

CHAPTER 13

Genital Cancers, Males: Relation with Medical Radiation

● Part 1. Introduction

Male Genital Cancers include cancers of the prostate and testis (see Chapter 4, Part 5, Number 9).

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

● - Part 2a.	1921	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:	
Pacific	165.11	17.2	Constant	-3.0904
New England	142.24	18.2	Std Err of Y Est	1.7784
West North Central	140.93	16.5	R Squared	0.6097
Mid-Atlantic	137.29	15.8	No. of Observations	9
East North Central	136.06	15.8	Degrees of Freedom	7
Mountain	135.38	15.8		
West South Central	125.15	11.6	X Coefficient(s)	0.1336
East South Central	119.76	10.4	Std Err of Coef.	0.0404
South Atlantic	110.32	12.8	Coefficient / S.E.	3.3066
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● - Part 2b.	1923	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:	
Pacific	163.06	17.2	Constant	-1.7908
New England	137.39	18.2	Std Err of Y Est	1.7122
West North Central	138.31	16.5	R Squared	0.6382
Mid-Atlantic	138.92	15.8	No. of Observations	9
East North Central	131.82	15.8	Degrees of Freedom	7
Mountain	130.51	15.8		
West South Central	119.16	11.6	X Coefficient(s)	0.1274
East South Central	113.16	10.4	Std Err of Coef.	0.0363
South Atlantic	106.79	12.8	Coefficient / S.E.	3.5139
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● - Part 2c.	1925	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:	
Pacific	161.67	17.2	Constant	-0.5537
New England	138.31	18.2	Std Err of Y Est	1.6140
West North Central	133.92	16.5	R Squared	0.6785
Mid-Atlantic	134.36	15.8	No. of Observations	9
East North Central	127.54	15.8	Degrees of Freedom	7
Mountain	122.30	15.8		
West South Central	112.83	11.6	X Coefficient(s)	0.1218
East South Central	107.22	10.4	Std Err of Coef.	0.0317
South Atlantic	103.61	12.8	Coefficient / S.E.	3.8437
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● - Part 2d.	1927	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:	
Pacific	157.83	17.2	Constant	-0.1623
New England	137.50	18.2	Std Err of Y Est	1.4890
West North Central	131.54	16.5	R Squared	0.7264
Mid-Atlantic	138.40	15.8	No. of Observations	9
East North Central	126.18	15.8	Degrees of Freedom	7
Mountain	118.75	15.8		
West South Central	108.25	11.6	X Coefficient(s)	0.1207
East South Central	102.07	10.4	Std Err of Coef.	0.0280
South Atlantic	102.13	12.8	Coefficient / S.E.	4.3110
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● - Part 2e.	1929	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:	
Pacific	156.64	17.2	Constant	0.1163
New England	138.46	18.2	Std Err of Y Est	1.3938

West North Central	128.72	16.5	R Squared	0.7603
Mid-Atlantic	138.49	15.8	No. of Observations	9
East North Central	126.51	15.8	Degrees of Freedom	7
Mountain	118.68	15.8		
West South Central	105.60	11.6	X Coefficient(s)	0.1195
East South Central	99.41	10.4	Std Err of Coef.	0.0254
South Atlantic	100.86	12.8	Coefficient / S.E.	4.7115

● - Part 2f.		1931	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:		
Pacific	159.97	17.2	Constant	1.3504	
New England	142.35	18.2	Std Err of Y Est	1.3958	
West North Central	126.50	16.5	R Squared	0.7596	
Mid-Atlantic	140.82	15.8	No. of Observations	9	
East North Central	128.59	15.8	Degrees of Freedom	7	
Mountain	118.89	15.8			
West South Central	105.95	11.6	X Coefficient(s)	0.1089	
East South Central	96.73	10.4	Std Err of Coef.	0.0232	
South Atlantic	99.59	12.8	Coefficient / S.E.	4.7024	

● - Part 2g.		1934	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:		
Pacific	160.09	17.2	Constant	2.8680	
New England	148.60	18.2	Std Err of Y Est	1.3830	
West North Central	125.96	16.5	R Squared	0.7640	
Mid-Atlantic	149.62	15.8	No. of Observations	9	
East North Central	129.36	15.8	Degrees of Freedom	7	
Mountain	117.16	15.8			
West South Central	104.68	11.6	X Coefficient(s)	0.0962	
East South Central	92.00	10.4	Std Err of Coef.	0.0202	
South Atlantic	98.41	12.8	Coefficient / S.E.	4.7598	

● - Part 2h.		1936	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:		
Pacific	158.44	17.2	Constant	3.1726	
New England	150.18	18.2	Std Err of Y Est	1.3490	
West North Central	126.14	16.5	R Squared	0.7754	
Mid-Atlantic	155.05	15.8	No. of Observations	9	
East North Central	130.42	15.8	Degrees of Freedom	7	
Mountain	119.80	15.8			
West South Central	103.52	11.6	X Coefficient(s)	0.0932	
East South Central	89.94	10.4	Std Err of Coef.	0.0190	
South Atlantic	99.16	12.8	Coefficient / S.E.	4.9160	

● - Part 2i.		1938	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:		
Pacific	157.62	17.2	Constant	3.9334	
New England	154.08	18.2	Std Err of Y Est	1.3946	
West North Central	124.95	16.5	R Squared	0.7600	
Mid-Atlantic	160.69	15.8	No. of Observations	9	
East North Central	131.98	15.8	Degrees of Freedom	7	
Mountain	119.88	15.8			
West South Central	102.79	11.6	X Coefficient(s)	0.0866	
East South Central	88.21	10.4	Std Err of Coef.	0.0184	
South Atlantic	99.26	12.8	Coefficient / S.E.	4.7078	

● - Part 2j.		1940	1940	Genital Cancers, Males	
	PhysPop	MortRate	Regression Output:		
Pacific	159.72	17.2	Constant	5.1480	
New England	161.55	18.2	Std Err of Y Est	1.5112	
West North Central	123.14	16.5	R Squared	0.7182	
Mid-Atlantic	169.76	15.8	No. of Observations	9	
East North Central	133.36	15.8	Degrees of Freedom	7	
Mountain	119.89	15.8			
West South Central	103.94	11.6	X Coefficient(s)	0.0758	
East South Central	85.83	10.4	Std Err of Coef.	0.0179	
South Atlantic	100.74	12.8	Coefficient / S.E.	4.2234	

Box 1 of Chap. 13

Summary: Regression Outputs, Genital Cancers, Males.

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	0.6097	-3.09	0.1336	0.0404	3.3066
2b	1923	0.6382	-1.79	0.1274	0.0363	3.5139
2c	1925	0.6785	-0.55	0.1218	0.0317	3.8437
2d	1927	0.7264	-0.16	0.1207	0.0280	4.3110
2e	1929	0.7603	0.12	0.1195	0.0254	4.7115
2f	1931	0.7596	1.35	0.1089	0.0232	4.7024
2g	1934	0.7640	2.87	0.0962	0.0202	4.7598
2h ---->	1936 Max	0.7754	3.17	0.0932	0.0190	4.9160
2i	1938	0.7600	3.93	0.0866	0.0184	4.7078
2j	1940	0.7182	5.15	0.0758	0.0179	4.2234

Box 2 of Chap. 13

Input-Data for Figure 13-A. Genital Cancers. Males.

Part 2h, Best-Fit Equation: $\text{Calc. MortRate} = (0.0932 * \text{PhysPop}) + (3.17)$

Census Divisions	1940 Observed PhysPops	1940 Observed MortRates	Best-Fit Calc. MortRates
Pacific	159.72	17.2	18.056
New England	161.55	18.2	18.226
West No. Central	123.14	16.5	14.647
Mid-Atlantic	169.76	15.8	18.992
East No. Central	133.36	15.8	15.599
Mountain	119.89	15.8	14.344
West So. Central	103.94	11.6	12.857
East So. Central	85.83	10.4	11.169
South Atlantic	100.74	12.8	12.559
Additional PhysPops	70.00		9.694
--- not "observed" ---	60.00		8.762
down to zero PhysPop	50.00		7.830
(zero medical radiation).	40.00		6.898
For each, we calculate	30.00		5.966
a best-fit MortRate.	20.00		5.034
These additional x,y pairs	10.00		4.102
are also part of the	0		3.170
best-fit line (Chap 5, Part 5e).			

Box 3 of Chap. 13
Presumptive Fraction of Cancer MortRate Attributable to Medical Radiation.

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

Genital Cancers. MALES.

● MALE National MortRate (MR) 1940, from Table 13-B	15.2	National MortRate
● Constant, from regression, Part 2h	3.1726	Constant
● Fractional Causation, Best Est. = (Natl MR - Constant) / Natl MR	79.1%	Frac. Causation

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

X-Coefficient, from Part 2h	0.0932	X-Coeff., Best Est.
Standard Error (SE) of X-Coefficient, from Part 2h	0.0190	Standard Error
Upper 90% C.L. on X-Coeff. = (Coef) + (1.645 * SE) =	0.1245	New X-Coefficient
New Constant = (Natl MR) - (New X-Coeff * 1936 Natl PhysPop) =	-0.7215	New Constant
Frac. Causation, High-Limit = (Natl MR - New Constant) / Natl MR =	104.7% #	New Frac. Caus'n.
# The Upper-Limit is 100%. Negative Constants produce values > 100%. See Chapter 22, Part 3.		
Lower 90% C.L. on X-Coeff. = (Coef) - (1.645 * SE) =	0.0619	New X-Coefficient
New Constant = (Natl MR) - (New X-Coeff * 1936 Natl PhysPop) =	7.2754	New Constant
Frac. Causation, Low-Limit = (Natl MR - New Constant) / Natl MR =	52.1%	New Frac. Caus'n.

Box 4 of Chap 13.

Error-Check on Our Own Work: Genital Cancers, Males.

Please see text in Chapter 6, Part 5.

Below, Columns A, C, and E come directly from the regression input in Part 2h. 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."

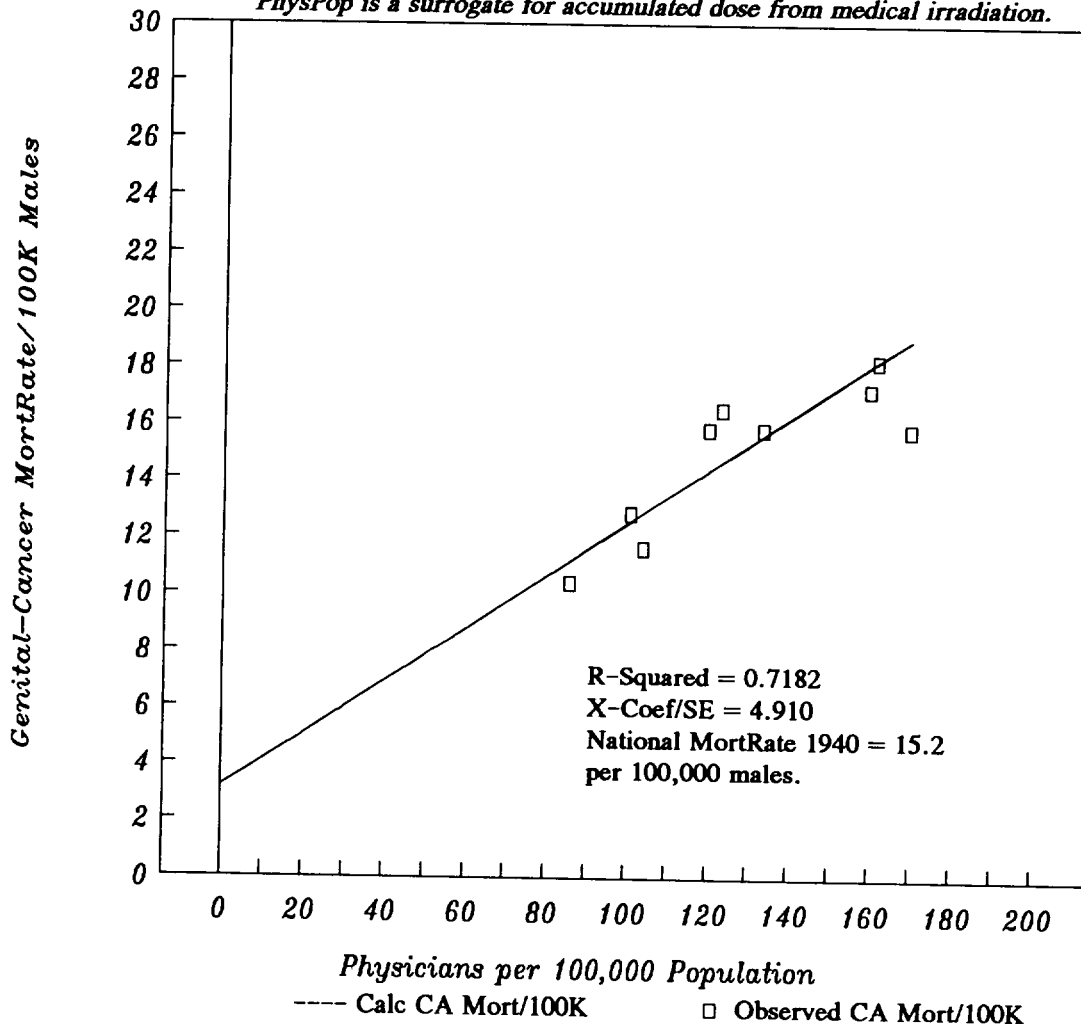
The Weighted-Avg. Nat'l PhysPop, 1936, is the sum of Column-D entries =	127.93
The 1936 PhysPop approximation is weighted by the 1940 population-fractions.	
The Weighted-Avg. Nat'l Male MortRate, 1940, is sum of Col.F entries =	14.87
The Nat'l Male MortRate is also (X-Coeff * Nat'l PhysPop) + Constant =	15.10
Comparison: The Nat'l Male MortRate, 1940, in Table 13-B =	15.20

(A) Census Division	(B) Pop'n Fraction	(C) PhysPop 1936	(D) Weighted PhysPop	(E) MortRate 1940	(F) Weighted MortRate
Pacific	0.0739	158.44	11.71	17.2	1.27
New England	0.0641	150.18	9.63	18.2	1.17
West No. Central	0.1027	126.14	12.95	16.5	1.69
Mid-Atlantic	0.2092	155.05	32.44	15.8	3.31
East No. Central	0.2022	130.42	26.37	15.8	3.19
Mountain	0.0315	119.80	3.77	15.8	0.50
West So. Central	0.0992	103.52	10.27	11.6	1.15
East So. Central	0.0819	89.94	7.37	10.4	0.85
South Atlantic	0.1354	99.16	13.43	12.8	1.73
Sums	1.0000		127.93		14.87

1940 Genital-System Cancer Mortality-Rates versus
1936 PhysPop Values for the 9 Census Divisions, USA.

Dose-Response Relationship

PhysPop is a surrogate for accumulated dose from medical irradiation.



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, Genital-Cancer Mortality-Rate per 100,000 males = 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 2h). 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 Genital-Cancer Mortality (Males) by Medical Radiation

79 % from Best Estimate (Box 3).

52 % at lower 90 % confidence limit (Box 3). ~100 % at upper 90% confidence limit (Box 3).

Table 13-A.

Genital Cancer Mortality Rates by Census Divisions: Males.

Rates are annual deaths per 100,000 male population, USA, age-adjusted to the 1940 reference year. There are no exclusions by color or "race." Sources are stated in Table 13-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	17.2	14.0	13.4	13.9	14.4	15.9
New England	18.2	16.6	15.7	15.3	14.8	16.6
West North Central	16.5	16.6	15.4	14.8	14.2	16.3
Mid-Atlantic	15.8	14.2	13.6	14.2	14.8	16.8
East North Central	15.8	15.1	15.1	15.2	15.3	17.2
Mountain	15.8	13.6	15.2	14.9	14.5	16.6
West South Central	11.6	13.3	14.6	14.5	14.3	16.7
East South Central	10.4	14.7	15.9	15.7	15.4	17.5
South Atlantic	12.8	14.7	14.6	15.5	16.4	18.6
Average, ALL	14.9	14.8	14.8	14.9	14.9	16.9
Average, High-5	16.7	15.3	14.6	14.7	14.7	16.6
Average, Low-4	12.7	14.1	15.1	15.1	15.2	17.4
Ratio, Hi5/Lo4	1.32	1.09	0.97	0.97	0.97	0.95

Table 13-B.

Genital 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	23.5	15.2	32.1
1950	21.0	14.9	27.2
1960	18.5	14.6	22.4
1970	--	14.8	18.0
1979-81	--	15.0	13.7
1989-1991	--	16.9	--

- - 1940, 1950, 1960: All rates come from Grove 1968, Table 67, p.693, "Malignant neoplasms of genital organs (171-179)" ICD/7.
- - 1970: All rates are interpolations (Chap. 4, Parts 2b, 2c).
- - 1980: All rates (ICD/9, 179-187) come from the reference NatCtrHS 1980.
- - 1990 male rates by Divisions and National come from Monthly Vital Statistics Vol.43, No.8, January 31, 1995. Females: Not available.