CHAPTER 18

"Difference" Cancers, Males: Relation with Medical Radiation

• Part 1. Introduction

Difference-Cancers are All-Cancers-Minus-Respiratory-System Cancers. The dramatic increase in Respiratory-System Cancers since 1940 has put such cancers into a class by themselves. By subtracting Respiratory-System Cancers from All-Cancers, we can observe how all the REST of the cancers behave. We are not alone in creating a cancer category for "All-Minus-Respiratory." The National Cancer Institute regularly presents an entry for "All Except Lung" in its reports from the SEER Program (Surveillance, Epidemiology, and End Results Program --- for example, see SEER 1997, p.45).

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

• - Part 2a.	1921 PhysPop	1940 MortRate
Pacific	165.11	110.9
New England	142.24	122.0
West North Central	140.93	103.2
Mid-Atlantic	137.29	123.8
East North Central	136.06	109.0
Mountain	135.38	92.0
West South Central	125.15	79.3
East South Central	119.76	68.7
South Atlantic	110.32	80.6

Difference-Cancers, Males Regression Output:	
Constant	-20.9581
Std Err of Y Est	14.9455
R Squared	0.4951
No. of Observations	9
Degrees of Freedom	7
X Coefficient(s)	0.8894
Std Err of Coef.	0.3395
Coefficient / S.E.	2.6199

• - Part 2b.	1923 PhysPop	1940 MortRate
Pacific	163.06	110.9
New England	137.39	122.0
West North Central	138.31	103.2
Mid-Atlantic	138.92	123.8
East North Central	131.82	109.0
Mountain	130.51	92.0
West South Central	119.16	79.3
East South Central	113.16	68.7
South Atlantic	106.79	80.6

Difference-Cancers, Males Regression Output:	
Constant	-17.8582
Std Err of Y Est	13.7707
R Squared	0.5714
No. of Observations	9
Degrees of Freedom	7
X Coefficient(s)	0.8907
Std Err of Coef.	0.2916
Coefficient / S.E.	3.0546

• - Part 2c.	1925 PhysPop	1940 MortRate
Pacific	161.67	110.9
New England	138.31	122.0
West North Central	133.92	103.2
Mid-Atlantic	134.36	123.8
East North Central	127.54	109.0
Mountain	122.30	92.0
West South Central	112.83	79.3
East South Central	107.22	68.7
South Atlantic	103.61	80.6

Difference-Cancers, Males Regression Output:	
Constant	-10.3231
Std Err of Y Est	12.9650
R Squared	0.6200
No. of Observations	9
Degrees of Freedom	7
X Coefficient(s)	0.8604
Std Err of Coef.	0.2546
Coefficient / S.E.	3.3798

• - Part 2d.	1927 PhysPop	1940 MortRate
Pacific	157.83	110.9
New England	137.50	122.0
West North Central	131.54	103.2
Mid-Atlantic	138.40	123.8
East North Central	126.18	109.0
Mountain	118.75	92.0
West South Central	108.25	79.3

Difference-Cancers, Males Regression Output:	
Constant	-13.2331
Std Err of Y Est	10.7969
R Squared	0.7365
No. of Observations	9
Degrees of Freedom	7
X Coefficient(s)	0.8984

East South Central	102.07	68.7	Std Err of Coef.	0.2031
South Atlantic	102.13	80.6	Coefficient / S.E.	4.4232

● - Part 2e.	1929 PhysPop	1940 MortRate	Difference-Cancers, Males Regression Output:	
Pacific	156.64	110.9	Constant	-11.6016
New England	138.46	122.0	Std Err of Y Est	9.9319
West North Central	128.72	103.2	R Squared	0.7770
Mid-Atlantic	138.49	123.8	No. of Observations	9
East North Central	126.51	109.0	Degrees of Freedom	7
Mountain	118.68	92.0		
West South Central	105.60	79.3	X Coefficient(s)	0.8927
East South Central	99.41	68.7	Std Err of Coef.	0.1807
South Atlantic	100.86	80.6	Coefficient / S.E.	4.9390

● - Part 2f.	1931 PhysPop	1940 MortRate	Difference-Cancers, Males Regression Output:	
Pacific	159.97	110.9	Constant	-3.6338
New England	142.35	122.0	Std Err of Y Est	9.5091
West North Central	126.50	103.2	R Squared	0.7956
Mid-Atlantic	140.82	123.8	No. of Observations	9
East North Central	128.59	109.0	Degrees of Freedom	7
Mountain	118.89	92.0		
West South Central	105.95	79.3	X Coefficient(s)	0.8238
East South Central	96.73	68.7	Std Err of Coef.	0.1578
South Atlantic	99.59	80.6	Coefficient / S.E.	5.2199

● - Part 2g.	1934 PhysPop	1940 MortRate	Difference-Cancers, Males Regression Output:	
Pacific	160.09	110.9	Constant	3.6805
New England	148.60	122.0	Std Err of Y Est	7.4329
West North Central	125.96	103.2	R Squared	0.8751
Mid-Atlantic	149.62	123.8	No. of Observations	9
East North Central	129.36	109.0	Degrees of Freedom	7
Mountain	117.16	92.0		
West South Central	104.68	79.3	X Coefficient(s)	0.7606
East South Central	92.00	68.7	Std Err of Coef.	0.1086
South Atlantic	98.41	80.6	Coefficient / S.E.	7.0037

● - Part 2h.	1936 PhysPop	1940 MortRate	Difference-Cancers, Males Regression Output:	
Pacific	158.44	110.9	Constant	4.9134
New England	150.18	122.0	Std Err of Y Est	6.2783
West North Central	126.14	103.2	R Squared	0.9109
Mid-Atlantic	155.05	123.8	No. of Observations	9
East North Central	130.42	109.0	Degrees of Freedom	7
Mountain	119.80	92.0		
West South Central	103.52	79.3	X Coefficient(s)	0.7463
East South Central	89.94	68.7	Std Err of Coef.	0.0882
South Atlantic	99.16	80.6	Coefficient / S.E.	8.4596

● - Part 2i.	1938 PhysPop	1940 MortRate	Difference-Cancers, Males Regression Output:	
Pacific	157.62	110.9	Constant	9.0069
New England	154.08	122.0	Std Err of Y Est	5.4086
West North Central	124.95	103.2	R Squared	0.9339
Mid-Atlantic	160.69	123.8	No. of Observations	9
East North Central	131.98	109.0	Degrees of Freedom	7
Mountain	119.88	92.0		
West South Central	102.79	79.3	X Coefficient(s)	0.7095
East South Central	88.21	68.7	Std Err of Coef.	0.0714
South Atlantic	99.26	80.6	Coefficient / S.E.	9.9430

● - Part 2j.	1940 PhysPop	1940 MortRate
Pacific	159.72	110.9
New England	161.55	122.0
West North Central	123.14	103.2
Mid-Atlantic	169.76	123.8
East North Central	133.36	109.0
Mountain	119.89	92.0
West South Central	103.94	79.3
East South Central	85.83	68.7
South Atlantic	100.74	80.6

Difference-Cancers, Males Regression Output:	
Constant	16.6486
Std Err of Y Est	5.3951
R Squared	0.9342
No. of Observations	9
Degrees of Freedom	7
X Coefficient(s)	0.6388
Std Err of Coef.	0.0641
Coefficient / S.E.	9.9695

Box 1 of Chap. 18
Summary: Regression Outputs, "Difference" Cancers, Males.

Below are the summary-results from regressing the 1940 cancer MortRates upon the ten sets of PhysPops (1921-1940), as presented in Parts 2a-2j of this chapter.

Part	PhysPop	R-squared	Constant	X-Coef	Std Err	X-Coef/SE
2a	1921	0.4951	-20.96	0.8894	0.3395	2.6199
2b	1923	0.5714	-17.86	0.8907	0.2916	3.0546
2c	1925	0.6200	-10.32	0.8604	0.2546	3.3798
2d	1927	0.7365	-13.23	0.8984	0.2031	4.4232
2e	1929	0.7770	-11.60	0.8927	0.1807	4.9390
2f	1931	0.7956	-3.63	0.8238	0.1578	5.2199
2g	1934	0.8751	3.68	0.7606	0.1086	7.0037
2h	1936	0.9109	4.91	0.7463	0.0882	8.4596
2i	1938	0.9339	9.01	0.7095	0.0714	9.9430
2j --->	1940 Max	0.9342	16.65	0.6388	0.0641	9.9695

Box 2 of Chap. 18
Input-Data for Figure 18-A. "Difference" Cancers. Males.

Part 2j, Best-Fit Equation: Calc. MortRate = (0.6388 * PhysPop) + (16.65)

Census Divisions	1940 Observed PhysPops	1940 Observed MortRates	Best-Fit Calc. MortRates
Pacific	159.72	110.9	118.679
New England	161.55	122.0	119.848
West No. Central	123.14	103.2	95.312
Mid-Atlantic	169.76	123.8	125.093
East No. Central	133.36	109.0	101.840
Mountain	119.89	92.0	93.236
West So. Central	103.94	79.3	83.047
East So. Central	85.83	68.7	71.478
South Atlantic	100.74	80.6	81.003
Additional PhysPops	70.00		61.366
--- not "observed" ---	60.00		54.978
down to zero PhysPop	50.00		48.590
(zero medical radiation).	40.00		42.202
For each, we calculate	30.00		35.814
a best-fit MortRate.	20.00		29.426
These additional x,y pairs	10.00		23.038
are also part of the	0		16.650
best-fit line (Chap 5, Part 5e).			

Box 3 of Chap. 18

Presumptive Fraction of Cancer MortRate Attributable to Medical Radiation.

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

Difference-Cancers. MALES.

• MALE National MortRate (MR) 1940, from Table 18-B	104.0	National MortRate
• Constant, from regression, Part 2j	16.6486	Constant
• Fractional Causation, Best Est. = (Natl MR - Constant) / Natl MR	84.0%	Frac. Causation

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

X-Coefficient, from Part 2j	0.6388	X-Coef., Best Est.
Standard Error (SE) of X-Coefficient, from Part 2j	0.0641	Standard Error
Upper 90% C.L. on X-Coef. = (Coef) + (1.645 * SE) =	0.7442	New X-Coefficient
New Constant = (Natl MR) - (New X-Coef * 1940 Natl PhysPop) =	5.7300	New Constant
Frac. Causation, High-Limit = (Natl MR - New Constant) / Natl MR =	94.5%	New Frac. Caus'n.
Lower 90% C.L. on X-Coef. = (Coef) - (1.645 * SE) =	0.5334	New X-Coefficient
New Constant = (Natl MR) - (New X-Coef * 1940 Natl PhysPop) =	33.5757	New Constant
Frac. Causation, Low-Limit = (Natl MR - New Constant) / Natl MR =	67.7%	New Frac. Caus'n.

Box 4 of Chap. 18

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

Please see text in Chapter 6, Part 5.

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."

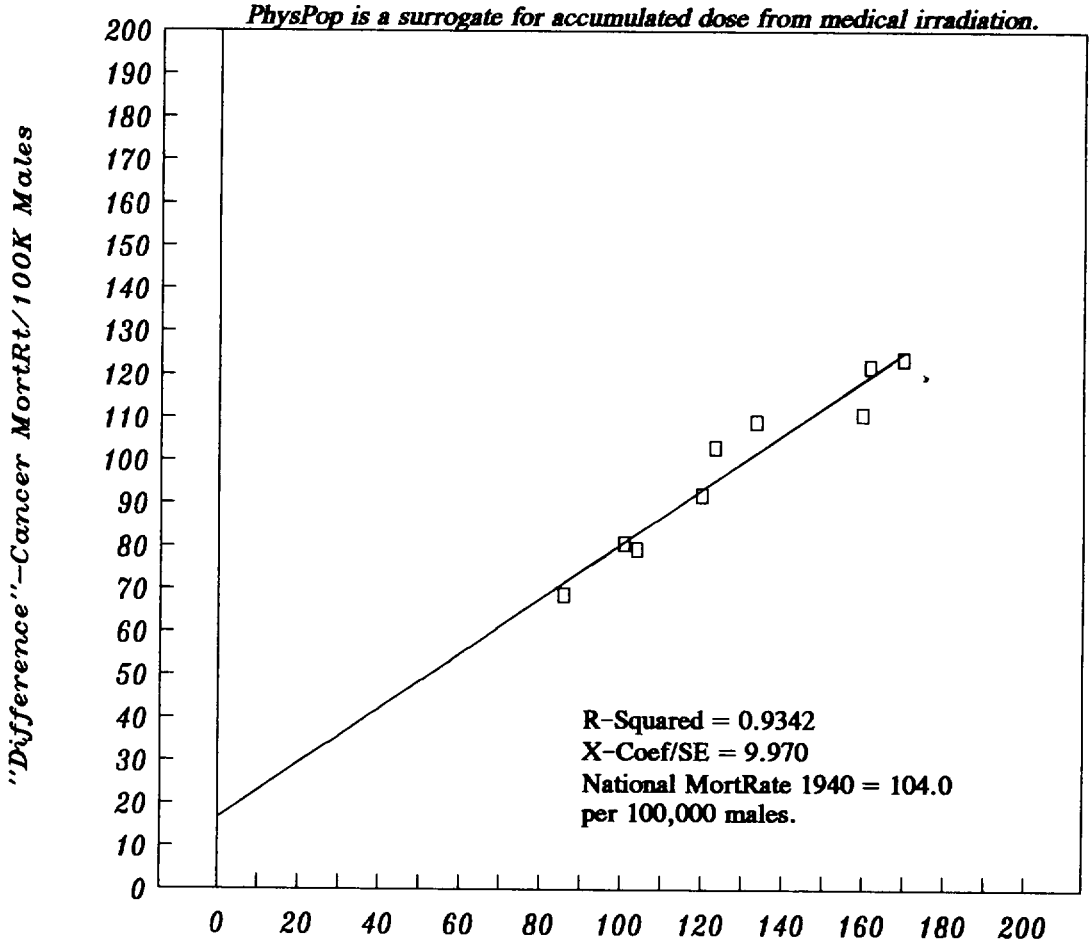
The Weighted-Avg. Nat'l PhysPop, 1940, is the sum of Column-D entries =	132.04
The Weighted-Avg. Nat'l Male MortRate, 1940, is sum of Col.F entries =	101.86
The Nat'l Male MortRate is also (X-Coef * Nat'l PhysPop) + Constant =	101.00
Comparison: The Nat'l Male MortRate, 1940, in Table 18-B =	104.00

(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	110.9	8.20
New England	0.0641	161.55	10.36	122.0	7.82
West No. Central	0.1027	123.14	12.65	103.2	10.60
Mid-Atlantic	0.2092	169.76	35.51	123.8	25.90
East No. Central	0.2022	133.36	26.97	109.0	22.04
Mountain	0.0315	119.89	3.78	92.0	2.90
West So. Central	0.0992	103.94	10.31	79.3	7.87
East So. Central	0.0819	85.83	7.03	68.7	5.63
South Atlantic	0.1354	100.74	13.64	80.6	10.91
Sums	1.0000		132.04		101.86

1940 "Difference" 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.



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, "Difference" 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 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 "Difference" Cancer Mort-Rate (Male) by Medical Rad'n 84 % from Best Estimate (Box 3).

68 % at lower 90 % confidence limit (Box 3). ~94 % at upper 90 % confidence limit (Box 3).

Table 18-A.
"Difference" Cancer MortRates by Census Divisions: Males.

"Difference" Cancers are (All-Cancers minus Respiratory-System Cancers). The entries below are the corresponding entries in Table 6-A (All-Cancers, Male) minus the corresponding entries in Table 16-A (Respiratory-System 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."

Census Division	1940	1950	1960	1970	1980	1988
Pacific	110.9	106.1	105.8	103.0	100.2	97.8
New England	122.0	128.8	126.5	119.8	113.0	110.8
West North Central	103.2	108.8	107.2	102.8	98.3	99.7
Mid-Atlantic	123.8	127.6	123.4	118.4	113.4	110.9
East North Central	109.0	116.5	115.0	111.6	108.1	108.9
Mountain	92.0	91.4	93.2	92.2	91.1	94.9
West South Central	79.3	93.7	98.9	99.5	100.1	105.0
East South Central	68.7	90.0	96.1	99.7	103.3	109.1
South Atlantic	80.6	96.5	101.4	103.7	106.2	107.3
Average, ALL	98.8	106.6	107.5	105.6	103.7	104.9
Average, High-5	113.8	117.6	115.6	111.1	106.6	105.6
Average, Low-4	80.2	92.9	97.4	98.8	100.2	104.1
Ratio, Hi5/Lo4	1.42	1.27	1.19	1.12	1.06	1.01

Table 18-B.
"Difference" Cancer Mortality Rates, USA National.

Annual MortRates in Table 18-B are obtained by subtracting Table 16-B from Table 6-B.

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	113.1	104.0	122.8
1950	114.7	111.2	118.6
1960	109.6	110.5	109.6
1970	101.4	107.8	100.0
1979-81	95.8	105.1	90.5
1987-89	--	103.0	86.8

● - Sources are stated in Table 16-B and Table 6-B.