Urinary-System Cancers, Females: Relation with Medical Radiation

● Part 1. Introduction

Urinary-System Cancers include cancers of the kidney, bladder, "and other urinary organs" (Chapter 4, Part 5, Number 10).

● Part 2. How the Dose-Response Develops, 1921-1940

● - Part 2a.

	1921 PhysPop	1940 MortRate	Urinary-System Ca, Females Regression Output:	
Pacific	165.11	4.1	Constant	-0.4804
New England	142.24	4.7	Std Err of Y Est	0.6216
West North Central	140.93	3.7	R Squared	0.4148
Mid-Atlantic	137.29	4.9	No. of Observations	9
East North Central	136.06	4.1	Degrees of Freedom	7
Mountain	135.38	3.5		
West South Central	125.15	3.1	X Coefficient(s)	0.0314
East South Central	119.76	2.7	Std Err of Coef.	0.0141
South Atlantic	110.32	3.0	Coefficient / S.E.	2.2273

● - Part 2b.

	1923 PhysPop	1940 MortRate	Urinary-System Ca, Females Regression Output:	
Pacific	163.06	4.1	Constant	-0.4168
New England	137.39	4.7	Std Err of Y Est	0.5807
West North Central	138.31	3.7	R Squared	0.4894
Mid-Atlantic	138.92	4.9	No. of Observations	9
East North Central	131.82	4.1	Degrees of Freedom	7
Mountain	130.51	3.5		
West South Central	119.16	3.1	X Coefficient(s)	0.0318
East South Central	113.16	2.7	Std Err of Coef.	0.0123
South Atlantic	106.79	3.0	Coefficient / S.E.	2.5901

● - Part 2c.

	1925 PhysPop	1940 MortRate	Urinary-System Ca, Females Regression Output:	
Pacific	161.67	4.1	Constant	-0.1529
New England	138.31	4.7	Std Err of Y Est	0.5556
West North Central	133.92	3.7	R Squared	0.5326
Mid-Atlantic	134.36	4.9	No. of Observations	9
East North Central	127.54	4.1	Degrees of Freedom	7
Mountain	122.30	3.5		
West South Central	112.83	3.1	X Coefficient(s)	0.0308
East South Central	107.22	2.7	Std Err of Coef.	0.0109
South Atlantic	103.61	3.0	Coefficient / S.E.	2.8242

● - Part 2d.

	1927 PhysPop	1940 MortRate	Urinary-System Ca, Females Regression Output:	
Pacific	157.83	4.1	Constant	-0.3300
New England	137.50	4.7	Std Err of Y Est	0.4767
West North Central	131.54	3.7	R Squared	0.6558
Mid-Atlantic	138.40	4.9	No. of Observations	9
East North Central	126.18	4.1	Degrees of Freedom	7
Mountain	118.75	3.5		
West South Central	108.25	3.1	X Coefficient(s)	0.0328
East South Central	102.07	2.7	Std Err of Coef.	0.0090
South Atlantic	102.13	3.0	Coefficient / S.E.	3.6521

● - Part 2e.

	1929 PhysPop	1940 MortRate	Urinary-System Ca, Females Regression Output:	
Pacific	156.64	4.1	Constant	-0.2984

	PhysPop	MortRate	Regression Output:	
New England	138.46	4.7	Std Err of Y Est	0.4439
West North Central	128.72	3.7	R Squared	0.7015
Mid-Atlantic	138.49	4.9	No. of Observations	9
East North Central	126.51	4.1	Degrees of Freedom	7
Mountain	118.68	3.5		
West South Central	105.60	3.1	X Coefficient(s)	0.0328
East South Central	99.41	2.7	Std Err of Coef.	0.0081
South Atlantic	100.86	3.0	Coefficient / S.E.	4.0562

● – Part 2f.

Urinary-System Ca, Females

	1931 PhysPop	1940 MortRate	Regression Output:	
Pacific	159.97	4.1	Constant	-0.0396
New England	142.35	4.7	Std Err of Y Est	0.4213
West North Central	126.50	3.7	R Squared	0.7312
Mid-Atlantic	140.82	4.9	No. of Observations	9
East North Central	128.59	4.1	Degrees of Freedom	7
Mountain	118.89	3.5		
West South Central	105.95	3.1	X Coefficient(s)	0.0305
East South Central	96.73	2.7	Std Err of Coef.	0.0070
South Atlantic	99.59	3.0	Coefficient / S.E.	4.3637

● – Part 2g.

Urinary-System Ca, Females

	1934 PhysPop	1940 MortRate	Regression Output:	
Pacific	160.09	4.1	Constant	0.1704
New England	148.60	4.7	Std Err of Y Est	0.3327
West North Central	125.96	3.7	R Squared	0.8323
Mid-Atlantic	149.62	4.9	No. of Observations	9
East North Central	129.36	4.1	Degrees of Freedom	7
Mountain	117.16	3.5		
West South Central	104.68	3.1	X Coefficient(s)	0.0287
East South Central	92.00	2.7	Std Err of Coef.	0.0049
South Atlantic	98.41	3.0	Coefficient / S.E.	5.8947

● – Part 2h.

Urinary-System Ca, Females

	1936 PhysPop	1940 MortRate	Regression Output:	
Pacific	158.44	4.1	Constant	0.1916
New England	150.18	4.7	Std Err of Y Est	0.2829
West North Central	126.14	3.7	R Squared	0.8788
Mid-Atlantic	155.05	4.9	No. of Observations	9
East North Central	130.42	4.1	Degrees of Freedom	7
Mountain	119.80	3.5		
West South Central	103.52	3.1	X Coefficient(s)	0.0283
East South Central	89.94	2.7	Std Err of Coef.	0.0040
South Atlantic	99.16	3.0	Coefficient / S.E.	7.1239

● – Part 2i.

Urinary-System Ca, Females

	1938 PhysPop	1940 MortRate	Regression Output:	
Pacific	157.62	4.1	Constant	0.3153
New England	154.08	4.7	Std Err of Y Est	0.2330
West North Central	124.95	3.7	R Squared	0.9177
Mid-Atlantic	160.69	4.9	No. of Observations	9
East North Central	131.98	4.1	Degrees of Freedom	7
Mountain	119.88	3.5		
West South Central	102.79	3.1	X Coefficient(s)	0.0272
East South Central	88.21	2.7	Std Err of Coef.	0.0031
South Atlantic	99.26	3.0	Coefficient / S.E.	8.8378

● – Part 2j.

Urinary-System Ca, Females

	1940 PhysPop	1940 MortRate	Regression Output:	
Pacific	159.72	4.1	Constant	0.5714
New England	161.55	4.7	Std Err of Y Est	0.1998
West North Central	123.14	3.7	R Squared	0.9395
Mid-Atlantic	169.76	4.9	No. of Observations	9
East North Central	133.36	4.1	Degrees of Freedom	7
Mountain	119.89	3.5		
West South Central	103.94	3.1	X Coefficient(s)	0.0247
East South Central	85.83	2.7	Std Err of Coef.	0.0024
South Atlantic	100.74	3.0	Coefficient / S.E.	10.4305

Box 1 of Chap. 12

Box 1 of Chap. 12
Summary: Regression Outputs, Urinary-System Cancers, Females.

Below are the summary-results from all the calculations of Part 2, for the 1940 MortRates regressed on PhysPop.

Part	PhysPop	R-squared	Constant	X-Coef	Std Err	X-Coef/SE
2a	1921	0.4148	-0.48	0.0314	0.0141	2.2273
2b	1923	0.4894	-0.42	0.0318	0.0123	2.5901
2c	1925	0.5326	-0.15	0.0308	0.0109	2.8242
2d	1927	0.6558	-0.33	0.0328	0.0090	3.6521
2e	1929	0.7015	-0.30	0.0328	0.0081	4.0562
2f	1931	0.7312	-0.04	0.0305	0.0070	4.3637
2g	1934	0.8323	0.17	0.0287	0.0049	5.8947
2h	1936	0.8788	0.19	0.0283	0.0040	7.1239
2i	1938	0.9177	0.32	0.0272	0.0031	8.8378
2j --->	1940 Max	0.9395	0.57	0.0247	0.0024	10.4305

Box 2 of Chap. 12
Input-Data for Figure 12-A. Urinary-System Cancers. Females.

Part 2j, Best-Fit Equation: Calc. MortRate = (0.0247 * PhysPop) + (0.57)

Census Divisions	1940 Observed PhysPops	1940 Observed MortRates	Best-Fit Calc. MortRates
Pacific	159.72	4.1	4.515
New England	161.55	4.7	4.560
West No. Central	123.14	3.7	3.612
Mid-Atlantic	169.76	4.9	4.763
East No. Central	133.36	4.1	3.864
Mountain	119.89	3.5	3.531
West So. Central	103.94	3.1	3.137
East So. Central	85.83	2.7	2.690
South Atlantic	100.74	3.0	3.058
Additional PhysPops	70.00		2.299
--- not "observed" ---	60.00		2.052
down to zero PhysPop	50.00		1.805
(zero medical radiation).	40.00		1.558
For each, we calculate	30.00		1.311
a best-fit MortRate.	20.00		1.064
These additional x,y pairs	10.00		0.817
are also part of the	0		0.570
best-fit line (Chap 5, Part 5e).			

Box 3 of Chap. 12
Presumptive Fraction of Cancer MortRate Attributable to Medical Radiation.

Please see text in Chapter 6, Parts 4 and 6.

Urinary-System Cancers. FEMALES.

- FEMALE National MortRate (MR) 1940, from Table 12-B   4.0   National MortRate
- Constant, from regression, Part 2j   0.5714   Constant
- Fractional Causation, Best Est. = (Natl MR - Constant) / Natl MR   85.7%   Frac. Causation

....

90% Confidence-Limits (C.L.) on Fractional Causation. See text in Chapter 6, Part 4b, please.

X-Coefficient, from Part 2j	0.0247	X-Coef., Best Est.
Standard Error (SE) of X-Coefficient, from Part 2j	0.0024	Standard Error

Upper 90% C.L. on X-Coef. = (Coef) + (1.645 * SE) =	0.0286	New X-Coefficient
New Constant = (Natl MR) - (New X-Coef * 1940 Natl PhysPop) =	0.2173	New Constant
Frac. Causation, High-Limit = (Natl MR - New Constant) / Natl MR =	94.6%	New Frac. Caus'n.

Lower 90% C.L. on X-Coef. = (Coef) - (1.645 * SE) =	0.0208	New X-Coefficient
New Constant = (Natl MR) - (New X-Coef * 1940 Natl PhysPop) =	1.2599	New Constant
Frac. Causation, Low-Limit = (Natl MR - New Constant) / Natl MR =	68.5%	New Frac. Caus'n.

Box 4 of Chap. 12
Error-Check on Our Own Work: Urinary-System Cancers, Females.

Below, Columns A, C, and E come directly from the regression input in Part 2j. Column B, the fraction of the whole 1940 population in each Census Division, comes from Table 3-B in Chapter 3. Each Column-D entry is the product of (B-entry times C-entry). Each Column-F entry is the product of (B-entry times E-entry). PhysPops and MortRates are each "per 100,000."

The Weighted-Avg. Nat'l PhysPop, 1940, is the sum of Column-D entries =   132.04

The Weighted-Avg. Nat'l Female MortRate, 1940, is sum of Col.F entries =   3.88
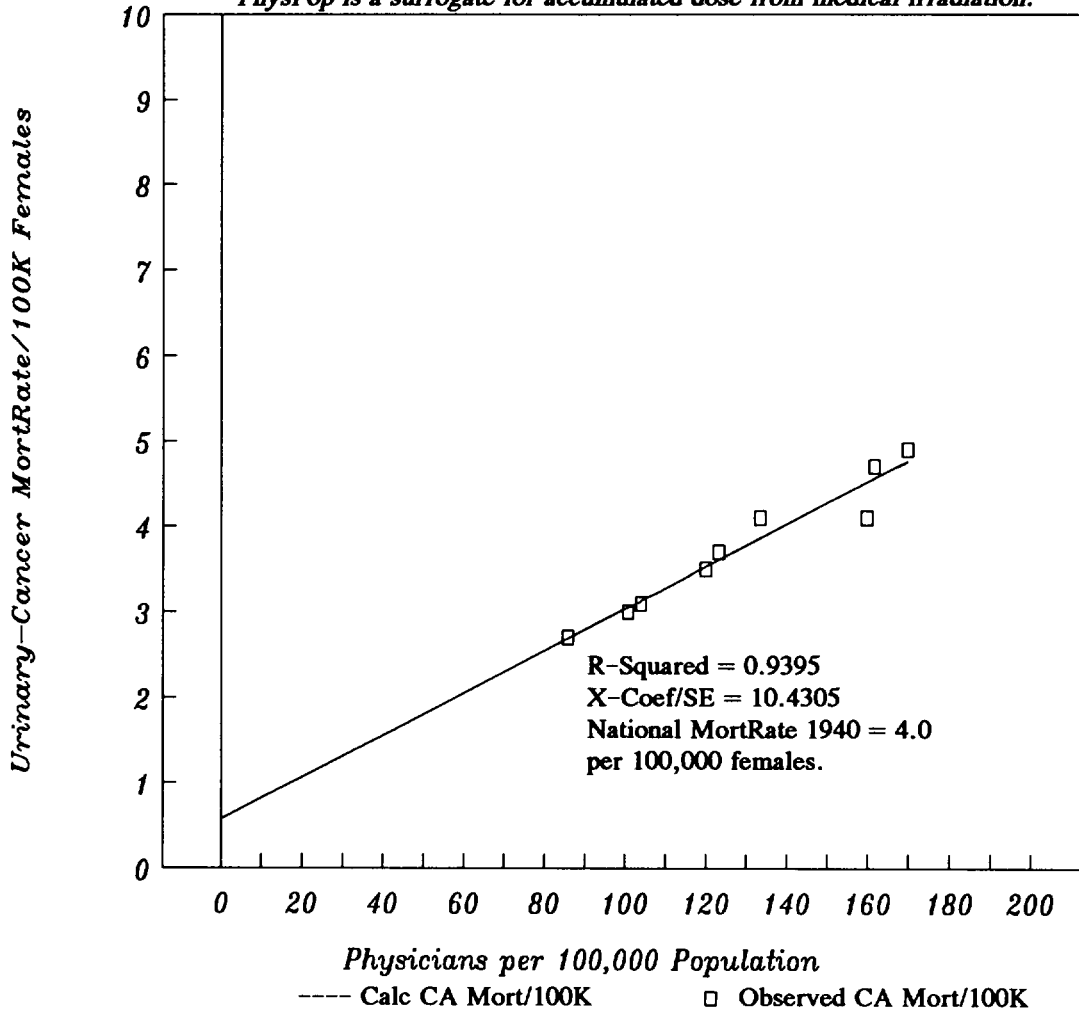The Nat'l Female MortRate is also (X-Coef * Nat'l PhysPop) + Constant =   3.83
Comparison: The Nat'l Female MortRate, 1940, in Table 12-B =   4.00

(A) Census Division	(B) Pop'n Fraction	(C) PhysPop 1940	(D) Weighted PhysPop	(E) MortRate 1940	(F) Weighted MortRate
Pacific	0.0739	159.72	11.80	4.1	0.30
New England	0.0641	161.55	10.36	4.7	0.30
West No. Central	0.1027	123.14	12.65	3.7	0.38
Mid-Atlantic	0.2092	169.76	35.51	4.9	1.03
East No. Central	0.2022	133.36	26.97	4.1	0.83
Mountain	0.0315	119.89	3.78	3.5	0.11
West So. Central	0.0992	103.94	10.31	3.1	0.31
East So. Central	0.0819	85.83	7.03	2.7	0.22
South Atlantic	0.1354	100.74	13.64	3.0	0.41
Sums	1.0000		132.04		3.88

1940 Urinary–System Cancer Mortality–Rates versus 1940 PhysPop Values for the 9 Census Divisions, USA.

Dose–Response Relationship

PhysPop is a surrogate for accumulated dose from medical irradiation.

R–Squared = 0.9395
X–Coef/SE = 10.4305
National MortRate 1940 = 4.0
per 100,000 females.

Physicians per 100,000 Population

---- Calc CA Mort/100K   □ Observed CA Mort/100K

On the X-axis, PhysPop values = Physicians per 100,000 Population in the Nine Census Divisions of the USA Population, Year 1940. This variable is a surrogate for accumulated radiation dose --- the more physicians per 100,000 people, the more radiation procedures are done per 100,000 people.

On the Y-axis, Urinary-Cancer Mortality-Rate per 100,000 females = the reported rates in USA Vital Statistics for the Nine Census Divisions, Year 1940.

Shown above is the strongest relationship between these two variables (Part 2j). The nine datapoints (boxy symbols) were collected long ago for other purposes, and are free from potential bias with respect to this dose-response study. Fractional Causation is (Natl MortRate minus the Y-intercept) / (Natl MortRate).

Fractional Causation of Urinary–Cancer Mortality (Females) by Medical Radiation

85.7 % from Best Estimate (Box 3).

68 % at lower 90 % confidence limit (Box 3). 94.6 % at upper 90% confidence limit (Box 3).

Table 12-A.

Urinary-System Cancer Mortality Rates by Census Divisions: Females.

Rates are annual deaths per 100,000 female population, USA, age-adjusted to the 1940 reference year. There are no exclusions by color or "race." Sources are stated in Table 12-B, and described in Chap. 4, Part 2. The Nine Census-Division MortRates are population-weighted (Chap. 4, Part 2b). The averages below them are not.

Census Division	1940	1950	1960	1970	1980	1990
Pacific	4.1	3.9	3.3	3.1	2.8	--
New England	4.7	3.9	3.9	3.7	3.4	--
West North Central	3.7	3.6	3.3	3.2	3.0	--
Mid-Atlantic	4.9	4.5	4.0	3.6	3.2	--
East North Central	4.1	4.2	3.9	3.5	3.0	--
Mountain	3.5	3.5	3.4	3.0	2.5	--
West South Central	3.1	3.4	3.2	3.0	2.8	--
East South Central	2.7	3.6	3.0	2.9	2.8	--
South Atlantic	3.0	3.6	3.3	3.1	2.9	--
Average, ALL	3.8	3.8	3.5	3.2	2.9	--
Average, High-5	4.3	4.0	3.7	3.4	3.1	--
Average, Low-4	3.1	3.5	3.2	3.0	2.8	--
Ratio, Hi5/Lo4	1.40	1.14	1.14	1.13	1.12	--

Table 12-B.

Urinary-System Cancer Mortality Rates, USA National.

Rates are age-adjusted to the 1940 reference year. Both sexes: Deaths per 100,000 population (males + females). Males: Deaths per 100,000 male population. Females: Deaths per 100,000 female population. No exclusions by color or "race."

	Both Sexes	Male	Female
1940	5.7	7.4	4.0
1950	6.0	8.1	3.9
1960	5.9	8.5	3.6
1970	5.6	8.4	3.3
1979-81	5.2	8.2	3.0
1990	--	--	--

● - 1940, 1950, 1960: All rates come from Grove 1968, Table 67, p.697, "Malignant neoplasm of urinary organs (180-181)" ICD/7.

● - 1970: All rates are interpolations (Chap. 4, Parts 2b, 2c).

● - 1980: All rates (ICD/9, 188-189) come from the reference NatCtrHS 1980.

● - 1990: No data obtained. Please see Chap.4, Part 2c.