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A Brief Original Contribution

NEUROBLASTOMA AND PARENTAL OCCUPATION

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A matched case-control study of neuroblastoma investigated parental occupational risk factors. Cases diagnosed in 1970–1979 were identified through tumor registries in the Greater Philadelphia area. Controls were selected by random digit dialing and were matched to cases on race, birthdate, and telephone exchange. Parents of 104 matched pairs were interviewed by telephone. In contrast to results of a previous study, no significant associations were noted for paternal employment in a job cluster of occupations in electricity, electronics, insulation, utility, and printing; in jobs with electromagnetic field exposure; or in jobs as workers in electronics. Six cases and one control, however, had a father or mother who worked in electrical or electronic products assembly.

electromagnetics; electronics; neoplasms, embryonal and mixed; neuroblastoma; occupations

Parental occupational exposures to mutagens or carcinogens have been studied as possible risk factors for childhood cancers (1–17). Such exposures could result in cancer through an effect on the germ cells before the child's conception. Because of the early age at onset in its victims, neuroblastoma is a good candidate for a cancer in which parental occupational exposures may play a role. Only one study, however, has investigated such exposures. In that study, Spitz and Johnson (12) observed significantly increased risk for children of fathers employed in occupations with electromagnetic field (EMF) exposure, particularly children of fathers who were workers in electronics. In the present study, we sought to replicate the analysis of Spitz and Johnson (12) using data from a case-control interview study of neuroblastoma, in which other factors were also studied.

MATERIALS AND METHODS

Children diagnosed with neuroblastoma between 1970 and 1979 were identified through the population-based Greater Delaware Valley Pediatric Tumor Registry (18) and the tumor registry of the Children's Hospital of Philadelphia. The latter registry included children residing outside the Greater Delaware Valley Pediatric Tumor

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Abbreviation: EMF, electromagnetic field(s).

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egistry area. Eligibility criteria were the llowing: physician's approval to contact rents, an English-speaking biologic other available for interview, and histoic confirmation of diagnosis.

One control per case was selected by telephone random digit dialing. Controls were matched to cases by the area code and the xt five digits of the telephone number at agnosis and by race and date of birth lus or minus 3 years). The random digit aling procedure has been described previously (19).

Parents of cases and controls were interviewed by telephone. A complete occupational history was obtained for each parent, cluding the name and location of the mpany, job title, and major duties. If the her was not available, the mother proed a proxy interview. Data on nonoccuonal factors were also collected. The ults of the analysis of these data have n published previously (20).

Occupations were categorized by the e methods used by Spitz and Johnson). Occupations of mothers and fathers e coded by industry and job title accordg to the classification scheme of Hoar et (21). Each industry-occupation combiion was assigned to one of 30 clusters ed on shared exposures and degrees of posure, as designed by Hsieh et al. (22). obs of 6 months or more prior to the 's conception and all jobs during the nancy were coded.

clusters were analyzed as dichotoariables (ever vs. never empioyed in ster) for each of two time periods: to the index child's conception and the pregnancy. For the preconceperiod, analyses were performed using ded jobs and using only the longest b. The results for all preconception the longest held job were compared the possibility of recall bias conshort-term jobs held many years the interview. The results differed d results for the longest held job nted unless noted otherwise.

tios for matched pairs were calculated for potential risk factors, and the corresponding two-sided p values were computed using McNemar's test. Adjustment for possible confounders was performed by conditional multiple logistic regression. Statistical significance was defined at the 5 percent. level.

RESULTS

One hundred eighty-one cases of confirmed neuroblastoma were identified. Of these, 21 cases (12 percent) resided outside the Greater Delaware Valley Pediatric Tumor Registry area. Thirty-two cases were not included for the following reasons: 12 for whom the physician could not be contacted, 10 for whom the physician refused permission, six residing outside the United States, and four with non-English-speaking parents. Of the 149 cases contacted for interview, 19 could not be traced, 18 parents refused to participate, and eight could not be interviewed before the study ended. The participation rate for cases invited to participate was 70 percent (104 of 149). Of those participating, 13 cases (13 percent) and their matched controls resided outside the Greater Delaware Valley Pediatric Tumor Registry area.

An analysis of the selection of controls for this study has been published previously (18). The response rate among children identified as eligible and whose parents were invited to participate was 57 percent (104 of 181).

The educational level of fathers of cases and controls differed ($p = 0.05$) with more control than case fathers having had vocational training (seven case vs. 29 control fathers). The distribution of fathers among other educational levels was similar for cases and controls. The educational levels of case and control mothers were almost identical.

Among case fathers, 61 percent had blue collar jobs: 24 percent had professional, technical, or managerial jobs; and 14 percent had white collar jobs as their longest held jobs. The longest held jobs for control fathers were 50 percent blue collar, 30 per-

cent professional, technical, or managerial, and 19 percent white collar. The case-control differences in job distribution were not statistically significant.

Analysis of Hsieh's clusters for paternal occupation uncovered no significant associations. Nonsignificant case excesses with odds ratios of 2.0 or higher were observed for employment in several clusters (table 1).

Spitz and Johnson (12) observed an association with job cluster 7 and with occupations with potential EMF exposure, especially workers in electronics (12). We found no associations for these groupings (table 2). Using their definitions of EMF exposure, we observed only a small case excess of workers in electrical and electronic products assembly and repair. One control and four case fathers had jobs assembling electrical or electronic products. Adjustment for educational level and source of the father's data (proxy vs. nonproxy interview) was performed for all groupings except electrical and electronic products assembly workers and did not change the results. Small numbers precluded adjustment in the case of the assembly workers.

Few mothers worked in industrial settings. When all jobs before conception were considered, nonsignificant case e were noted in clusters 5 (stock textile and food product packers, f and two controls) and 15 (plastic packers, four cases and zero control case and no control mothers had jo cluster 7 (electrical products assembly metal product fabrication workers). One the case mothers in cluster 7 and one oth case mother worked in electronics produc assembly.

DISCUSSION

The analysis of parental occupation w performed to attempt to corroborate t findings of Spitz and Johnson (12) and generate other hypotheses. The associatio observed by Spitz and Johnson wit Hsieh's cluster 7 (occupations in insulation electricity, electronics, and printing) and with workers in electronics and electricity specifically, was not observed here. Spitz and Johnson reported an odds ratio of al most 12 (95 percent confidence interva 1.4–99) for workers in electronics and elec tricity; the present study had a power of 8 percent to detect an odds ratio of 6. If th actual odds ratio was close to the lowe confidence interval of 1.4, our study woul not have detected the excess risk. A cas excess was observed for a subset of EMF

TABLE 1

Job clusters of parental occupation: selected results of a matched case-control study of neuroblastoma diagnosed in the Greater Philadelphia area between 1970 and 1979*

Job cluster and exposures of father	Description	Preconception			Pregnancy		
		Odds ratio	Ratio†	95% confidence interval	Odds ratio	Ratio	95% confidence interval
5	Food product packers and warehouse men	4.0	4:1	0.4–195	1.5	3:2	0.2–18.0
13	Farmers and agricultural workers	3.5	7:2	0.7–34.6	0.7	2:3	0.1–5.8
22	Some electrical equipment assembly and repair jobs, rubber processing, and painting	2.0	4:2	0.3–22.1	0.8	4 5	0.2–3.7
27	Chemistry occupations and tire manufacturing	2.0	4:2	0.3–22.1	1.3	4:3	0.2–9.1

* As defined by Hsieh et al. (22).

† Case exposed-control unexposed pairs:case unexposed-control exposed pairs.

TABLE 2

Occupational groupings relevant to the study of Spitz and Johnson (12) results of a matched case-control *study of neuroblastoma diagnosed in the Greater Philadelphia area between 1970 and 1979*

	Preconception			Pregnancy		
	Odds ratio	Ratio'	Exact 95% confidence interval	Odds ratio	Ratio	Exact 95% confidence interval
Fathers						
Job cluster 7†	**0.3**	3:10	0.05–1.2	**0.3**	3:9	**0.1–1.3**
Occupations with EMF exposure						
Narrow definition$	1.3	9 7	**0.4–4.1**	0.3	3:9	0.1–1.3
Broad definitions	**1.0**	**14:14**	0.4–2.3	0.6	7:12	0.2–1.6
Electrical and electronic products workers	1.6	8 5	0.5–6.2	**0.4**	3:8	0.1–1.6
Electrical and electronic products assemblers	**4.0**	**4:1**	**0.4–195**	**0.0**	**0 1**	**Not** calculable
Mothers‖						
Job cluster 7	***a***	2:0	Not calculable			
Electrical and electronic products assemblers	∝	2:0	Not calculable			

* Case exposed-control unexposed pairs:case unexposed-control exposed pairs.

† As defined by Hsieh et al. (22), this consists of electricians, insulation and utility workers, and workers in electricity, electronics, and printing.

‡ As defined by Spitz and Johnson (12), this includes electricians, electrical and electronic products workers, linemen, welders, and utility employees.

§ As defined by Spitz and Johnson (12), this includes all those in the narrow definition plus electrical equipment salesmen and repairmen.

‖ The preconception period includes all jobs; no mothers had jobs in these categories during the index pregnancy.

exposed workers, i.e., electrical and electronic products assembly workers. There were six cases with either a mother or father who held such a job in the preconception period compared with one control. Larger studies or studies in geographic areas with more manufacturing of electrical and electronic products would be needed to determine if the excess was due to chance or etiologic interest.

The nonparticipation rates were substantial, especially for the controls, selection bias might explain our negative findings for cluster 7 and related job groupings. It is difficult to imagine a bias that selects against workers with specific exposures. Selection on socioeconomic status, however, could bias a study of occupational factors. Case and control fathers did differ in educational level with more control than case fathers having had vocational training. On the other hand, slightly more case than control fathers were blue collar workers, and nearly all the occupations in the job groupings of interest were blue collar jobs. Therefore, one might have expected a bins toward finding the associations previously reported.

We did not find the previously reported associations of neuroblastoma with paternal employment in cluster 7 or in an occupation with potential EMF exposure. We did observe, however, small, nonsignificant case excesses of fathers and mothers in electrical or electronic products assembly jobs. Future studies will face the challenge of investigating narrow occupational groupings while retaining sufficient power.

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