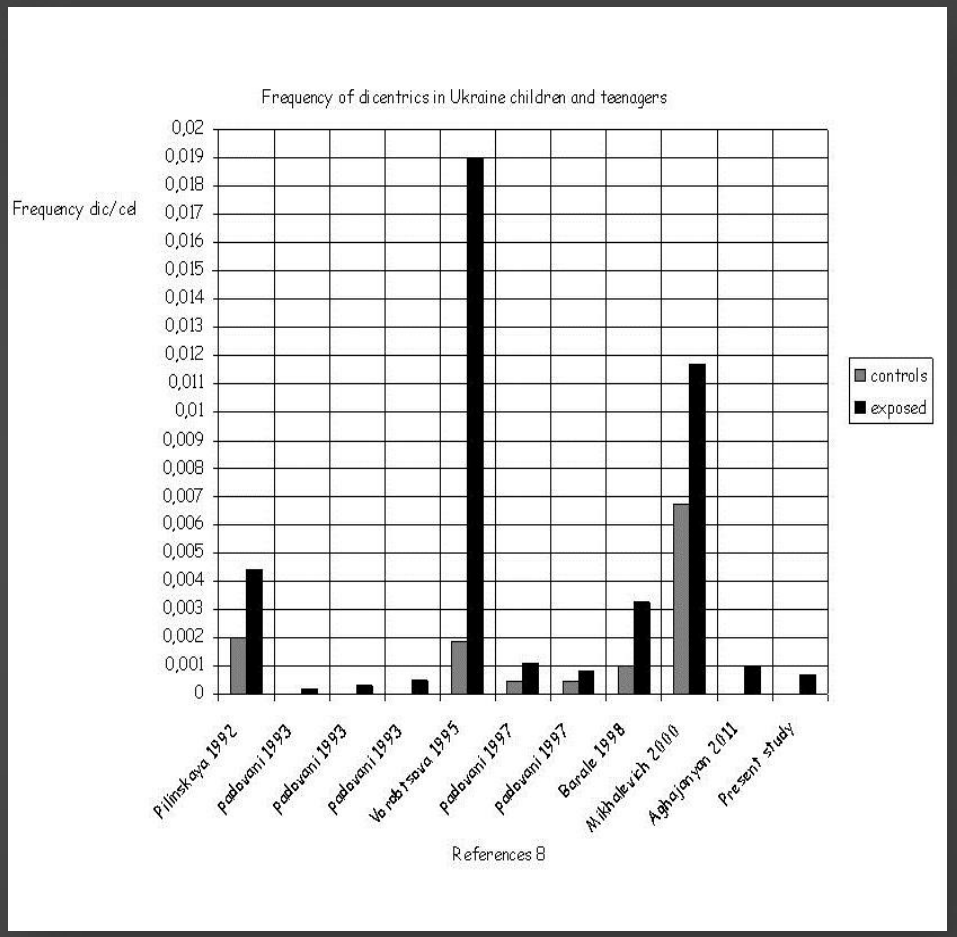


Figure 2. Frequency of dicentrics in Ukrainian children From contaminated areas reflected in the literature.

Conclusions

In our study, we found a mean dicentrics frequency of 0.0007 ± 0.0001 which is between the background levels of dicentrics fixed by the IAEA in 2011 (0.0005-0.001).

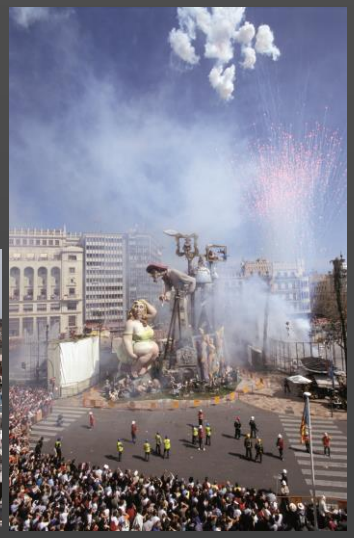
The collective absorbed dose was also estimated, although this was below the detection limit, therefore, any overexposure was detected by biological dosimetry.

To the best of our knowledge, our study is the most recent reported in the literature, and therefore it should be expected that the effects of radiation in genomic damage would be lower and that the frequency of the dicentrics were similar to the background level.

Data from our cytogenetic study revealed that the children living in the area surrounding Chernobyl did not have an increased frequency of dicentrics compared to the internationally accepted background level.

Further studies of other genomic biomarkers could show another type of chromosomal damage or radiation-induced genomic instability in this population.

Valencia - Spain



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