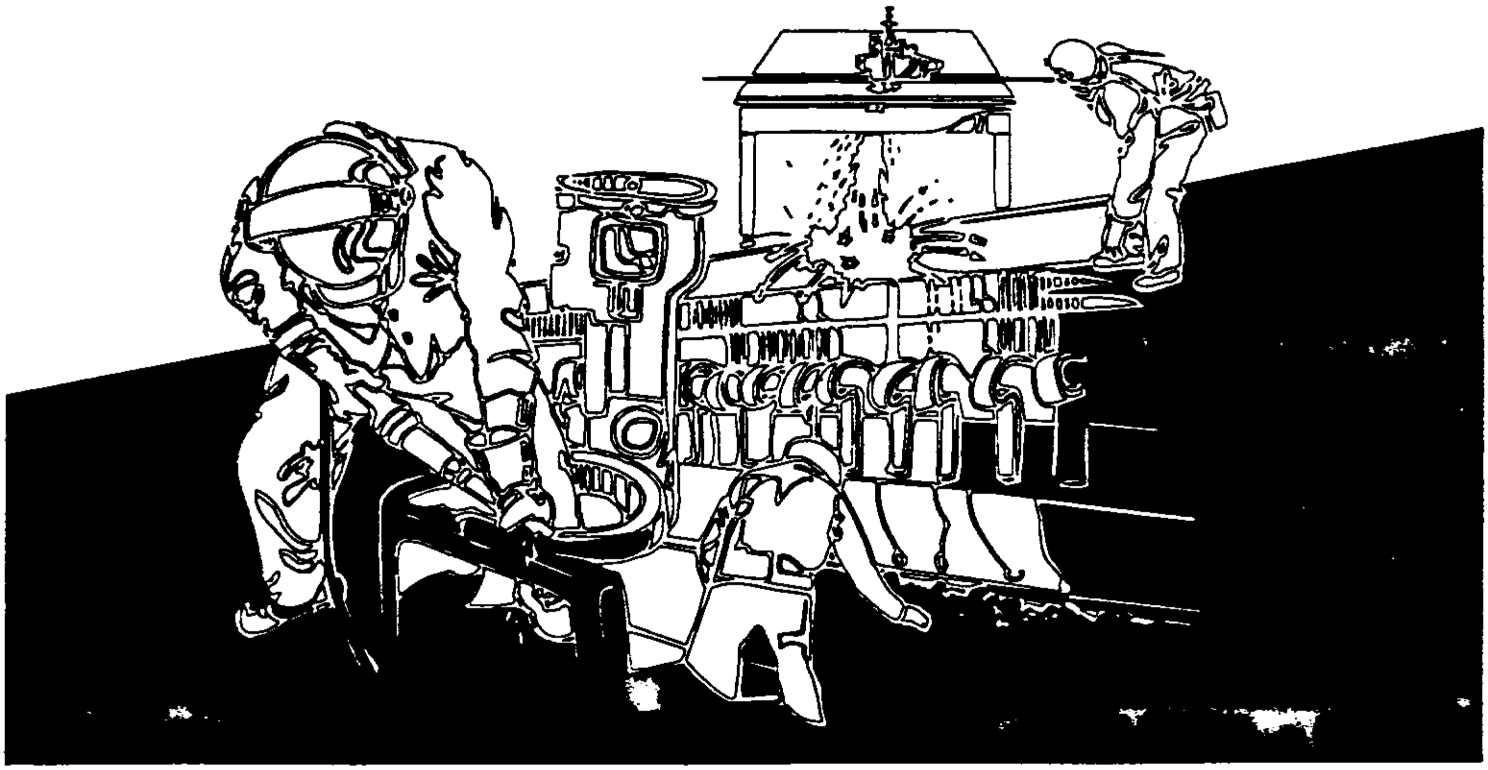
NIOSH

HEALTH HAZARD EVALUATION REPORT

HETA 86-469-2189
JAMES RIVER CORPORATION
NEWNAN, GEORGIA



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer and authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 86-469-2189
MARCH 1992
JAMES RIVER CORPORATION
NEWNAN, GEORGIA

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I. SUMMARY

In June 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request for technical assistance from the Occupational Safety and Health Administration (OSHA) to investigate a possible cancer cluster at James River Corporation, Newnan, Georgia. The plant produces printed paperboard boxes for use as food containers. Concern had been raised by a local physician who reported that one worker had been diagnosed with kidney cancer and another had been diagnosed with bladder cancer while working in the Finishing Department. The purpose of this investigation was to determine if an excess of bladder or kidney cancer had occurred at this facility and, if so, whether it was associated with any specific exposure or work-related process.

The investigation included two walk-through tours of the facility, collection of information on known cases of cancer, and the review of material safety data sheets (MSDSs) for substances used in the Finishing Department and the ink mixing room. A three-phase epidemiologic investigation that focused on the occurrence of urinary tract cancers among persons who had worked at the plant was conducted. The first phase was to determine if James River Corporation workers had experienced an excess number of deaths as compared to a standard U.S. population of persons of the same age and sex. The second phase involved the identification of all cases of bladder and kidney cancers (living and dead), an estimate of the expected number of such cancers, and a comparison of the observed and expected numbers of these cancers. The last phase involved a case-control study to identify factors that differed between workers with kidney cancer and other workers.

Potential exposures in the Finishing Department include wax and its additives, various adhesives, paper dust, and ink from the printed cartons. We determined from the suppliers that several red, yellow, and orange pigments used at James River Corporation were manufactured from 3,3′-dichlorobenzidine (DCB) and from various substituted derivatives of toluidine. Both DCB and toluidine are suspected bladder carcinogens. Laboratory analyses of the 16 bulk pigment samples we obtained were inconclusive. The free amines of interest could not be detected in any of the samples. A second analysis to determine the total benzidine, DCB, and toluidine congener content was also unsuccessful, apparently due to difficulties in separating the pigments from the extracting solvents. Thus, it was not possible to confirm if these compounds were present in the printing inks we sampled.

A total of 2050 workers, who had worked at the facility between January 1, 1957, and June 30, 1988, were included in the epidemiologic study. Overall mortality for the cohort was similar to that expected [standardized mortality ratio (SMR) = 1.0, 95% confidence interval (CI) 0.9-1.2], as was mortality from diseases of the heart (SMR = 0.9, 95% CI 0.7-1.3), accidents (SMR = 1.0, 95% 0.7-1.5), and violence (SMR 1.2, 95% CI 0.6-1.9). The SMR for all cancers was less than expected (SMR = 0.6, 95% CI 0.3-0.9). Only one bladder cancer death (SMR = 2.6, 95% CI 0.1-15.0) and one kidney cancer death (SMR = 1.4, 95% 0.0-7.7) were included in the life-table analysis.

Personal interviews and company contacts identified eight cases of cancer, one of which had since died. Fifteen cancers were identified by the Georgia Center for Cancer Statistics, three of which were also identified from death certificates. A total of nine urinary tract cancer cases was identified. We observed six cases of kidney cancer compared to 1.6 expected [standardized incidence ratio (SIR = 3.7, 95% CI 1.7, 7.3), and three cases of bladder cancer, compared to 2.8 expected (SIR = 1.1, 95% CI 0.1, 4.3).

The case-control analysis of the six kidney cancer cases and 48 controls revealed that cases worked at the plant more than four times as long as their matched controls. However, the association between duration of employment and kidney cancer risk was not limited to any single department or work process.

It is not clear why an excess risk of kidney cancer should exist in this facility. Whether this finding is a spurious association or due to an unidentified causal exposure is unknown.

This study had several limitations. We could not determine the vital status of approximately 10% of the cohort, and the site-specific mortality rates were underestimated because the death certificates for 17% of those known to have died could not be obtained. Cancer morbidity information could not be thoroughly assessed, and the number of kidney and bladder cancers in this cohort may have been higher than we observed. Also, a selection bias may have resulted in a spurious association in this study between duration of employment and cancer risk. Workers with kidney cancer and a long duration of employment may have been more easily identified than other workers with kidney cancer because they had worked at the plant more recently than many short-term workers.

On the basis of the epidemiologic data, we concluded that workers at James River Corporation had an increased rate of kidney cancer. This investigation could not, however, identify any specific causal agent. Recommendations include (1) the removal or reduction of exposures to the lowest feasible level of inks containing pigments manufactured from aromatic amines, and (2) the continued follow-up of this cohort.

KEY WORDS: SIC 2657 (Manufacturers of Folding Paperboard Boxes), renal cell carcinoma, bladder cancer, pigments, inks, dichlorobenzidine, o-toluidine.

II. INTRODUCTION

In June 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request for technical assistance from the Occupational Safety and Health Administration (OSHA) to investigate a possible cancer cluster at the James River Corporation paperboard packaging manufacturing plant in Newnan, Georgia. The plant produces printed paperboard boxes for use as food containers. Concern had been raised by a local physician who reported that one worker had been diagnosed with kidney cancer and another had been diagnosed with bladder cancer while working in the Finishing Department.

The paperboard packaging plant had been in operation for over 30 years. In 1986, the plant employed approximately 310 workers, 80 of whom worked in the Finishing Department. The manufacturing process involves four basic operations: 1) rolled paperboard is cut into sheets (sheeting); 2) printing presses are used to print colored product labelling and designs onto paperboard (printing); 3) printed paperboard sheets are cut to carton size, windows are cut into the cartons if required, and the cartons are creased for folding (cut and creasing); 4) cartons are waxed and cellophane is glued in place over any windows (finishing). The purpose of this investigation was to determine if an excess of bladder or kidney cancer had occurred and, if so, whether-or-not it was associated with any specific exposure or work-related process.

III. METHODS

Cancer Mortality

A retrospective cohort mortality study was conducted to assess the mortality experience of this cohort. Name, date of birth, sex, race, and social security number were abstracted from all personnel and death records in possession of the company. We considered workers whose race was unknown (85%) as white and whose sex was unknown (0.2%) as male. The study-begin date was January 1, 1957, the date from which we assumed all personnel records were complete. The study-end date was June 30, 1988, when data collection began. Thirty-six workers were excluded from the analysis due to a missing date of hire or birth, having worked at the facility for only one day, or having not worked at the facility during the study period.

Vital status was determined by the Social Security Administration (SSA) and by verifying a current mailing address through the United States Postal Service. An initial list of 825 employees was sent to the SSA in July 1988 for vital status determination. SSA reported if workers were alive as of December 31, 1985, known to be dead, or if vital status could not be determined. SSA discontinued this service shortly after this computer list was sent. To determine the vital status of the remaining 1257 workers, we cross-referenced the complete list of

2082 workers with SSA mortality tapes for the years 1937-1990. These tapes provide death information but do not provide any other information. A subject was considered alive if we could identify a current mailing address as of April 15, 1989. If not, workers were considered alive as of December 31, 1985, if so indicated by the SSA. Workers whose vital status could not be verified by either a current mailing address or the SSA were considered alive as of their last day observed (June 30, 1988, for current workers and the last day of employment for terminated workers).

Copies of all death certificates were requested from the respective state vital statistics offices. Underlying cause of death was coded by a qualified nosologist according to the International Classification of Disease[1] in effect at the time of death.

Person-years at-risk (PYAR) of dying were accumulated for each worker starting the first day of employment at the plant or January 1, 1957, whichever came later. We stopped accumulating PYAR at the study-end date (June 30, 1988), the date of death, or the date last observed, whichever came first. The NIOSH Life Table Analysis System[2] was used to distribute PYAR over sex and race specific five-year calendar time periods and five-year age groups. Expected numbers of cause-specific deaths were calculated by multiplying the age, sex, and calendar time specific United States mortality rates by the corresponding PYAR. The number of observed cause-specific deaths was divided by the number of expected cause specific deaths to yield a Standardized Mortality Ratio (SMR.)[3] Ninety-five percent confidence intervals (95% CI) around the SMR were calculated using an approximation based on the Poisson distribution.[4]

Cancer Morbidity

Current and former workers who had developed cancer were identified from three sources. First, we interviewed employees and management officials and examined company medical records. Second, we used the underlying and contributory causes of death noted on death certificates. Third, the master list of all current and former employees was sent to the Georgia Center for Cancer Statistics in May 1989 and matched against three data bases. The Atlanta Metropolitan Area Surveillance, Epidemiology, and End Results (Atlanta-SEER) registry collects cancer incidence and mortality data on all residents of the five county metropolitan area of Atlanta. Over 70,000 cancer cases diagnosed since January 1, 1975, were included in this database. Since the plant is located just outside of the Atlanta-SEER catchment area, a second incident cancer database was also used. This was the Atlanta-SEER ineligible file which included data on an additional 48,000 people who lived outside of the five county Atlanta metropolitan area, but who were treated for cancer within metropolitan Atlanta hospitals since January 1, 1975. Finally, the cohort was matched against 180,000 records in a state-wide registry, the Georgia State Tumor Registry. This registry has collected diagnostic information on all Georgia residents since January 1, 1980. Since the state registry relies on voluntary reporting by hospitals, it is known to be incomplete, including approximately half of the number of cases expected. Where possible, we accessed medical records to confirm the diagnosis and used these records to establish the date of diagnosis.

Next, a Standardized Incidence Ratio (SIR) was calculated for kidney and bladder cancers. This calculation was limited to white males in the cohort who represented 88% of the PYAR. The number of expected incident bladder and kidney cancers was estimated using age-specific PYAR accumulated through December 30, 1990. PYAR were multiplied by age-specific cancer incidence rates[5] from the Atlanta Metropolitan SEER Registry, for the years 1973-1977. The numbers of observed kidney and bladder cancer cases were then divided by the estimated expected numbers to calculate the SIRs. Approximate 95% confidence intervals were then calculated.[4]

Case-control study

A nested case-control study was conducted to determine if work assignment (department) was related to the risk of kidney cancer. Cases included all workers who developed kidney cancer after their date of first employment. Eight controls per case were chosen at random from a risk set of all employees born within five years of the case, the same sex as the case, and having attained the age at which the case was diagnosed (or died if date of diagnosis was unknown) without being diagnosed with kidney cancer.[6] Control eligibility also required that the age of first employment at the plant be less than the case's age at diagnosis.

The detailed work histories of cases and controls were used to determine the length of employment in each department. Work histories for controls were truncated at the age at which the index case was diagnosed. We tested the association between kidney cancer and duration of employment in specific departments and the plant overall. Conditional logistic regression[7] was used for statistical analysis. The variables included in the final multivariate model were those that contributed independently to the overall model as determined by attaining statistical significance using a likelihood ratio test. Also included were variables representing department-specific durations of employment when the odds ratio for a five year difference attained a value of 2.0 or greater. Ninety-five percent confidence intervals (95% CI) were calculated for the estimated rate ratios using a test-based method proposed by Miettinen.[8] Time since first employment, date of hire, and age at hire were also examined. However, these variables were dropped since they did not alter the coefficient(s) for duration of employment and did not otherwise improve the predictive ability of the model. To account for the long latent period of kidneycancer, we reanalyzed the duration of employment variables by discounting duration of employment (lagged duration) just prior to the age of failure for each case using a five and ten year lagged duration.

Environmental Assessment

The MSDSs were reviewed for materials shown on the chemical inventory for the Finishing Department and the ink mixing and storage rooms. In cases where the MSDSs provided little or no information on chemical contents of the product, the manufacturer was contacted. The identified chemicals were reviewed for carcinogenic potential. Bladder cancer has been associated with occupational exposure to various aromatic amines used in dye production.[9] Because several colored inks are used in the printing process at the study plant, we contacted manufacturers to determine if the inks contained aromatic amines. Sixteen bulk samples of red, yellow, and orange printing inks were submitted to the NIOSH laboratory for measurement of free, unreacted dichlorobenzidine and ortho-toluidine content.[10]

IV. RESULTS

Cancer Mortality

As of the study-end date, 141 workers (7%) were deceased, 1705 (83%) were alive, and 204 (10%) had been lost to follow-up (Table 1). A total of 115 (82%) death certificates was obtained from state vital statistics departments. For the final cohort, the median time since first employment was 20.4 years (mean = 19.8; range 0.2 to 31.6), the median duration of employment was 2.5 years (mean = 2.9 years; range 2 days to 32.7 years), the median age at hire was 23.7 years (mean = 26.4 years; range 18 to 58.7 years), and the median age at the study-end date was 44.6 years (mean = 46.4; range 19.4 to 83.1). The distribution of person-years at-risk by duration of employment and time since first employment is provided in Table 2.

Overall mortality for the cohort was similar to that expected (SMR = 1.0, 95% CI 0.9-1.2), as was mortality from diseases of the heart (SMR = 0.9, 95% CI 0.7-1.3), accidents (SMR = 1.0, 95% 0.7-1.5), and violence (SMR 1.2, 95% CI 0.6-1.9) (Table 3). The SMR for all cancers was less than expected (SMR = 0.6, 95% CI 0.3-0.9). One bladder cancer death (SMR = 2.6, 95% CI 0.1-15.0) and one kidney cancer death (SMR = 1.4, 95% 0.0-7.7) were included in the life-table analysis. Although the risks of mortality were greater than expected for these cancers, they were based on only one death each and were not statistically significant.

The worker who died of kidney cancer began employment 24 years before his death and left employment 5 years before he died. The worker who died of bladder cancer did so 11 years after beginning employment at the facility and working at the plant for 6 years.

Twenty-two deaths occurred after June 30, 1988, and were not included in the life-table analysis. The underlying cause of death for two of these deaths was kidney cancer. One of the two more recent kidney cancer deaths occurred 19 years since first employment and this worker had been employed at the facility for 19 years. The third kidney cancer death occurred 22 years since first employment, but this worker had only been employed at the facility for one month.

Mortality from other and unspecified causes of death was greater than expected due to the relatively large number of deceased workers for whom no death certificate was obtained. As a result, the estimated cause-specific mortality rates presented in this analysis underestimate the true rates for some causes. Death certificates could not be obtained for three deaths that occurred after the study-end date.

Cancer Morbidity

A total of three workers with bladder cancer and six workers with kidney cancer were identified (Table 4). Interviews with employees and management identified four cases of renal cancer and two cases of bladder cancer. Sixteen workers with cancer were identified by the Georgia Center for Cancer Statistics, but none of these had been diagnosed with cancer of the urinary tract. The SSA records identified three renal cancer deaths (one of which was known to the company) and one bladder cancer. The six observed cases of kidney cancer exceeded the 1.6 cases expected (SIR = 3.7, 95% CI 1.7, 7.3). No increased risk of bladder cancer was observed (2.8 cases expected, SIR = 1.1, 95% CI 0.1, 4.3).

Nested case-control study

The nested case-control analysis included six cases of kidney cancer and 48 controls. Cases and controls were similar in terms of age at hire and time since first employment (Table 5). On average, the six cases worked at the plant more than four times as long as their matched controls and this difference was statistically significant (odds ratio for a five year increase [OR_5] = 3.3, 95% CI 1.8, 6.3). The odds ratio for duration of employment increased when the most recent five years (OR_5 = 3.8, 95% CI 1.6, 7.9) or ten years (OR_5 = 3.5, 95% CI 1.6, 7.8) were not included in the calculation. Three of the workers with kidney cancer worked in the Finishing Department, one worked as a press operator, one worked in cut and crease, and one worked in the office. One of the workers who developed kidney cancer and worked in finishing also worked in maintenance. The association between kidney cancer risk and duration of employment was not limited to any single department or work process (Table 5).

Environmental Exposure Assessment

Three potential carcinogens were identified in a review of the company MSDS's: methylene chloride,[11] formaldehyde,[11] and trichloroethylene.[12] However, these chemicals have not been associated with urinary tract cancers in either humans or animals.

We contacted the suppliers of the printing inks and determined that several red, yellow, and orange pigments used in the paperboard printing process were manufactured from 3,3'-dichlorobenzidine (DCB) and from various substituted derivatives of toluidine. Laboratory analysis of 16 bulk pigment samples, however, was inconclusive. The free amines of interest could not be detected in any of the samples. A second analysis to determine the total benzidine, DCB, and toluidine congener content was also unsuccessful, apparently due to difficulties in separating the pigments from the extracting solvents. Thus, it was not possible to confirm if these compounds were present in the printing inks we sampled.

Three workers with kidney cancer worked in the Finishing Department where exposures included wax and its additives, various adhesives, and paper dust. Printed boxes enter the Finishing Department where they may be coated with wax, cellophane windows may be added, and/or various glues may be applied. Our investigation did not determine whether Finishing Department workers were exposed to inks from recently printed cartons.

V. DISCUSSION

This study represents the first report of excess kidney cancer among paperboard printing manufacturing workers. It was initiated due to an apparent cluster of urinary tract cancers and should be interpreted with caution. As a group, this population experienced an excess risk of kidney cancer. Five of the six kidney cancers were not identified in the original cluster. The excess risk was associated with overall duration of employment but was not limited to any single department or work process.

Kidney, bladder, and other urologic cancers accounted for over 70,000 new cases and over 20,000 deaths in the U.S. in 1989.[13] The annual age-adjusted kidney cancer rate for the United States was 8.3 cases per 100,000 persons in 1987 and this rate had been steadily increasing by approximately 2% per year since 1973.[14] The annual age-adjusted kidney cancer incidence rate in men is almost double the rate in women (11.6 versus 5.6 per 100,000 persons in 1987). Incident rates for kidney cancer do not vary between white and black men (11.7 versus 12.9 cases per 100,000 persons in 1987).

Little is known about the etiology of kidney cancer. However, in the last ten years, there has been growing evidence suggesting occupational causes of kidney cancer. Employment in petroleum refining and gasoline distribution,[15-16] production dry cleaning,[17-18] coke oven work,[19] and leather work[20] have been associated with kidney cancer. Recently, architects have been reported to be at excess risk of kidney cancer.[21]

It is not clear why this workforce should be at excess risk of kidney cancer. Whether this finding is spurious, or related to an unidentified causal exposure is not clear. Certain pigments containing bladder carcinogens had been used at this plant. Both DCB and toluidine are suspected of causing cancer of the transitional cell epithelium that lines the bladder and the renal pelvis.[22-23] These chemicals are not thought to increase the risk of cancer of the renal parenchyma, the presumed site of all kidney cancers identified in this study. Furthermore, it could not be determined which workers were actually exposed to these chemicals.

The mortality analysis had several limitations. Because of changes in the availability of information normally supplied by the SSA, we could not determine the vital status of approximately 10% of the cohort. To account for this, we limited the PYAR contribution from those lost to follow-up to the date last observed. However, we have no reason to believe that the lack of follow-up information is associated with disease outcome. A second limitation was the fact that the site-specific mortality rates were under estimated because the death certificates for 17% of those known to have died could not be obtained. Future follow-up of this cohort should help us obtain these death certificates. The completeness of the cohort was not verified and could have resulted in an underestimation of PYAR and our missing additional cancer deaths.

Cancer morbidity information could not be thoroughly assessed and the SIR we estimated should be considered as a rough estimate of the true kidney cancer risk. The number of kidney and bladder cancers experienced by this cohort may have been higher than we observed. There are a number of potential reasons for this. First, Atlanta-SEER collects cancer incidence data from all hospitals within the metropolitan Atlanta region and does not include the nearby county where the facility was located. Second, the Georgia State Tumor Registry is considered incomplete and has only collected tumor incidence data since 1975. Third, migration of cohort members from the Atlanta-SEER catchment area would prevent identification of cancers among these persons. Finally, workers diagnosed with cancer before 1975 could only be identified through interviews with employees and management or death certificates. At the same time, due to the small, but steady increase in kidney cancer incidence, the expected number of kidney cancers we calculated may have been slightly underestimated for person-years cumulated since 1980.

Another limitation in this study was the potential for selection bias due to our reliance on the reports of management and workers to identify persons with cancer. Thus, long-term workers who developed cancer may have been more easily identified than short-term workers who developed cancer. This may have resulted in a spurious association between duration of employment and kidney cancer. The finding that the association between kidney cancer and duration of employment was not limited to a single department supports the hypothesis that such a bias may have occurred. However, this type of selection bias would not have affected the overall kidney cancer excess experienced by this cohort.

In summary, we confirmed an excess risk of kidney cancer among workers at this paperboard printing manufacturer. The excess risk was associated with duration of employment. However, no single work process or causative agent(s) could be identified to explain the excess. Known bladder carcinogens were present in some of the inks and dyes used at the plant but we could not verify that workers were exposed to these agents.

VI. RECOMMENDATIONS

1. Although the study could not link any specific exposure to the excess kidney cancer cases, carcinogenic aromatic amines had been present in some of the pigments used by the company. Based on the fact that these chemicals are potentially carcinogenic, pigments containing aromatic amines should be removed from the production process or controlled in such a manner as to reduce exposure to the lowest feasible levels. Personal protective equipment should be used where appropriate but should not be considered a substitute for adequate engineering controls.

2. The company and union should institute a surveillance program to determine if employees continue to have an increased rate of renal cancer.

3. NIOSH will attempt to notify each current and former employee of the study and its results, even though there is no currently available effective method for the early detection of kidney cancer.

VII. REFERENCES

1. International Classification of Diseases: Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Deaths, 9th Revision. WHO Geneva 1977

2. Waxweiler RJ, Beaumont JJ, Henry JA, et al. A modified life-table analysis system for cohort studies. JOM. 1983;25:115-123.

3. Breslow NE, Day NE. Statistical Methods in Cancer Research: Volume II - The design and analysis of cohort studies. IARC Pub No.82. 1987

4. Rothman KJ, Boice JD. Epidemiologic analysis with a programmable calculator. US Dept HEW Pub No 79-1649. 1979

5. Cancer Incidence and Mortality in the United States: SEER 1973-81. NIH Pub No 85-1837. National Cancer Institute Bethesda, Maryland. 1984.

6. Beaumont J, Steenland K, Minton A, Meyer S. A computer program for incidence density sampling of controls in case-control studies nested within occupational cohort studies. Am J Epidemiol 1989; 129:212-219.

7. Statistics and Epidemiology Research Corporation. EGRET Version 1.00. Seattle Washington. 1990

8. Miettinen OS. Estimability and estimation in case-referent studies. Am J Epidemiol. 1976; 103: 226-235.

9. Schulte PA, Ringen K, Hemstreet GP, Ward E. Occupational Cancer of the Urinary Tract. Occupational Medicine: State of the art reviews. 1987; 2: 85-107.

10. Neumeister C. The determination of unsolphonated primary aromatic amines in water-soluble food dyes and other food additives. Analyst 100:476-481; 1975.

11. Current Intelligence Bulletin: Reprints of Bulletins 31-47. NIOSH US Dept HHS, DHEW (NIOSH) Pub No 86-122, 1986.

12. Current Intelligence Bulletin 2: Trichloroethylene, NIOSH US Dept of HHS, DHEW (NIOSH) 1975.

13. The Guide to Clinical Preventive Services; The U.S. Preventive Services Task Force. Williams and Wilkins; 1989,155-161.

14. Cancer Statistics Review 1973-1987. NIH Pub No 90-2789. National Cancer Institute Bethesda, Maryland. 1990.

15. Bertazzi PA, Pesatori AC, Zochetti C, Latocca R. Mortality study of cancer risk among oil refinery workers. Int Arch Occupational & Environmental Health. 61:261-270; 1989.

16. Wen CP, Tsai SP, Moffitt KB, Bondy M, Gibson RL. Epidemiologic studies of the role of gasoline (hydrocarbon) exposure in kidney cancer risk. in: Advances in modern experimental toxicology Vol 7. Renal effects of petroleum hydrocarbons. Chapter XVII: 245-257; 1984.

17. Katz RM, Jowett D. Female laundry and dry cleaning workers in Wisconsin: a mortality analysis. AJPH 71:305-307, 1981.

18. Brown DP, Kaplan SD. Retrospective cohort mortality study of dry cleaner workers using perchloroethylene. JOM 29:535-541, 1987.

19. Redmund CK, Ciocco A, Lloyd JW, Rush HW. Long-term mortality study of steelworkers. VI - Mortality from malignant neoplasms among coke oven workers. JOM 14:621-629; 1972.

20. Stern FB, Beaumont JJ, Halperin WE, Murthy LI, Hills BW, Fajen JM. Mortality of chrome leather tannery workers and chemical exposures in tanneries. Proceedings of the fourth NCI/EPA/NIOSH Collaborative Workshop: Progress on Joint Environmental and Occupational Cancer Studies. NIH Pub No 88-2960: 149-181, 1988.

21. Lowry JT, Peters JM, Deapen D, London SJ. Renal cell carcinoma among architects. Am J Ind Med. 20:123-5; 1991.

22. NIOSH Recommendations for Occupational Safety and Health Standards, MMWR, 35-1S, 1986.

23. Ward E, Carpenter A, Marhowitz S, Roberts D, Halperin W. Excess number of bladder cancers in workers exposed to ortho-toluidine and aniline. JNCI 83:501-506; 1991.

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Copies of this report have been sent to:

1. James River Corporation
2. Graphic Communications International Union, Local 641
3. Occupational Safety and Health Administration, Region IV

For the purpose of informing affected employees who are still employed at the facility, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1
Cohort Description and Vital Status

James River Corporation
Newnan, Georgia
HETA 86-469

A: Cohort Status Breakdown

Race/Sex	Total Cohort	Rejected	Final Cohort
White Males	1792	27	1765
White Females	228	9	219
Black Males	63	0	63
Black Females	3	0	3
Total	2086	36	2050

B: Vital Status

Vital Status	In	Rejected	Analyzed
Alive	1732	27	1705
Dead	144*	3	141
Unknown	210	6	204**
Total	2086	44	2050

* 22 additional deaths occurred after the study-end date and were considered alive in the analysis.

** Person-years at-work for these workers were censored at the date of last follow-up.

Table 2
Person-years at Risk by Latency and Duration of Employment

James River Corporation
Newnan, Georgia
HETA 86-469

Duration of Employment

Years Since First Employment	<6 mos	6 mos to <5 yrs	5 to <10 yrs	10 to <15 yrs	15 to <20 yrs	20+ yrs	Total
<5	4656	4642					9298
5-<10	3999	2321	2443				8763
10-<15	3759	2091	495	1701			8046
15-<20	2842	1692	430	108	1291		6364
20-<25	1061	822	286	82	83	738	3071
+25	282	253	122	49	47	447	1201
Total	16598	11822	3776	1940	1422	1184	36744

Note: Discrepancies in totals are due to rounding errors.

Table 3
Observed and Expected Deaths, Standardized Mortality Ratios (SMR), and 95% Confidence Intervals

James River Corporation
Newnan, Georgia
HETA 86-469

Underlying Cause of death	Observed deaths	Expected deaths	SMR	95% C.I. lower-upper
All Causes	141	135.0	1.0	0.9 - 1.2
All Cancers	16	27.8	0.6*	0.3 - 0.9
Site Specific Cancers				
Digestive Organs	5	6.1	0.8	0.3 - 1.9
Respiratory System	5	9.4	0.5	0.2 - 1.2
Kidney	1	0.7	1.4	0.0 - 7.7
Bladder	1	0.4	2.6	0.1 - 14.7
Hematopoietic	1	3.4	0.3	0.0 - 1.6
Other and Unspecified	2	4.7	0.4	0.1 - 1.5
Nonmalignant causes of death				
Heart Diseases	35	37.0	0.9	0.7 - 1.3
Respiratory Diseases	8	5.2	1.5	0.7 - 3.0
Accidents	24	23.3	1.0	0.7 - 1.5
Violence	15	12.9	1.2	0.6 - 1.9
Other Causes**	27	4.1		

* $p<0.05$

** Deaths from other causes include 23 deaths for which a death certificate was not obtained. Twenty-two deaths occurred after the study-end date and are not considered in this analysis.

Table 4
Characteristics of Workers with Cancer of the Kidney or Bladder

James River Corporation
Newnan, Georgia
HETA 86-469

Kidney Cancer	Sex	Dates Of Birth	Employment	DX	Death	Pathology
A	M	07/31	09/62-06/88	01/89	na	renal carcinoma (clear cell)
B	M	03/31	10/69-06/88	12/88	02/90	renal carcinoma (hypernephroma)
C	M	08/40	02/62-06/88	11/87	na	renal carcinoma (adenocarcinoma)
D	M	10/33	04/60-09/85	02/85	na	renal carcinoma (clear cell)
E	M	01/13	01/57-02/76	na	02/81	renal carcinoma*
F	M	07/39	02/66-03/66	na	07/88	renal carcinoma*
Bladder Cancer						
AA	M	03/36	01/57-06/88	03/79	na	transitional cell
BB	M	08/35	06/61-06/88	07/82	na	transitional cell
CC	M	09/13	02/57-04/63	na	05/68	primary bladder*

* - no pathology data obtained

na - not available or not applicable

Cases A, B, C, D, AA, and BB were identified using company records and employee interviews. Cases B, E, F, and CC were identified through the Social Security Administration. No cases were identified through a search of the Georgia Center for Cancer Statistics records.

Table 5
The Association Between Kidney Cancer and Years Since First Employment (YSFE), Age at Hire, Duration, and Department-specific Duration of Employment

James River Corporation
Newnan, Georgia
HETA 86-469

Kidney Cancer (6 cases, 48 controls)	Exposed cases mean (sd)	Exposed Controls mean (sd)	OR_5*	(95% CI)
YSFE	23.9 (2.3)	22.1 (5.5)	1.4	(0.6, 3.1)
Age at Hire	31.5 (8.6)	33.2 (9.2)	0.7	(0.4, 2.5)
Employment (years) by department:	18.8 (9.8)	3.9 (7.2)	3.3	(1.8, 6.3)
Cut & Crease (1 case, 11 controls)	0.1 (--)	1.6 (2.7)	0.0	(0.0, 10.9)
Finishing (3 cases, 29 controls)	18.3 (7.2)	2.6 (6.0)	2.7**	(1.3, 4.1)
Maintenance (1 case, 12 controls)	7.7 (--)	2.3 (4.8)	1.5	(0.4, 5.6)
Office (1 case, 1 control)	25.8 (--)	2.2 (--)	6.7**	(1.2, 38.5)
Press Operators (1 case, 2 controls)	24.7 (--)	3.2 (1.0)	7.7**	(1.3, 44.8)

* The Odds Ratios estimate the risk associated with any 5-year increase in the variable.

** Duration of employment in the finishing department, office, and press operators as independent variables in a single model.