

Solid cancer mortality in Mayak workers cohort

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Introduction

Mayak PA – Russian first nuclear cycle factory.

Auxiliary, Reactor, Radiochemical and Pu production plants

Workers are exposed to external gamma- and incorporated Plutonium

Current analyses use updated dosimetry “Doses-2008”

Methods:

Cohort study; Follow-up through the end of 2008; Poisson regression in terms of Excess Relative Risk model;

Solid cancers other than lung, liver and bone are included into analyses since lung, liver and bone are organs of primary deposition of Pu. Doses of exposure were lagged for 5 years.

Results:

Background mortality modeled in terms of age attained, gender, smoking and migration status.

RR for smoking: males 1.51 (95% CI 1.32 – 1.74);

females 1.58 (95% CI 0.001-2.37)

Migrants had about 15% lower cancer mortality compared to Ozersk residents, adjusting for that had no effect on radiation risk estimates.

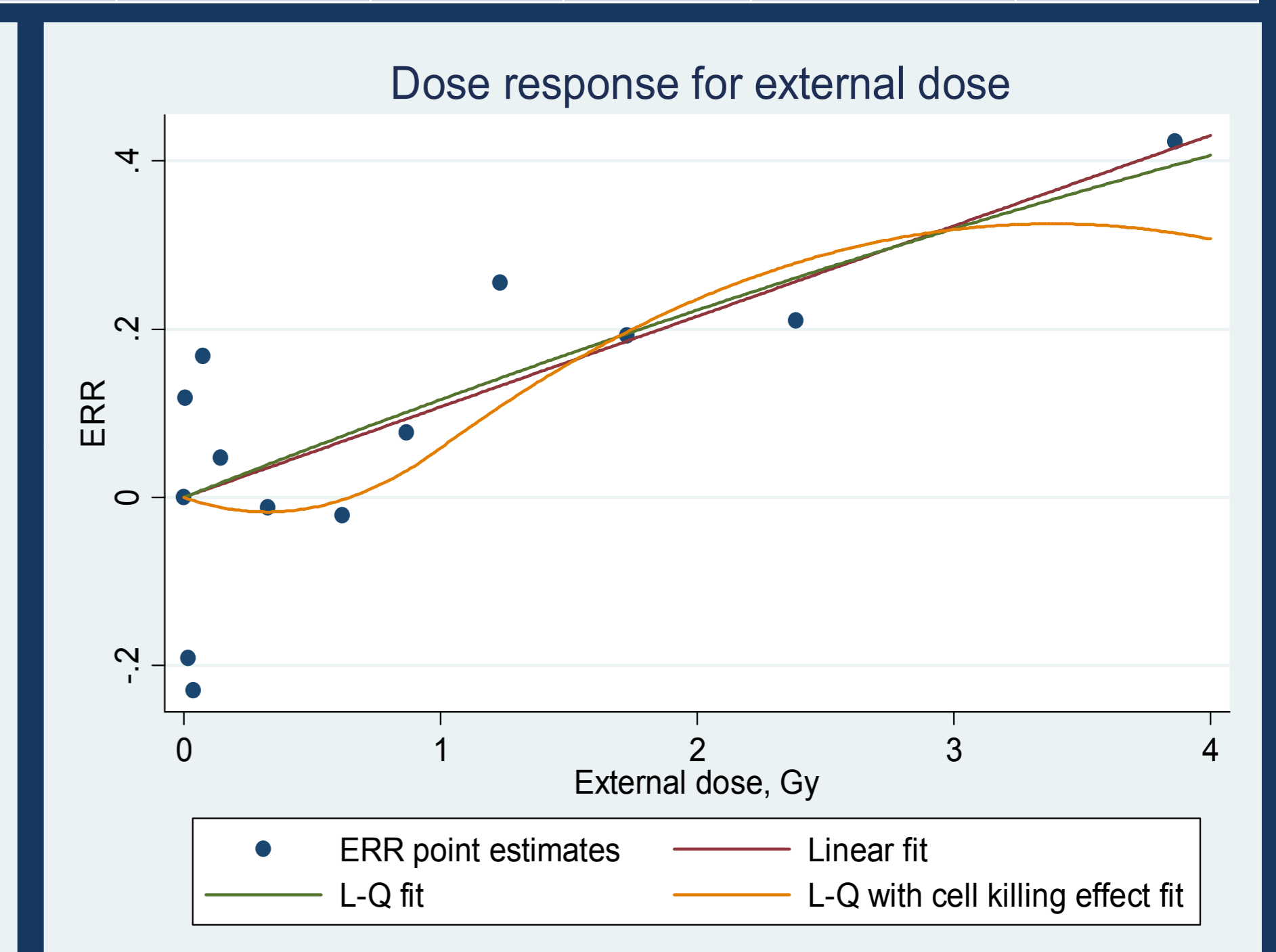
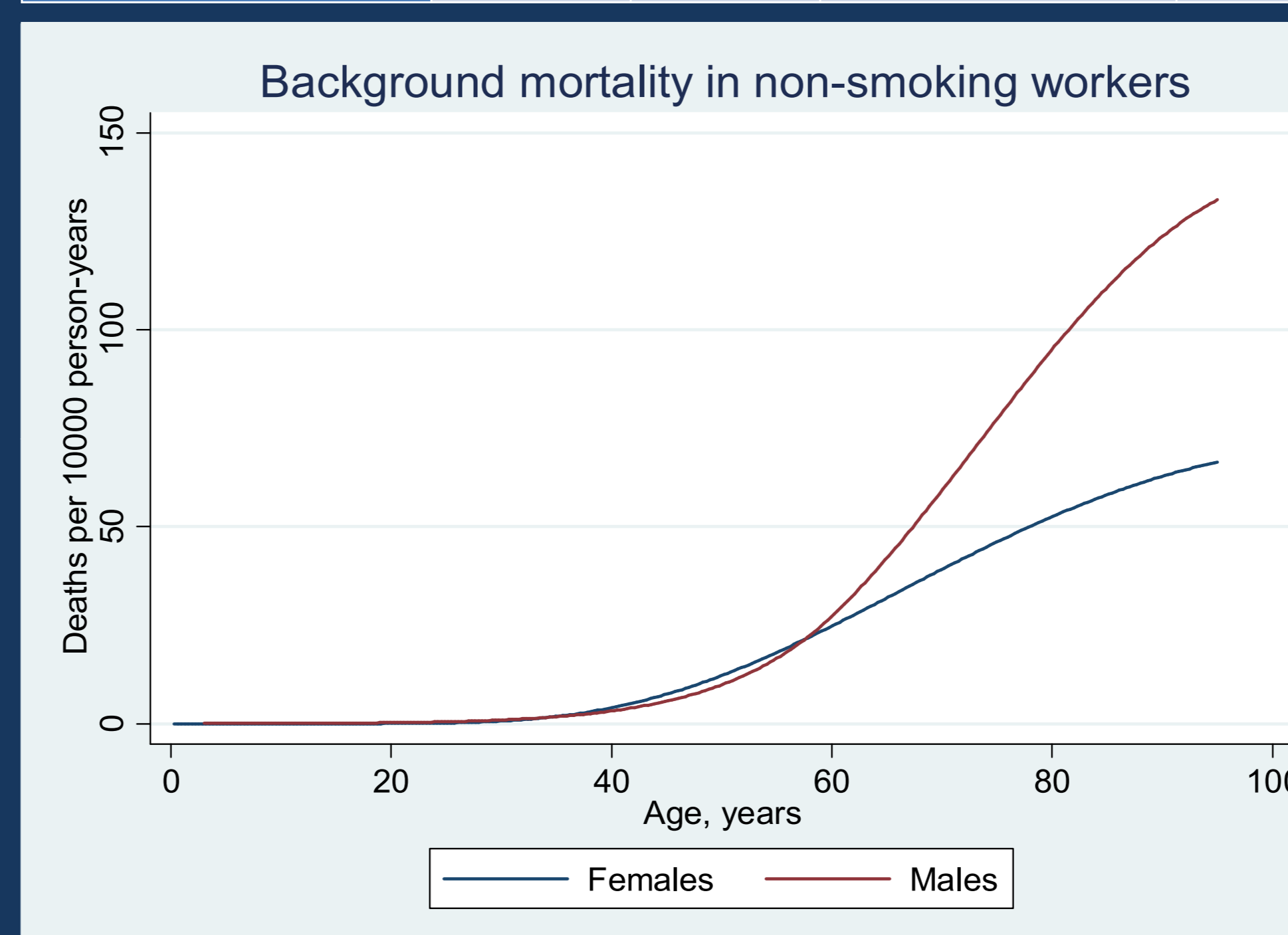
External dose-response: ERR/Gy was 0.11 (95% CI 0.04 – 0.19). There is no evidence of non-linearity or threshold using linear-quadratic, linear-quadratic with cell killing effect models. Pu exposure: borderline significant dose-response (0.16; 95% CI 0.003 – 0.39). About 86% of excess cases are associated with external exposure.

Discussion:

Previous analyses [1] used film badge doses and shorter follow-up (through the end of 1997) including 1062 deaths from solid cancers other than lung, liver and bone. That analysis found ERR for external gamma-exposure of 0.08 per Gy, which is slightly lower compared to current analyses and non-linear dose response with downward curvature at higher doses. This most probably is explained by the fact that film badge dosimeters overestimated exposure at higher doses. We do not see such curvature in risk estimates made using updated dosimetry data from Doses-2008 which were adjusted for dosimeter sensitivity [2].

Our estimate of excess relative risk per unit dose (0.11) is about 25% of that observed in LSS cohort: 0.47 [3]. It should be noted that while doses of external exposure were substantial in Mayak workers cohort, the exposure had been protracted over worker’s occupational history and occurred in wide range of doses and dose rates. In the same time [3] provides risk estimates for all solid cancers combined whereas we report effect of external exposure to solid cancers other than lung, liver and bone. Our results compare with LSS cohort in terms of dose-response shape which is linear in both analyses.

General description of the Mayak Worker Cohort (MWC) by gender, workplace and period of first hire.									
	No. Workers	Exposure characteristics					Follow-up		
		External exposure		Plutonium			No. deaths	(% unknown cause)	% loss to follow-up
		Mean external dose mGy	Percentage of workers with zero external dose	No. Monitored for Pu	Mean body burden kBq	Mean liver dose from Pu mGy			
Total	25 757		8,0%	7 059			12 438	3,7%	5,4%
Sex									
Males	19395	480.1	6,7%	4937	0.13	233	9916	4,0%	5,6%
Females	6362	402.6	12,1%	2122	0.22	452	2522	2,7%	4,7%
Primary work place									
Auxiliary departments	3384	103,4	28,1%	55	0.02	21.4	1386	5,6%	6,5%
Reactor	5416	462,3	4,0%	307	0.03	45.7	2700	3,9%	5,2%
Radiochemical	9194	777,7	0,7%	3683	0.10	222.9	4586	3,9%	5,9%
Plutonium Auxiliary	3505	148,1	23,2%	1130	0.08	179.7	1574	2,9%	6,0%
Plutonium Main 1	1994	190,4	0,6%	920	0.08	119.2	952	1,9%	2,2%
Plutonium Main 2	2264	428,3	0,3%	964	0.62	998.6	1240	2,7%	4,2%
Period of hire									
1948-53	9213	901,8	7,7%	2181	0.39	769.0	5968	3,5%	8,9%
1954-58	4221	445,9	5,4%	1228	0.11	188.8	2207	3,9%	5,5%
1959-63	4378	209	8,8%	1256	0.07	105.0	2128	4,2%	4,8%
1964-72	3675	115,9	11,6%	1209	0.03	40.4	1352	4,2%	1,9%
1973-82	4270	79,8	7,4%	1185	0.02	18.4	783	3,2%	1,4%



Number of person years, observed, expected and excess cases of solid cancers other than lung, liver and bone in categories of 5-years lagged external dose

Dose, Gy	Person-years	Observed	Expected	Excess		
				External exposure	Internal exposure	Total
0	202096	157	141.4	0.0	0.2	0.2
>0-0.01	65050	78	69.5	0.0	0.1	0.1
> 0.01 - 0.025	55516	58	71.4	0.1	0.1	0.2
>0.025 - 0.05	68560	75	96.9	0.4	0.1	0.5
>0.05 - 0.1	92439	182	155.3	1.2	0.5	1.7
>0.1 - 0.2	103175	216	205.5	3.2	0.9	4.1
>0.2 - 0.5	145730	341	342.5	12.1	2.2	14.3
>0.5 - 0.75	57709	145	146.8	9.7	1.5	11.2
>0.75 - 1.0	40553	118	109.0	10.1	1.1	11.2
>0.1 - 1.5	50801	179	140.0	18.5	2.7	21.2
>1.5 - 2.0	30897	114	94.0	17.4	2.4	19.8
> 2.0 - 3.0	29557	120	96.8	24.7	3.8	28.6
>3.0	8821	42	28.7	11.9	2.2	14.0
Total	950903	1825	1697.8	109.3	17.8	127.2

References:

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