

HLR # 707-96
MR # 11003

S-088

Final Report

Study No.: S-088

Study Title: A Case-Control Study of Leukemia
at the Washington Works Site

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Study Sponsor: Polymer Products

Study Initiation Date: 05/01/89
Study Completion Date: 12/31/91

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INTRODUCTION

ABSTRACT

A case-control study (Study No. S-088) was initiated to determine whether the risk of developing leukemia is related to workplace exposures at the Washington Works plant. The study found no association between employment at Washington Works in any particular job or area grouping and the risk of developing leukemia. A statistically significant excess of leukemia was observed in those who worked as custodians or chemists prior to working at the Washington Works. These findings are based on few cases so that considerable variability was observed in the estimated odds ratios.

PURPOSE

The purpose of the study was to determine whether the risk of developing leukemia is related to workplace exposures at the Washington Works plant.

RATIONALE

The study was started in response to employee concerns regarding an apparent cluster of leukemia at the Parkersburg, West Virginia site. Prior to the present study, a cluster investigation had been carried out by Walrath and Burke (1989). Their investigation was initiated after an elevated standardized incidence ratio ($SIR = 1.47$ with 6 observed cases versus 4.08 expected cases) was detected during routine cancer surveillance. In addition, employee concerns were also raised regarding new cases of leukemia. No commonality of exposure was found when work histories were reviewed. This study was undertaken to determine whether the leukemia cluster was related to the work environment.

RESEARCH METHODS

STUDY DESIGN

A case-control study design was used. Cases were identified through the Du Pont Cancer Registry. The Cancer Registry is limited to cancer cases diagnosed among active employees after 1955 (Pell, et al., 1978 and O'Berg et al., 1987). Cases were restricted to those diagnosed with leukemia while working at the Washington Works site during the period 1956 to 1989.

Four controls were selected for each case from the site's employee roster that corresponded to the case's diagnosis year. Each control was matched on gender, year of birth (within three years), and payroll status at the time of diagnosis.

EXPOSURE ASSESSMENT

Occupational exposures were determined through job title and work area matrices. Duration of employment was calculated in each job title and area combination. Although an attempt was made to utilize the chemical-specific information, little data were available for the majority of subjects.

DATA ANALYSIS

Conditional logistic regression models were used to assess possible relationships between exposure and the risk of developing leukemia (Rothman, 1986). The Egret software package was used to derive the estimates of relative risk (SERC, 1990). The odds ratio was calculated as an index of the strength of the relationship. Ninety percent confidence intervals were calculated for each odds ratio as an index of variability. Any odds ratio whose lower 90% confidence ratio exceeded 1.0 was defined as statistically significant.

RESULTS

The nine cases were distributed over a range of leukemia types. Five cases were acute non-lymphocytic leukemias, three were chronic myelocytic leukemias, and one was an acute lymphocytic leukemia. These are distinct leukemia types which are not thought to come from a common exposure (Linnet, 1985).

A comparison of demographic and work experience characteristics between cases and controls is in Table 1. All subjects were male. The matching of controls to cases was successful: no significant differences were observed between cases and controls regarding age or payclass. Table 2 compares the work experience between cases and controls.

Table 1
Washington Works Leukemia Study:
Characteristics of Cases and Controls

Variable Name	Cases n=9 % of cases	Controls n=36 % of controls
Birth year		
1902-33	11	22
1934-36	33	25
1937-42	33	25
1943-54	22	28
Pay class:		
Salary	33	33
Wage	66	66

Table 2
Washington Works Leukemia Study:
Employment Characteristics of Cases and Controls

Variable Name	Cases n=9 mean (SD)	Controls n=36 mean (SD)
Age start at WW	29 (10.3)	27 (8.4)
Total years at WW	15 (8.8)	18 (7.6)
Year started at WW	65 (4.8)	63 (8.8)
Years in prior jobs	8 (8.8)	7 (6.1)

Occupations prior to coming to Washington Works were categorized into nine groups (Table 3). Custodians and engineers had statistically significantly elevated odds ratios (OR) of 8.0 (90% CI: 1.1, 60) and 7.9 (90% CI: 1.0, 76), respectively. Chemists, construction, office, and other workers had elevated but not statistically significant odds ratios.

Industry experience prior to Washington Works was categorized into nine groups (Table 4). Those who worked in the service or retail sectors had an elevated odds ratio of 4.1 (90% CI: 0.9, 17.5); however, this was not statistically significant.

Table 3
Washington Works Leukemia Study:
Matched Odds Ratio and 90% Confidence Interval
on Prior Occupation Group

Prior Occupation	Number of cases	Number of controls	Matched Odds Ratio	90% C.L. on the Odds Ratio
Chemist/ Lab	2	4	2.7	0.5, 15.4
Construction	4	13	1.4	0.4, 4.8
Custodian	2	1	8.0	1.1, 60.0
Engineer	3	2	7.9	1.0, 76.0
Automobile	0	12	-	-
Mfg.	5	20	1.0	0.3, 3.7
Military	0	3	-	-
Office	4	12	1.7	0.5, 6.5
Other	5	11	2.9	0.8, 10.4

Table 4:
Washington Works Leukemia Study:
Matched Odds Ratio and 90% Confidence Interval
on Prior Industry Group

Prior Industry	Number of cases	Number of controls	Matched Odds Ratio	90% C.I. on the Odds Ratio
Chemical, Metal	3	14	0.8	0.2, 2.8
Construction	1	4	1.0	0.2, 6.3
Manufacturing	2	9	0.9	0.2, 3.5
Military	1	12	0.3	<.01, 1.6
Other Du Pont	2	9	0.7	<.01, 6.1
Petroleum	1	12	0.3	<.01, 1.6
Service, Retail	6	14	4.1	0.9, 17.5
Transportation	1	7	0.5	<.01, 3.4
Other	1	3	1.5	0.1, 15.4

Washington Works experience was analyzed by job title and by work area. The paucity of data precluded further combinations or stratifications. Job titles were categorized into eight groups (Table 5). Elevated odds ratios were observed in chemists (OR=1.9), engineers (OR=5.1), office workers (OR=2.0), and custodial workers (OR=4.0). All confidence intervals on the odds ratios included 1.0 and were not statistically significant.

Work areas were grouped into nine categories (Table 6). The work area analysis was done by determining if the subject had ever worked in the area or never worked in the area. Maintenance, laboratories, and office areas had elevated odds ratios greater than 1.5. However, all confidence intervals included 1.0.

Table 5
Washington Works Leukemia Study:
Matched Odds Ratio and 90% Confidence Interval
on Job Title Group

Job Title	Number of cases	Number of controls	Matched Odds Ratio	90% C.L. on the Odds Ratio
Chemist	3	8	1.9	0.4, 8.1
Foreman	0	9	-	-
Engineer	2	3	5.1	0.6, 42.6
Handler	4	20	0.4	<.01, 2.2
Mechanic	6	29	0.5	0.1, 2.8
Office	1	2	2.0	0.3, 15.0
Operator	6	28	0.6	0.1, 3.2
Custodial	1	1	4.0	0.4, 41.0

Table 6
Washington Works Leukemia Study:
Matched Odds Ratio and 90% Confidence Interval
on Area of Work Group

Area of work	Number of cases	Number of controls	Matched Odds Ratio	90% C.L. on the Odds Ratio
Butacite	4	20	0.6	0.2, 2.2
Delrin	2	8	1.0	0.2, 4.3
Maintenance	8	30	2.1	0.2, 21.5
Mechanical	1	12	0.3	<.01, 1.6
Nylon/ Acrylics	2	19	0.2	<.01, 1.0
Teflon	4	19	0.7	0.2, 2.5
Zytel	4	13	1.5	0.4, 5.7
Lab	4	11	2.1	0.5, 8.3
Office	1	2	2.4	0.2, 26.9

DISCUSSION

This study of leukemia at the Washington Works found no association between employment in any particular job or area grouping and the risk of developing leukemia. A statistically significant excess of leukemia was observed in those who formerly worked as custodians or chemists prior to working at the Washington Works. These findings are based on few cases, thus wide confidence intervals bracket the odds ratios.

This study could be missing a true positive association because of a number of factors. Misclassification of exposure as approximated by work history is possible and could lead to a false negative result. However, since exposure was assigned based on job title and without knowledge of the subject's disease status, this is unlikely. Misclassification of the disease status is also possible although unlikely given the high awareness of the disease at the site. Also, several types of leukemia are grouped together in this study. These types of leukemia probably have different etiologies, latency periods, and different age groups at risk. Unmeasured confounders such as cigarette smoking and non-occupational exposures could also play a role. The small number of cases severely limits the statistical power of the study to detect a true association.

The positive finding of an excess of leukemia among those who worked as custodians and chemists prior to joining Du Pont is provoking. Both occupations have potential exposures to multiple chemical agents and exposures could be at high levels. Because of lack of specific information on the exposures in their former jobs, and lack of understanding of the selection process that brought them to Washington Works, no conclusions can be drawn.

CONCLUSION

This case-control study of leukemia found no association between employment in any particular Washington Works job or area grouping and the risk of developing leukemia. The site should be monitored for future cases of leukemia to determine if the excess persists and any patterns emerge with respect to workplace exposures.

ACKNOWLEDGEMENTS

The authors would like to thank the Washington Works staff who collected the data, the Occupational Health consultants, Amy Berg and Bill Anderson and the Epidemiology Section programmers, Alan Mann and John Gerlach, who assisted in the data processing and analysis for this study.

REFERENCES

Linnet, M.S. The Leukemias: Epidemiologic Aspects, New York: Oxford University Press, 1985

O'Berg, M., Burke, C., Chen, J., Walrath, J., Pell, S., and Gallie, C., "Cancer incidence and mortality in the Du Pont Company: an update" in Journal of Occupational Medicine, 1987, 29:3, p. 245-252.

Pell, S., O'Berg, M., and Karrh, B., "Cancer epidemiologic surveillance in the Du Pont Company" in Journal of Occupational Medicine, 1978, 20:11, 725-740.

Rothman, Kenneth, Modern Epidemiology, Little, Brown, and Company, 1986, p. 297-298.

Statistics and Epidemiology Research Corporation, EGRET Reference Manual, Version 1, Revision 1, 1990.

Walrath, J. and Burke, C. "An investigation into the occurrence of leukemia at Washington Works", Internal Report from the Epidemiology Section, Medical Division of the Du Pont Co., revised April, 1989.