

The Association Between Parental Occupation and Childhood Malignancy

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A case control study was conducted to test Fabia and Thuy's observation that there was an excess of fathers in hydrocarbon-related occupations among children who died of childhood cancer compared to their controls. The study comprised 692 children who were born and died in Massachusetts for the years 1947-1957, and 1963-1967 and a control group of 1,384. No significant association was found between the four major groups of childhood cancer and the three hydrocarbon-related occupations: (1) mechanics and gas station attendants; (2) machinists; and (3) painters, cleaners, and dyers. However, there were two significant associations: (a) paternal employment as a paper or pulp mill worker was associated with tumors of the brain and other parts of the nervous system (relative odds of 2.8); and (b) paternal employment as a mechanic or machinist was associated with tumors of the urinary tract (relative odds of 2.5). Without strong supporting evidence from other studies, the authors are reluctant to conclude that these associations are causal. A weak association between childhood leukemia-lymphoma and parents' ages was observed.

Several investigators have studied the relationship of parental occupation to the risk of an offspring developing a childhood malignancy.¹⁻³ Fabia and Thuy¹ proposed that "hydrocarbon-related" occupations of the father at the time of the birth are associated with cancer in the offspring. Children who had fathers employed in hydrocarbon-related occupations had a 2:1 relative risk of dying from malignancy before the age of five compared to the non-exposed group. Hakulinen et al.,² in Finland, and Zack et al.,³ in Texas, did similar studies. No significant associations were found between the most common types of

childhood cancers and hydrocarbon-related occupations.

This study has been conducted with similar objectives in Massachusetts, using data from a previous investigation of the role of prenatal x-ray in causing childhood cancer.⁴

Material and Method

The basic design of this investigation was a case-control study. Deaths from childhood cancer in Massachusetts were identified with the assistance of the National Center for Health Statistics.⁵ In this data set, there was a total of 692 children who were born during the years 1947 to 1957 and 1963 to 1967 and who died of cancer before the age of 15 in Massachusetts. Three cases in which either the children were twins or information on the fathers was not accessible due to confidentiality maintained in connection with illegitimacy or adoption were not included in this study. For each case two controls were selected. These were the children whose birth registration immediately preceded and followed that of the case subject. The total control population was 1,384.

For analysis, cancer deaths were divided into four categories of malignant neoplasms: leukemia and lymphoma (ICD No. 200, 202, 204), brain and nervous system cancer (ICD No. 193), urinary tract and Wilm's tumor (ICD No. 180, 181), and all other tumors (ICD No. 140-205).

Three groups of occupations of possible high risk of exposure to hydrocarbons were identified using Fabia and Thuy's classification: (1) motor vehicle mechanics and service station attendants; (2) machinists, miners and lumbermen; and (3) painters, dyers, and cleaners.

The parental occupations were extracted from the birth certificates and were coded using a code developed by Wegman, which initially contained several hundred occupational titles. These codes were combined into nine categories based on the type of chemical exposure, the nature of the work, and the number of cases (Table 1). Statistical analysis was done with the *Statistical Package for the Social Sciences*.⁶

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Table 1. — Distribution of Occupations of Fathers for Cases and Controls.

Occupation of Father*	Cases†		Controls†	
	No.	%	No.	%
Mechanics, gas station attendants	35	5.1	61	4.4
Machinists	71	10.3	127	9.3
Painters, cleaners, dyers	10	1.4	24	1.7
Motor vehicle drivers	42	6.1	91	6.6
Printers	15	2.2	17	1.2
Baker, restaurant workers	18	2.6	27	2.0
Professionals and administrators	172	24.6	334	24.3
White-collar workers	75	10.8	161	11.7
Blue-collar workers and others	254	36.7	503	38.6
Total	692	100.0	1372	100.0

* Occupation at the time of birth of the offspring

† No occupation was listed on the birth certificates for 12 of the controls

Results

The results will be presented in three parts: (a) the distribution of occupations among parents of the children who died of cancer and of the controls; (b) the distribution of occupations among parents of the children who died by specific type of malignancy; and (c) the distribution by age of parents of the subjects and of the controls.

First, the distribution of occupations of fathers does not differ between cases and controls (Table 1). The proportion of cases with fathers in the three hydrocarbon-related occupations^{1,2,3} is not excessive. Several occupations are represented by proportionately more cases than controls; however, when compared with all other occupations, these excesses were not statistically significant. For 98% of both the cases and the controls "housewife" was listed as the occupation of the mother.

Second, the distribution of specific type of childhood cancer cases and of controls by paternal occupation does not support the hypothesis that paternal occupation at the time of the birth of the offspring is related to the subsequent risk of the offspring dying from leukemia (Table 2). Two associations were statistically significant. There is a weak association between the combined group of blue-collar workers and the diagnosis of central nervous system tumors (relative odds of 1.48 and p of 0.67 by chi-square). Within the group of blue-collar workers, the strongest association between specific occupation title

and central nervous system cancer was for paper and pulp mill workers (relative odds of 2.8 and p of 0.03). There were six cases of nervous system cancer in this group (Table 3). Likewise, there was an association between the combined occupational categories of mechanics¹ and machinists² and the diagnosis of urinary tract tumors (relative odds of 2.5 and p of 0.02). The occupational title with the largest number of cases of urinary tract tumors was machinists, with five (Table 3). There were similar distributions of cases to controls when analysis was restricted to cases under the age of five in a manner similar to that of Fabia and Thuy.

Third, there is a statistically significant but weak association between maternal and paternal ages and deaths from leukemia or lymphoma (Table 4). Because of the high correlation between the mother's and father's ages and the weakness of the association between parental age groups and leukemia in the offspring, the authors were not able to separate the effects of the mother's age from those of the father's age upon the incidence of leukemia. Similarly, there was a weak but statistically significant association between being a male child and dying from leukemia or lymphoma (Table 4). Deaths from tumors of the urinary tract or the nervous system were not related to the age of the parents or the sex of the child. Since 97% of the cases and the controls were Caucasian, they did not differ with regard to race.

Table 2. — Distributions of Occupations of Fathers at Time of Birth for Cases and Controls by Diagnosis for Ages < 15 Years.

Occupation of Father	Leukemia, Lymphoma Cases		Neurological Cancer Cases		Urinary Tract Cancer Cases		All Other Cancer Cases		% Controls	% Cases
	Cases	%	Cases	%	Cases	%	Cases	%		
Mechanics and gas station attendants	21	4.9	6	4.5	4	11.8	4	4.2	61	4.4
Machinists	49	11.4	9	6.8	6	17.6	7	7.3	127	9.3
Painter	7	1.6	1	0.8	1	2.9	1	1.0	24	1.7
Printer	9	2.9	2	1.5	1	2.9	3	3.1	17	1.2
Motor vehicle driver	28	6.5	5	3.8	2	5.9	7	7.3	91	6.6
Baker, cook, restaurant worker	12	2.8	2	1.5	0	0.0	4	4.2	27	2.0
Professionals, administrators	102	23.7	32	24.2	6	17.6	32	33.3	334	24.3
White-collar workers	53	12.3	12	9.1	2	5.9	8	8.3	161	11.7
Blue-collar workers	149	34.7	63	47.7	12	35.3	30	31.3	530	38.6
Total	430	100	132	100	34	100	96	100	1372	100

Table 3 — Age at Death and Year of Birth of Selected Cases.			
Occupation*	Age at Death	Year of Birth	Cause of Death
Paper or pulp mill	2	1947	Brain or N.S. †
Paper or pulp mill	2	1947	Brain or N.S.
Paper or pulp mill	2	1949	Brain or N.S.
Paper or pulp mill	1	1950	Brain or N.S.
Paper or pulp mill	1	1952	Brain or N.S.
Paper or pulp mill	1	1954	Brain or N.S.
Machinist	1	1947	Kidney
Machinist	2	1947	Kidney
Machinist	2	1948	Kidney
Machinist	1	1953	Kidney
Machinist	1	1960	Kidney
Auto mechanic	2	1949	Kidney
Auto mechanic	2	1958	Kidney
Mechanic Misc.	1	1948	Kidney
Mechanic Misc.	1	1950	Kidney
Filer	1	1947	Kidney

*Paper or pulp mill — paper, pulp mill worker, machinist — machinists, type unspecified; auto mechanic — mechanics and repairmen, type unspecified; filer — filers, grinders and polishers, metal cutters

†Malignant neoplasm of brain or other parts of nervous system

Discussion

One of the principal purposes of this study was to evaluate the finding reported by Fabia and Thuy that there is a relationship between an offspring's risk of dying from cancer by the age of five and paternal occupation which involves hydrocarbon exposures. Interestingly, there was no evidence in their data for an association of paternal occupation and offspring risk of dying of Wilm's tumor, the major tumor of the urinary tract in children. However, the only association the authors found involving hydrocarbon-related jobs and childhood cancer is an association between urinary tract tumors (Wilm's tumors) and some paternal occupations involving exposure to hydrocarbons.

It is believed that the data in this study are more consistent with those of Hakulinen and Zack who did not find any relationship between hydrocarbon-related occupations and childhood cancer. Because the number of cases for the hydrocarbon-related occupations is small, and because neither Fabia, Hakulinen or Zack found a similar association, it cannot be concluded that paternal employment in these occupations is causally related to the development of Wilm's tumors in offspring. Likewise, the authors cannot conclude that paternal employment in paper-pulp mills is causally related to the development of tumors of the nervous system in offspring. It is reassuring that none of these cases occurred after 1954, despite the fact that data were collected from 1947 to 1957 and from 1963 to 1967.

This study has several limitations; first, the listing of occupations in birth certificates is often not very specific and probably somewhat unreliable. However, this applies equally to records of both subjects and controls. Second,

Table 4. — Relation Between Parent's Age, Sex of the Child, and Leukemia.			
	Control	Cases with Leukemia or Lymphoma	p*
Number of subjects	1384	430	
Age of father ($\pm$ SD)	30.5 $\pm$ 6.6	31.5 $\pm$ 7.0	0.007
Age of mother ($\pm$ SD)	27.6 $\pm$ 5.7	28.6 $\pm$ 6.0	0.003
Percent male	51.3	59.5	0.003

*p by t-test or chi-square test

attempts to investigate the mother's occupation were unsuccessful because for 98% of both the subjects and the controls it was listed as "housewife." Third, the large variety of occupations listed on the birth certificates forces one to combine occupations into groups. This process necessarily results in groups with heterogeneous exposures. However, with a few occupations it was possible to form groups which were represented by at least ten cases and which were likely to have had similar exposure, such as printers.

The associations between older fathers and the incidence of childhood cancer are of interest. Previous authors^{1,6,7} who studied childhood cancers had studied the effect of maternal age as one of their basic variables. Choi et al⁷ found that children with nervous system cancer tended to have younger mothers. When the data are analyzed by individual types of cancer, more cases than controls in older paternal and maternal age groups are observed, and the mean ages of parents of cases are found to be greater than those of controls. However, the association is significant only for childhood leukemia and lymphoma. The magnitude of the association between the youngest and oldest parental groups is small.

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