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Cancer effects in the Techa River Cohort

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Introduction: As a result of activities of the Mayak Production Association (Mayak PA), residents of the Techa riverside area (Southern Urals, Russia) were exposed to chronic internal and external irradiation. Maximum waste releases took place in 1950-1952. The main radionuclides were ^{90}Sr, ^{89}Sr and ^{137}Cs. Researchers of the Urals Research Center for Radiation Medicine (URCRM) have identified the Techa River Cohort (TRC) which includes persons born before 1.1.1950 who were permanent residents of the Techa riverside villages during the period from 1.1.1950 through 31.12.1960. Studies into late radiation-induced effects for this population have been successfully implemented over the recent 15 years in the framework of a collaborative Russian-American projects with the USA National Cancer Institute and the USA Department of Energy under the aegis of the JCCRER

Objective: To present results of solid cancer incidence risk analyses in the Techa River Cohort (TRC) resident in Chelyabinsk Oblast, based on the recent Techa River Dosimeter System TRDS -2009. , and to investigate how incidence varies with radiation dose and how other factors modify these risks

Materials and Methods:

The Techa River Cohort (TRC) (~30,000 people) is an unselected population of men and women of all ages mostly from two ethnic groups, who were resident in riverside villages through which the Techa flows.

Study Cohort: Techa River Incidence Cohort (TRIC) includes (about 17.5 thousands) of the TRC members lived in the riverside villages in Chelyabinsk oblast at any time between 1-1-1956 and 12-31-1960.

Incidence Catchment area (ICA): includes 5 Chelyabinsk oblast raions and Chelyabinsk city (Territory that is available for collection information about cancer cases systematically). Migrantes who moved from the catchment area are included in the analysis from the date of initial exposure to the date of departure from the catchment area.

Follow-up period: 1956-2005

Methods: Cancer incidence rates in this cohort were analyzed using excess relative risk (ERR) models. The analyses make use of individualized dose estimates that take into account residence history, age and other factors. Based on the dosimetry system TRDS-2009, median, mean and maximum doses accumulated by the end of the follow-up period in soft tissues of TRC members amounted to 11 mGy, 36 mGy and 960 mGy, respectively, and the doses accumulated in the red bone marrow reached 270 mGy, 430 mGy and 9000mGy, respectively). Cases are identified on the basis of continuing, active follow-up of mortality and cancer incidence.

Table 1: Characteristics of the Techa River Incidence cohort

Characte-ristics (%)	Non-Migrants	Migrants	Total
Female	57	56	57
Tartar/Bashkir	37	16	32
Late entrants	20	26	21
Age at entry <20	39	55	42
People	13,775	3,660	17,435

Table 2: Solid cancer follow-up status in the Techa River Incidence cohort through 31.12.2005

Follow-up status	People
Solid cancer cases	2,017
Hematopoietic malignancies	95
Alive (no cancer)	3,747
Dead (no cancer)	7,016
Lost to follow-up*	4,560
Person years	464,019

*Includes 5% with Unknown vital status and 21% migrants

Quality of confirmation was significantly improved in last two decades, figures 1-2

Figure 1. **Confirmation of diagnoses in 1956-1989, %**

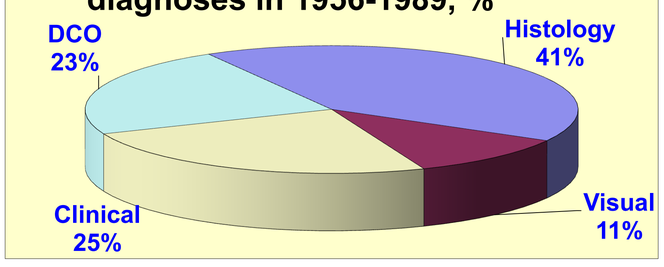


Figure 2. Confirmation of diagnoses in 1990-2005, %

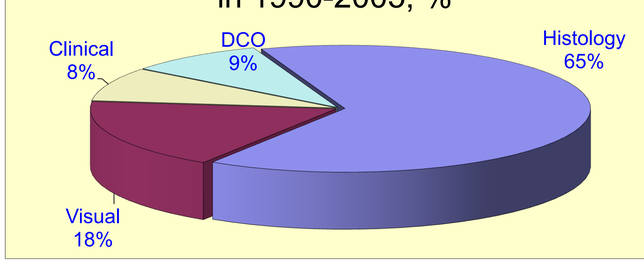


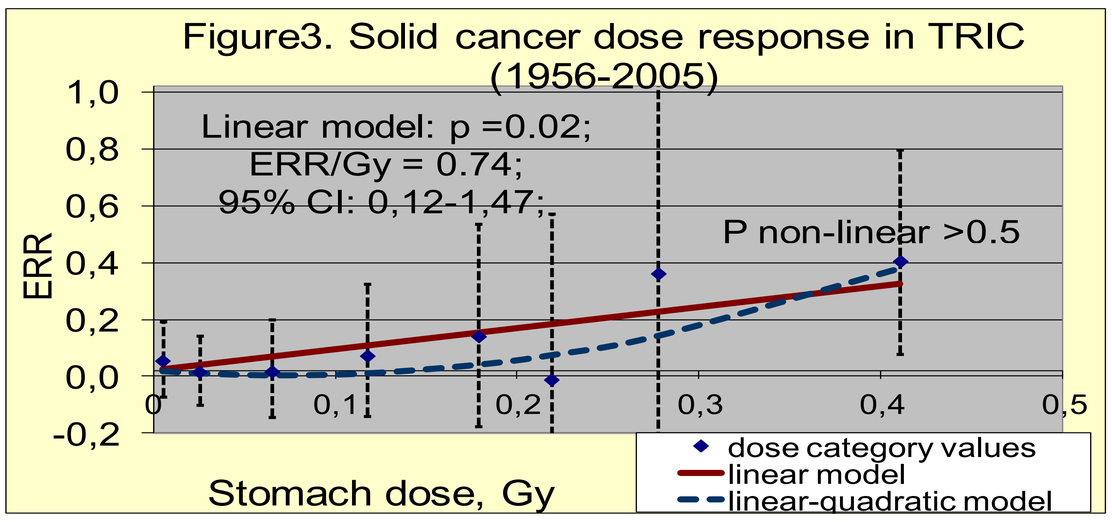
Table 3: Distribution of PYR, solid cancers and excess of cases by dose categories

TRDS-2009 dose (Gy)	PYR	Solid cases	Fitted excess	AR%
0	11,870	17	0.0	0.0%
- 0.01	151,744	660	2.5	0.4%
- 0.05	192,709	851	14.4	1.7%
- 0.1	57,152	244	11.3	4.6%
- 0.15	23,166	108	8.8	8.1%
- 0.3	16,472	70	9.3	13.3%
0.3+	10,905	67	15.1	22.5%
Total	470,643	2017	61.4	3.0%

Results and Discussion:

Based on 2017 solid cancer cases with 470 643 person years accrued over 51 years of follow-up (1956-2005), solid cancer incidence rates were found to increase with dose and about 3% of the cases were attributable to radiation exposure. The ERR was 0.74/Gy (P = 0.004, 95% CI:0.3; 1.9) in a linear dose-response model. There was no significant non-linearity in the dose response and no indication of effect modification by gender, ethnicity, attained age or age at first exposure.

Figure3. Solid cancer dose response in TRIC (1956-2005)



Conclusion:

Analyses of cancer incidence risks showed a statistically significant linear dependence of cancer incidence on dose received and confirmed our previous results obtained over a period by 3 years shorter than the current follow-up period and using an earlier version of the dosimetry system