Distributions of Actinide Elements Concentrations in USTUR donors

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USTUR donors

USTUR registrants were voluntary partial or whole body organ donors, who had generally been involved in various radiation incidents during their carriers including inhalation and puncture wound events where there was an established intake of transuranium radionuclides in their bodies and often a history of cancer development.

Main questions

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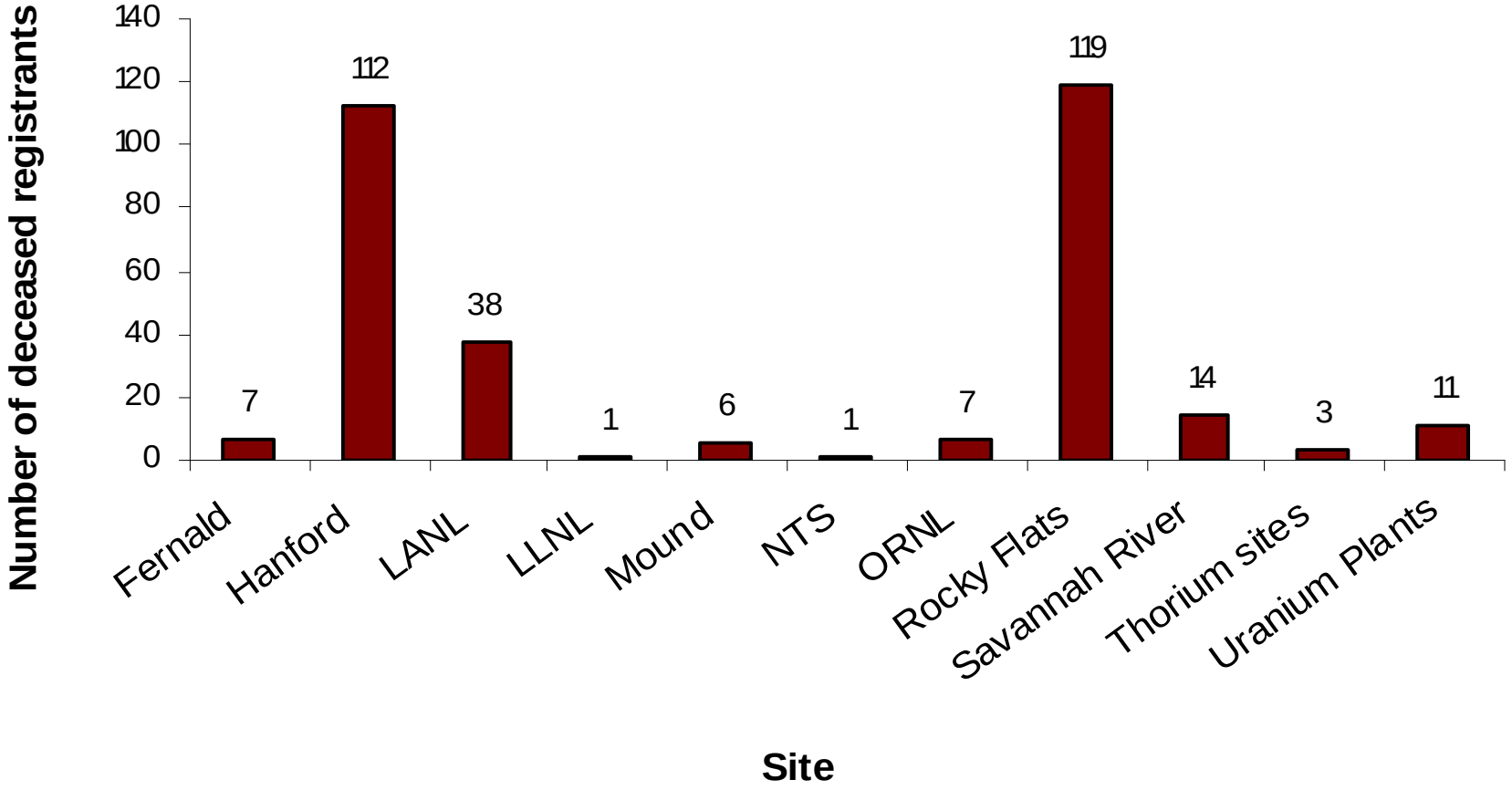
- What is the range of internal/external doses received by the USTUR registrants following accidents and subsequent to mitigating actions?

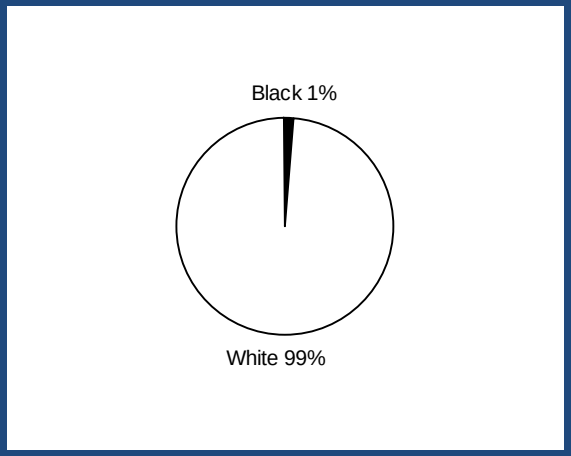
- Is there any association between occupational exposures to transuranic radionuclides, such as plutonium, and cancer death?

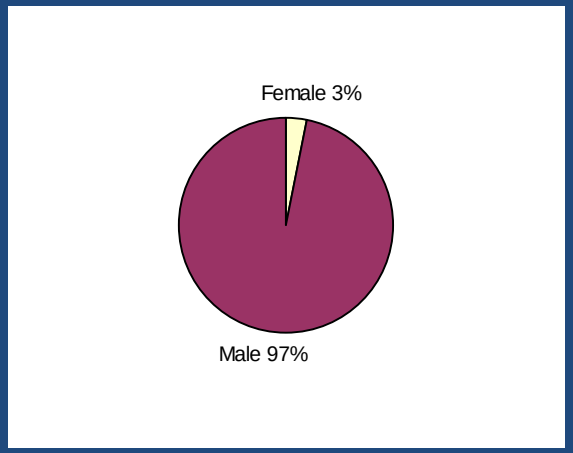
General information



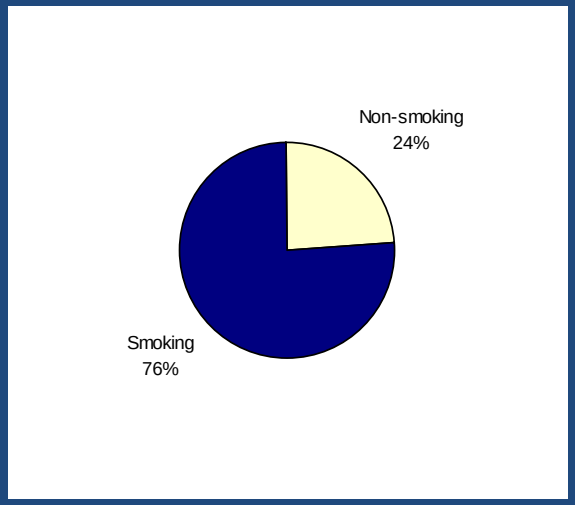
Number of deceased registrants at each facility

General information



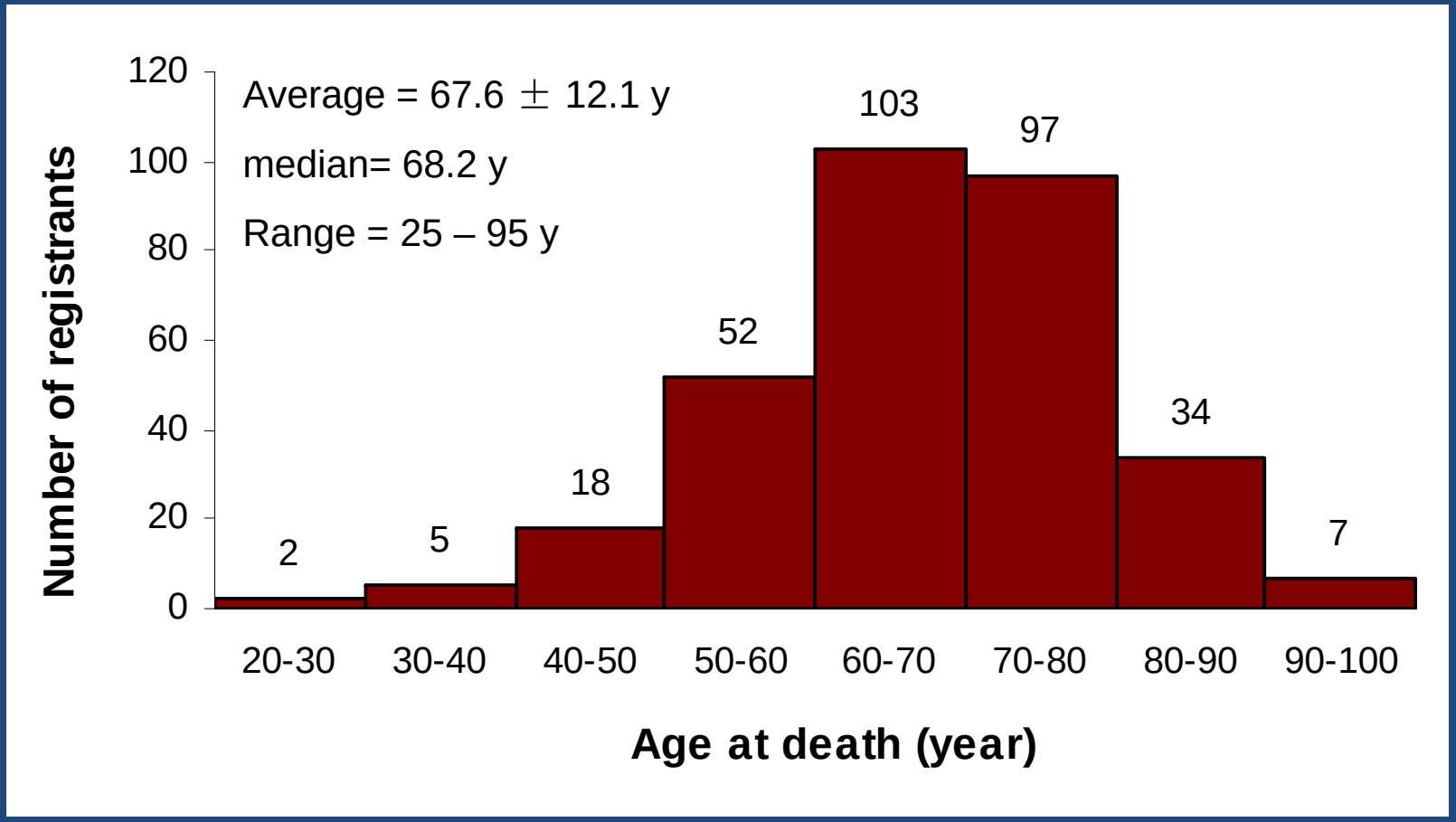


Majority of the registrants were white males.



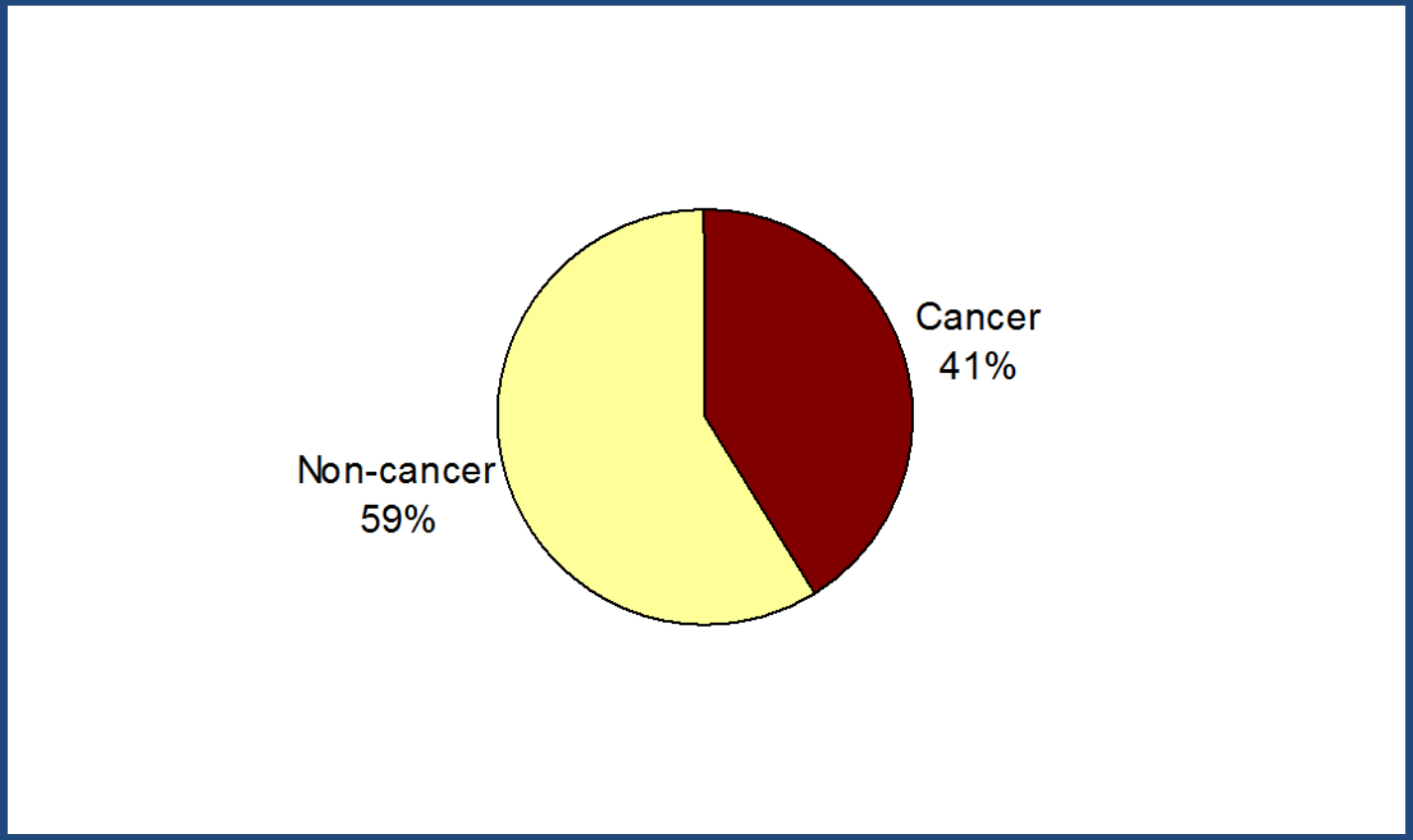
Among 230 deceased registrants, who had smoking history information, 76% were smokers (55 non-smokers and 175 smokers).

General information



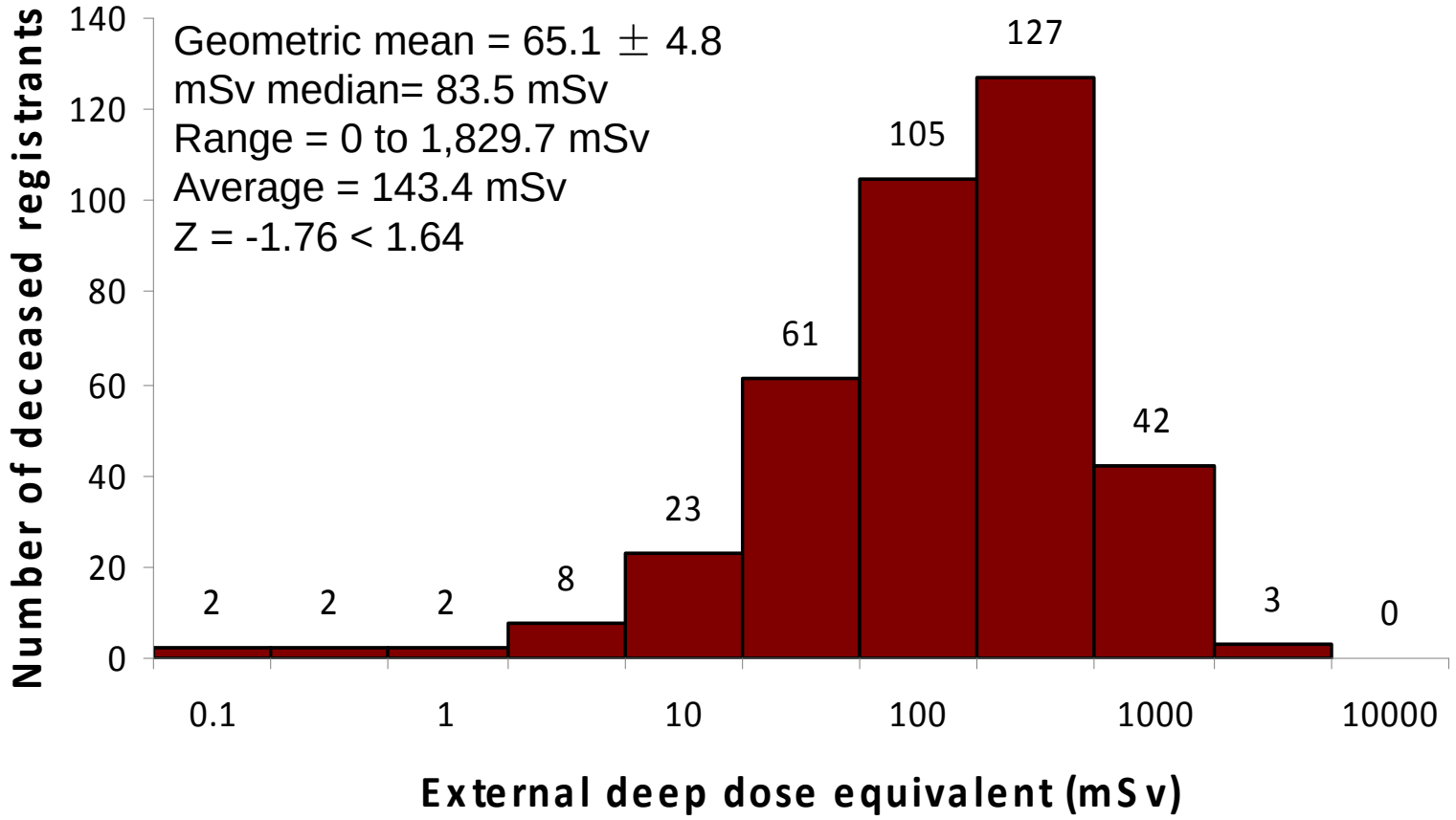
Age distribution of the USTUR registrants at the time of death

General information



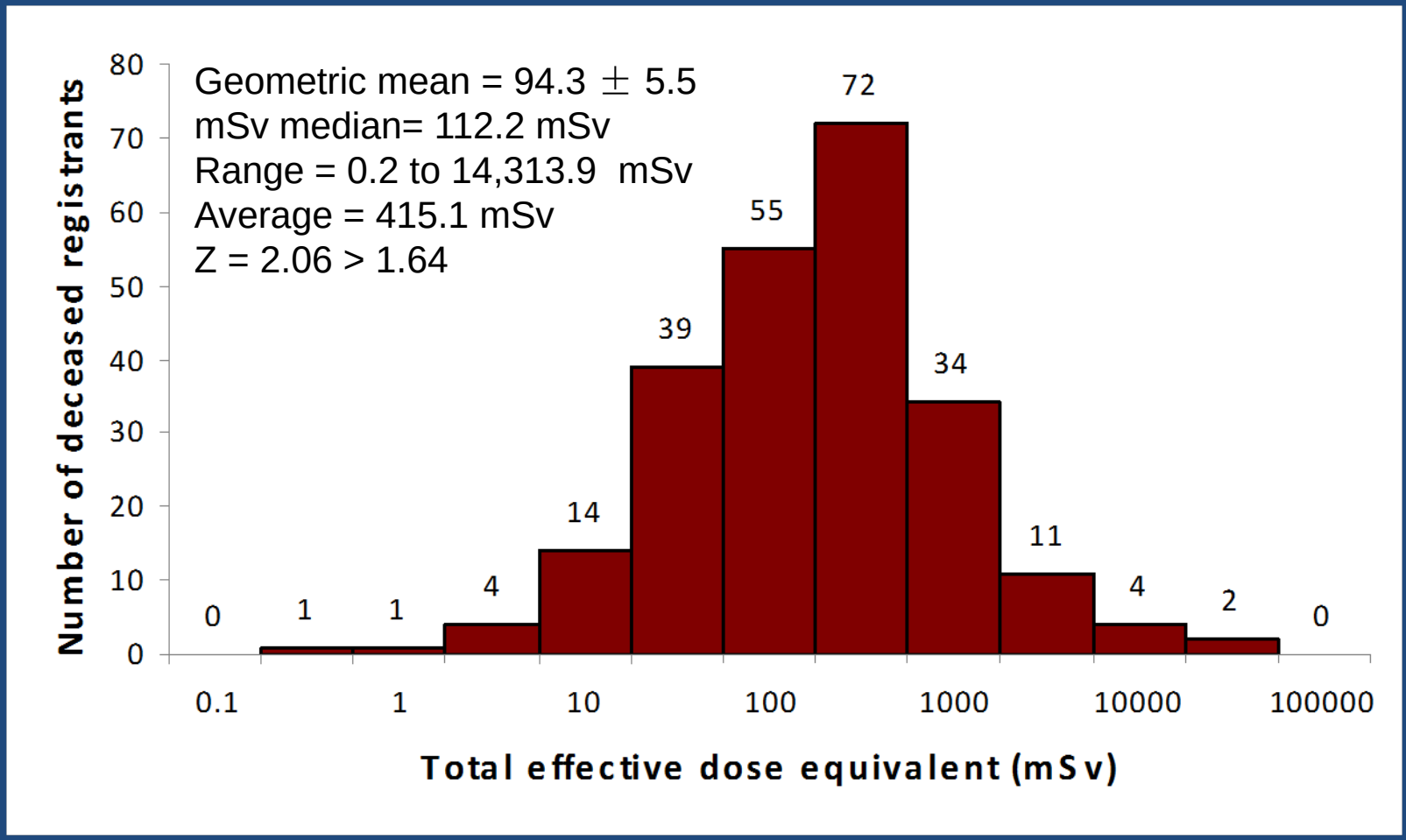
Distribution of the cancer development as primary or contributing causes of death among the USTUR registrants

1. External dose



Distribution of the external dose equivalents of the USTUR registrants

2. External and internal doses



Distribution of the TEDE of the USTUR registrants

Dose-response relationship studies

The USTUR study group was not a random sample of the deceased nuclear workers;

Therefore, this group was not compared with the U.S. population for the dose-response relation study and an internal comparison within the set of USTUR registrants was made.

Analyses of maximum likelihood estimates for cancer of any site

Parameter	DF	Estimate	Standard error	Wald Chi-square	Pr > ChiSq
AmPuDE	1	-7.80×10^{-8}	5.53×10^{-8}	1.99	0.16
AmPuTDE	1	-9.91×10^{-8}	6.34×10^{-8}	2.44	0.12
External Dose	1	-0.20×10^{-4}	1.10×10^{-5}	2.67	0.10

Analyses of maximum likelihood estimates for lung cancer

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
AmPuDE	1	1.60×10^{-7}	1.10×10^{-7}	2.14	0.14
AmPuTDE	1	-2.17×10^{-6}	2.27×10^{-6}	0.91	0.34
External Dose	1	3.34×10^{-6}	1.20×10^{-5}	0.07	0.79

Analyses of maximum likelihood estimates for liver cancer

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
AmPuDE	1	-2.00×10^{-4}	4.20×10^{-5}	0.31	0.58
AmPuTDE	1	-2.00×10^{-4}	2.60×10^{-5}	0.35	0.55
External Dose	1	-3.56×10^{-6}	3.40×10^{-5}	0.01	0.92

Analyses of maximum likelihood and odds ratio estimates for cancer of any site (controlling for other confounders – stepwise LR)

Parameter	Wald Chi-Square	Pr > ChiSq	Odds Ratio		
			Point Estimate	95% Wald Confidence Limits	
Cigarette Rate (p/d)	8.248	0.004	2.695	1.370	5.301
Smoker	6.086	0.014	5.407	1.415	20.667
Benzene/ Toluene Exposure	4.018	0.045	5.708	1.039	31.341

Analyses of maximum likelihood and odds ratio estimates for lung cancer (controlling for other confounders – stepwise LR)

Parameter	Wald Chi-Square	Pr > ChiSq	Odds Ratio		
			Point Estimate	95% Wald Confidence Limits	
Uranium exposure	7.526	0.006	0.029	0.002	0.363
Chlorinated solvents	3.912	0.048	10.847	1.022	115.165
Duration of Exp. to Chlorinated solvents	4.545	0.033	1.118	1.009	1.238

Conclusions

- The USTUR registrants, who had been exposed to tranusuranic radionuclides such as Pu-238, Pu-239, and Am-241 can not be categorized as a low dose population.

- Among four critical organs of interest in this study (i.e., liver, lungs, thoracic lymph nodes and skeleton), thoracic lymph nodes had the highest mean concentrations of plutonium and americium, which indicates that these radionuclides were mainly in the form of insoluble particles.

Conclusions

- Causes of death due to lung and liver cancers were not found to be associated with exposure of the lungs and liver to transuranic elements such as plutonium and americium.

- No association was found between causes of death due to cancers of any site and the total dose equivalent received by the whole body due to exposure to plutonium and americium. There was also no relationship between cancer deaths and exposure to external penetrating radiation such as gamma rays and neutrons.

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