Mortality through 2000 among Workers Employed Between 1944 and 1992 at the Pittsburgh Energy Technology Center

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Introduction

The Pittsburgh Energy Technology Center (PETC) was a government-owned facility operated by the Department of Energy (DOE) and managed by the Assistant Secretary for Fossil Energy from 1977 to 1996. In late 1996 the Federal Energy Technology Center (FETC) was established through consolidation of Energy Technology Centers in Pittsburgh and Morgantown. In December 1999 the National Energy Technology Laboratory (NETL) was created from FETC and was designated as DOE's 15th national laboratory. Historically this facility was involved in a wide variety of research and development activities for promoting the use of coal, including coal preparation and combustion, coal gasification, coal liquefaction, flue gas clean-up, and oil shale activities. It was founded in 1944 as the Bruceton Research Center by the United States (U.S.) Bureau of Mines (BOM), Office of Synthetic Liquid Fuels. Certain research and development activities were transferred to the Energy Research and Development Administration on January 19, 1975, and the site was designated as the Pittsburgh Energy Technology Center (PETC) by the DOE on October 1, 1977.

Exposures to organic and inorganic chemicals resulted from the major activities and associated research and development support activities at PETC. In March 1992 workers at PETC expressed concern that workplace exposures may be having an adverse effect on their health. Specifically, they were concerned about the possibility of an increase in heart attacks among former workers, the potential cumulative health effects of chemical exposures, and a possible relationship between exposure to perchloroethylene and psychological effects such as nervous tension, irritability, and anger.

In response to these worker concerns a descriptive epidemiologic investigation was initiated to examine mortality through 1992 among PETC workers employed at least four months between 1944 and 1992. Details of this investigation can be found in the study report (Dupree et al., 1996). Because of the materials used at PETC, cancers and diseases of the nervous system, the respiratory system, and kidneys were of particular interest, along with examining heart disease as the workers requested. With follow-up through 1992, results for male workers showed that mortality from heart diseases (17 deaths) was approximately 57% of what was expected based on U.S. comparison rates and 49% of expected deaths using Allegheny County rates. Mortality from all cancers combined (24 deaths) was 91% and 84% of expected based on U.S. and Allegheny

County rates, respectively. The relatively small number of deaths made it difficult to investigate specific causes of death with any precision. Results for female workers were also unremarkable. The lower mortality through 1992 may have been influenced by the healthy worker effect, which lessens with time since hire.

To further examine potential health effects over time, an updated investigation was initiated to determine whether significant mortality increases occurred with additional follow-up. This current report summarizes the results of the updated mortality among PETC workers through 2000.

Methods

On November 1994, staff of the Oak Ridge Institute for Science and Education (ORISE) Center for Epidemiologic Research (CER) photocopied service record cards [Standard Form 7 (SF7)] of all active and inactive PETC workers. Each card contained full name, social security number, birth date, gender, and job history, and facility of employment, but data on race were incomplete to the point of being useless.

Vital status of the cohort through December 31, 1992, was determined from combined sources including the SF7, the Pension Benefit Information Incorporated (PBI) and the National Death Index (NDI). Death certificates were retrieved from state death registries, and each underlying cause of death was classified to the Eighth Revision of the International Classification of Diseases, Adapted for Use in the United States (ICD8). OCMAP software (Marsh, 1980) was used to calculate standardized mortality ratios (SMRs) using the U.S. general population and the Allegheny County, Pennsylvania, population as the reference groups. Person-years of follow-up were calculated beginning 122 calendar days after the date of first hire (January 1, 1944 if later) until the date of death, date last known alive, or December 31, 1992, whichever was earliest. NDI identifies deaths beginning January 1, 1979. Workers with unknown vital status and known to be alive prior that date were considered lost to follow-up on the last date known alive. Workers known to be alive on or after January 1, 1979, were considered alive on December 31, 1992 if there was no indication of death by NDI.

For the current updated vital status through December 31, 2000, mortality information was obtained from PBI, and cause of death information on the newly identified deaths was supplied by the NDI. For consistency, all cause of death codes were converted to ICD-9. Analyses were based on the previous study cohort of 986 workers, which included 260 women and 726 men. (See Dupree, et al., 1996 for additional details.)

EPICURE© software was used to conduct SMR analysis with U.S. general population rates as the referent and extending the rates for 1990-1995 through December 31, 2000. If gender, age, and calendar year specific external rates are denoted by r*(z,t) then the model for calculating the SMR is this: $r(z,t) = \beta(r^*(z,t))$. Likelihood ratio methods were used to calculate 95% confidence limits using the AMFIT module of EPICURE©.

Results

Updated results through December 31, 2000 determined a total of 123 deaths with 110 for men and 13 for women. Cause of death for the nine men (8.2%) previously known to be deceased but without death certificates were still not retrievable, but cause was established for all newly determined deaths. The cohort accumulated 20,921 person-years of follow up with 16,612 (79%) contributed by men and 4,309 by women. The average length of follow-up was 22.9 years for men and 16.6 years for women.

The SMRs using the male and female U.S. rates as the referent are presented in Table 2 for men and women combined, with appropriate rates applied to male and female person-years. No SMRs were statistically elevated at the 5% level of significance. The only statistically significant SMRs were decreases for all causes of death, all circulatory diseases and its subcategory arteriosclerotic heart diseases, non-malignant respiratory diseases, and accidents. All of the other SMRs were not statistically different from 100, having a lower 95% confidence interval bound below 100 and an upper bound of 100 or higher.

Although the SMR for all cancers combined was 90.2, SMRs for many site-specific cancers were greater than 100, including buccal cavity and pharynx, digestive organs and peritoneum, stomach, rectum, pancreas, kidney, Hodgkins disease, and leukemia and

alleukemia. However, there were few observed deaths for any cancer sites except the lung and combined the digestive organs and peritoneum.

Table 2 : Standardized Mortality Ratios Based on U.S. Population Rates for Males and Females

Cause of death	Observed Deaths	Expected Deaths	SMR	95% C.I.
All causes (001.0-999.9)	123	208.76	58.9	49.1, 70.0
All cancers (140.0-202.1,202.4,202.7-208.9, 238.4,238.6,239.8)	50	55.38	90.3	67.5, 117.7
Buccal cavity and pharynx (140.0-149.0)	2	1.29	155.0	25.8, 478.7
Digestive organs and peritoneum (150.0-159.0,159.2-159.9)	17	13.02	130.5	77.9, 202.8
Esophagus (150.0-150.9)	1	1.47	68.1	1.7, 379.3*
Stomach (151.0-151.9)	2	1.68	119.3	19.8, 368.4
Large intestine (153.0-153.9,159.0)	5	4.76	105.1	37.7, 225.9
Rectum (154.0-154.2,154.4-154.9)	3	0.97	309.6	77.0, 802.9
Pancreas (157.0-157.9)	4	2.66	150.7	46.8, 350.0
Lung (162.0-162.9)	12	20.17	59.5	31.9, 99.8
Prostate (185.0-185.9)	3	4.27	70.3	17.5, 182.4
Kidney (189.0-189.9,188.7)	2	1.44	139.1	23.1, 429.4
Bladder (188.0,188.6,188.8,188.9)	2	1.27	158.0	19.1, 570.5*
All lymphatic and hematopoietic (200.0-202.1,202.4,202.7,208.9,238.4,238.6,239.8)	4	5.53	72.3	22.5, 168.0

Hodgkins (201.0-201.9)	1	0.32	311.4	17.8, 1371.0
Leukemia and Alleukemia (204.0-208.9,202.4,203.1)	3	2.05	146.7	36.5, 380.3
Diabetes mellitus (250.0-250.9)	2	3.74	53.5	8.9, 165.3
All circulatory disease (390.0-45.99)	44	87.17	50.5	37.0, 66.9
Arteriosclerotic heart disease with CHD (410.0-414.9,429.2)	33	60.50	54.5	38.0, 75.3
All vascular lesions (430.0-43.89)	6	9.00	66.6	26.5, 135.0
Non-malignant respiratory disease (460.0-519.9)	7	15.53	45.1	19.4, 87.2
All pneumonia (480.0-486.9,507.0)	2	4.84	41.3	6.9, 127.6
All genitor-urinary diseases (580.0-629.9)	2	2.38	84.1	14.0, 259.6
Chronic nephritis (582.0-582.9)	1	0.25	407.4	23.3, 1794.0
All accidents (E800.0-E949.9)	4	12.27	32.6	10.1, 75.7
Motor vehicle accidents (E810.0-E829.9)	2	6.04	33.1	5.5, 102.2
*Confidence limits are likelihood ratio bounds except for those designated by *, which were calculated using exact Poisson limit multipliers from Table 2.11, Breslow and Day (1987).				

DISCUSSION

The significantly decreased SMR for all causes of death, also seen in the study with follow-up through 1992, is not unexpected in an occupational cohort study. The low mortality rates were driven by heart disease and other circulatory diseases, for which there were 87.2 deaths expected but only 44 observed. Other significant deficits included non-malignant respiratory diseases and accidents.

While no SMRs for specific cancer sites were statistically significantly increased, several

remained elevated, although only lung and combined digestive had more than five observed deaths. Cancer causes of death of a priori interest were bladder, kidney, liver, lung, prostate, skin and leukemia. There were no liver or skin cancer deaths. The two bladder, two kidney, and three leukemia cancer deaths resulted in elevated SMRs, while the 12 lung and three prostate cancer deaths produced decreased SMRs.
Malignant and non-malignant respiratory diseases might be expected in excess in this cohort because of occupational exposure, but this was not the case. Respiratory deaths are also increased among smokers. The low SMR for lung cancer and two smoking-related causes of death, circulatory disease and non-malignant respiratory disease, might point to lower levels of smoking in the study group than in the referent U.S. population. However, bladder cancer, which is also smoking-related, had two observed deaths with 1.3 expected. Smoking pattern information was not available for this analysis.

If available, information on the department or area of the facility where these individuals worked would have been useful to evaluate whether or not a disease was clustered in individuals who worked in a given department or area of the plant. The nine of workers identified as deceased in follow-up through 1992 without cause of death identification continued to cause underestimation in the site-specific analyses, although the percent with unknown causes decreased from 14% to 8%. These nine deaths were included only in the all causes category. Because the total number of deaths in this population was small with only 12.5% of the cohort deceased by the end of 2000, the addition of a few deaths to any one category could have had a large effect on the value of the SMR for that cause of death.

The current study added a potential eight years of follow-up to each cohort member, raising the average length of follow-up to 23 years in men and 17 years in women. It would be expected that 20 years of follow-up should be sufficient for the suggestion of increased risk from occupational exposures to be seen. In particular, there is no indication whatsoever of a cohort-wide increase of deaths from diseases of the circulatory system, which include cardiovascular diseases.

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