J. L. Nelson — This was read to Dennis Polite of the Louisville Times yesterday in response to a query about the number of employees currently at home and their compensation.

August 14, 1974

W. T. Duke
8/15/74

STATEMENT FOR USE IN REPLY TO QUERY FROM DENNIS POLITE

It is our practice to remove employees with liver abnormalities from their jobs when our plant physician feels it is warranted. In some cases, these employees are moved to other work. In other cases they are sent home until further diagnostic study can be completed or the abnormality is corrected. The number of such employees has been small. None of these employees sent home have been laid off. They are receiving full benefits under our programs.

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TO	FIELD POINT OR AKRON DEPARTMENT & BLDG. NO.	DATE YOUR LETTER
B. M. G. Zwicker	Cleveland	
FROM	FIELD POINT OR AKRON DEPARTMENT & BLDG. NO.	DATE THIS LETTER
J. C. Schaap A. M. Fairlie	Cleveland	August 22, 1974

SUBJECT

Comments on Peters and Monson and NIOSH Mortality Tables -- Proportional vs. Actual Mortality Analysis

SUMMARY:

Proportional and actual mortality analyses are two methods commonly used to construct mortality tables. The proportional mortality table is useful in determining whether a population has an abnormal distribution of deaths among various diseases, but may be misleading as to whether the death rate of a specific disease is actually abnormal. The actual mortality table permits this latter determination.

Peters and Monson use proportional mortality analysis to show that rates of brain, liver, lung, and total cancers are abnormally high in the Louisville and Calvert City plants mortality data. An actual mortality analysis by BFG indicates that only brain and liver are significantly in excess. Data from a NIOSH study of the Louisville plant indicates that brain, liver, and total cancer rates are again high. However, the method of mortality analysis is not given.

DISCUSSION:

Dr. John M. Peters of Harvard University testified before OSHA on June 27, 1974. He and Dr. Richard Monson obtained data on 161 deceased workers from the Louisville and Calvert City BFG plants. They constructed a mortality table based on this data and the age distribution of the plants' employees (Table 1).

Their major findings indicated (1) a 50% excess of total cancer deaths, (2) a 60% excess of lung cancer, and (3) a 320% excess of brain cancer. Liver cancer cases were ten times that expected. The above conclusions are based on a proportional mortality analysis. In addition, a study by NIOSH has indicated an excess of cancer deaths among 86 deceased employees of the Louisville plant.[1] This data could also have been analyzed on a proportional mortality basis, but at this time we are not certain of this.

The above conclusions are not consistent with those found in the Tabershaw-Cooper MCA study, nor with Table D of TCA's addendum to the BFG study. The discrepancy is apparently caused by the differences between the numbers of

1. "Louisville VC Study" to A. Vittone from M. N. Johnson

expected deaths calculated in the proportional mortality analysis used above, and the actual mortality analysis method employed by TCA.[1]

The numbers of expected deaths in the actual mortality analysis are calculated from the observed death rates of the U.S. male population having an identical age distribution. An expectation of, say, 40 cancer deaths in a plant's employee population means that 40 people will, on the average, have died of cancer, regardless of the rates of other diseases.

Numbers of expected deaths in a proportional mortality analysis are found by computing the proportion of deaths in the age adjusted U.S. male population, and multiplying these proportions by the total number of observed worker deaths. An expectation of, say, 40 cancer deaths in a proportional mortality table containing 200 total deaths would indicate a 20% proportion of cancer deaths in the age adjusted U.S. male population.

It is our opinion that an actual mortality analysis reflects true relationships between observed and expected death rates while the proportional mortality analysis can lead to serious distortions. The differences between these two analyses can be more easily seen in the following hypothetical example.

Suppose 20% of an age adjusted U.S. male population will, on the average, die of cancer, 60% of heart disease, and 20% of other causes. Also assume that the expected number of deaths calculated by the actual mortality analysis is 200. Then the expectations of actual mortality are:

Disease	Expected Number of Deaths
Cancer	40
Heart	120
Other	40
Total	200

If 40, 120, and 40 plant people had actually died of cancer, heart disease, and other causes, respectively, the plant population would be considered "normal." However, suppose only 80 had died of heart disease, but still 40 of cancer and 40 of other causes. The actual mortality table would be:

Disease	Observed	Expected
Cancer	40	40
Heart	80	120
Other	40	40
Total	160	200

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1. The term "actual mortality analysis" refers to the method used by TCA in determining the Standardized Mortality Ratio (SMR).

The rate of heart disease is 33% less than normal. Cancer and other diseases occur at normal rates. The overall death rate is 20% less than normal.

The proportional mortality table does not lead to the same conclusion. Multiplying the respective proportions (.2, .6, .2) by the total number of observed deaths (160), the proportional mortality table is:

Disease	Observed	Expected
Cancer	40	32
Heart	80	96
Other	40	32
Total	160	160

Cancer and other diseases are now indicated as 25% in excess. Heart disease is 17% less than normal. This apparent increase in the rate of cancer is actually due to the lower incidence of heart disease.

The Peters and Monson table is a proportional mortality table. Much of the cancer excess indicated in their Table 1 is apparently due to the lower incidence of heart disease found at Louisville and perhaps also at Calvert City.

The MCA study and the BFG addendum indicate that vinyl chloride workers in general and also Louisville employees have significantly lower death rates than comparable age adjusted U.S. male populations. Taking this lower mortality into account, the Peters and Monson table can be corrected to express actual rather than proportional mortality death rates.[1] This correction is only approximate since it is based just on the Louisville workers included in Table D of the addendum, and not on the combined Louisville and Calvert City plant populations.

The corrected data are displayed in Table 2. Major conclusions are:

(1) Total deaths due to all cancers are not significantly higher than expected (41 actual vs. 35.1 expected).

(2) Liver and biliary cancers are significantly in excess (8 actual vs. 1.0 expected).

(3) Cancer of the brain is significantly in excess (5 actual vs. 1.5 expected).

(4) Cardiovascular and renal diseases are significantly lower than expected (74 actual vs. 98.1 expected).

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1. Corrected by multiplying each expected number of deaths in the proportional mortality table by 1.257 =

$$\frac{\text{expected number of deaths among Louisville employees with EI 1.1-3.0}}{\text{actual number of deaths among Louisville employees with EI 1.1-3.0}}$$

The NIOSH data may have also been analyzed on a proportional mortality basis. If so, the same correction factor (1.257) could be applied:

	PROPORTIONAL MORTALITY			ACTUAL MORTALITY		
Cause of Death	Observed	Expected	Obs/Exp	Observed	Expected	Obs/Exp
All Malignancies	26	16.3	1.6 *	26	20.5	1.3
Liver Malignancy	6	.4	15.0 *	6	.5	12.0 *
Brain Malignancy	3	.57	5.3 *	3	.7	4.3 *
Leukemia and Related Malignancy	3	1.6	1.9	3	2.0	1.5
All Others	14	13.69	1.0	14	17.2	0.8

* Significant with 95% confidence

The actual mortality analysis indicates that liver and brain malignancies are significantly in excess. The proportional mortality analysis also indicates (incorrectly) that the "all malignancy" category is abnormally high.

A. M. Fairlie

J. C. Schaap

AMF/JCS:cls

cc: A. Vittone
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TABLE 1

OBSERVED AND EXPECTED DEATHS IN VINYL CHLORIDE WORKERS [a]

ICD Number [b]	Cause of Death	Observed	Expected	Obs/Exp
----	All	161	161.0	1.0
140-205	All cancer	41	27.9	1.5
150-159	Digestive	13	8.3	1.6
155	Liver & Biliary Tract	8	0.8	10.0
162,163	Lung	13	7.9	1.6
193	Brain	5	1.2	4.2
200-205	Lymphatic & Hematopoetic	5	3.4	1.5
----	Other [c]	5	7.1	0.7
330-334	CNS Vascular	8	9.5	0.8
400-468	Circulatory	66	68.6	1.0
800-998	External	22	24.5	0.9
960-969	Suicide	10	5.3	1.9
----	All Other [d]	24	30.5	0.8

a. Expected numbers based on age-time specific proportional mortality rates for U.S. white males

b. International Classification of Diseases, 7th Revision

c. Nasopharynx - 1, prostate - 1, kidney - 1, thyroid - 1, undetermined - 1

d. Includes 2 cirrhosis (4.2 expected)

TABLE 2

Actual Mortality Analysis

Approximate Observed and Expected Deaths in Louisville and Calvert City VCl Workers, Adjusting for Overall Death Rate of Non-Exposed Age Specific U.S. Male Population

ICD	Cause of Death	Observed	Expected	Obs/Exp
	All Causes	161	202.4	.80 *
140-205	All Cancer	41	35.1	1.17
150-159	Digestive	13	10.4	1.25
155	Liver and Biliary	8	1.0	8.00 *
162,163	Lung	13	9.9	1.31
193	Brain	5	1.5	3.33 *
200-205	Lymphatic and Hematopoetic	5	4.3	1.16
	Other Cancers	5	8.9	.56
330-334 400-468	Cardiovascular and Renal	74	98.1	.75 *
330-334	CNS Vascular	8	11.9	.67
400-468	Circulatory	66	86.2	.77 *
800-998	External	22	30.8	.71
960-969	Suicide	10	6.7	1.49
	All Other (Inc. 2 Cirrhosis, 5.3 Expected)	24	38.3	.63 *

* Significant with 95% confidence