Pratt & Whitney Jet Engine Manufacturing Workers Study

Overview of Methods, Final Results and Conclusions – May 2013

Background and Investigators

The union that represents workers and some family members asked the Connecticut Department of Public Health (CTDPH) to study worker health at Pratt & Whitney (P&W). P&W, its workers and their families wanted to know if cases of brain cancer were related to working at the North Haven (NH) jet engine manufacturing plant. Because the study was too big for the CTDPH to do alone, they got university researchers to conduct the study. P&W paid for the study but the researchers worked in collaboration with the CTDPH. The study was led by Dr. Gary Marsh, from the University of Pittsburgh (UPitt), Department of Biostatistics, Center for Occupational Biostatistics and Epidemiology, and Dr. Nurtan Esmen, from the University of Illinois at Chicago (UIC), Department of Environmental and Occupational Health Sciences.

Goals of the Study

The primary goals of the study were:

- To determine if an excess of malignant or benign brain tumors exists among employees from eight past and present P&W plants in Connecticut (CT) as compared to the general US population and the population of the state of CT
- To compare death rates for all causes of death, including brain cancer, in P&W workers with those in the general population
- To describe the work environment in the plants by job title, the types of engine parts made and manufacturing processes used and levels of workplace exposure
- To examine whether specific causes of death, including brain cancer, were related to workplace exposures in the jet engine manufacturing setting

Who Was Included in the Study?

222,123 men and women who worked one or more days in one or more of eight Connecticut P&W manufacturing facilities from 1952 to 2001 were included in the analyses of mortality.

210,784 men and women who worked one or more days in one or more of eight Connecticut P&W manufacturing facilities from 1952 to 2001 and who were alive between 1976 and 2004 were included in the analyses of central nervous system cancer incidence.

What Information Did the UPitt Researchers Use?

The epidemiology and biostatistical component of the study, conducted by UPitt, included:

- Historical cohort mortality and cancer incidence studies
- A nested case-control study of malignant and benign neoplasms of the brain and other central nervous system (CNS) cancer sites
- A genetics study based on tissue specimens obtained from cases of malignant brain neoplasms

For these components, the researchers looked at:

- Plant records of when and where people worked and their age, race and sex
- National and state records to determine if workers were living or deceased and the cause of death for deceased workers
- Matches from 21 state cancer registries to get information on whether and when an employee was diagnosed with CNS cancer and what specific type of cancer

The researchers compared:

- Number of deaths among workers to the number expected in the general population of the US and of CT for
    - All causes of death combined, groups of diseases (such as all cancer) and specific diseases (such as lung cancer)
    - CNS cancers, including malignant and benign brain tumors
- Number of CNS cancer cases among workers to the number expected in the general population of the US and of CT for specific types of malignant CNS cancers, including:
    - Glioblastoma
    - Astrocytoma
    - Other malignant CNS cancers

The researchers conducted statistical tests to determine:

- If there was an excess number of CNS cases among P&W workers
- If the results were related to factors such as payroll type, age group, year of hire or the length of time worked
- If the results were due to work in a specific process or with a part group at P&W
- If the results were due to exposure to specific agents at P&W
- If the results were due to chance or not

What Information Did the UIC Researchers Use?

A companion exposure assessment project, conducted independently UIC, characterized the historical work practices and exposures that occurred within the P&W study plants. The UIC exposure assessment considered 11 chemical or physical agents on the basis of known or suspected carcinogenic potential in the CNS and/or other organ systems. UIC generated quantitative estimates for soluble and mineral oil metalworking fluids, nickel, cobalt, chromium, solvents and the incomplete combustion aerosol from metalworking fluids generated during high speed and high temperature grinding ("blue haze") that was unique to NH. Qualitative estimates (exposed/ unexposed) were assigned for ionizing radiation, electromagnetic fields, polychlorinated biphenyls and lead-cadmium. The exposure estimates showed decreasing trends for all agents during the study period and the quantitative exposure levels were similar to or less than published data from other industries. The assessment also involved estimation of worker time spent in 20 categories of "parts produced" and 16 categories of "processes performed" as a screening tool to detect possible excess GB risk in relation to some 3,000 exposure agents present in the P&W workforce but not characterized in the quantitative exposure assessment.

Study Results

CNS Study Results

For CNS neoplasms, the results of the initial mortality and incidence studies were generally consistent, revealing no statistically significant elevations in overall rates among the P&W workforce compared with the corresponding rates in the general populations of the US and CT.

In both studies, internal comparisons within the P&W workforce revealed elevated rates of CNS neoplasms (and GB in the incidence study) among workers in the NH plant compared with other plant groups and in certain subgroups of workers from NH, but no evidence of an association with general workplace factors at P&W such as duration of employment.

In general, the elevated rates in NH were small to moderate and not statistically significant. The subsequent evaluations of CNS neoplasm incidence in relation to estimated workplace exposures and our evaluation of GB incidence in relation to workplace experiences with parts and processes also revealed no workplace associations overall, and did not explain the elevated rates of GB in NH.

Results for Other Causes of Death

UPitt/UIC evaluated whether mortality rates from all causes of death combined or from any malignant or non-malignant cause of death category (excluding CNS neoplasms) were elevated or related to workplace experiences or exposures. With the exception of elevated rates in two study plant groups for certain chronic obstructive pulmonary disease (COPD)-related categories, this evaluation found no evidence of elevated rates. The COPD-related mortality excesses were not related to the P&W workplace exposure factors studied. UPitt/UIC could not rule out occupational exposures received outside of work at P&W or uncontrolled positive confounding by smoking as reasons for the COPD-related excesses.

Results for the Nested Case-Control Study of Brain Cancers

The UPitt/UIC investigation identified 723 cases of CNS neoplasms (malignant, benign and unspecified), including 277 GB cases. Investigators attempted all possible means to obtain detailed information on personal lifestyle, behavior and medical histories for these cases and similar "matched controls" (workers who were like the cases but without brain cancer). Unfortunately, poor subject participation rates (40% of cases/ 18% of controls) did not provide enough information to allow us to analyze the survey data. The case-control study was used for a more refined exposure assessment.

Genetics Component

The genetics study was not completed due to lack of relevant results from the main studies.

Study Conclusions

Comprising close to a quarter million subjects and a 53-year observation period (1952-2004), the UPitt/UIC study is one of the largest and most comprehensive cohort studies ever undertaken in the occupational setting and the first and only large-scale study of workers in this industry. UPitt/UIC reported results of their investigation in 10 peer-reviewed journal papers.

UPitt/UIC drew several conclusions about occupational exposure conditions and the long-term mortality and CNS neoplasm incidence experience of the P&W workforce overall and among workers at the NH plant:

- Occupational exposures to chemical or physical agents with known or suspected carcinogenic potential in the CNS and/or other organ systems have decreased over the time frame of the study and quantitatively estimated levels were similar to or less than published data from other industries.
- With the exception of elevated COPD-related mortality in two of eight study plant groups, the UPitt/UIC evaluation of total and cause-specific mortality rates (excluding CNS neoplasms) found no evidence of elevated rates.
- The elevated COPD-related mortality rates in two study plant groups were not related to the occupational factors studied. Occupational exposures received outside of work at P&W or uncontrolled positive confounding by smoking cannot be ruled out as reasons for these excesses.
- For CNS neoplasms, including GB, the results of the UPitt/UIC incidence study revealed no statistically significant elevations in overall rates among the P&W workforce compared with rates in the general populations of the US and CT. Some small to moderate elevations in GB incidence were observed in the NH plant where the index GB cases arose, but the pattern of findings did not support an association with employment at P&W.
- If not due to chance alone, the small to moderately elevated GB rates in NH may reflect unmeasured external occupational factors or non-occupational factors unique to NH or the baseline East Hartford plant used in the internal comparisons.