"All-Cancer-Except-Genital-Cancer": Relation with Medical Radiation

● Part 1. "All-Cancer-Except-Genital-Cancer": A Result of Chapter 14

In Chapter 14, we found that the MortRate for female Genital Cancers showed no significant relationship, either positive or negative, with medical radiation (discussion in Chapter 14). In this chapter, we obtain the estimated Fractional Causation by medical radiation for female All-Cancer deaths in 1940 except for Genital-Cancer deaths --- a group which can be called "All-Cancer-Except-Genital" or "All-Minus-Genital." The "All-Minus-Genital" group accounts for 74.5% of all cancer-deaths in 1940 among females (Table 20-A, Row 26, at the end of this chapter).

Although Chapter 13 uncovered a strong relationship between medical radiation and MALE Genital-Cancer MortRates in 1940, we do the analysis here for All-Minus-Genital for males too. All-Minus-Genital accounts for 86.8% of All-Cancer deaths in 1940 among males (Table 20-A, Row 13).

● Part 2. Regression Analysis, with Estimated Fractional Causation

Below, we show the linear regression analyses for the 1940 MortRates regressed upon the 1940 PhysPops --- males first (Part 2a), then females (Part 2b). We omit the "build-up" years which use PhysPops prior to 1940. The Universal PhysPop Table 3-A, and Table 20-A, provide the input-data for these regressions. Box 1 does not exist in this chapter.

Part 2a. MALES.	1940 PhysPop	1940 MortRate	MALES: All-Minus-Genital Regression Output:	
Pacific	159.72	105.7	Constant	6.4004
New England	161.55	117.3	Std Err of Y Est	5.1290
West North Central	123.14	94.4	R Squared	0.9468
Mid-Atlantic	169.76	125.1	No. of Observations	9
East North Central	133.36	103.8	Degrees of Freedom	7
Mountain	119.89	84.0		
West South Central	103.94	75.3	X Coefficient(s)	0.6799
East South Central	85.83	63.2	Std Err of Coef.	0.0609
South Atlantic	100.74	76.1	Coefficient / S.E.	11.1621

Part 2b. FEMALES.	1940 PhysPop	1940 MortRate	FEMALES: All-Minus-Genital Regression Output:	
Pacific	159.72	94.3	Constant	23.9237
New England	161.55	112.5	Std Err of Y Est	6.3277
West North Central	123.14	91.7	R Squared	0.8675
Mid-Atlantic	169.76	110.2	No. of Observations	9
East North Central	133.36	98.2	Degrees of Freedom	7
Mountain	119.89	84.0		
West South Central	103.94	69.8	X Coefficient(s)	0.5087
East South Central	85.83	69.3	Std Err of Coef.	0.0751
South Atlantic	100.74	74.4	Coefficient / S.E.	6.7698

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Box 4 will precede Box 3.

Box 2 of Chap. 20
Input-Data for Figure 20-A (males), Figure 20-B (females).

Part 2a, Best-Fit Equation: Calc. MortRate = (0.6799 * PhysPop) + (6.4004)
Part 2b, Best-Fit Equation: Calc. MortRate = (0.5087 * PhysPop) + (23.9237)

Census Divisions	1940 Observed PhysPops	1940 Observed MortRates MALES	Best-Fit Calc. MortRates MALES	1940 Observed MortRates FEMALE	Best-Fit Calc. MortRates FEMALES
Pacific	159.72	105.7	114.994	94.3	105.173
New England	161.55	117.3	116.238	112.5	106.104
West No. Central	123.14	94.4	90.123	91.7	86.565
Mid-Atlantic	169.76	125.1	121.820	110.2	110.281
East No. Central	133.36	103.8	97.072	98.2	91.764
Mountain	119.89	84.0	87.914	84.0	84.912
West So. Central	103.94	75.3	77.069	69.8	76.798
East So. Central	85.83	63.2	64.756	69.3	67.585
South Atlantic	100.74	76.1	74.894	74.4	75.170
Additional PhysPops	70.00		53.993		59.533
--- not "observed" --	60.00		47.194		54.446
down to zero PhysPop	50.00		40.395		49.359
(zero med. radiation).	40.00		33.596		44.272
For each, we calculate	30.00		26.797		39.185
a best-fit MortRate.	20.00		19.998		34.098
These additional x,y	10.00		13.199		29.011
pairs are also part of	0		6.400		23.924
the best-fit line (Chap 5, Part 5e).					

Box 4 of Chap. 20
Error-Check on Our Own Work: All-Minus-Genital.

The Weighted-Avg. Nat'l PhysPop, 1940, is the sum of Column-D entries =	132.04
The Weighted-Avg. Nat'l MALE MortRate of 1940 is the sum of Column-F entries =	97.78
The Nat'l Male MortRate is also (X-Coef * 1940 Nat'l PhysPop) + Constant =	96.17
Comparison: The National MALE MortRate of 1940, in Table 20-A, Row 12 =	99.80
The Weighted-Avg. Nat'l FEM. MortRate of 1940 is the sum of Column-H entries =	91.83
The Nat'l Female MortRate is also (X-Coef * 1940 Nat'l PhysPop) + Constant =	91.09
Comparison: The National FEM. MortRate of 1940, in Table 20-A, Row 25 =	94.00

(A) Census Division	(B) Pop'n Fraction	(C) PhysPop 1940	(D) Weighted PhysPop	(E) MALE MortRate 1940	(F) MALE Weighted MortRate	(G) FEM. MortRate 1940	(H) FEM. Weighted MortRate
Pacific	0.0739	159.72	11.80	105.7	7.81	94.3	6.97
New England	0.0641	161.55	10.36	117.3	7.52	112.5	7.21
West No. Central	0.1027	123.14	12.65	94.4	9.69	91.7	9.42
Mid-Atlantic	0.2092	169.76	35.51	125.1	26.17	110.2	23.05
East No. Central	0.2022	133.36	26.97	103.8	20.99	98.2	19.86
Mountain	0.0315	119.89	3.78	84.0	2.65	84.0	2.65
West So. Central	0.0992	103.94	10.31	75.3	7.47	69.8	6.92
East So. Central	0.0819	85.83	7.03	63.2	5.18	69.3	5.68
South Atlantic	0.1354	100.74	13.64	76.1	10.30	74.4	10.07
Sums	1.0000		132.04		97.78		91.83

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

All-Minus-Genital Cancers. MALES.

- MALE National MortRate (MR) 1940, from Table 20-A, Row 12   99.8   National MortRate
- Constant, from regression, Part 2a   6.4004   Constant
- Fractional Causation, Best Est. = (Natl MR - Constant) / Natl MR   93.6%   Frac. Causation

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90% Confidence-Limits (C.L.) on Fractional Causation. See text in Chapter 6, Part 5.
X-Coefficient, from Part 2a   0.6799   X-Coef., Best Est.
Standard Error (SE) of X-Coefficient, from Part 2a   0.0609   Standard Error

Upper 90% C.L. on X-Coef. = (Coef) + (1.645 * SE) =   0.7801   New X-Coefficient
New Constant = (Natl MR) - (New X-Coef * 1940 Natl PhysPop) =   -3.2018   New Constant
Frac. Caus'n, High-Limit = (Natl MR - New Constant) / Natl MR =   103.2% # 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-Coef. = (Coef) - (1.645 * SE) =   0.5797   New X-Coefficient
New Constant = (Natl MR) - (New X-Coef * 1940 Natl PhysPop) =   23.2538   New Constant
Frac. Caus'n, Low-Limit = (Natl MR - New Constant) / Natl MR =   76.7%   New Frac. Caus'n.

All-Minus-Genital Cancers. FEMALES.

- FEMALE National MortRate 1940, from Table 20-A, Row 25   94.0   National MortRate
- Constant, from regression, Part 2b   23.9237   Constant
- Fractional Causation, Best Est. = (Natl MR - Constant) / Natl MR   74.5%   Frac. Causation

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90% Confidence-Limits (C.L.) on Fractional Causation. See text in Chapter 6, Part 5.
X-Coefficient, from Part 2b   0.5087   X-Coef., Best Est.
Standard Error (SE) of X-Coefficient, from Part 2b   0.0751   Standard Error
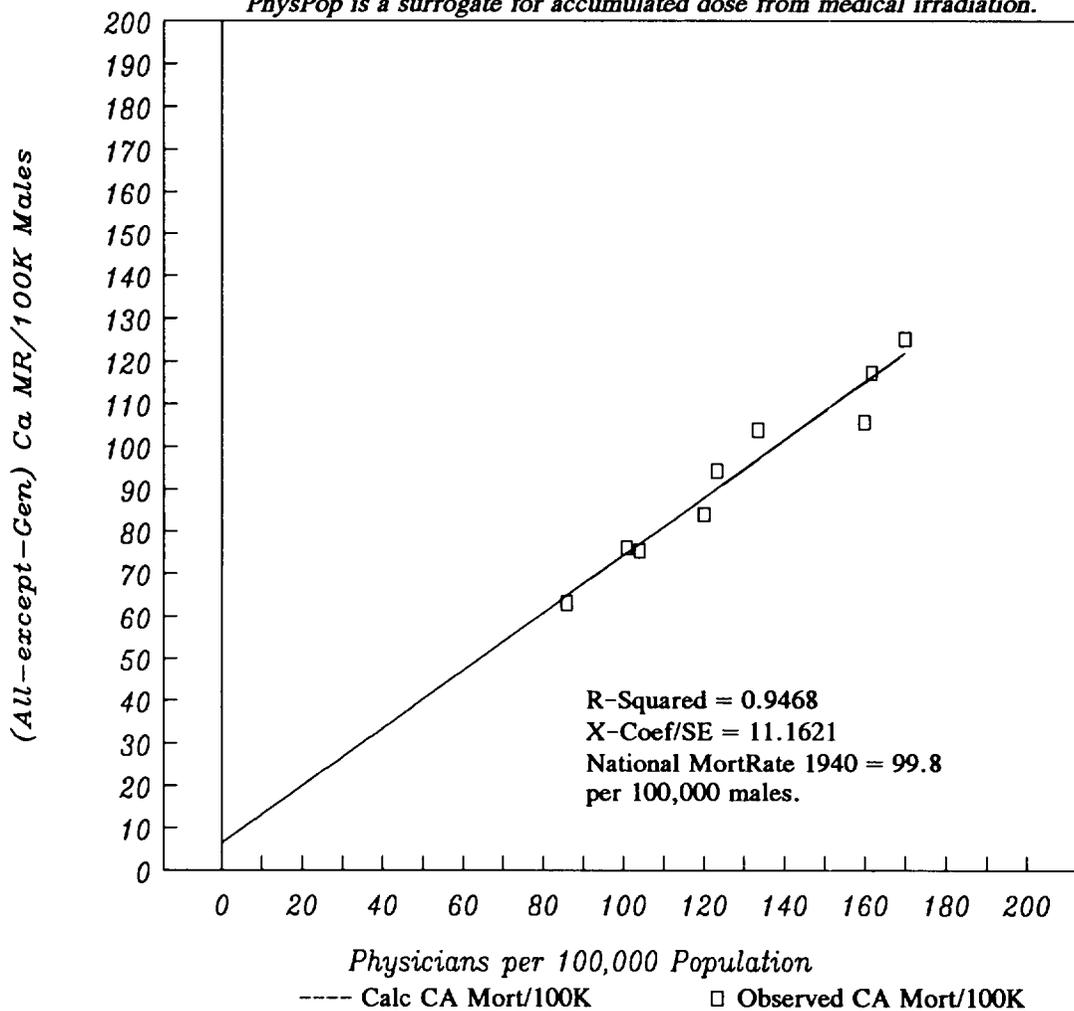
Upper 90% C.L. on X-Coef. = (Coef) + (1.645 * SE) =   0.6322   New X-Coefficient
New Constant = (Natl MR) - (New X-Coef * 1940 Natl PhysPop) =   10.5191   New Constant
Frac. Caus'n, High-Limit = (Natl MR - New Constant) / Natl MR =   88.8%   New Frac. Caus'n.

Lower 90% C.L. on X-Coef. = (Coef) - (1.645 * SE) =   0.3852   New X-Coefficient
New Constant = (Natl MR) - (New X-Coef * 1940 Natl PhysPop) =   43.1434   New Constant
Frac. Caus'n, Low-Limit = (Natl MR - New Constant) / Natl MR =   54.1%   New Frac. Caus'n.

1940 (All Minus Gen) 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 = 0.9468
X–Coef/SE = 11.1621
National MortRate 1940 = 99.8
per 100,000 males.

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, 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 relationship between these two variables (Part 2a). 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 "All–Except–Genital Ca" (Male) by Medical Rad'n
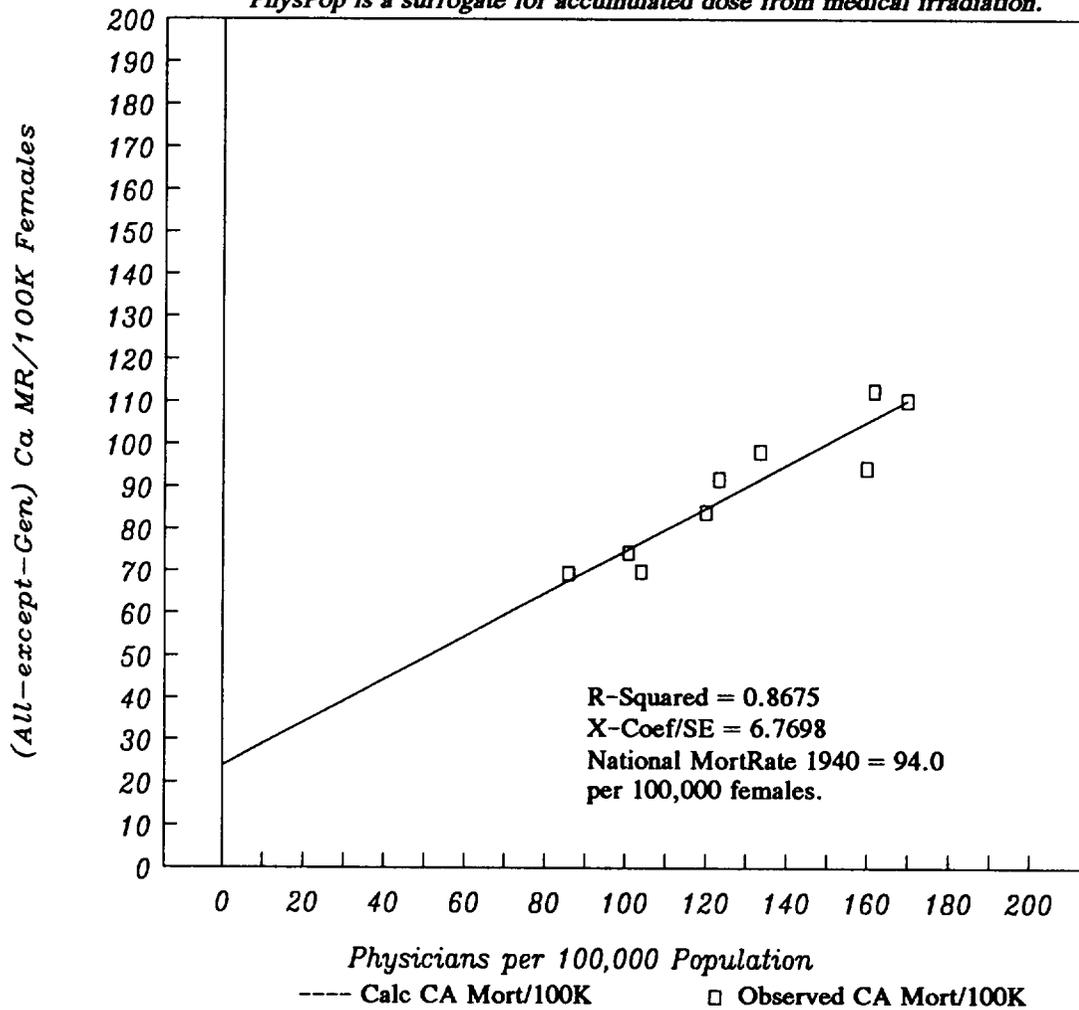*93.6 % from Best Estimate (Box 3).*

~77% at lower 90 % confidence limit (Box 3).   ~100 % at upper 90 % confidence limit (Box 3).

1940 (All Minus Gen) 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 = 0.8675
X-Coef/SE = 6.7698
National MortRate 1940 = 94.0
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, 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 relationship between these two variables (Part 2b). 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 "(All-Except-Genital) Ca" (Female) by Medical Rad'n
74.5 % from Best Estimate (Box 3).

~54% at lower 90 % confidence limit (Box 3). ~89 % at upper 90 % confidence limit (Box 3).

Table 20-A.
All-Cancer-Except-Genital MortRates: Males, Females.

"All-Cancer-Except-Genital" male mortality rates (MRs) below are the corresponding entries in Table 6-A+B (All-Cancers, Male) minus the corresponding entries in Table 13-A+B (Genital Cancers, Male). 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." Corresponding comments apply to female values below (calculated from Chapters 7 and 14).

------------------------ MALES ---

| Census Division | Males | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 |
Row							
1	Pacific	105.7	113.2	127.3	133.3	139.3	132.6
2	New England	117.3	135.8	148.9	152.3	155.5	150.5
3	West North Central	94.4	108.7	120.2	129.0	137.8	139.6
4	Mid-Atlantic	125.1	141.8	150.4	153.7	157.0	151.6
5	East North Central	103.8	123.2	135.6	144.9	154.2	154.0
6	Mountain	84.0	94.5	103.5	111.9	120.2	122.5
7	West South Central	75.3	99.4	119.2	133.9	148.6	156.2
8	East South Central	63.2	90.0	109.2	134.0	158.7	170.7
9	South Atlantic	76.1	101.6	122.5	138.7	155.0	157.2
10	Natl, All-Cancer MR	115.0	132.8	145.7	155.1	164.5	162.7
11	Natl, Genital-Cancer MR	15.2	14.9	14.6	14.8	15.0	16.9
12	Natl, All-Minus-Genital MR	99.8	117.9	131.1	140.3	149.5	145.8
13	Percent, Row 12/Row10	86.8%	88.8%	90.0%	90.5%	90.9%	89.6%

------------------------ FEMALES --

| Census Division | Females | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 |
Row							
14	Pacific	94.3	92.2	90.1	93.6	97.1	--
15	New England	112.5	107.0	100.7	101.9	103.0	--
16	West North Central	91.7	93.7	89.0	88.3	87.7	--
17	Mid-Atlantic	110.2	109.8	105.2	104.2	103.2	--
18	East North Central	98.2	99.2	95.6	96.6	97.5	--
19	Mountain	84.0	82.4	82.6	82.9	83.2	--
20	West South Central	69.8	81.9	80.8	84.2	87.6	--
21	East South Central	69.3	80.6	80.1	84.5	88.9	--
22	South Atlantic	74.4	83.4	83.4	87.5	91.5	--
23	Natl, All-Cancer MR	126.1	123.2	114.9	111.7	108.5	111.3
24	Natl, Genital-Cancer MR	32.1	27.2	22.4	18.0	13.7	--
25	Natl, All-Minus-Genital MR	94.0	96.0	92.5	93.7	94.8	--
26	Percent, Row 25/Row23	74.5%	77.9%	80.5%	83.9%	87.4%	--