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EXPOSURE TO ELECTROMAGNETIC FIELDS AND RISK OF LEUKEMIA

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The analysis of data from case-control study performed in 958 age, sex and place of residence matched pairs of adult inhabitants of Polish towns showed no relation between risk of leukemia and exposure to electromagnetic fields.

INTRODUCTION

The past 25 years have seen a substantial growth in research on the biologic effects of electromagnetic radiation. Evidence has been adduced that such fields can, in some circumstances, affect cell membranes, molecular structures, and physiologic processes, although the applicability of these findings to carcinogenesis is unclear [2, 5].

In 1979, *Wertheimer* and *Leeper* [26] (by case-control study) reported corelation between risk for leukemia and other childhood cancers and electromagnetic fields from electrical distribution lines. Contrary to these results, *Fulon* et. al. [8] found no association between leukemia and nonionizing electromagnetic fields. These authors hypothesized that the unresolved differences in the findings might relate to a confounding environmental factor which was not common to the two locations (Denver vs Rhode Island). Also, these studies have been criticized for deficiencies in their design and for nonexistent or inadequate exposure measurements [17, 23].

A reported association between occupational electromagnetic field exposures and leukemia by *Milham* in [14] spurred a series of other reports in the next several years. *Wright* et al. [28], *Coleman* et al. [4], *McDowall* [12], *Milham* [15], *Pearce* et al. [19], *Call* and *Savitz* [3] examined the risk of leukemia in an assembly of „electrical workers", a set of occupations originally suggested by *Milham* [14]. These studies investigated populations in Great Britain, United States, and New Zealand. There are other studies [7, 10, 11, 13, 16, 17, 18, 24, 25] which address the issue of whether elevated electromagnetic field exposure is associated with leukemia risk. Five of them, *Milham* [16], *Gilman* et al. [11], *Flodin* et al. [7], *Stern* et al. [24], *Gajewski* et al. [10] showed positive associations.

Savitz and *Call* [20] calculated a summary estimate of the relative risk across ten studies of 1.2, with 95% confidence interval of 1.1 – 1.3.

Adult leukemia from residential electromagnetic fields has been studies by *McDowall* [13], *Wertheimer* and *Leeper* [27]. None of these studies showed a relationship between exposure and leukemia in persons age 20–69.

This paper is dedicated to test relation between risk of leukemia and exposure to electromagnetic fields.

MATERIAL AND METHODS

Cases

The group included 958 adults (over 18 years old) with leukemia diagnosed between July 1, 1976 and March 31, 1980 who were residents of 12 big towns with population over 100 thousend each. The Central Cancer Register of Institute of Oncology in Warsaw was the main source of data on leukemia cases.

Controls

The control group for alive cases at time of interview was sampled from the Population Census of 1978. The controls for deceased cases were sampled from the pool of death certificates of the Central Statistical Office of Poland. Controls were matched by sex, age and when possible, by place of residence.

The detailed description of the cases and controls selection, the criteria of leukemia classification and interviews collection have been published previously [9].

Nonionizing Electromagnetic Fields.

Information concerning exposure to electromagnetic fields for cases and controls was collected during the interviews. The questionaire contained the following questions on occupation: place, type of equipment, duration of work as well as occupied position.

Statistical analysis

The risk of leukemia related to the analysed material was estimated by odds ratio calculated as the ratio of discordant pairs [6, 22]. *McNemar's* test (paired chi-square) with *Yates* continuity correction was used to assess to significance of departure of odds ratio (OR) from 1 [21]. When the number of discordant pairs was smaller than 10, the bionomial test was used to test the significance of OR [1, 29].

RESULTS AND DISCUSSION

The number of cases and controls occupationally exposed to electromagnetic fields are given in Table I.

Table I. Leukemia and control subjects by sex and exposure to electromagnetic fields

Electromagnetic fields	Males		Females		Total	
	cases	controls	cases	controls	cases	controls
Exposed	25	31	4	3	29	24
Non-exposed	477	494	418	416	895	910

The sources of nonionizing electromagnetic fields were mainly: short-wave diathermy, heat sealer, capacitor discharge welder, induction welder. This analysis concerned above all men (86% of all exposed to electromagnetic fields).

Table II give respectively the odds ratio by leukemia cell type and occupationally exposed to electromagnetic fields for men, and women, and total. The analysis that the values od odds ratio were not significantly ($p > 0.05$) different from 1. Elevated risk of acute and chronic myeloid leukemia, however, should be noted.

Table II. Exposure to electromagnetic fields and leukemia - odds ratio/OR/ by leukemia cell type

Leukemia cell type	Males			Females			Total		
	Discordant pairs	OR	p	Discordant pairs	OR	p	Discordant pairs	OR	p
Lymphatic	10/14	0.71	0.54	1/1	–	–	11/15	0.73	0.56
actue	1/1	–	–	0/1	–	–	1/2	–	–
chronic	8/13	0.62	0.38	0/0	–	–	8/13	0.62	0.38
unspecified	1/0	–	–	1/0	–	–	2/0	–	–
Myeloid	13/6	2.17	0.17	3/2	1.50	0.50	16/8	2.00	0.15
actue	10/5	2.00	0.30	2/1	–	–	12/6	2.00	0.24
chronic	3/1	–	–	1/1	–	–	4/2	2.00	0.34
unspecified	0/0	–	–	0/0	–	–	0/0	–	–
Other or unspecified	1/0	–	–	0/0	–	–	1/0	–	–
All leukemias	24/20	1.20	0.65	4/3	1.33	0.50	28/23	1.22	0.58

The results of this study are in good agreement with several other studies [4, 13, 17, 18, 25] that did not show a relation between an exposure to electromagnetic fields and risk of leukemia. In few studies showing a positive association the temporal raltionship between exposure and the effect was not established, the observed associations were weak, the dose-response relationships were based on qualitative levels of exposure or secondary sources of exposure.

The proportionate mortality which was used in most of the occupational studies was unreliable estimates of relative risk. Given these intrinsic methodologic problems and the questionable biologic plausibility of the realtionship, it seems premature to conclude that exposure to electromagnetic fields causes leukemia, but the possibility cannot be ruled out.

Further epidemiological research is needed to confirm or reject thy hypothesis that occupational exposure to electromagnetic fields causes leukemia.

SUMMARY

Using the data from a case-control study performed in 958 age, sex and place of of residence matched pairs of adult inhibitants o9f Polish tows, the risk of leukemia related to work in electromagnetic fields.

Information concerning exposure to electromagnetic fields for 958 cases and corresponding number of nonionizing electromagnetic fields were mainly: short-wave diatermy, heat sealer, capacitor discharge welder and induction welder.

For workers exposed to electromagnetic fields, the odds ratio (OR) was not significantly elevated all leukemias ($p > 0.05$).

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EKSPOZYCJA NA POLA ELEKTROMAGNETYCZNE A RYZYKO BIAŁACZKI

Streszczenie

Wykorzystując dane dotyczące 958 osób chorych na białaczkę i takiej samej liczby osób kontrolnych dobranych parami pod względem płci, wieku i miejsca zamieszkania określono ryzyko zachorowania na białaczkę dla osób zawodowo narażonych na pole elektromagnetyczne.

Infromacje o ekspozycji na niejonizujące promieniowanie elektromagnetyczne uzyskano w trakcie wywiadu. Źródłami pól były głównie: diatermie krótkofalowe, zgrzewarki do tworzyw szutucznych, zgrzewarki do nagrzewania indukcyjnego jak i pojemnościowego.

Dla pracowników narażonych na pola elektromagnetyczne nie stwierdzono statystycznie istotnego podwyższenia ryzyka względnego (OR) zachorowania na białaczkę ($p > 0,05$).

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