CHAPTER 50

All-Cancers, Females, 1940-1988: Fractional Causation by Medical Radiation

• Table 50-A, Column A, shows that the female National All-Cancer MortRate is falling through time --- despite the rising female MortRate from Respiratory-System Cancers. The net decline, in the female's National All-Cancer MortRate, receives big assistance from the steep post-1940 declines in the National MortRate for female Genital Cancers (Table 14-B) and female Digestive- System Cancers (Table 10-B).

• Box 1 includes ratios below 1.00 in Columns D and I, and negative numbers in Columns F and K. These findings reflect the fact that, after 1940, the female populations in the TopTrio and MidTrio enjoy a DECREASE in their own 1940 All-Cancer MortRates. A falling rate produces a ratio (fraction) below 1.0, of course. By 1988, female All-Cancer MortRates in the TopTrio are down to 0.835 (83.5%) of their 1940 value. In the MidTrio, rates are down to 89.1% (Column I). Meanwhile, the LowTrio population experiences an 8% INCREASE in its own 1940 rates (ratio = 1.081, in Column I). The facts in Box 1 indicate clearly that a carcinogenic co-actor (smoking) is operating more strongly in the LowTrio than in the TopTrio (Chapter 48, Part 5b). We must match the Census Divisions for smoking, before evaluating Fractional Causation by medical radiation.

• Besides Chapter 50, Chapter 56 also permits evaluation of Fractional Causation of female All-Cancer MortRates by medical radiation. The two chapters are in very satisfactory accord.

Table 50-A
All-Cancers, Females: Fractional Causation by Medical Radiation over Time

Year	Col.A Natl MR	Col.B Frac.C	Col.C R-Sq	Col.D X-Coef	Col.E StdErr	Col.F Coef/SE	Col.G Source
1940	126.1	58%	0.8608	0.5279	0.0802	6.5801	Chap.7
1950	123.2	53%	0.8644	0.4894	0.0733	6.6803	Tab 50-B
1960	114.9	54%	0.8689	0.4661	0.0684	6.8105	Tab 50-C
1970	111.7	52%	0.8799	0.4285	0.0598	7.1600	Tab 50-D
1980	108.5	52%	0.8839	0.3857	0.0528	7.3005	Tab 50-E
1988	111.3	50%	0.8703	0.3393	0.0495	6.8536	Tab 50-F

Box 1, Chap. 50
All-Cancers, Females: Post-1940 Change in MortRates by Census Trios

1960 vs. 1940, by Trios: Col.D expresses change by ratios. Col.F expresses change by subtraction.
1988 vs. 1940, by Trios: Col.I expresses change by ratios. Col.K expresses change by subtraction.
High-PhysPop Trio shows the lowest growth-ratio. Low-PhysPop Trio shows the highest growth-ratio.

	• 1940	>>> • Compare 1960 with 1940 • <<<					>>> • Compare 1988 with 1940 • <<<				
	Col.A 1940 MortRate Tab 7-A	Col.B 1960 MortRate Tab 7-A	Col.C Ratio Col.B /Col.A	Col.D Input from Col.C	Col.E Diff: Col.B minus A	Col.F Input from Col.E	Col.G 1988 MortRate Tab 7-A	Col.H Ratio Col.G /Col.A	Col.I Input from Col.H	Col.J Diff: Col.G minus A	Col.K Input from Col.J
Pacif	127.4	110.1	0.864	Avg Chg	-17.3	Avg Chg	111.5	0.875	Avg Chg	-15.9	Avg Chg
NewE	145.3	122.4	0.842	TopTrio	-22.9	TopTrio	116.4	0.801	TopTrio	-28.9	TopTrio
MidAtl	142.9	127.4	0.892	0.866	-15.5	-18.6	118.6	0.830	0.835	-24.3	-23.0
WNoCen	120.1	109.3	0.910	Avg Chg	-10.8	Avg Chg	106.8	0.889	Avg Chg	-13.3	Avg Chg
ENoCen	131.4	119.8	0.912	MidTrio	-11.6	MidTrio	116.5	0.887	MidTrio	-14.9	MidTrio
Mtn	111.8	101.0	0.903	0.908	-10.8	-11.1	100.4	0.898	0.891	-11.4	-13.2
WSoCen	99.8	102.9	1.031	Avg Chg	3.1	Avg Chg	109.8	1.100	Avg Chg	10.0	Avg Chg
ESoCen	102.5	104.8	1.022	LowTrio	2.3	LowTrio	112.7	1.100	LowTrio	10.2	LowTrio
SoAtl	106.9	107.4	1.005	1.019	0.5	2.0	111.6	1.044	1.081	4.7	8.3

Box 2, Chap. 50

All-Cancers, Females: Calculation of Adjustment Factor

This adjustment is discussed fully in Chapter 49.

• Part 1: Calculate average population-weighted MortRate for the combined TopTrio Census Divs.

Census Div.	Col.A 1940 MR Tab 7-A	Col.B 1940 Pop'n Tab 3-B	Col.C 1940 Popn /45,710,039	Col.D Col.A * Col.C
Pacific	127.4	9,733,262	0.2129	27.13
NewEng	145.3	8,437,290	0.1846	26.82
Mid-Atl	142.9	27,539,487	0.6025	86.09
1940		Sum TopTrio 45,710,039	Sum 1.0000	TopTrio 140.043

Census Div.	Col.A 1950 MR Tab 7-A	Col.B 1950 Pop'n Tab 3-B	Col.C 1950 Popn /53,964,513	Col.D Col.A * Col.C
Pacific	117.7	14,486,527	0.2684	31.60
NewEng	132.1	9,314,453	0.1726	22.80
Mid-Atl	137.0	30,163,533	0.5590	76.58
1950		Sum TopTrio 53,964,513	Sum 1.0000	TopTrio 130.973

Census Div.	Col.A 1960 MR Tab 7-A	Col.B 1960 Pop'n Tab 3-B	Col.C 1960 Popn /65,875,863	Col.D Col.A * Col.C
Pacific	110.1	21,198,044	0.3218	35.43
NewEng	122.4	10,509,367	0.1595	19.53
Mid-Atl	127.4	34,168,452	0.5187	66.08
1960		Sum TopTrio 65,875,863	Sum 1.0000	TopTrio 121.035

Census Div.	Col.A 1970 MR Tab 7-A	Col.B 1970 Pop'n Tab 3-B	Col.C 1970 Popn /75,017,000	Col.D Col.A * Col.C
Pacific	110.2	26,087,000	0.3477	38.32
NewEng	119.4	11,781,000	0.1570	18.75
Mid-Atl	122.4	37,149,000	0.4952	60.61
1970		Sum TopTrio 75,017,000	Sum 1.0000	TopTrio 117.686

Census Div.	Col.A 1980 MR Tab 7-A	Col.B 1980 Pop'n Tab 3-B	Col.C 1980 Popn /80,615,000	Col.D Col.A * Col.C
Pacific	110.4	31,523,000	0.3910	43.17
NewEng	116.4	12,322,000	0.1528	17.79
Mid-Atl	117.5	36,770,000	0.4561	53.59
1980		Sum TopTrio 80,615,000	Sum 1.0000	TopTrio 114.556

Census Div.	Col.A 1988 MR Tab 7-A	Col.B 1990 Pop'n Tab 3-B	Col.C 1990 Popn /88,495,000	Col.D Col.A * Col.C
Pacific	111.5	37,837,000	0.4276	47.67
NewEng	116.4	12,998,000	0.1469	17.10
Mid-Atl	118.6	37,660,000	0.4256	50.47
1988		Sum TopTrio 88,495,000	Sum 1.0000	TopTrio 115.241

• Part 2: Take ratios of these TopTrio MortRates, with 1940 as the denominator of each ratio.
Col.D modifies Col.C by separate PhysPop adjustments for MidTrio and LowTrio Census Divisions.

	Col.A TopTrio Mean MR	Col.B 1940 TopTrio Mean MR	Col.C = Col.A / Col.B	Col.D ppAdju Tab 47-B	Col.E = Col.C * Col.D	ALL CANCERS. Females.
				MidTrio		
1950	130.973	140.043	0.935	0.99	0.93	= MidTrio Adjustment Factor, 1950
1960	121.035	140.043	0.864	0.97	0.84	= MidTrio Adjustment Factor, 1960
1970	117.686	140.043	0.840	0.95	0.80	= MidTrio Adjustment Factor, 1970
1980	114.556	140.043	0.818	0.94	0.77	= MidTrio Adjustment Factor, 1980
1988	115.241	140.043	0.823	0.94	0.77	= MidTrio Adjustment Factor, 1988
				LowTrio		
1950	130.973	140.043	0.935	1.00	0.94	= LowTrio Adjustment Factor, 1950
1960	121.035	140.043	0.864	1.01	0.87	= LowTrio Adjustment Factor, 1960
1970	117.686	140.043	0.840	1.02	0.86	= LowTrio Adjustment Factor, 1970
1980	114.556	140.043	0.818	1.04	0.85	= LowTrio Adjustment Factor, 1980
1988	115.241	140.043	0.823	1.07	0.88	= LowTrio Adjustment Factor, 1988

Table 50-B

All Cancers, Females: Fractional Causation in 1950

Part 1.

Calculation of the 6 Adjusted MortRates (Col.F) and the National Adjusted MortRate (Col.G).

The last six entries in Part 1, Col.F, are the products of (Col.D * Col.E), as discussed in Chap. 49.

Trio-Sequence	Col.A 1950 PopFrac Tab 3-B	Col.B 1950 Obs MR Tab 7-A	Col.C A * B	Col.D 1940 MR Mid,Low Tab 7-A	Col.E AdjuFact Bx2,Pt2 Col.E	Col.F 1950 Adju MortRates	Col.G A * F
Pacific	0.0961	117.7	11.311			117.7	11.311
New England	0.0618	132.1	8.164			132.1	8.164
Mid-Atlantic	0.2002	137.0	27.427			137.0	27.427
WestNoCentral	0.0933	117.1	10.925	120.1	0.93	111.69	10.421
EastNoCentral	0.2017	127.5	25.717	131.4	0.93	122.20	24.648
Mountain	0.0337	106.0	3.572	111.8	0.93	103.97	3.504
WestSoCentral	0.0965	109.3	10.547	99.8	0.94	93.81	9.053
EastSoCentral	0.0762	110.3	8.405	102.5	0.94	96.35	7.342
SouthAtlantic	0.1406	113.3	15.930	106.9	0.94	100.49	14.128
		Sum =	122.0				Sum =
1950 Observed Natl MR from Table 7-B =			123.2	1950 Natl Adjusted MR =			115.9982

Part 2.

Trio-Seq.	Col.A Mean1940 thru1950 PPs from Tab 47-A x'	Col.B 1950 Adju MRs from Col.F Part 1	Col.C All Cancers, Females: 1950 Adjusted MortRates regressed on Mean 1940 thru 1950 PPs Regression Output:		Col.D 1940 PPs from Table 3-A (TrioSeq) x''	Col.E All Cancers, Females: 1950 Adjusted MortRates regressed on 1940 PhysPops Regression Output:	
Pac	154.16	117.7	Constant	50.6985	159.72	Constant	50.6257
NewEng	162.03	132.1	Std Err of Y Est	6.1181	161.55	Std Err of Y Est	6.2790
MidAtl	169.24	137.0	R Squared	0.8644	169.76	R Squared	0.8572
WNoCen	121.60	111.69	No. of Observation	9	123.14	No. of Observation	9
ENoCen	128.53	122.20	Degrees of Freedom	7	133.36	Degrees of Freedom	7
Mtn	119.64	103.97			119.89		
WSoCen	102.64	93.81	X Coefficient(s)	0.4894	103.94	X Coefficient(s)	0.4834
ESoCen	84.44	96.35	Std Err of Coef.	0.0733	85.83	Std Err of Coef.	0.0746
SoAtl	99.91	100.49	XCoef / S.E. =	6.6803	100.74	XCoef / S.E.	6.4819

Part 3-A.

Calculation of Fractional Causation from Averaged PhysPops

1. Nonradiation rate is Adjusted Constant (Part 2, Col.C) = 50.6985

2. Radiation rate is Natl Adjusted MortRate (Part 1, Col.G = 115.9982) minus Nonradiation rate (50.6985) = 65.2997

3. 1950 Fractional Causation is radiation rate (65.2997) divided by OBSERVED Natl MR Part 1,Col.C= 123.2 = 0.53

Part 3-B.

Calculation of Fractional Causation from 1940 PhysPops

1. Nonradiation rate is Adjusted Constant (Part 2, Col.E) = 50.6257

2. Radiation rate is Natl Adjusted MortRate (Part 1, Col.G = 115.9982) minus Nonradiation rate (50.6257) = 65.3726

3. 1950 Fractional Causation is radiation rate (65.3726) divided by OBSERVED Natl MR Part 1, Col.C= 123.2 = 0.53

Table 50-C

All Cancers, Females: Fractional Causation in 1960

Part 1.

Calculation of the 6 Adjusted MortRates (Col.F) and the National Adjusted MortRate (Col.G).

The last six entries in Part 1, Col.F, are the products of (Col.D * Col.E), as discussed in Chap. 49.

Trio-Sequence	Col.A 1960 PopFrac Tab 3-B	Col.B 1960 Obs MR Tab 7-A	Col.C A * B	Col.D 1940 MR Mid,Low Tab 7-A	Col.E AdjuFact Bx2,Pt2 Col.E	Col.F 1960 Adju MortRates	Col.G A * F
Pacific	0.1182	110.1	13.014			110.1	13.014
New England	0.0586	122.4	7.173			122.4	7.173
Mid-Atlantic	0.1905	127.4	24.270			127.4	24.270
WestNoCentral	0.0858	109.3	9.378	120.1	0.84	100.88	8.656
EastNoCentral	0.2020	119.8	24.200	131.4	0.84	110.38	22.296
Mountain	0.0382	101.0	3.858	111.8	0.84	93.91	3.587
WestSoCentral	0.0945	102.9	9.724	99.8	0.87	86.83	8.205
EastSoCentral	0.0672	104.8	7.043	102.5	0.87	89.18	5.993
SouthAtlantic	0.1448	107.4	15.552	106.9	0.87	93.00	13.467
		Sum =	114.2				Sum =
1960 Observed Natl MR from Table 7-B =			114.9	1960 Natl Adjusted MR =			106.6598

Part 2.

Trio-Seq.	Col.A Mean1940 thru1960 PPs from Tab 47-A x'	Col.B 1960 Adju MRs from Col.F Part 1	Col.C All Cancers, Females: 1960 Adjusted MortRates regressed on Mean 1940 thru 1960 PPs		Col.D 1940 PPs from Table 3-A (TrioSeq) x''	Col.E All Cancers, Females: 1960 Adjusted MortRates regressed on 1940 PhysPops	
			Regression Output:			Regression Output:	
Pac	155.69	110.1	Constant	45.0231	159.72	Constant	44.6563
NewEng	162.81	122.4	Std Err of Y Est	5.6609	161.55	Std Err of Y Est	5.5178
MidAtl	167.04	127.4	R Squared	0.8689	169.76	R Squared	0.8754
WNoCen	118.15	100.88	No. of Observation	9	123.14	No. of Observation	9
ENoCen	123.87	110.38	Degrees of Freedom	7	133.36	Degrees of Freedom	7
Mtn	117.40	93.91			119.89		
WSoCen	102.31	86.83	X Coefficient(s)	0.4661	103.94	X Coefficient(s)	0.4596
ESoCen	85.63	89.18	Std Err of Coef.	0.0684	85.83	Std Err of Coef.	0.0655
SoAtl	101.72	93.00	XCoef / S.E. =	6.8105	100.74	XCoef / S.E.	7.0134

Part 3-A.

Calculation of Fractional Causation from Averaged PhysPops

1. Nonradiation rate is Adjusted Constant (Part 2, Col.C) = 45.0231

2. Radiation rate is Natl Adjusted MortRate (Part 1, Col.G = 106.6598) minus Nonradiation rate (45.0231) = 61.6368

3. 1960 Fractional Causation is radiation rate (61.6368) divided by OBSERVED Natl MR Part 1,Col.C= 114.9 = 0.54

Part 3-B.

Calculation of Fractional Causation from 1940 PhysPops

1. Nonradiation rate is Adjusted Constant (Part 2, Col.E) = 44.6563

2. Radiation rate is Natl Adjusted MortRate (Part 1, Col.G = 106.6598) minus Nonradiation rate (44.6563) = 62.0036

3. 1960 Fractional Causation is radiation rate (62.0036) divided by OBSERVED Natl MR Part 1, Col.C= 114.9 = 0.54

Table 50-E

All Cancers, Females: Fractional Causation in 1980

Part 1.

Calculation of the 6 Adjusted MortRates (Col.F) and the National Adjusted MortRate (Col.G).

The last six entries in Part 1, Col.F, are the products of (Col.D * Col.E), as discussed in Chap. 49.

Trio-Sequence	Col.A 1980 PopFrac Tab 3-B	Col.B 1980 Obs MR Tab 7-A	Col.C A * B	Col.D 1940 MR Mid,Low Tab 7-A	Col.E AdjuFact Bx2,Pt2 Col.E	Col.F 1980 Adju MortRates	Col.G A * F
Pacific	0.1398	110.4	15.434			110.4	15.434
New England	0.0546	116.4	6.355			116.4	6.355
Mid-Atlantic	0.1630	117.5	19.153			117.5	19.153
WestNoCentral	0.0759	101.0	7.666	120.1	0.77	92.48	7.019
EastNoCentral	0.1846	112.0	20.675	131.4	0.77	101.18	18.677
Mountain	0.0502	94.9	4.764	111.8	0.77	86.09	4.322
WestSoCentral	0.1049	100.1	10.500	99.8	0.85	84.83	8.899
EastSoCentral	0.0646	103.2	6.667	102.5	0.85	87.13	5.628
SouthAtlantic	0.1624	105.0	17.052	106.9	0.85	90.87	14.756
		Sum =	108.3			Sum =	
1980 Observed Natl MR from Table 7-B =			108.5	1980 Natl Adjusted MR =			100.2433

Part 2.

Trio-Seq.	Col.A Mean1940 thru1980 PPs from Tab 47-A x'	Col.B 1980 Adju MRs from Col.F Part 1	Col.C All Cancers, Females: 1980 Adjusted MortRates regressed on Mean 1940 thru 1980 PPs Regression Output:		Col.D 1940 PPs from Table 3-A (TrioSeq) x''	Col.E All Cancers, Females: 1980 Adjusted MortRates regressed on 1940 PhysPops Regression Output:	
Pac	177.35	110.4	Constant	43.5132	159.72	Constant	45.3316
NewEng	185.86	116.4	Std Err of Y Est	4.8101	161.55	Std Err of Y Est	5.1053
MidAtl	186.11	117.5	R Squared	0.8839	169.76	R Squared	0.8692
WNoCen	128.82	92.48	No. of Observation	9	123.14	No. of Observation	9
ENoCen	133.71	101.18	Degrees of Freedom	7	133.36	Degrees of Freedom	7
Mtn	133.45	86.09			119.89		
WSoCen	114.66	84.83	X Coefficient(s)	0.3857	103.94	X Coefficient(s)	0.4136
ESoCen	99.46	87.13	Std Err of Coef.	0.0528	85.83	Std Err of Coef.	0.0606
SoAtl	124.62	90.87	XCoef / S.E. =	7.3005	100.74	XCoef / S.E.	6.8210

Part 3-A.

Calculation of Fractional Causation from Averaged PhysPops

1. Nonradiation rate is Adjusted Constant (Part 2, Col.C) = 43.5132

2. Radiation rate is Natl Adjusted MortRate (Part 1, Col.G = 100.2433) minus Nonradiation rate (43.5132) = 56.7300

3. 1980 Fractional Causation is radiation rate (56.7300) divided by OBSERVED Natl MR Part 1,Col.C= 108.5 = 0.52

Part 3-B.

Calculation of Fractional Causation from 1940 PhysPops

1. Nonradiation rate is Adjusted Constant (Part 2, Col.E) = 45.3316

2. Radiation rate is Natl Adjusted MortRate (Part 1, Col.G = 100.2433) minus Nonradiation rate (45.3316) = 54.9117

3. 1980 Fractional Causation is radiation rate (54.9117) divided by OBSERVED Natl MR Part 1, Col.C= 108.5 = 0.51

Table 50-F

All Cancers, Females: Fractional Causation in 1988

Part 1.

Calculation of the 6 Adjusted MortRates (Col.F) and the National Adjusted MortRate (Col.G).

The last six entries in Part 1, Col.F, are the products of (Col.D * Col.E), as discussed in Chap. 49.

Trio-Sequence	Col.A 1990 PopFrac Tab 3-B	Col.B 1988 Obs MR Tab 7-A	Col.C A * B	Col.D 1940 MR Mid,Low Tab 7-A	Col.E AdjuFact Bx2,Pt2 Col.E	Col.F 1988 Adju MortRates	Col.G A * F
Pacific	0.1535	111.5	17.115			111.5	17.115
New England	0.0527	116.4	6.134			116.4	6.134
Mid-Atlantic	0.1527	118.6	18.110			118.6	18.110
WestNoCentral	0.0721	106.8	7.700	120.1	0.77	92.48	6.668
EastNoCentral	0.1713	116.5	19.956	131.4	0.77	101.18	17.332
Mountain	0.0543	100.4	5.452	111.8	0.77	86.09	4.674
WestSoCentral	0.1087	109.8	11.935	99.8	0.88	87.82	9.546
EastSoCentral	0.0621	112.7	6.999	102.5	0.88	90.20	5.601
SouthAtlantic	0.1725	111.6	19.251	106.9	0.88	94.07	16.227
		Sum =	112.7				Sum =
1988 Observed Natl MR from Table 7-B =			111.3	1988 Natl Adjusted MR =			101.4089

Part 2.

Trio-Seq.	Col.A Mean1940 thru1990 PPs from Tab 47-A x'	Col.B 1988 Adju MRs from Col.F Part 1	Col.C All Cancers, Females: 1988 Adjusted MortRates regressed on Mean 1940 thru 1990 PPs Regression Output:		Col.D 1940 PPs from Table 3-A (TrioSeq) x''	Col.E All Cancers, Females: 1988 Adjusted MortRates regressed on 1940 PhysPops Regression Output:	
Pac	191.97	111.5	Constant	46.2557	159.72	Constant	50.5238
NewEng	208.20	116.4	Std Err of Y Est	4.8659	161.55	Std Err of Y Est	5.8211
MidAtl	204.72	118.6	R Squared	0.8703	169.76	R Squared	0.8144
WNoCen	141.14	92.48	No. of Observation	9	123.14	No. of Observation	9
ENoCen	146.19	101.18	Degrees of Freedom	7	133.36	Degrees of Freedom	7
Mtn	145.91	86.09			119.89		
WSoCen	126.28	87.82	X Coefficient(s)	0.3393	103.94	X Coefficient(s)	0.3831
ESoCen	113.28	90.20	Std Err of Coef.	0.0495	85.83	Std Err of Coef.	0.0691
SoAtl	142.93	94.07	XCoef / S.E. =	6.8536	100.74	XCoef / S.E.	5.5419

Part 3-A.

Calculation of Fractional Causation from Averaged PhysPops

1. Nonradiation rate is Adjusted Constant (Part 2, Col.C) = 46.2557

2. Radiation rate is Natl Adjusted MortRate (Part 1, Col.G = 101.4089) minus Nonradiation rate (46.2557) = 55.1532

3. 1988 Fractional Causation is radiation rate (55.1532) divided by OBSERVED Natl MR Part 1,Col.C= 111.3 = 0.50

Part 3-B.

Calculation of Fractional Causation from 1940 PhysPops

1. Nonradiation rate is Adjusted Constant (Part 2, Col.E) = 50.5238

2. Radiation rate is Natl Adjusted MortRate (Part 1, Col.G = 101.4089) minus Nonradiation rate (50.5238) = 50.8851

3. 1988 Fractional Causation is radiation rate (50.8851) divided by OBSERVED Natl MR Part 1, Col.C= 111.3 = 0.46