

Evidence obtained from people living in High Background Radiation Area (HBRA)

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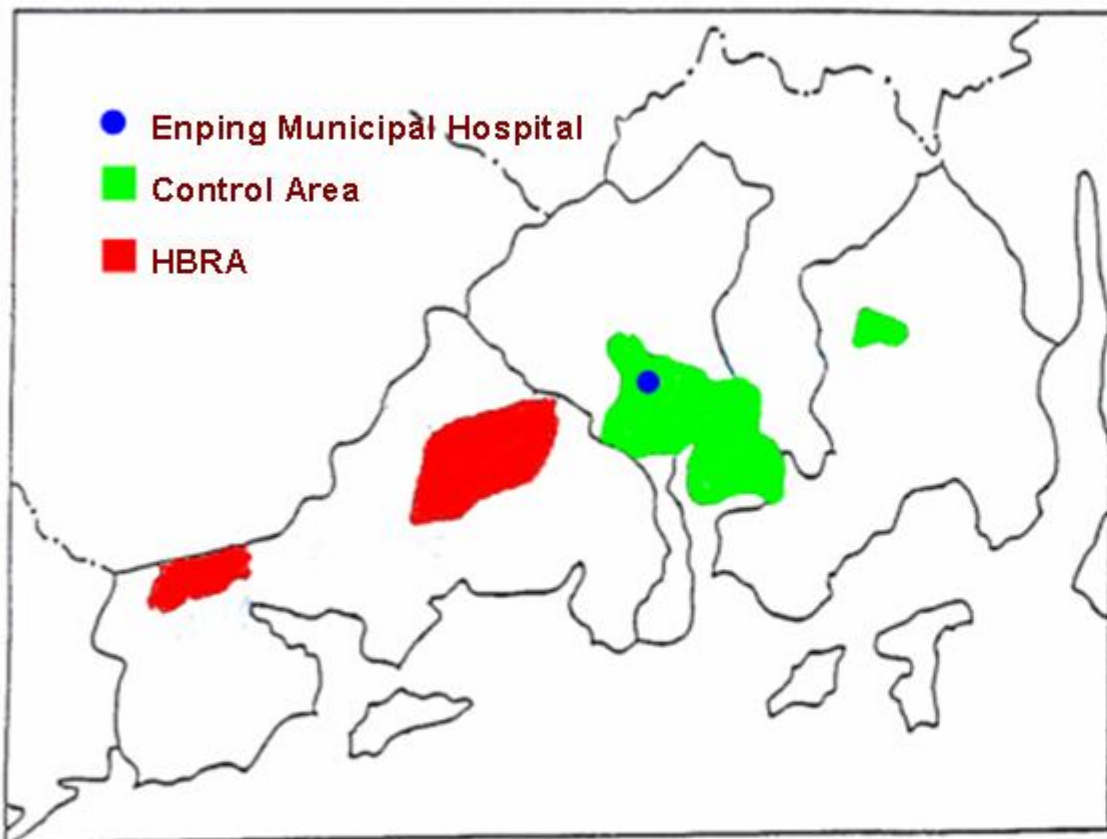
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Studied areas in Guangdong Province



In Guangdong Province of the southern China there is a high background radiation area (HBRA) where the environmental natural radiation is 3 to 5 times higher than that in control area (CA) due to radio-nuclides such as Thorium 232 and Uranium 238 decay products in the soil and in the building materials of houses. Those areas are rural places far away from a city. Residents are farmers living there more than several generations. Except for the level of natural radiation, cultural and genetic background are very similar in HBRA and CA.

➤ **Study of mortality for cancer and non-cancer diseases**

125,079 subjects during the period 1979-1998

1,992,940 person-years (PYs) at risk

12,444 deaths including 1,202 cancer deaths

Based on the hamlet-specific average external dose rates, the cohort members were categorized into four dose-rate groups.

HBRA

High: 2.46 (2.24-3.08) mSv/year

Intermediate: 2.10 (1.98-2.24) mSv/year

Low: 1.83 (1.25-1.98) mSv/year

Control area: 0.68 (0.50-0.96) m Sv/year

Relative risk of major malignant diseases in the residents of high background radiation area and of control area (1979-1998)

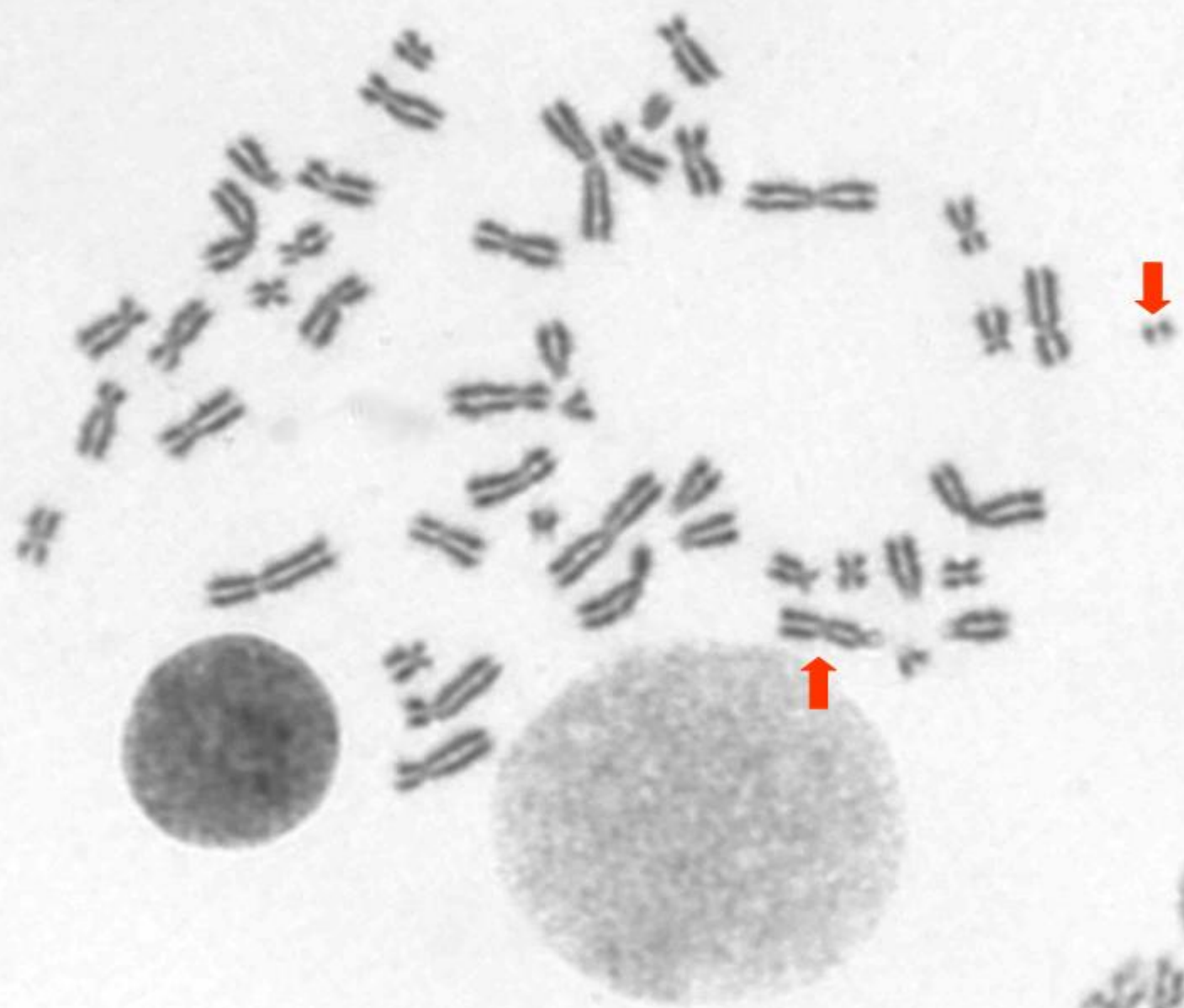
Site of cancer	CA	RR (95%CI) for HBRA			
	RR	Low Group	Interm. Group	High Group	Subtotal
All cancers	1.00	1.08 (0.93-1.26)	1.00 (0.86-1.17)	0.92 (0.78-1.08)	1.00 (0.89-1.14)
Leukemia	1.00	0.82 (0.35-1.86)	1.20 (0.57-2.56)	1.07 (0.47-2.39)	1.03 (0.56-2.02)
Solid cancers	1.00	1.10 (0.94-1.28)	0.99 (0.85-1.16)	0.91 (0.77-1.08)	1.00 (0.88-1.14)
Liver	1.00	1.07 (0.80-1.42)	0.84 (0.62-1.14)	0.74 (0.53-1.02)	0.89 (0.70-1.13)
Nasopharynx	1.00	0.96 (0.66-1.37)	0.98 (0.68-1.40)	0.88 (0.60-1.28)	0.94 (0.71-1.26)
Lung	1.00	0.93 (0.57-1.50)	0.67 (0.39-1.12)	1.04 (0.64-1.68)	0.87 (0.60-1.30)
Stomach	1.00	0.91 (0.55-1.48)	0.98 (0.60-1.57)	0.79 (0.46-1.33)	0.90 (0.61-1.34)
Esophagus	1.00	2.55 (0.91-8.21)	3.30 (1.26-10.24)	1.88 (0.60-6.37)	2.61(1.11-7.66)

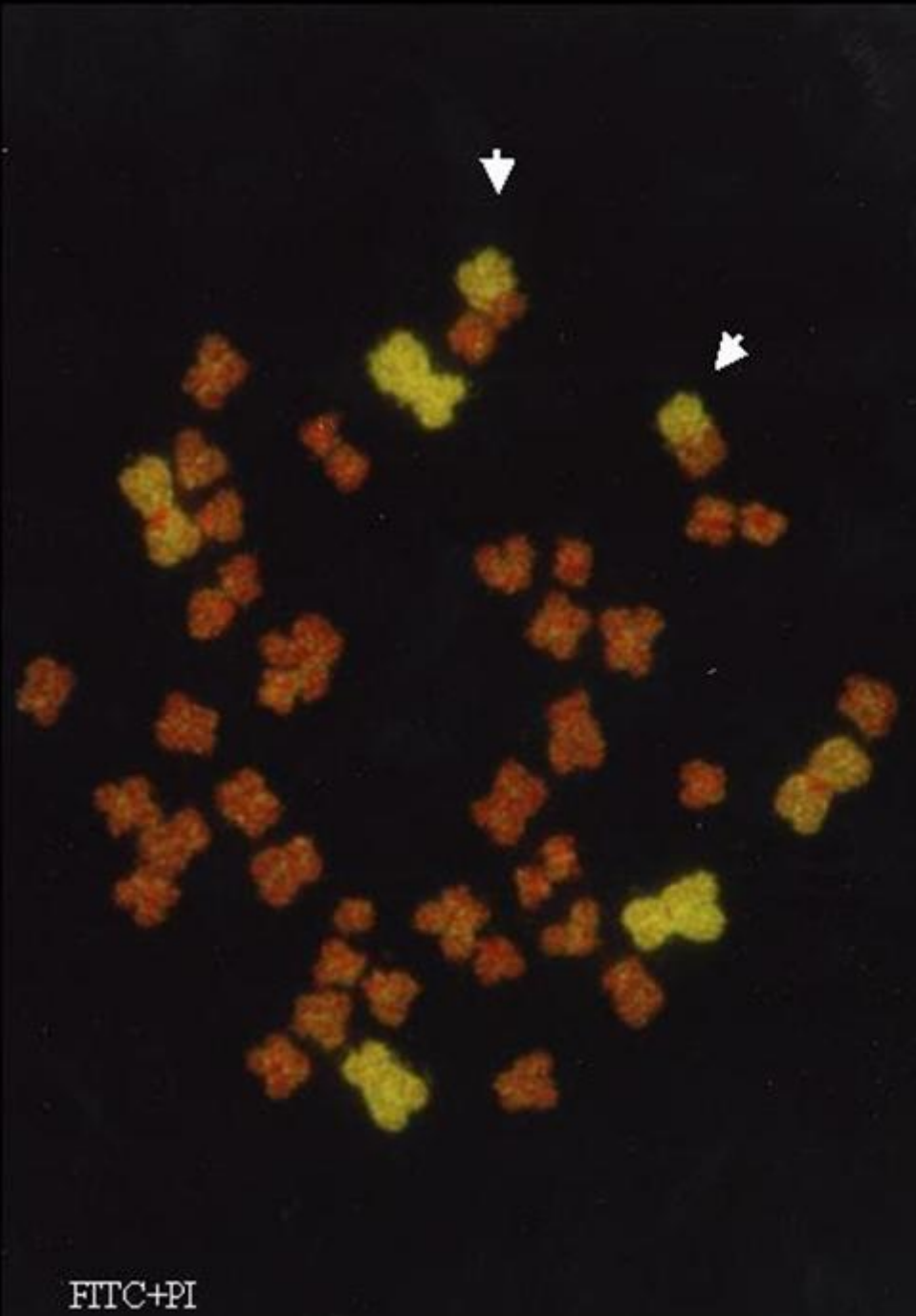
The average annual effective (external) doses (10^{-5} Sv/a) for high, intermediate, and low dose-rate groups in the HBRA, and the control group in the CA were 246.07 (224.10-308.04), 210.19 (198.07-224.09), 183.31 (125.29-198.06, and 67.92 (50.43-95.67), respectively.

Relative risk of mortality due to the diseases other than malignant diseases in the residents of high background radiation area and of control area

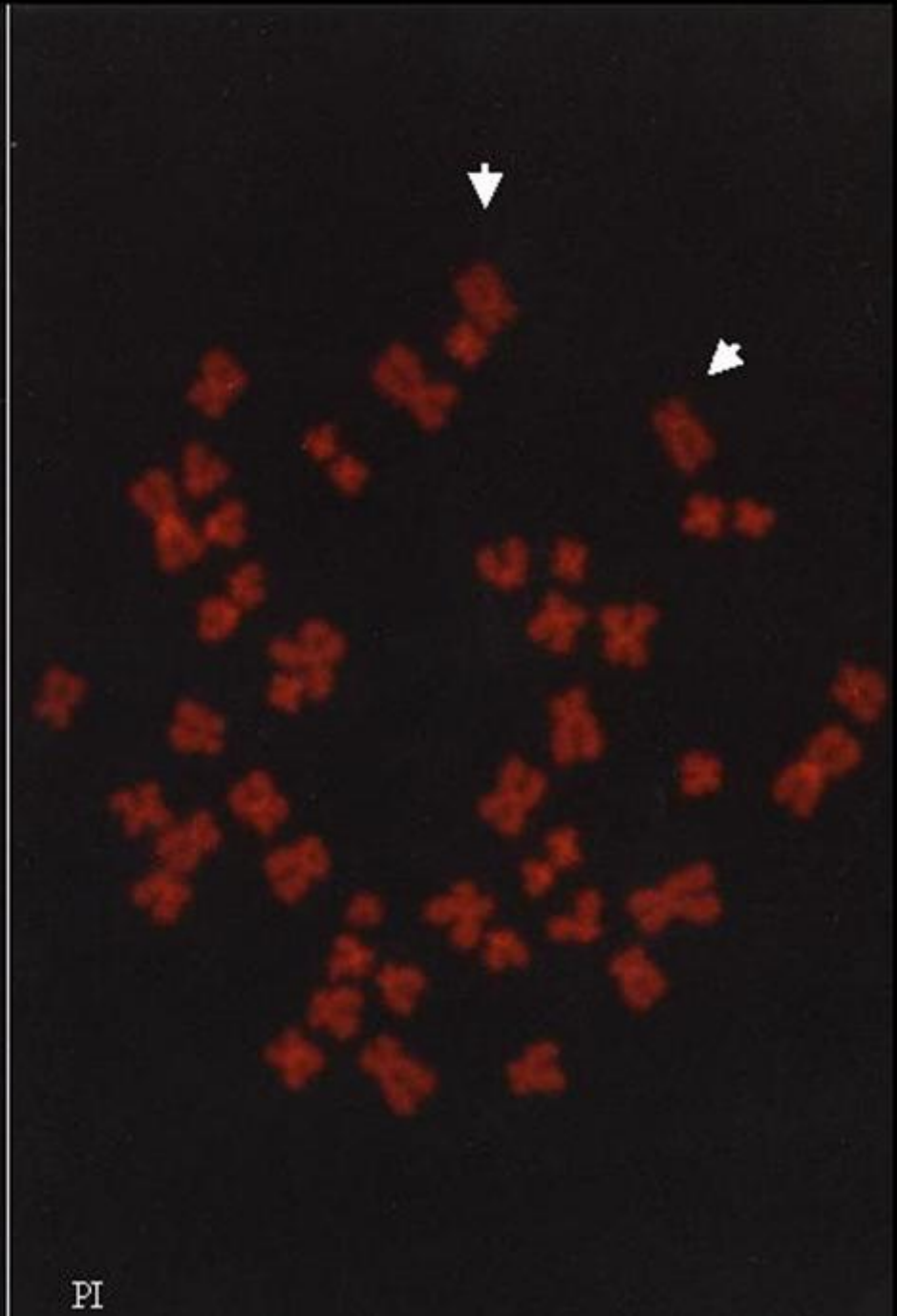
Factors		Control		HBRA	
		Cases	RR	Cases	RR (95% CI)
All		2847	1.00	7191	1.06 (1.01-1.10)*
Period	1979-86	1233	1.00	3094	1.02 (0.95-1.09)
	1987-98	1614	1.00	4097	1.09 (1.02-1.15)*
Sex	Female	1347	1.00	3353	1.05 (0.98-1.11)
	Male	1500	1.00	3838	1.06 (1.03-1.13)*
Age	0-39	285	1.00	992	1.31 (1.15-1.50)*
	40-49	90	1.00	305	1.28 (1.01-1.62)*
	50-59	208	1.00	525	1.00 (0.85-1.17)
	60-69	551	1.00	1288	1.06 (0.95-1.17)
	70+	1713	1.00	4081	1.01 (0.95-1.07)

*:P<0.05 is limited to those aged 50 years or younger, but it did not show a monotonic increase of mortality according to external radiation dose or cumulative lifetime dose.





FITC+PI



PI

Effect of natural radiation in high background radiation area (HBRA)

Subjects analyzed

Regarding dicentrics and rings :

22 members from 8 families in HBRA

17 members from 5 families in control

Each family consists of 3 generations

In total 101,395 cells (2,600 cells per member) were analyzed

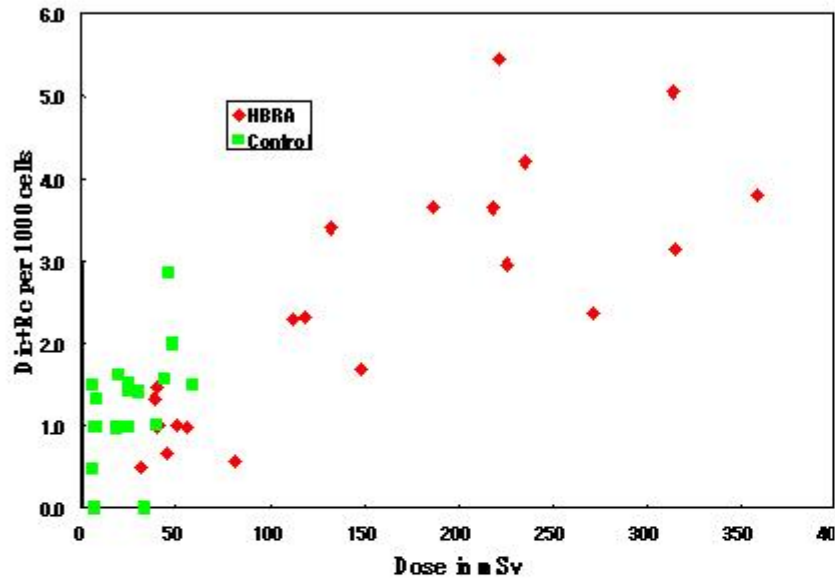
Regarding translocations :

27 aged persons and 6 children in HBRA

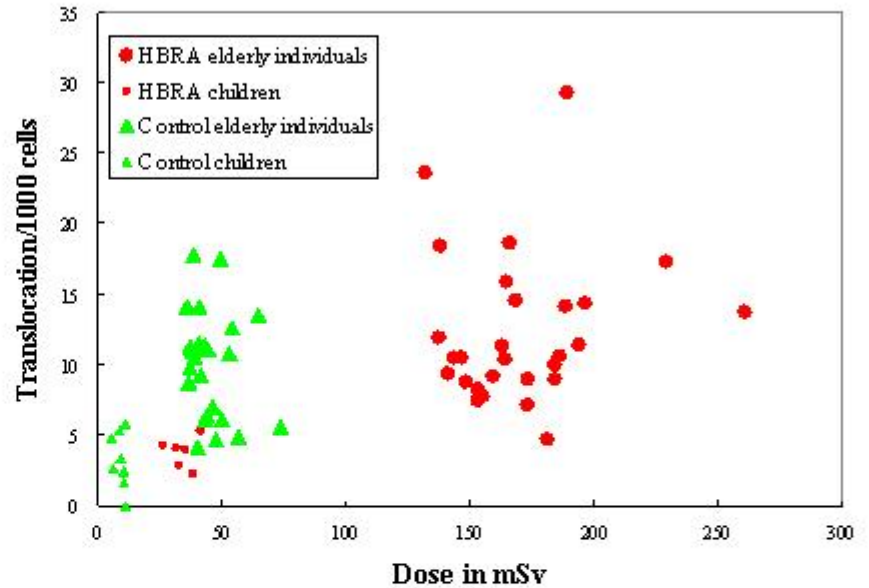
25 aged persons and 8 children in Control

In total 312,887 cells (4,741 cells per person) were analyzed

Dic+Ring per 1000 cells in relation to dose



Frequency of translocations in relation to dose



Dic+Ring increased along with the increase of the dose those residents received.

Frequency of translocation was much higher than that of Dic in both areas. The frequency and individual variation were low in children and high in adult.

Statistically there was no difference between HBRA and Control.

Effect of high level of natural radiation was detected in dicentrics and rings, which are very specific aberrations to radiation. On the other hand, the effect of high level of natural radiation was not detected in translocations, which reflects the effect of all kind of mutagens.

Effect of smoking

Subjects

HBRA

15 non-smokers

11 smokers

In total 123,065 cells (4,733 cells per person) were analyzed

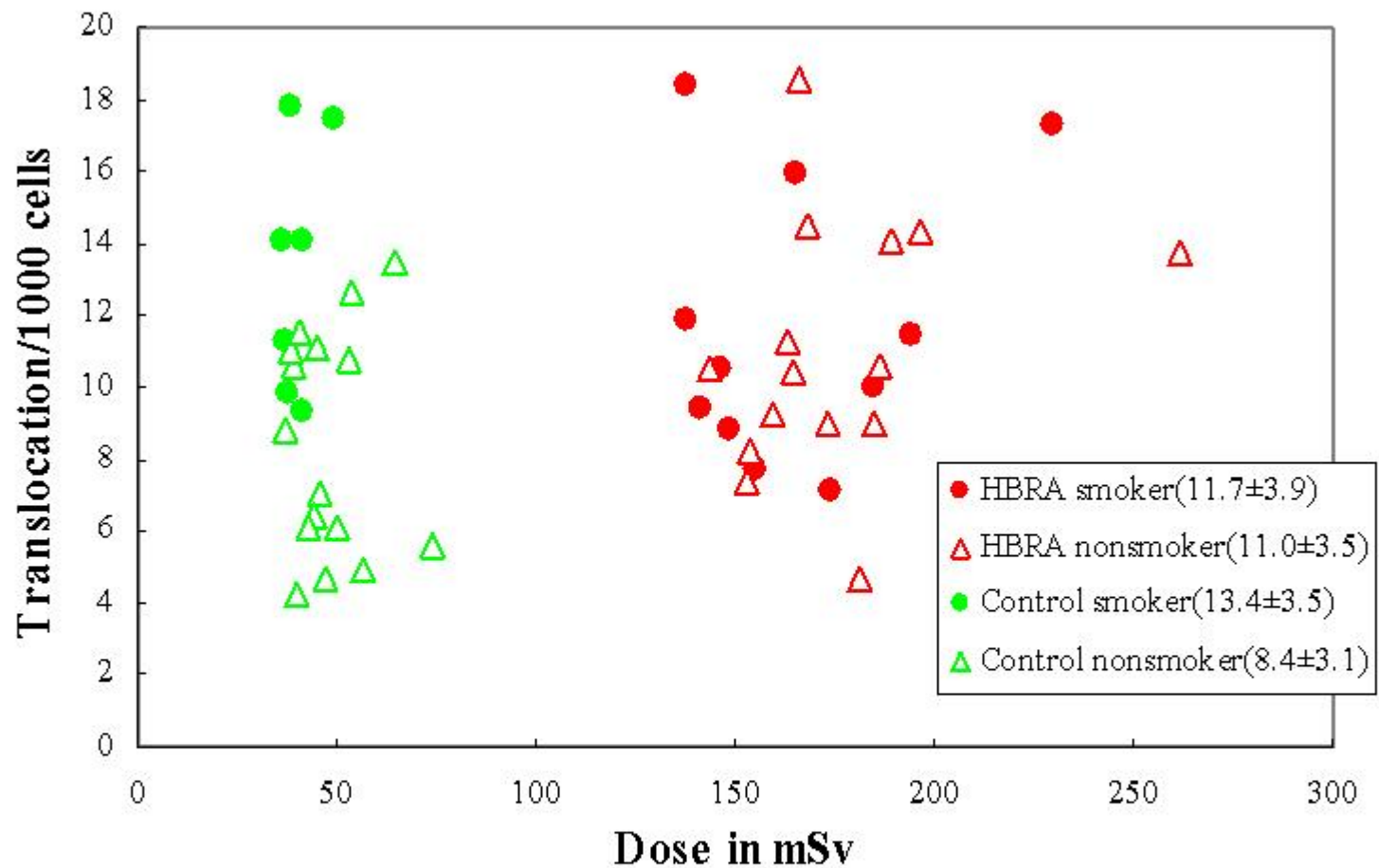
Control area

16 non-smokers

7 smokers

In total 93,117 cells (4,049 cells per person) were analyzed

Effect of smoking in relation to dose



There was a significant difference between smokers and nonsmokers in control.

On the other hand, there was no significant difference between smokers and nonsmokers in HBRA.

Tendency of difference was found between HBRA smokers and CA nonsmokers.

But there was no difference in the frequencies among other subgroups.

Effect of environmental mutagens in Beijing

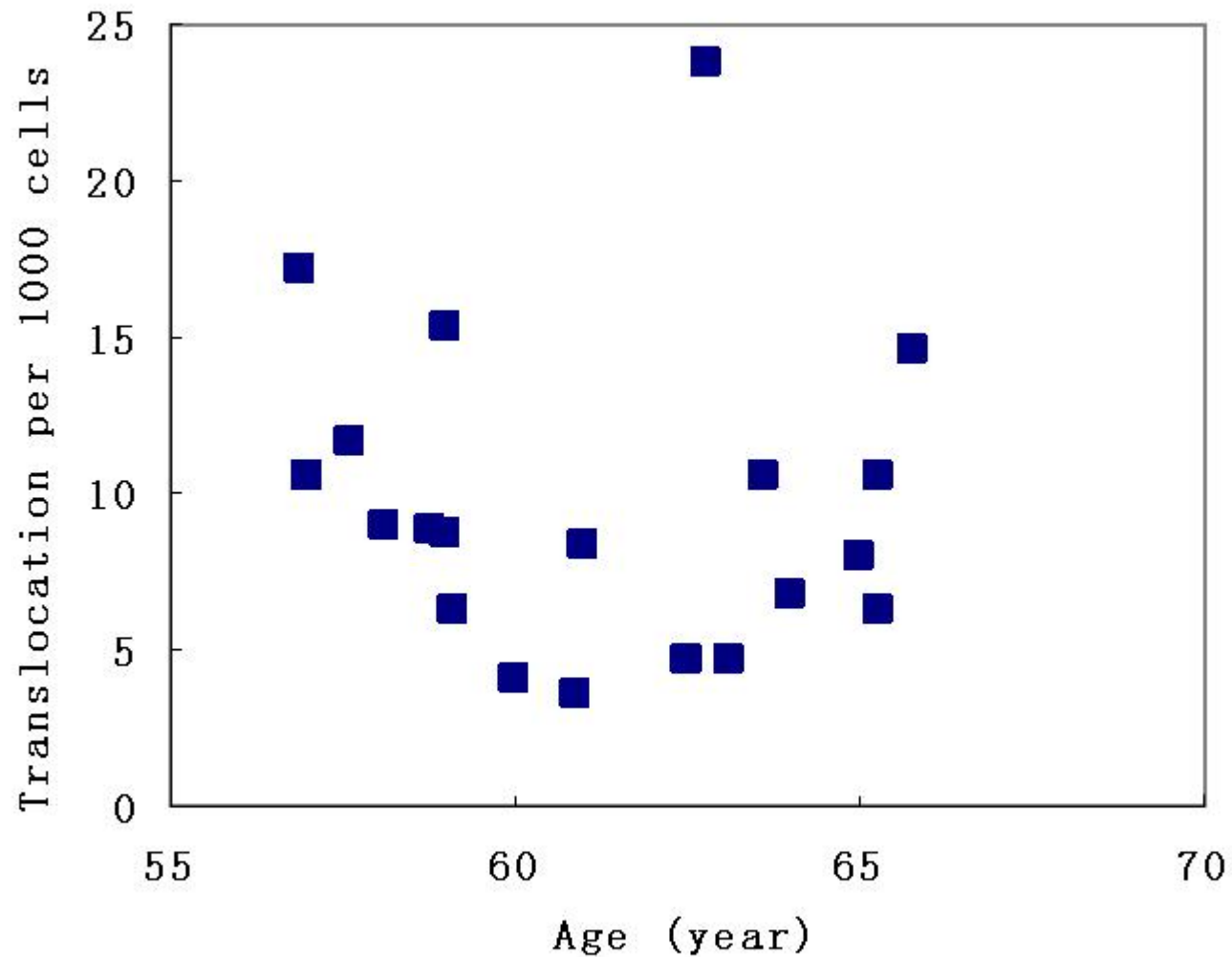
Subjects

Age matched 10 men and 10 women who have lived in Beijing
over 40 years

All of them were non-smokers

In total 78,281 cells (3,914 cells per person) were analyzed

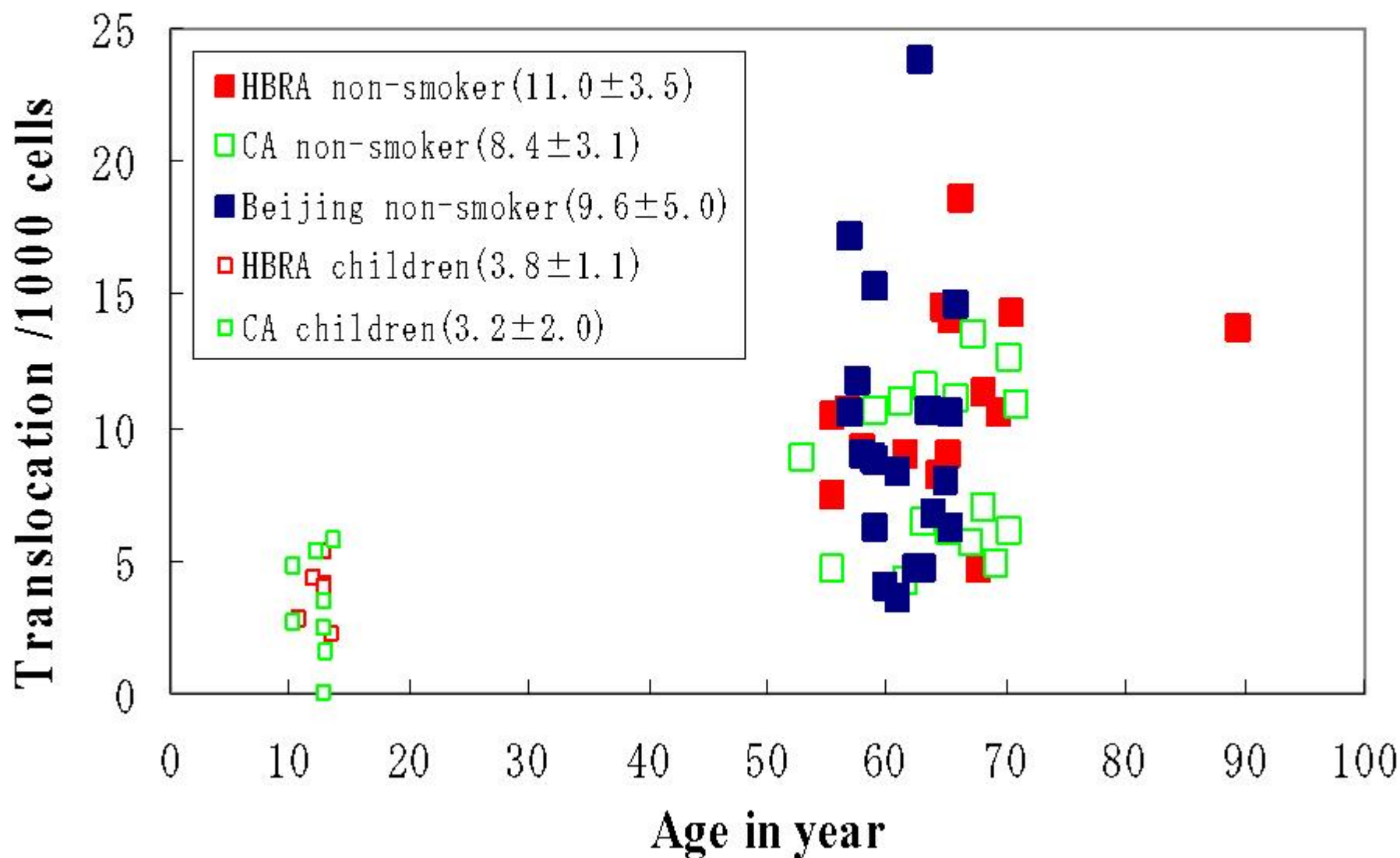
Effects of environmental mutagens



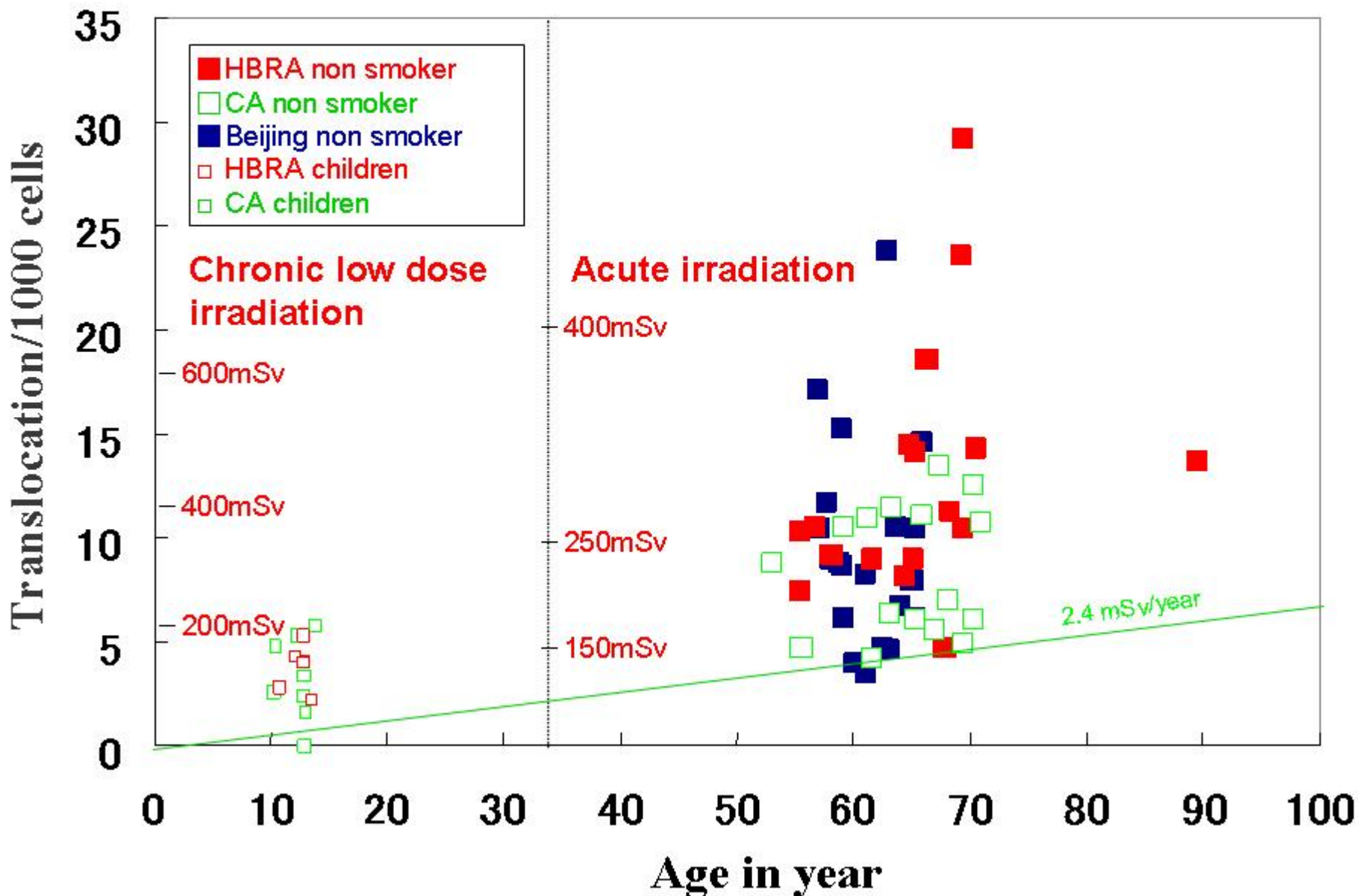
Average age: 61.2

Average frequency of Translocation : 9.6 per 1000 cells

Comparison of effects of environmental mutagens, smoking, and radiation



Radiation dose estimated with the frequency of chromosome aberration



Conclusion

- **Low dose radiation at least up to 3-5 times higher than the normal level does not have significant effect on the induction of the diseases to be caused by the chromosome aberrations such as cancer and congenital diseases, and its effect is within the individual variation of total effect to be caused by all kinds of clastogens in the normal living circumstances.**

Thank you for your attention!

