Biodosimetry methods

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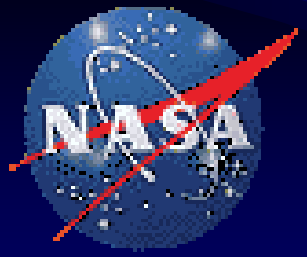


Detection limits

Method	Lower (Sv)	Upper (Sv)
Dicentrics (acute)	0.1	4
Translocations	0.1 (with pre-exposure sample) 0.3 (without pre-exposure sample)	2.5 (acute) 10 (chronic)
PCC+FISH	As for translocations	20

Biodosimetry of space radiation

- Physical dose is carefully measured in spacecrafts
- However, the RBE of the space radiation field, and the response of the organism to the radiation insult while in the space μg environment, are poorly known
- Biological dosimetry provides a measurement of the biologically relevant absorbed dose
- Biologically relevant equivalent dose is well correlated to health risk

Chromosome aberration dosimetry

- Measurement of chromosomal aberrations in peripheral blood lymphocytes is widely used for biodosimetry
- Conventional metaphase cell - analysis is complicated in astronauts by μg and high-LET radiation-induce cell-cycle delays
- Premature chromosome condensation (PCC) combined with fluorescence *in situ* hybridization (FISH) can overcome these problems

JCO Tokaimura radiation accident

- 30 September 1999 criticality accident
- Significant exposure were limited to 69 people
- Three workers poured uranyl nitrate into a tank
- They were not wearing badges

Biodosimetry for the 3 workers exposed to high (n, γ) doses

- Based on sodium activation levels and neutron flux calculations, first estimates were 18, 10, and 3 Sv
- PCC biodosimetry provided 9, 5, and 1.5 GyE
- The workers are still alive

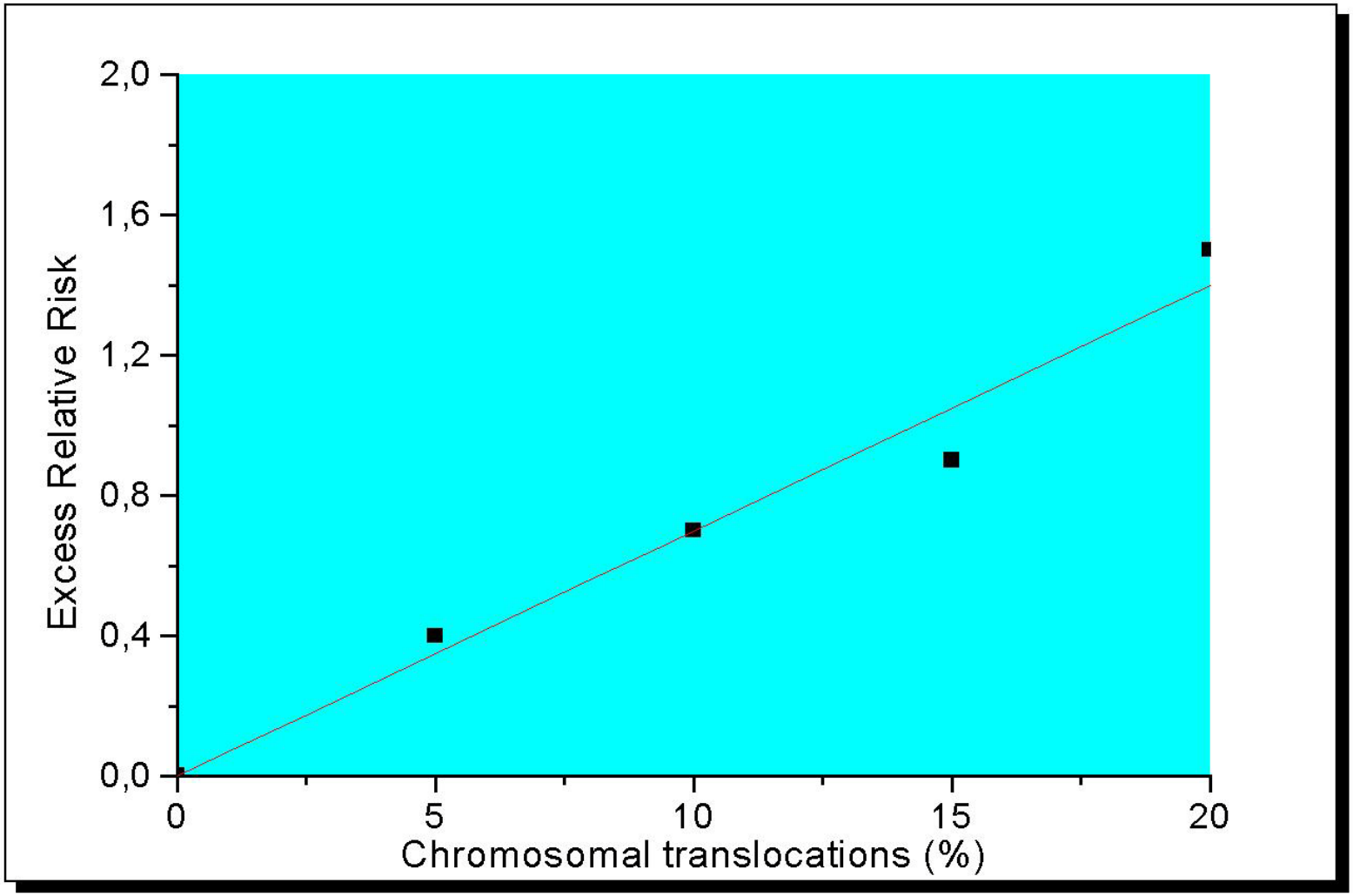
Biodosimetry on the trip to Mars calculations by:

Mission	Solar activity	Dicentrics per 1000 cells (background 1)	Translocations per 1000 cells (background 5)
3 years, 5 g/cm^2 Al-shielding	Minimum	36	48
3 years, 5 g/cm^2 Al-shielding	Maximum	9	13
SPE (August 1972)	Minimum	150	180

Experience in biodosimetry applications

- Metaphase (Giemsa or FISH): nuclear accidents (Chernobyl, Goiana), nuclear industry workers (NRPB, LLNL), radiology, radiotherapy, retrospective dosimetry in A-bomb survivors, environmental monitoring (radon), aircraft crews, astronauts (NASA, ESA)
- PCC (fusion): none
- PCC (chemical): radiotherapy, JCO-Tokaimura nuclear accident

Chromosomal aberrations vs. risk (A-bomb survivors, all cancers except leukemia, RERF)



Correlation between chromosmal aberrations and acute reactions in patients treated for esophageal cancer at NIRS (45-65 Gy to the tumor)