

Incidence of malignant tumors among different groups of Belarusian population after the Chernobyl accident

A.E. Okeanov* E.Y. Sosnovskaya**

*International Sakharov Environmental University, Minsk

**Republican Research and Practical Center of Radiation
Medicine and Human Ecology, Gomel

The groups of affected population included in the study

Group 1 – liquidators

Group 2– evacuated population

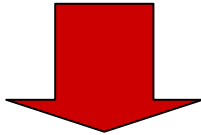
Group 3 - population living on the contaminated territories over 555 kBk/m²

Group 5 - population living on the contaminated territories of 37 - 555 kBk/m²

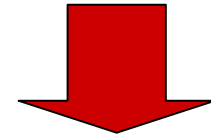
**Cancer
Registry**



**Chernobyl
Registry**



**Materials of
cancer
populational
statistics**



**Materials for
assessment
of health state
of affected
population**

Methodology

■ As a control group the population of the Vitebsk area has been taken. Criteria for choosing Vitebsk area as a control one were the following:

- the population of this area has received the lowest doses of radiation;
- the least number of population moved from polluted territories to Vitebsk area.

■ While analyzing the control group all cancer cases among moved population and liquidators were excluded from research.

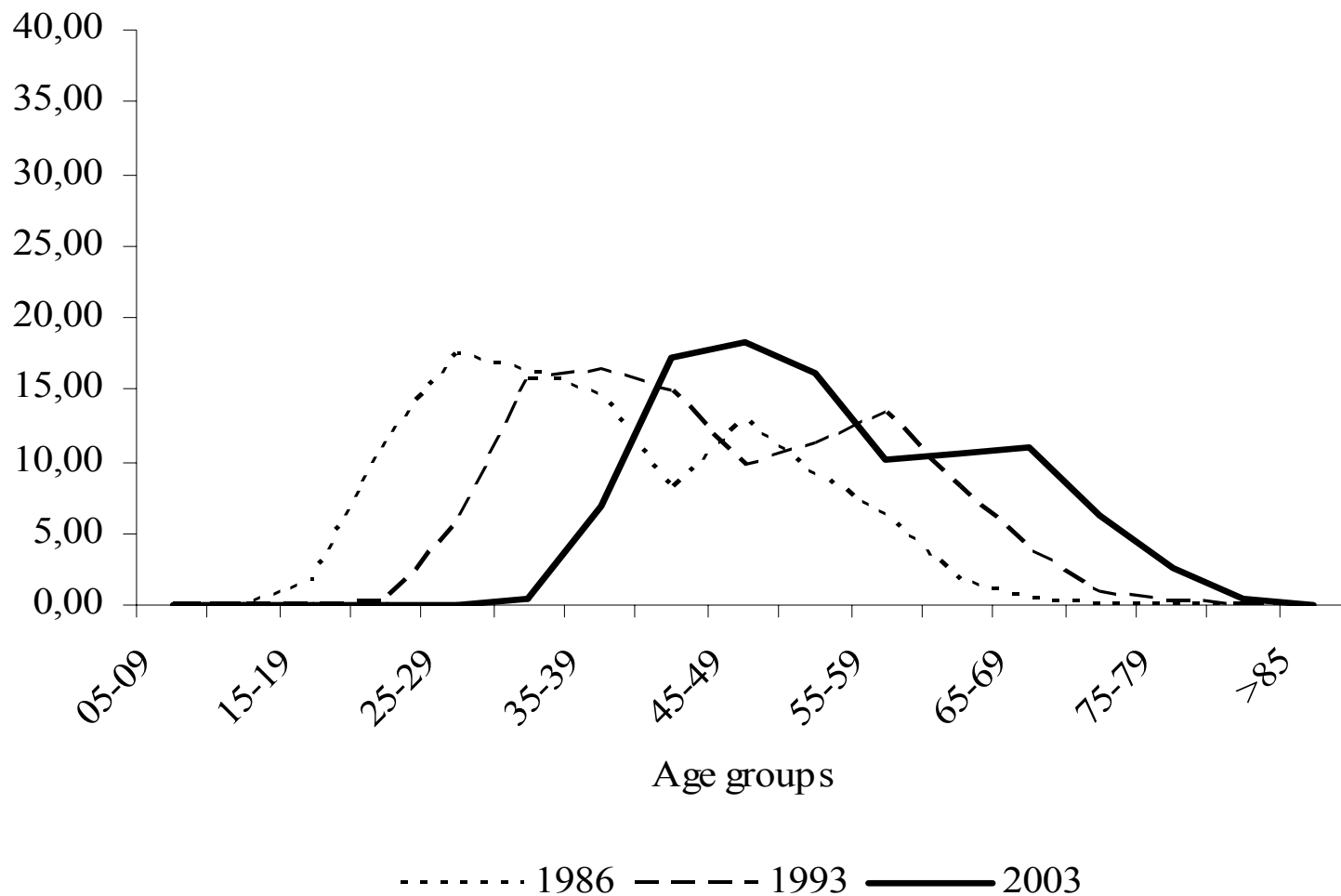
■ The comparative analysis of cancer incidence was carried out using standardized incidence rates.

■ Standardization of incidence rates of adult population and liquidators was performed by a method of truncated age-standardized rate (TASR) with use of the standard "World".

Specifics of surveyed cohorts

Groups	Number in groups (Thousands)	Number of person-years (Thousands)	Number of cancer cases
Liquidators	71.8	790.2	3857
Evacuated	7.5	82.6	331
Population > 555 kBk/m²	78.3	861.8	2655
population 37-555 kBk/m²	1245.3	13698.3	45490

Distribution of liquidators by age (%)



Number of detected cancers in the liquidators' cohort for the period of 1993-2003

Tumor Site	Total	Men	Woman
All sites	3857	3026	831
Stomach	408	338	70
Colon	155	127	28
Lung	540	523	17
Kidney	181	165	16
Urinary bladder	166	160	6
Thyroid	255	133	122
Breast	140	-	140

Incidence rate among liquidators depending duration of their staying in the zone (average values for 1993-2003)

Period of time (days)	Incidence per 100'000
< 30	414.7 ± 36.8
30 - 60	430.6 ± 31.6
60 - 90	465.5 ± 34.8
> 90	443 ± 29.8
Total	422.2 ± 5.3
Control	366.4 ± 5.3

Average levels and dynamics of incidence of malignant tumors among liquidators for the period of 1993-2003.
(TASR*±m per 100000 population)

Tumor Site	Incidence		Regression rate	
	Liquidators	Control region	Liquidators	Control region
All sites	422,2±20,6	366,4±5,3	13,15±5,29	4,69±1,10
Stomach	41,1±3,4	42,9±1,2	1,99±0,92	-0,99±0,19
Colon	19,1±2,1	16,1±0,4	1,14±0,59	0,24±0,12
Lung	55,6±5,4	53,6±1,2	3,78±1,26	-0,38±0,31
Kidney	15,7±1,9	10,8±0,5	1,78±0,27	0,68±0,16
Urinary bladder	16,7±1,2	13,8±0,8	0,89±0,23	0,28±0,12
Thiroid gland	28,4±4,1	10,1±1,0	1,08±1,03	0,8±0,18

Effect of A-Bomb Radiation on the Human Body.

Shigematsu I. et al.

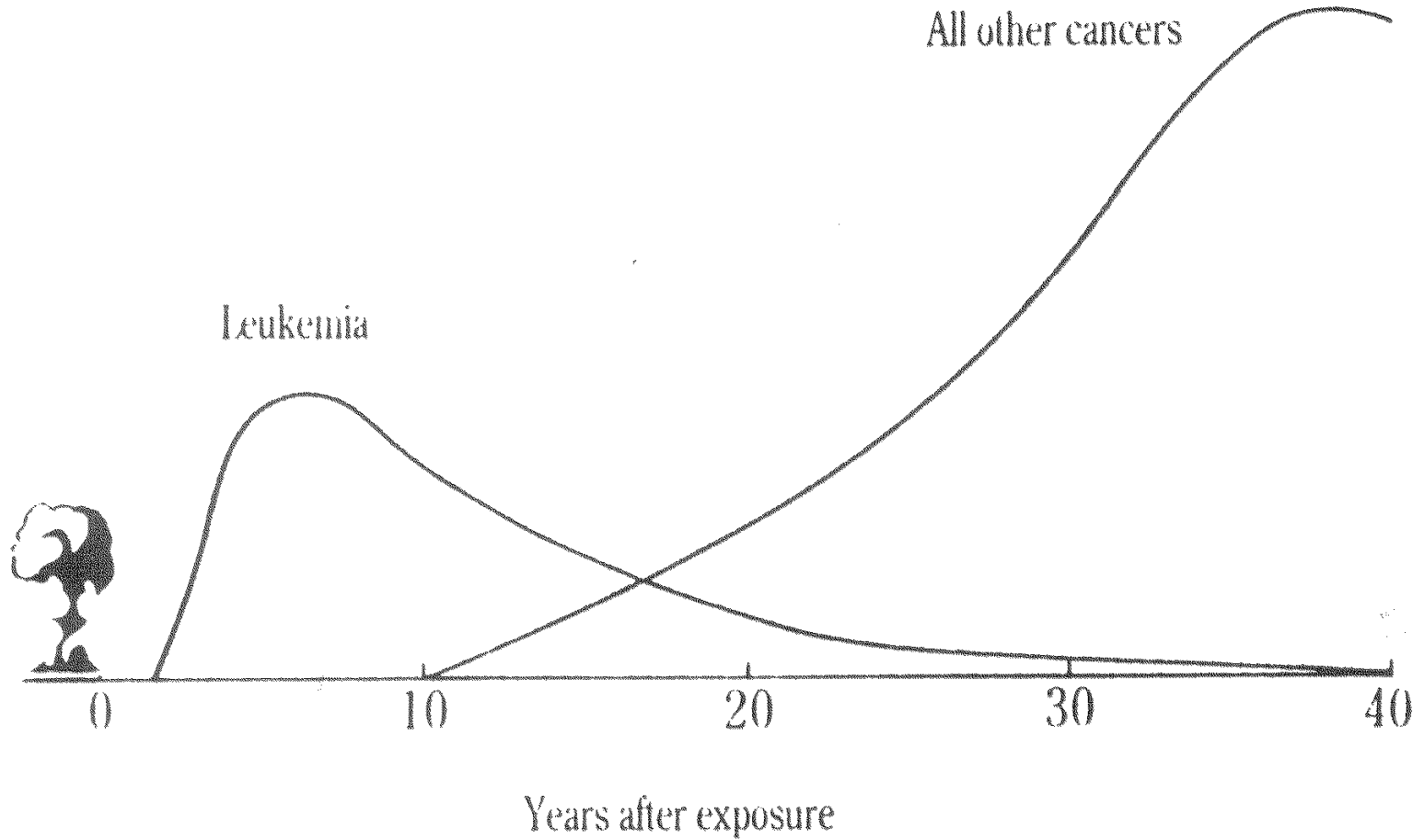


Figure 2 Incidence of radiation-induced cancer after atomic bombing

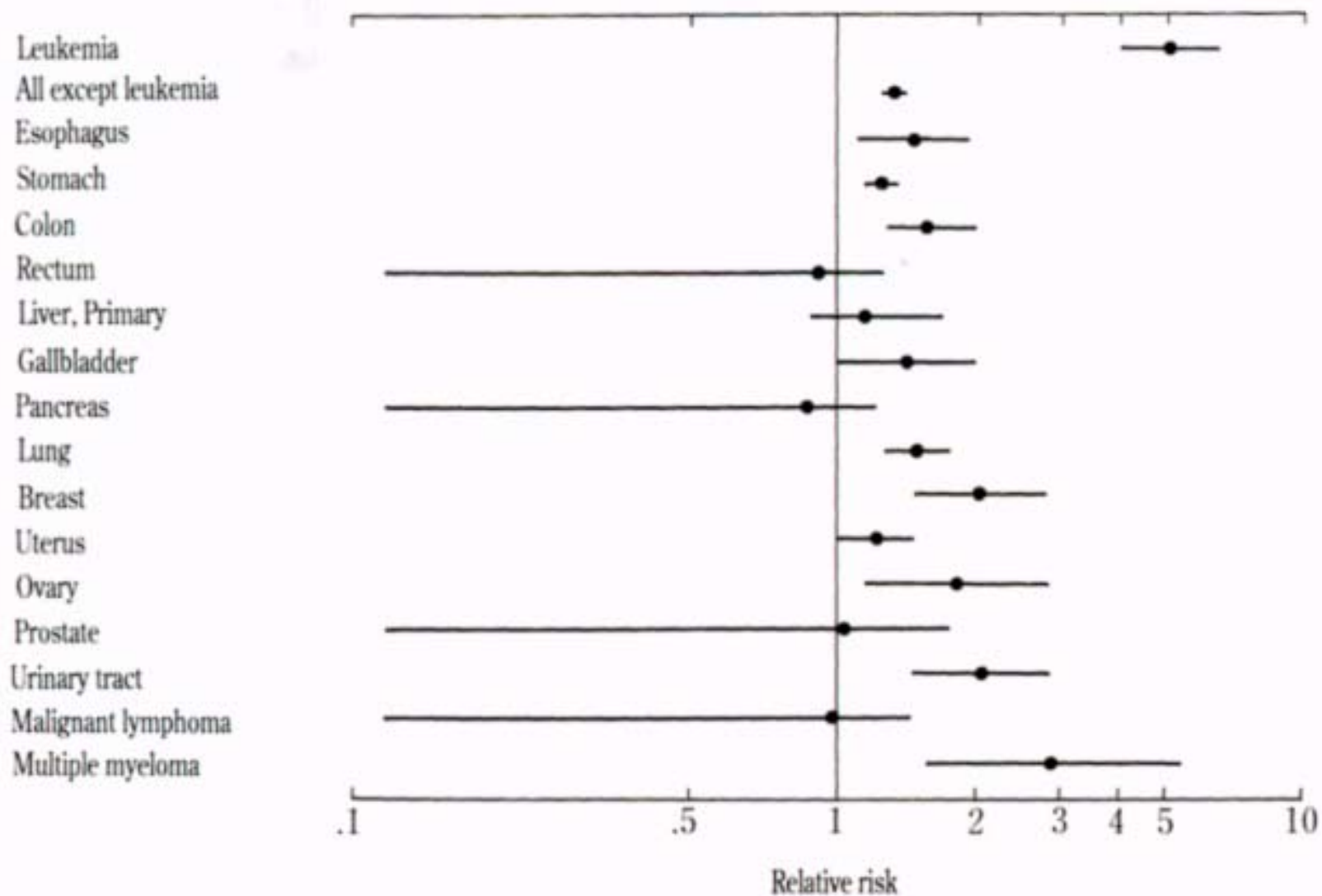
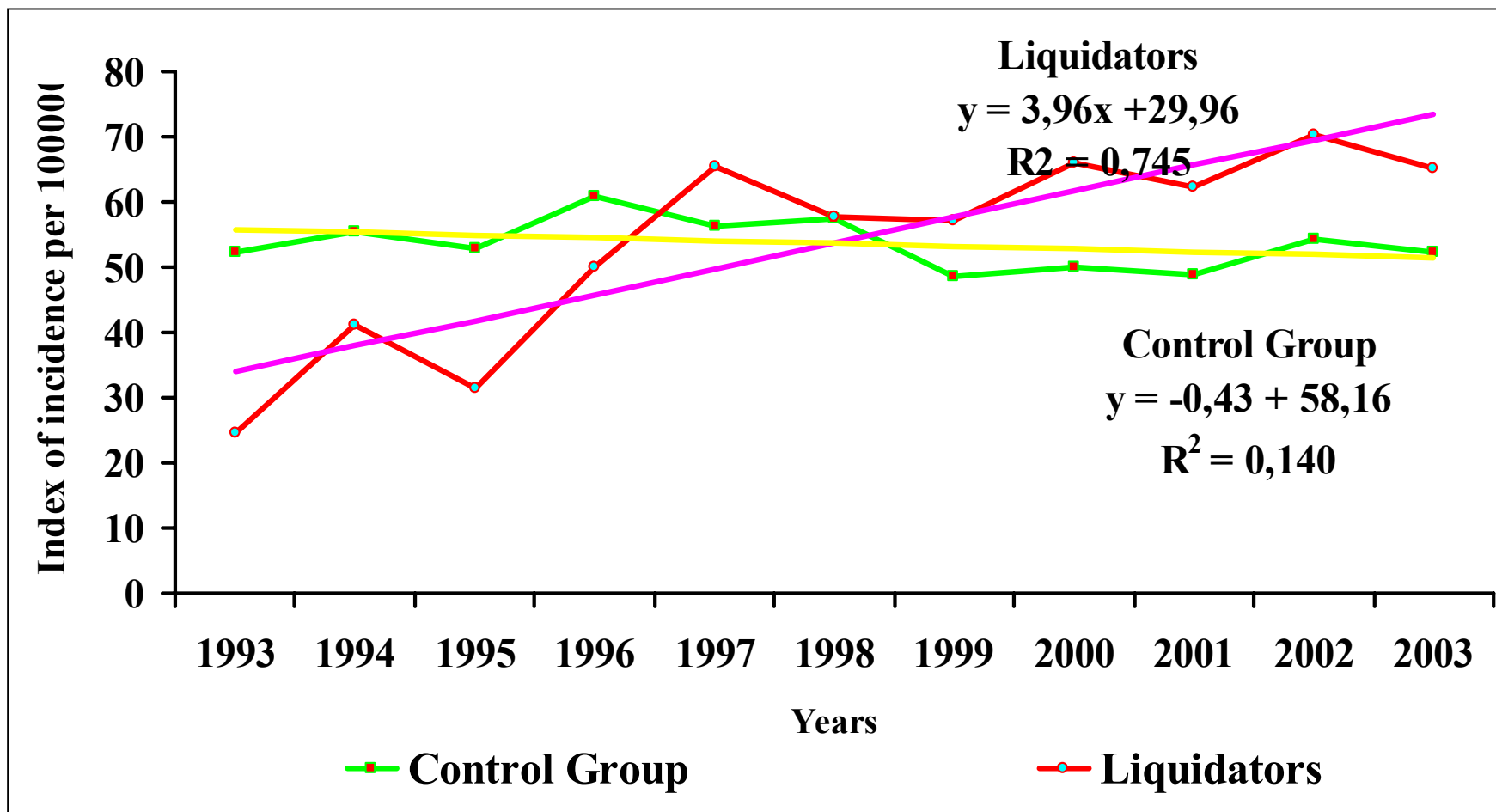
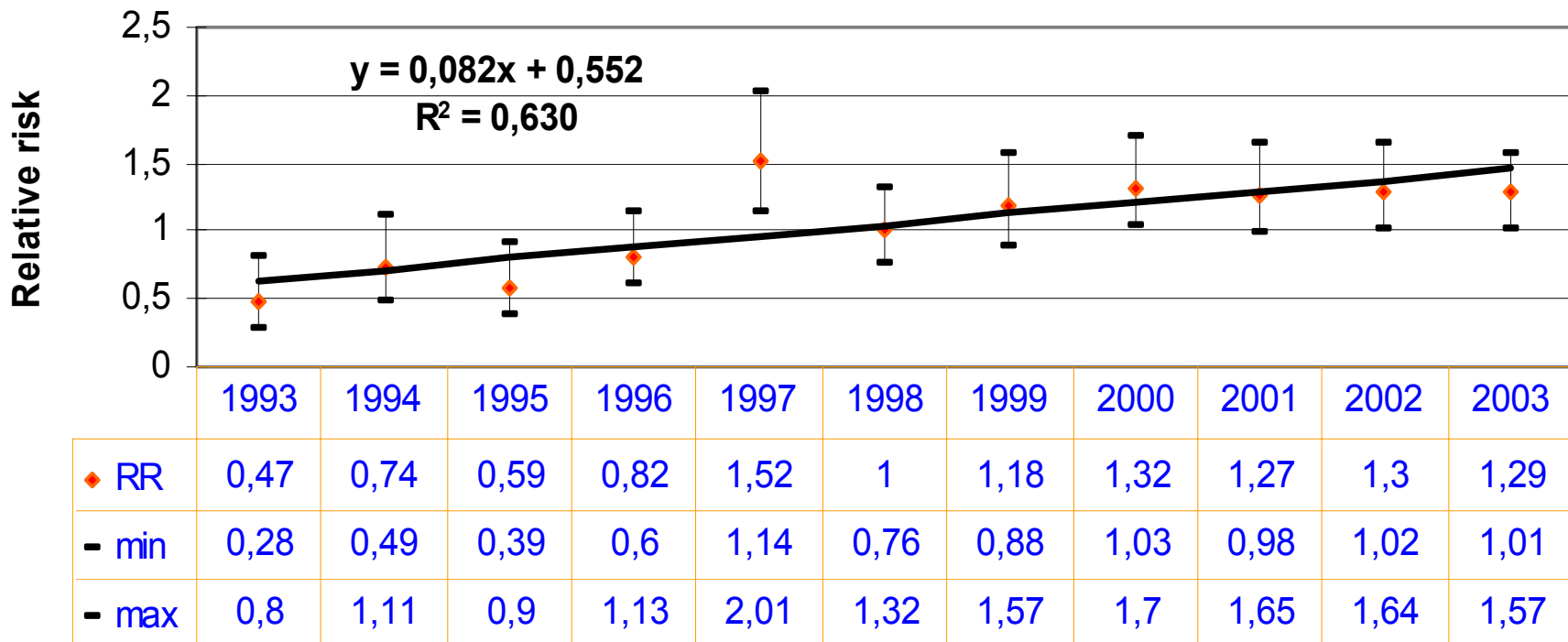


Figure 1 Relative risk at 1 Gy (shielded kerma) and 90% confidence limit, 1950-85³

Dynamics of lung tumor incidence (TASR) among liquidators and control group (Vitebsk region) for the period of 1993-2003



Dynamics of relative risk of lung cancer among Chernobyl liquidators



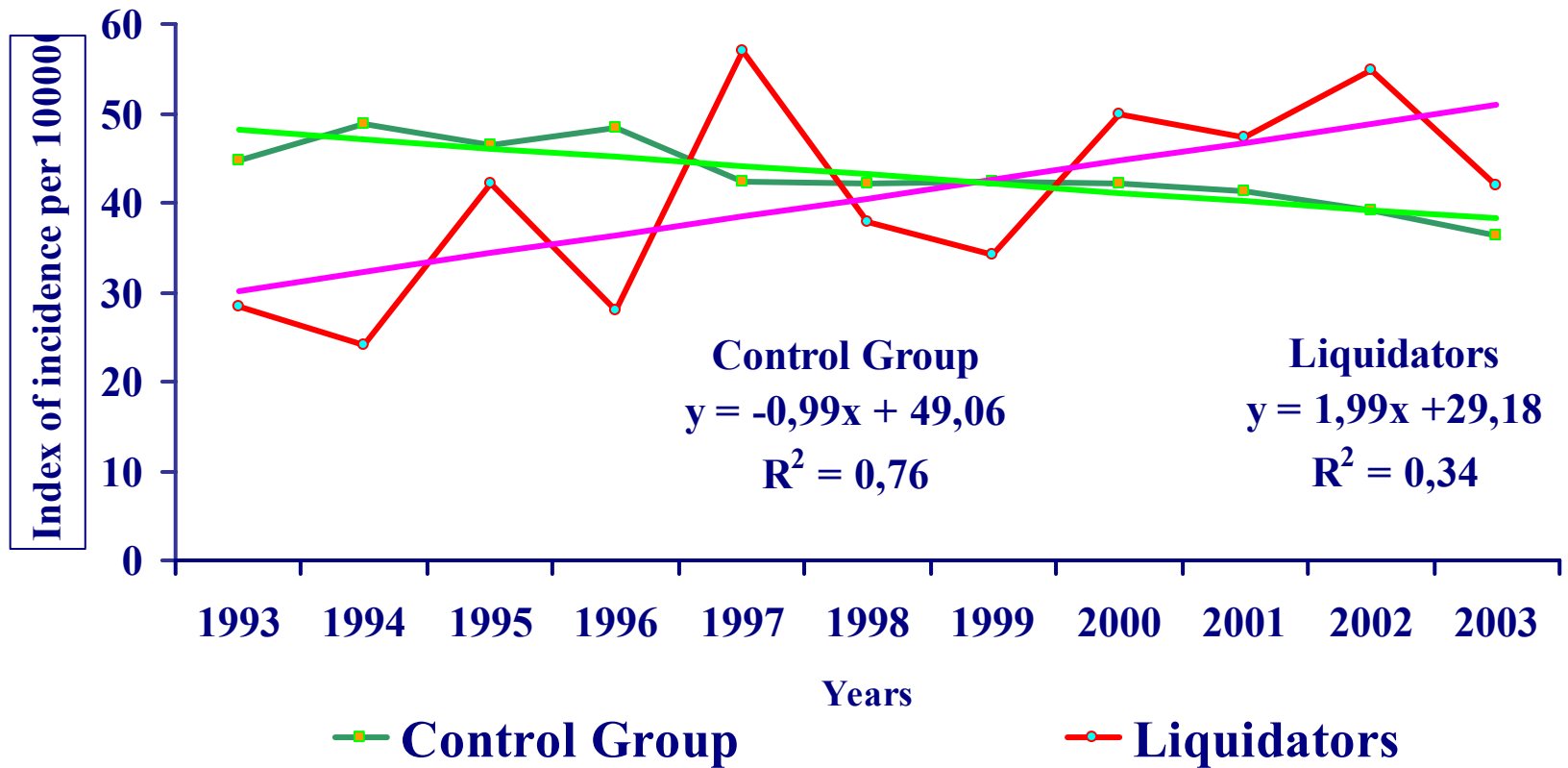
RR 1997-2003 = 1.26

Standardized rates of lung cancer incidence among exposed survivors in Hiroshima with T65DR (1950-1980)

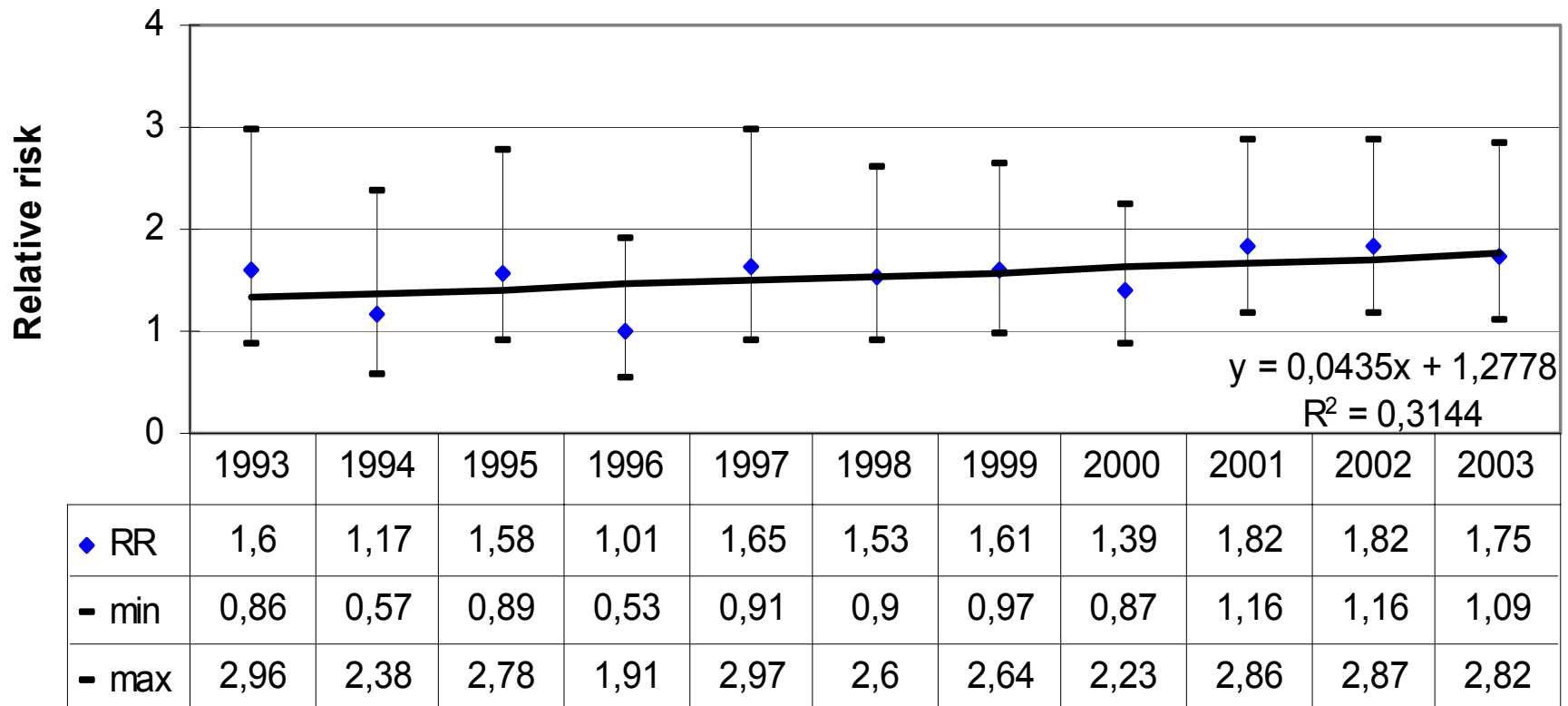
Radiation Dose (rad)	0	1-9	10-49	50-99	100-199	200-299	300-399	400+
Rate per 10⁵	36,4	37,8	45,7	53,1	84,3	76,1	97,6	91,9
Relative risk	1.00	1,04	1,25	1,46	2,32	2,09	2,68	2,52

Tsuomu Yamamoto et al. Lung Cancer Incidence among Japanese A-Bomb Survivors, 1950-80/J, Radiat, Res., 156-171 (1987).

Dynamics of stomach tumor incidence (TASR) among liquidators and control group




Dynamics of urinary bladder cancer relative risk among Chernobyl liquidators



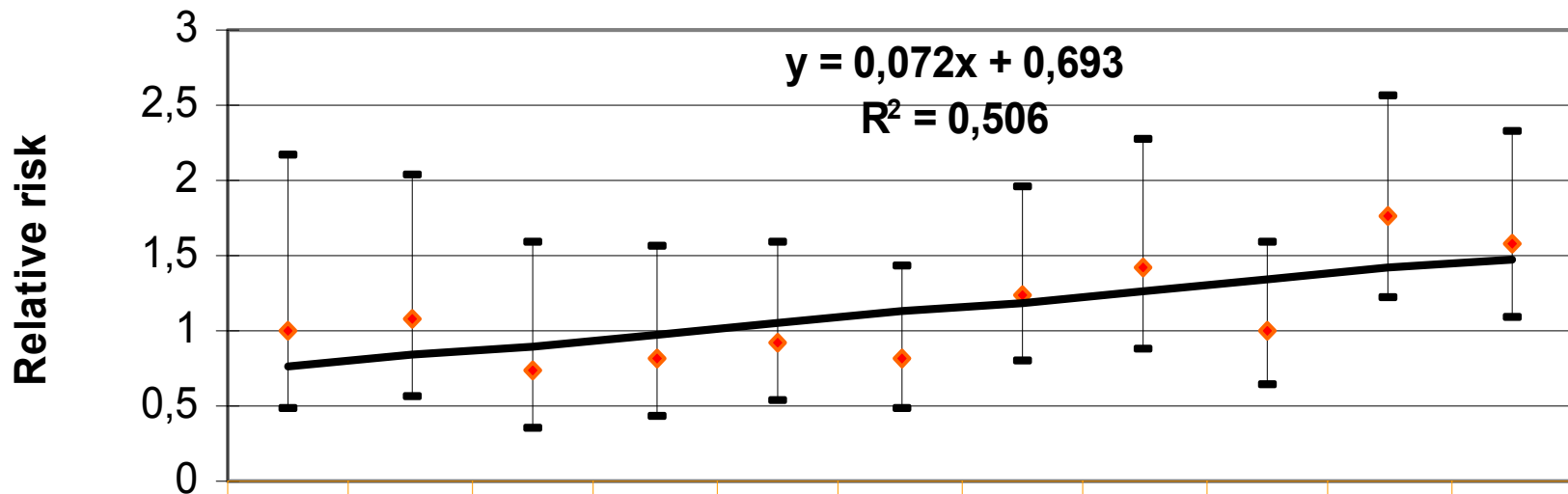
RR (1997-2003) = 1,65 min - 1,37 max - 1,98

Relative risk of **urinary bladder** cancer incidence among Chernobyl liquidators

Duration of staying in zone (days)	RR 1993-1996	95% confidential interval		RR 1997-2003	95% confidential interval	
		min	max		min	max
<30	1,04	0.64	1,68	1.41	1.07	1.87
30-60	1.50	0.75	3.02	1.50	0.99	2,27
60-90	3.92	1.75	8,75	2.09	0.94	4,66
>90	1.51	0.83	2.74	2.14	1.59	2.90
Total	1.33	0.97	1.82	1.65	1.37	1.98



Dynamics of relative risk of kidney cancer among Chernobyl liquidators



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
◆ RR	1	1,07	0,74	0,82	0,92	0,82	1,24	1,42	0,99	1,76	1,57
- min	0,47	0,56	0,35	0,43	0,53	0,48	0,79	0,88	0,62	1,2	1,07
- max	2,15	2,03	1,57	1,55	1,59	1,41	1,96	2,27	1,58	2,56	2,32

RR (1997-2003) = 1,24

min - 1,05

max - 1,47

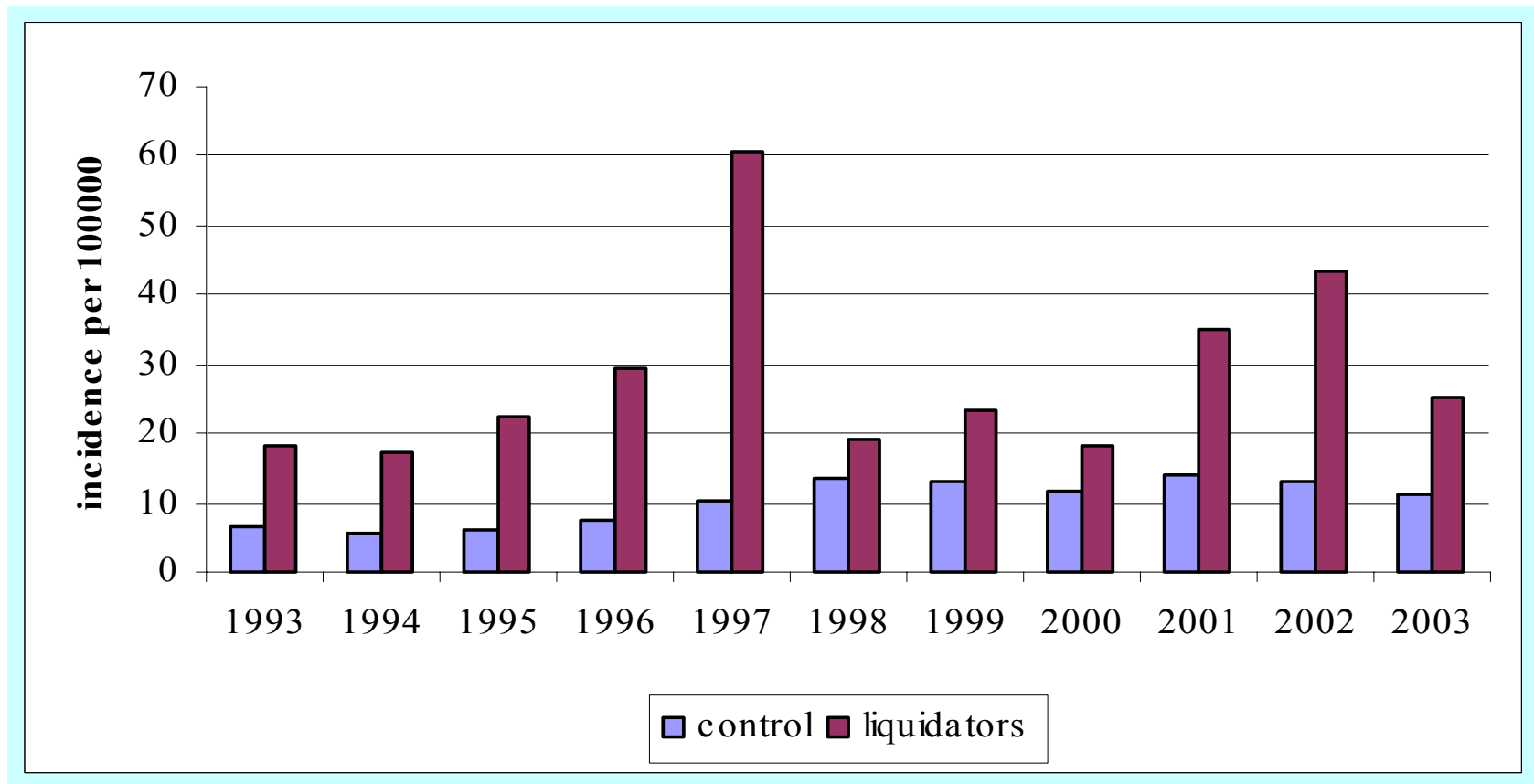
Relative risk of malignant tumors incidence among liquidators for the period of 1997-2003

Tumor site	Incidence rate (TASR*±m per 100000)		RR	95% confidential interval	
	Liquidators	Control group		Lower boarder	Upper boarder
All sites	464,6	379,3	1,23	1,18	1,27
Stomach	46,9	40,8	1,15	1,02	1,29
Colon	22,2	16,7	1,33	1,11	1,59
Lung	66,3	52,6	1,26	1,14	1,39
Kidney	19,1	15,4	1,24	1,05	1,47
Urinary bladder	18,7	11,4	1,65	1,37	1,98
Thyroid	32,2	12,3	2,62	2,23	3,07

Cancer incidence among liquidators

Tumor Site	Incidence per 100000 liquidators in cohorts			Control group
	26/04/1986-30/06/1986	01/07/1986-31/12/1987	1988	
All sites	456,1± 10,3*	437,8± 10,3*	356,5± 34,8	366,4± 5,3
Stomach	50,4± 3,4*	42,6± 3,2	42,5± 12,0	42,9± 1,2
Colon	18,7± 2,1	25,5± 2,5*	27,5± 9,7	16,1± 0,4
Lung	57,9± 3,7	67,1± 4,0*	60,5± 14,4	53,6± 1,2
Kidney	20,3± 2,2*	20,6± 2,2*	9,5± 5,7	10,8± 0,4
Urinary bladder	20,6± 2,2*	16,6± 2,0	7,6± 5,1	13,8± 0,8

Dynamics of thyroid gland cancer incidence among Chernobyl liquidators and control population



Incidence of thyroid cancer

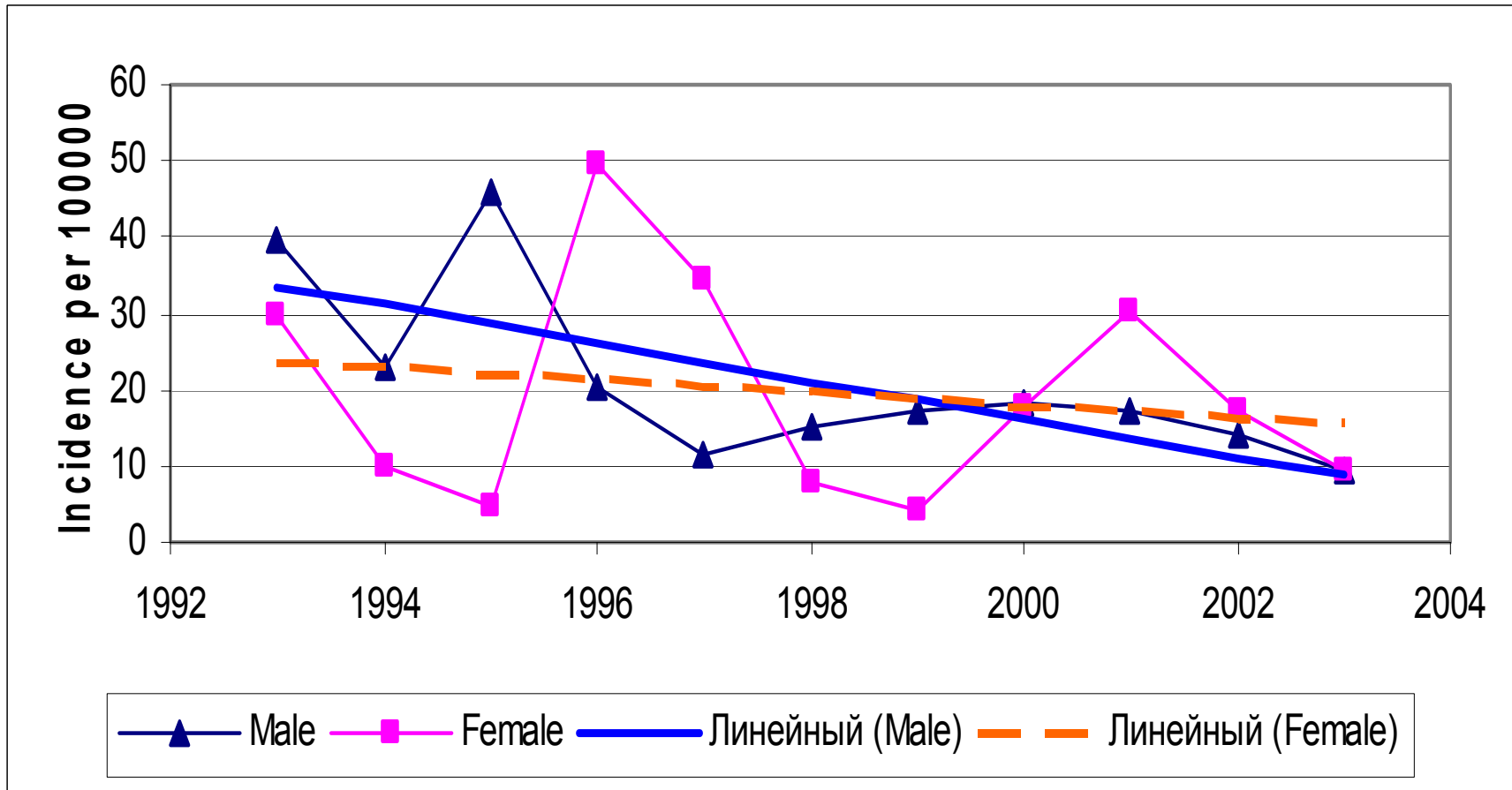
(average for 1993-2003)

Groups	Total	Male	Female
Liquidators	20.4 ± 4.06	15.7 ± 3.04	71.0 ± 13.9
Control	10.1 ± 0.97	2.6 ± 0.25	16.6 ± 1.62±

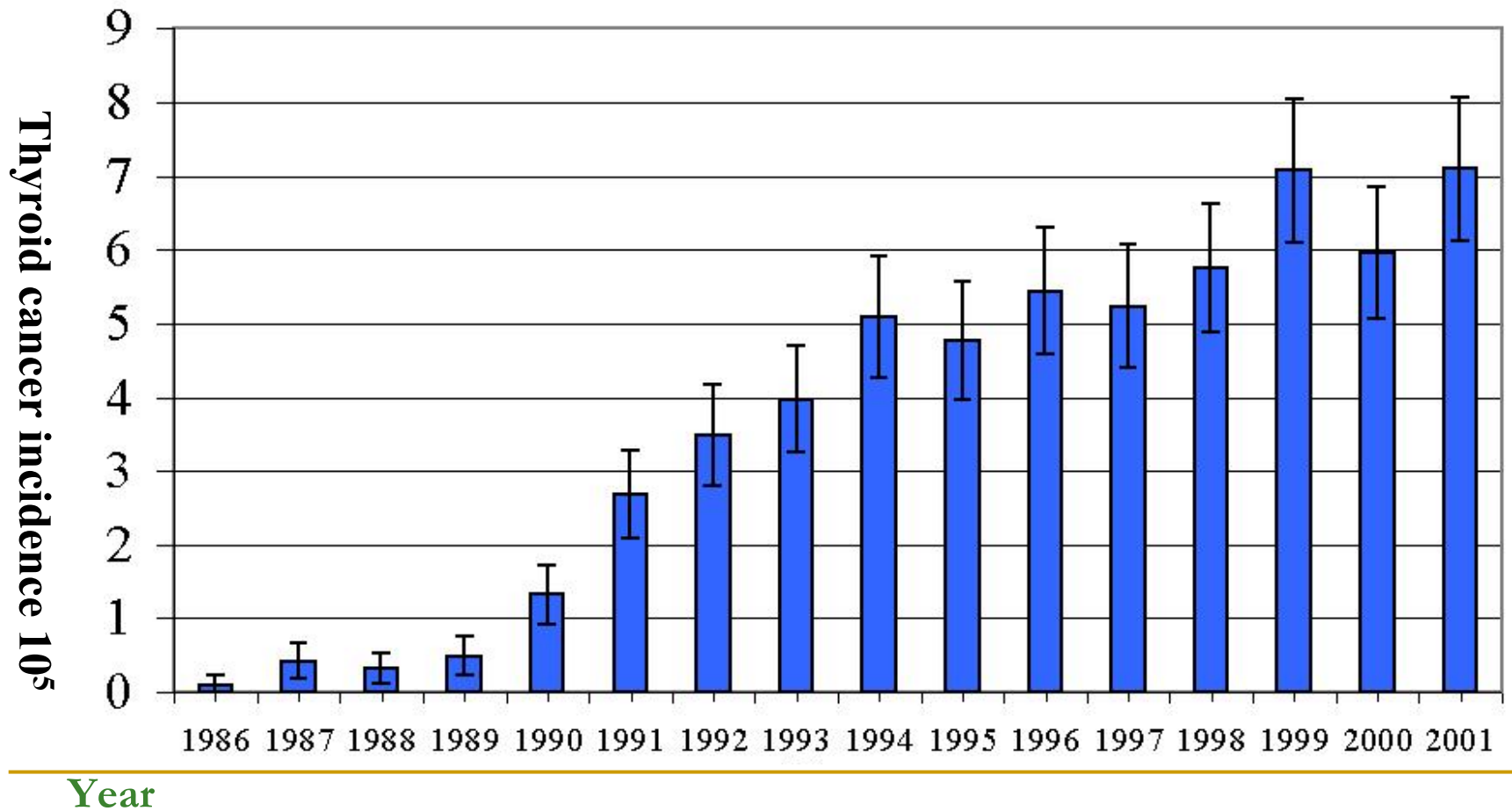
Leukemia incidence rate among population (average for 1993-2002 per 100,000; standard – Republic of Belarus 2001)

	Liquidators	Republic	P
male	21,2 ± 3,5	17,7 ± 1,3	P > 0,05
female	19,6 ± 4,4	9,4 ± 1,2	P < 0,05

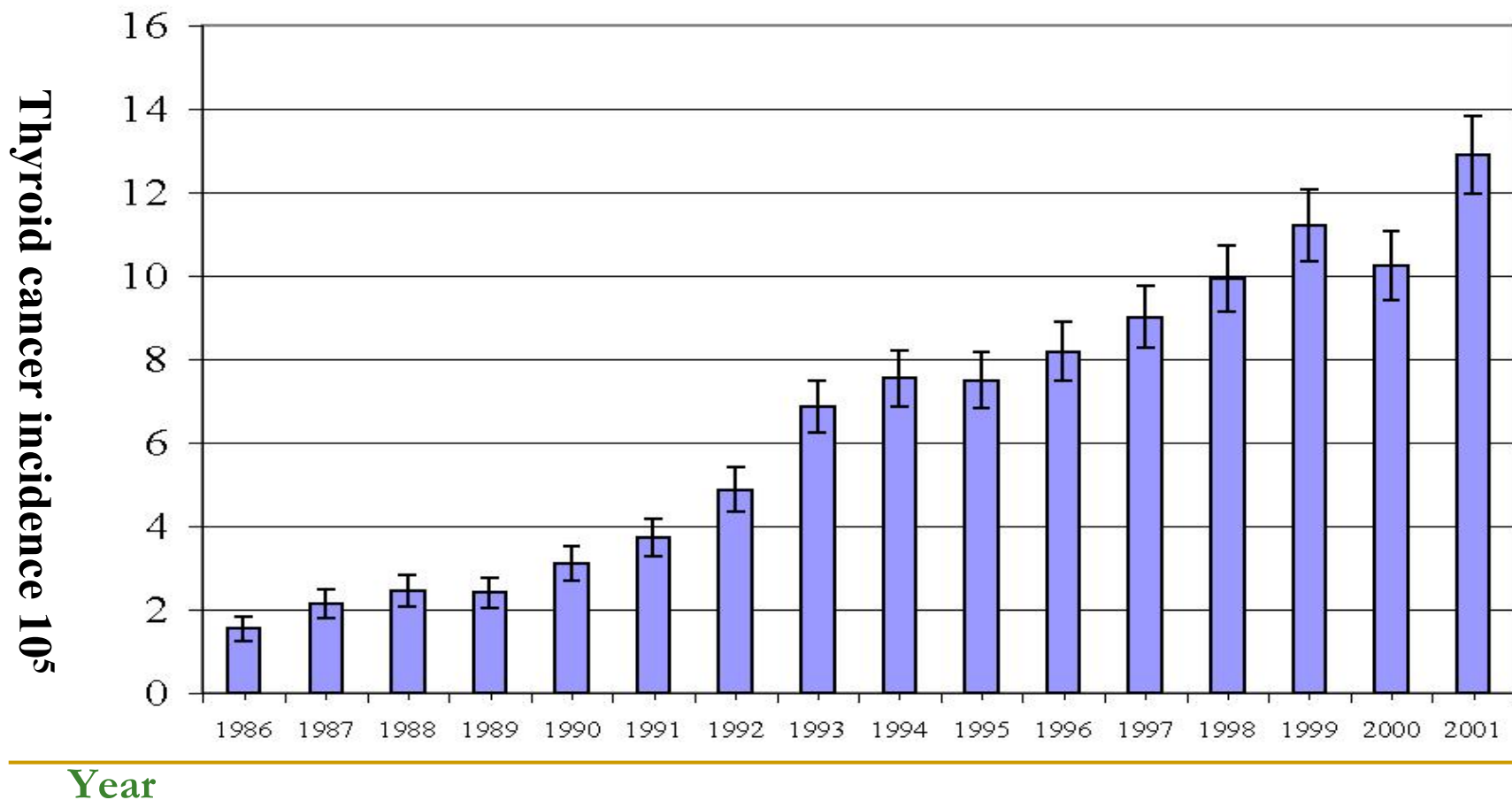
Dynamics of leukemia incidence among liquidators



Incidence of thyroid cancer among Belarus population exposed to ^{131}I at the age of 0-18 years



Incidence of thyroid cancer among Belarus population exposed to ^{131}I at the age of 19 and older



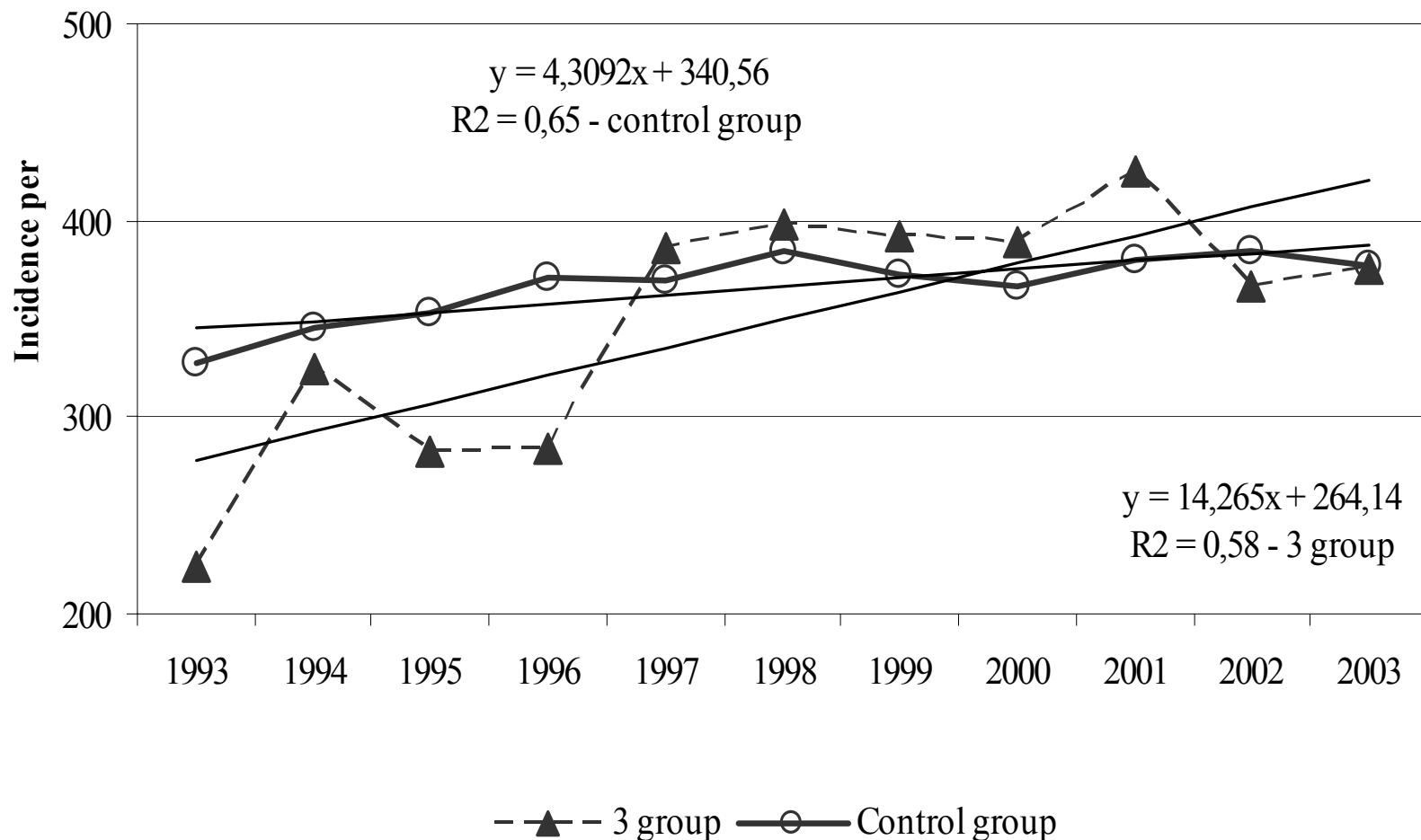
Incidence of cancer among evacuated population and control group

Tumor site	Groups	
	Evacuated	Control group
All sites	341,53 ± 25,63	366,41 ± 5,33
Stomach	39,17 ± 10,26	42,89 ± 1,18
Colon	5,69 ± 2,58	16,22 ± 0,38
Lung	29,35 ± 8,96*	53,32 ± 1,25
Breast	35 ± 17,62	59,25 ± 1,21
Kidney	4,27 ± 3,99	13,95 ± 0,82
Urinary bladder	2,92 ± 1,95	10,63 ± 0,33
Thyroid	74,28 ± 15,73*	10,06 ± 0,96

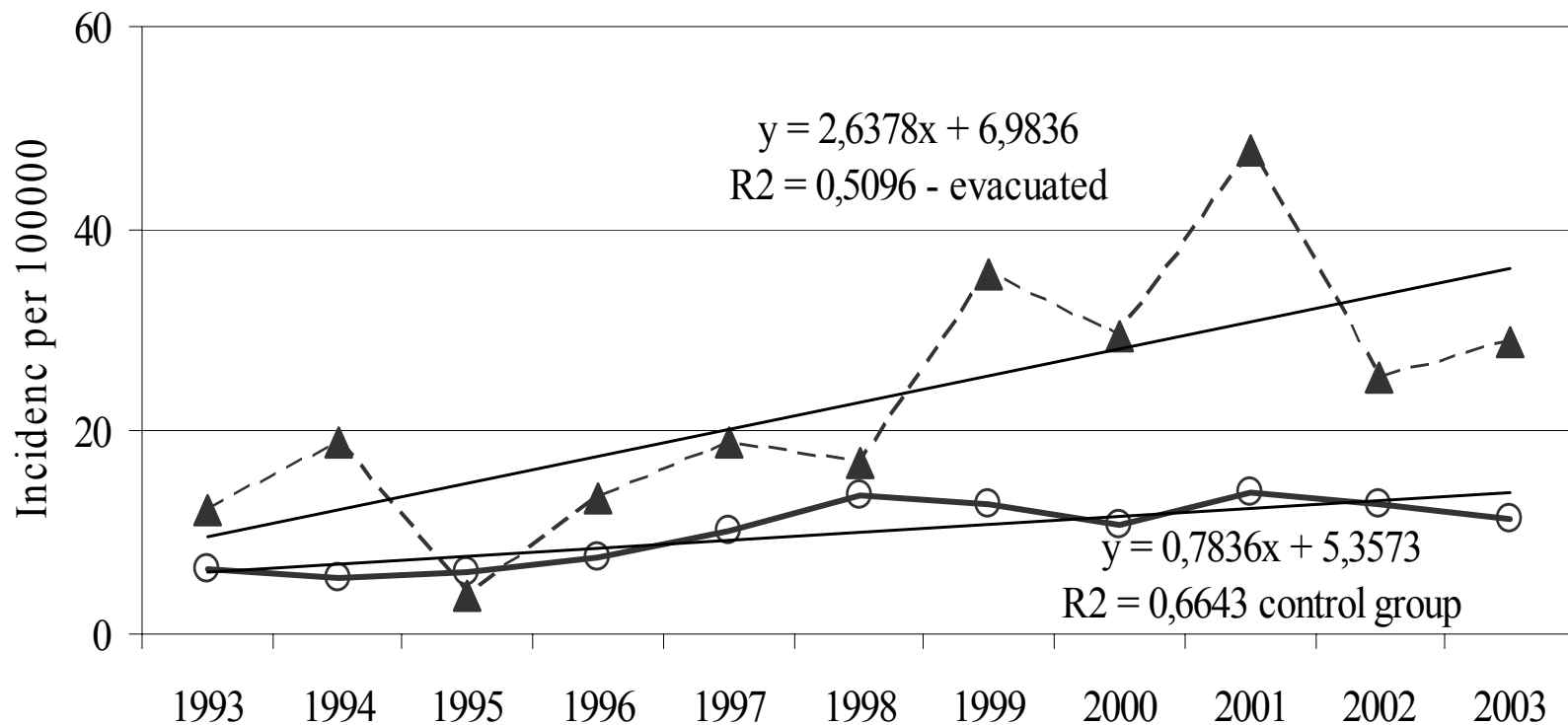
Relative risk thyroid cancer among evacuated population

Population	1993-1996			1997-2003		
	RR	95% CI		RR	95% CI	
		lower border	upper border		lower border	upper border
Total	9,00	4,79	16,91	6,83	4,59	10,17
Male	6,15	0,84	45,0	15,85	7,72	32,50
Female	8,26	4,24	16,07	5,49	3,4	8,88

Trends of cancer morbidity among population living in contamination area >555 kBk/m² and control group



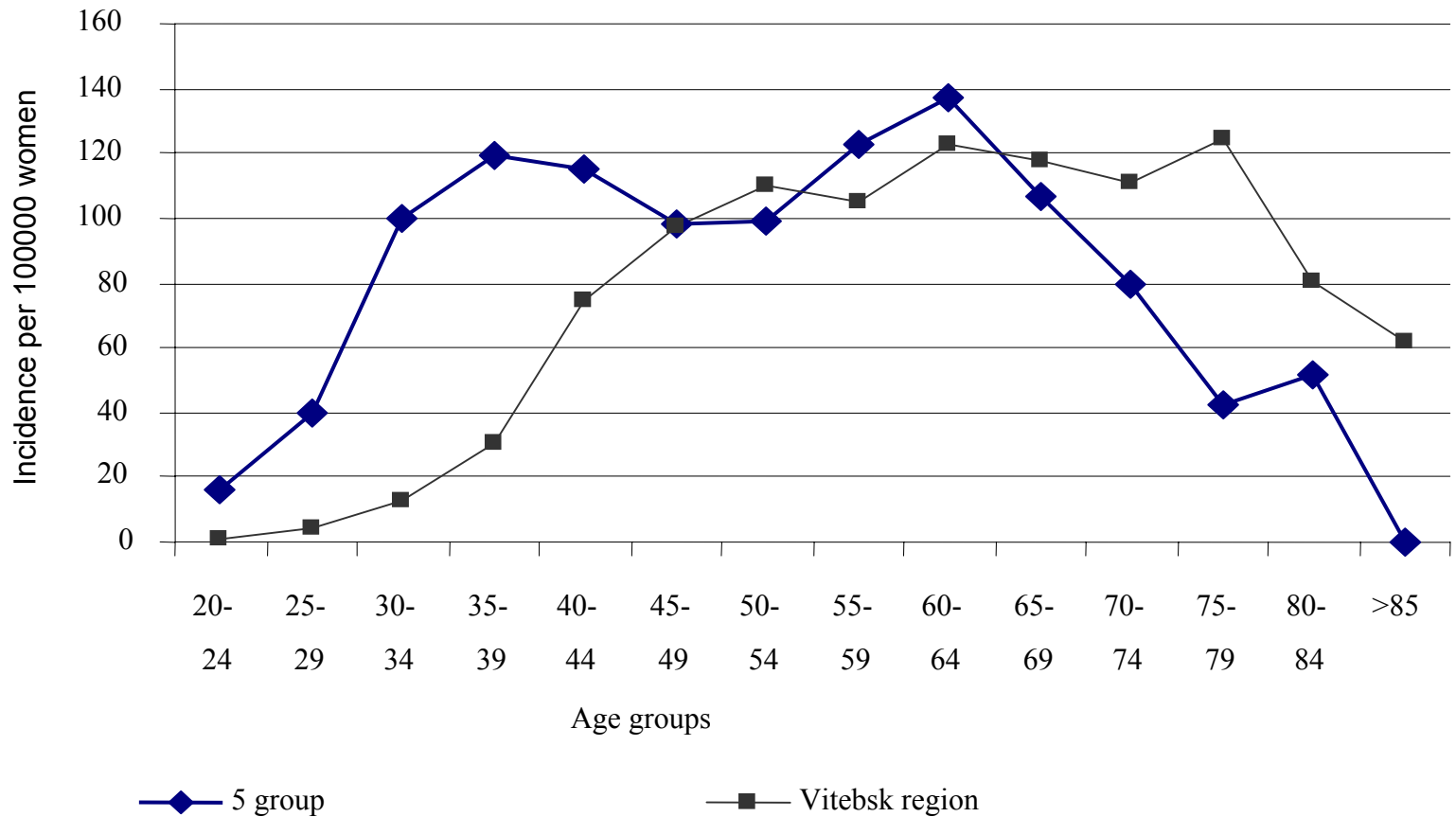
Trends of thyroid cancer morbidity among population living in contamination area >555 kBk/m² and control group



Relative risk of cancer among population living in contamination area 37-555 kBk/m²

Tumor Site	1993-1996			1997-2003		
	RR	95% CI		RR	95% CI	
		lower border	upper border		lower border	upper border
All sites	1,09	1,07	1,12	1,15	1,13	1,17
Stomach	1,03	0,97	1,09	1,03	0,98	1,07
Colon	1,01	0,91	1,12	1,23	1,15	1,32
Lung	0,91	0,86	0,97	0,93	0,89	0,98
Breast	1,16	1,08	1,26	1,25	1,18	1,32
Kidney	1,04	0,91	1,18	0,94	0,86	1,02
Urinary bladder	1,05	0,93	1,19	1,05	0,97	1,15
Thyroid	1,45	1,23	1,71	1,46	1,33	1,59

Age distribution of breast cancer morbidity among population living in contamination area (37-555kBk/m²) and control region



Groups of population	Recorded changes
1 group – liquidators	RR significant higher for cancer of stomach, colon, lung, kidney, urinary bladder, thyroid
2 group – evacuated population	Thyroid cancer 7 times higher than in Vitebsk population
3 group (> 555kBk/m²)	The dynamics of cancer increase is significantly higher than in Vitebsk population
5 group (37- 555kBk/m²)	RR is significantly higher for cancer of colon, urinary bladder, breast and thyroid