Computed Tomography Database for Radiation Risk Assessment ("CT Register")

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Introduction

Mayak PA – Russian first nuclear cycle factory for Plutonium production
Mayak Worker Cohort (MWC)- workers are exposed to external gamma- and incorporated plutonium (Pu-239)
Ozyorsk Population – people living in the surrounding area
Computed Tomography – a new source of man-made radiation exposure for both Ozyorsk population and Mayak workers since 1990-s

Methods

Retrospective cohort study started in 1993 when first CT-scanners appeared in the Southern Ural
Data collected from 5 hospitals located in the Southern Urals including Ozyorsk clinical hospital No.71
Cohort: Ozyorsk residents who were born between 1916-2018 yy.. and exposed to diagnostic CT have been analyzed
Follow-up period through the end of 2018
Medical and dosimetric information collected from archives of CT departments
Data from **MWC** have been linked to the analysis
Cancer incidence used for the analyses since exposure to ionizing radiation is a factor of cancerogenic risk. The data from local Cancer Register has been linked to the study.
Predisposed cases accounted (e.g. pre-cancer conditions found before the 1st CT examination)
Vital status has been updated for **65.3%** of cohort (as of December, 31, 2018)
Cause of death established for 86.1% of cohort members
Person-time (T) calculated from 1st CT to the date of exit: cancer diagnosis , death, end of 2018 or lost to follow-up
Regression model for cancer incidence in terms of age, sex, contact with Pu-239 and number of CT scans has applied

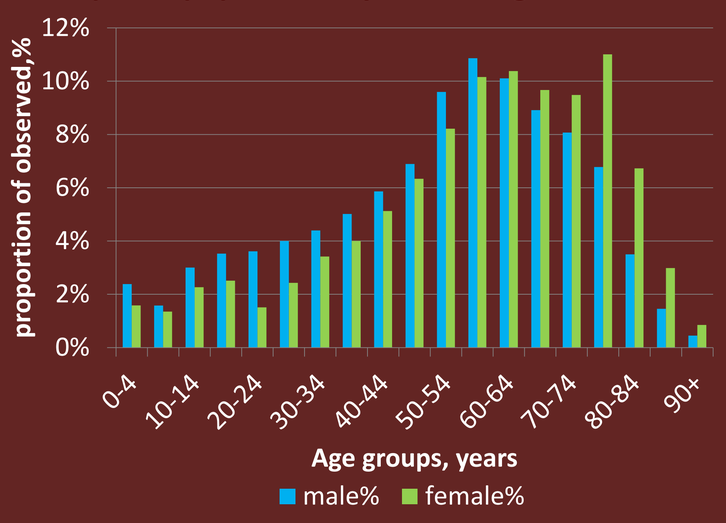
Results

Cohort of **16,653** exposed to CT (**26,626** observations)
Proportion of Mayak workers is **25 %** (**29.8%** of those worked with **Pu-239** and have individual dose**s)**
Mean Effective Dose for single CT **3.8** mSv (min 0.1-max 50.2); for Mayak workers **4.0** mSv (min 0.2-max 50.2)
Total Cancer cases to the end of follow-up **2,333** (14.0%)
Cancer cases among workers exposed to CT: 33.6%
Cancer diagnosed on or before CT (67.6%) as well as pre-cancer cases (24.7%) have been excluded from the analysis
% Deaths **30.2%** (cancer deaths 40.4%) % Alive **50.5%**
% Lost **19.4%** Mean survival time: T = 1527 days (0-9866)

Discussion

Limitations: Organ absorbed dose not calculated (ED estimate as referral).
Different scanner types used in hospitals (both single and multispiral).
CT outside SU not accounted. Short follow-up period for severely ill persons
Advantages: Detailed information on vital status, cancer incidence and cause of death of Ozyorsk population.
Single CT dose and cumulative dose data available.
Long-term follow-up.

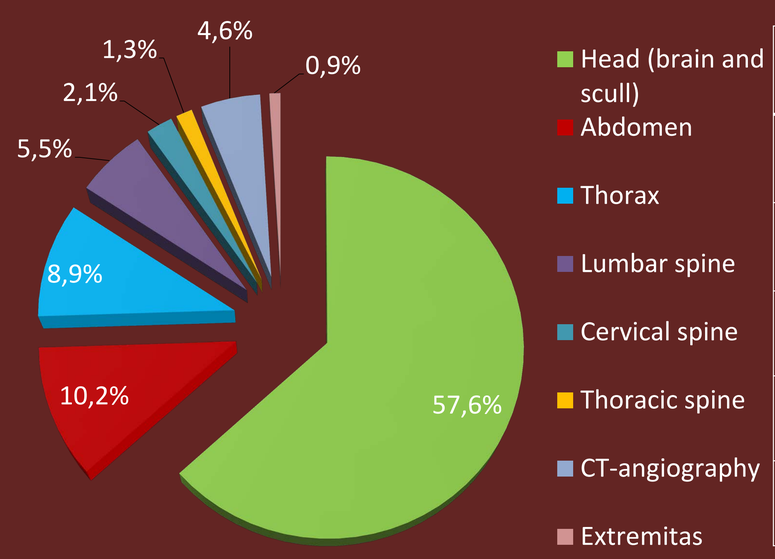
Exposed population by sex and age of 1st CT



Tab.1 Exposed population by sex and CT level

Level	Both sex	%	Male	%	Female	%
1 CT	11,326	68.0	5,400	67.1	5,927	68.9
2-3 CT	4,303	25.8	2,138	26.5	2,165	25.2
4-5 CT	725	4.4	358	4.4	367	4.3
6-9 CT	329	2.0	130	1.6	109	1.3
10> CT	60	0.4	26	0.3	34	0.4
Total	16,653	100.0	8,051	48.3	8,602	51.7

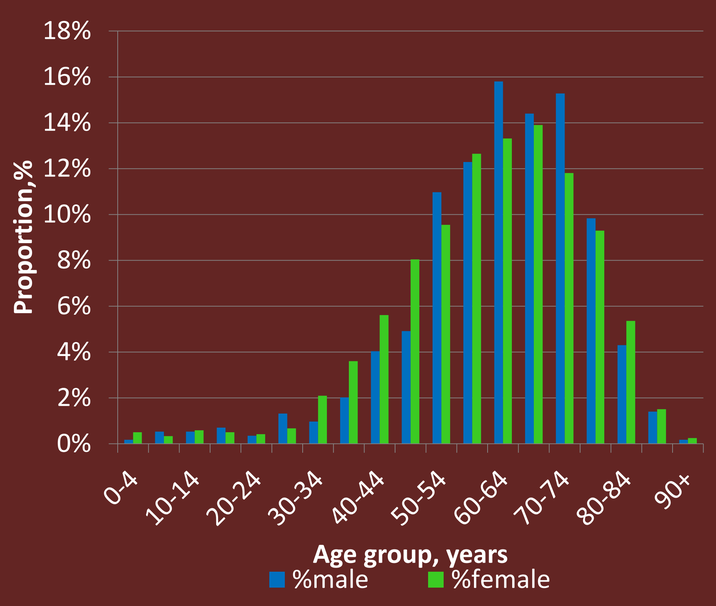
Cohort distribution by area exposed to CT



Tab.2 Exposed population by area exposed and ED, mSv

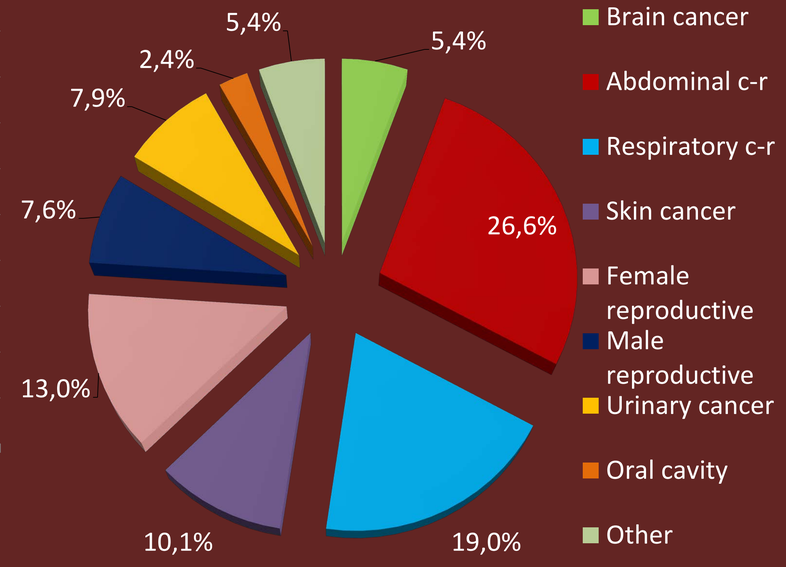
Area	Observed	%	Persons	%	Mean ED
Head	15,784	59.3	11,222	67.4	1.8 (0.1-8.6)
Thorax	3,225	12.1	2,041	12.3	4.0 (0.4-28.0)
Abdomen	3,278	12.3	2,522	15.1	12.4 (0.4-50.2)
Other	3,778	14.2	873	5.2	5.7 (0.2-26.7)
Total	26,626	100.0	16,658	100.0	3.8 (0.1-50.2)

Cancer incidence among exposed to CT by age and sex



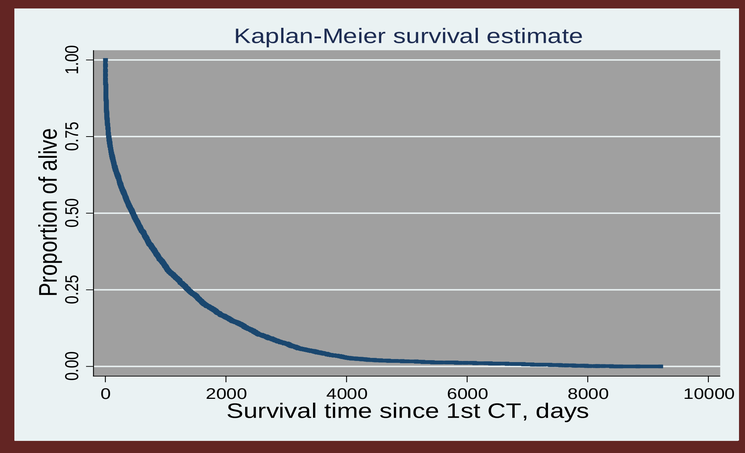
Person-time (cancer incidence) by age and sex

Cancer incidence structure by cancer site



Survival function for exposed to CT

Lag	Cases	Pre c-r%	Person-time	%deaths
0 yr	673	24.7	478 671	73.4
1 yr	269	7.4	445 598	69.9
2 yr	195	5.6	405 785	64.6
5 yr	81	3.7	269 552	58.0
Total	**673**	**24.7**	478 671	**52.5%**



Conclusions

A "CT Register" database (CTDB) is a unique source of information for the prospective epidemiological study of low dose health effects.
The information from "CT Register" database can be used for the radiation risk analysis to improve the radiation safety standards for nuclear workers and population exposed to low dose s of diagnostic radiation.

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