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Comments and Questions on Tables from
Mancuso, Stewart, Kneale Paper

By

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1. Since this analysis is a proportional mortality analysis (the population at risk is not considered) any elevation in the cancer proportion may represent a deficiency of deaths due to other causes. This can be a problem even for internal comparisons.

   Referring to example 1 (page 3), a comparison of short and long term workers by means of proportional analysis would reveal an elevated cancer proportion for long term workers when in fact the population based SMR's are identical. Similarly, in example 2, one might conclude that cancer deaths are excessive for the potentially exposed group if only proportional analysis is carried out.

2. Referring to tables 1, 6 and 7, are the authors aware that workers with no recorded radiation are primarily very short term workers? As noted above, and in example 1, such workers have slightly higher death rates from non-cancer causes than longer term workers. Hence the proportion of deaths due to cancer appears elevated for the longer term workers. Pertinent also to tables 8-12 is the fact that the longer one works at Hanford, the more opportunity one has to accumulate radiation exposure (i.e. the number of years at Hanford is correlated with radiation exposure) . Is it possible that other factors in the Hanford environment, particularly the medical surveillance program, have prevented or postponed deaths from non-cancer causes resulting in an elevated proportion of deaths due to cancer?

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3. What consideration has been given to age and calendar year of death? The proportion of deaths due to cancer, particularly respiratory cancer, has risen in recent years. (See Table A) Since workers dying in late years have had more opportunity to accumulate exposure, this could induce a correlation. Furthermore, for US white males the proportion of deaths due to cancer increases with age until about age 60 and then decreases. Our data indicate that total dose at death has a very similar relationship with age, again inducing a correlation.

4. What conclusions are drawn from Tables 2-5? What, if any, tests of significance are carried out? Since a given person contributes to several rows of each of the four tables, some consistency of direction is not surprising. A test which treated the 30 years as independent would not be correct. To me, the most striking feature of these tables is the agreement of case and control means -- especially in view of the comment below.

5. In view of the highly skewed nature of the dosimetry data, why was the mean chosen as the basic measure? Because only a very small proportion of Hanford workers have much potential for occupational exposure to radiation, the distribution of doses is extremely skewed (See Table B). With such data one or two large doses can have a very large effect on the mean. For example in Table 7, the mean for myeloma (203) is 948. Eliminating just two high doses reduces this mean to 239.

6. Referring to Tables 9-13, is a t-test appropriate for distributions that are so far from normal?

7. Has any attention been given to the fact that nearly all higher exposures are received in just a few specific occupations, all of them categorized craftsmen or operators? By contrast the low exposure group consists of a much wider variety of occupations. Could other occupational hazards and/or socio-economic factors play a role in the patterns observed?

8. In Tables 9-12, has any consideration been given to the fact that when one performs a large number of tests, a few will be significant by chance alone? This would appear to be a problem in interpreting the results for all cancers, solid tumors, lung cancer and breast cancer.

EXAMPLES

The following examples result from the population analysis currently under way at Battelle. The method used involves first calculating the deaths expected in the population at risk based on age-calendar year specific death rates for U.S. white males. The standard mortality ratio (SMR) is defined as the ratio of observed to expected deaths.

Example 1: Comparison of short term (employed at Hanford less than two years) and long term (employed two or more years) workers.

	Short Term Workers	Long Term Workers
SMR for All Causes	.86	.73
SMR for Cancer	.84	.86

Example 2: Comparison of craftsmen and operators employed in occupations with higher and lower potential for radiation exposure.

	Potential for Exposure	
	High	Low
SMR for All Causes	.65	.76
SMR for Cancer	.92	.92

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Table A

Proportion of Deaths Due to All Malignant Neoplasms (U.S. White Males)

Age at Death	Year of Death 50-	55-	60-	65-	71
25-	.090	.097	.100	.090	.086
30-	.107	.118	.122	.118	.115
35-	.117	.129	.132	.135	.129
40-	.129	.141	.148	.153	.157
45-	.151	.162	.168	.173	.183
50-	.168	.183	.188	.196	.207
55-	.184	.196	.204	.209	.227
60-	.187	.201	.208	.215	.228
65-	.179	.191	.199	.207	.226
70-	.165	.173	.179	.188	.204
75-	.146	.149	.152	.134	.177
80-	.119	.123	.122	.129	.144
85-	.085	.085	.086	.087	.098

Due to Cancer of Respiratory System

Age at Death	Year of Death 50-	55-	60-	65-	71
25-	.004	.005	.005	.003	.004
30-	.009	.013	.014	.013	.013
35-	.016	.022	.025	.029	.030
40-	.028	.033	.046	.045	.052
45-	.039	.048	.053	.059	.072
50-	.047	.058	.065	.072	.082
55-	.050	.064	.073	.078	.092
60-	.046	.061	.071	.079	.091
65-	.035	.049	.060	.070	.086
70-	.024	.033	.043	.053	.067
75-	.014	.020	.027	.035	.047
80-	.008	.011	.014	.019	.028
85-	.005	.006	.007	~~.083~~ .008	.013

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Table B

Distribution of Total Doses for Hanford White Males Dying 1949-1971

Percentile	Total Dose in Centirems
10	0
20	0
30	8
40	17
50	30
60	48
70	74
80	119
90	234
95	530
96	640
97	820
98	1500
99	2200

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Male Deaths from RES Neoplasms (200-209)

Cause Code	Total Dose (Centirads)	Yrs. of Hanford
200	128	49-51
	0	47-59
	72	61-65
	2	44-45
	114	44-45
	279	45-55
	39	47-55
	49	45-54
	785	44-67
	50	45-64
	318	45-76
	34	44-47
	52	44-57
	68	53-55
	32	44-56
	2	43-48
	—	44-45
201	122	44-60
	275	53-68
	—	56-59
	908	47-62
	377	48-58
	—	48-49
	10	48-49
	28	45-45
	28	44-45
	145	44-46
	1	58-62

Code	Dose	Yrs.
202	97	44-50
	—	44-45
	39	44-45
	7	48-51
	—	—
	—	—
	—	—
203	23	45-45
	—	45-45
	*2944	47-67
	*3438	45-65
	85	45-63
	*1998	47-64
	18	44-51
	9	44-45
	15	47-53
	0	44-44
	—	44-44
204	23	44-56
	—	44-44
	34	47-50
205	—	—
	0	47-47
	1	44-46
	0	57-61
	0	45-45
	—	44-44
	*1144	44-68
	30	45-47
	3	48-49

Code	Dose	Yrs.
206	20	45-55
	119	51-69
207	—	47-47
	505	
	—	—
208	—	44-44
209	6	47-61

* Note these four deaths almost completely account for dose relationship of Myeloid Neoplasms.

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