

Table 1.

Studies of Leukemia and Brain Cancer, and Occupational Exposure to Electromagnetic Fields included in Analysis.

no.	Reference	Design	Year	Type	exposure estimator	All leukemia			AML			CLL			Brain Tumors		
						Relative risk		Relative risk	Relative risk		Relative risk	Relative risk		Relative risk			
Occupational studies						RR	(95% C. I.)		RR	(95% C. I.)		RR	(95% C. I.)		RR	(95% C. I.)	
1	Guralnick	RC(M)	63	occ.	electrical occupations	1.20	0.90	1.60									
2	Peterson & Milham	PM	80	occ.	electrical occupations	0.90	0.60	1.30									
3	Wiklund et al.	RC(I)	81	occ.	telephone operators	1.03	0.53	1.79									
4	Milham(82,85b)	PM	82	occ.	9 occupations	1.37	1.15	1.62							1.23	1.00	1.40
5	Preston-Martin et al.	PI	82	occ.	electricians										1.42	0.71	2.54
6	Wright et al.	PI	82	occ.	11 occupations	1.29	0.90	1.79	2.10	1.30	3.10						
7	Coleman et al.	PI	83	occ.	10 occupations	1.17	0.95	1.44	1.20	0.80	1.70	1.30	0.90	1.80			
8	Howe & Lindsay	RC(M)	83	occ.	linemen and servicemen	2.41	0.97	4.97									
9	McDowall	PM	83	occ.	10 occupations	0.98	0.90	1.70	1.04	0.70	1.50						
10	McDowall	CC	83	occ.	electrical occupations				2.30	1.40	3.70						
11	Cammarano et al.	RC(M)	84	occ.	thermoelectric power workers										4.76	0.06	26.5
12	Dubrow & Wegman	CC	84	occ.	job titles	0.80	0.40	1.60									
13	NIOSH	PM	84	occ.		1.95	0.95	3.49									
14	NIOSH	CC	84	occ.		1.40	0.38	5.50									
15	Blair et al.	RC	85	occ.	electricians	0.90	0.50	1.50									
16	Calle & Savitz	PM	85	occ.	10 occupations	1.03	0.82	1.29									
17	Gilman et al.	CC	85	occ.	underground mining	2.50	1.10	5.70	3.80	0.60	23.40	6.30	1.30	31.8			
18	Lin et al.	CC	85	occ.	definite&probable vs. possible&none										1.88	1.15	3.08
19	Lin et al.	PM	85	occ.	high electrical field exposure										2.78	1.65	4.39
20	Milham(85a)	PM	85	occ.	amateur radio operators	1.91	1.22	2.84	2.90	1.40	5.20	1.40	0.30	4.20			
21	Olin et al.	RC(M)	85	occ.	elec. engineers	0.90	0.10	3.20							1.00	0.10	3.70
22	Vagero et. al	RC(I)	85	occ.	telecommunication workers										1.00	0.30	2.30
23	Flodin et al.	CC	86	occ.	electrical workers				3.80	1.50	9.50						
24	Pearce et al.		86	occ.		1.70	0.90	3.20									
25	Stern et al.	CC	86	occ.	electrician	3.00	1.29	6.98	2.30	0.80	7.10	6.00	1.47	24.5			
26	Stern et al.	CC	86	occ.	welders	2.25	0.92	5.53	3.83	1.28	11.46						
27	Tornqvist et al.	RC(M)	86	occ.	power linemen	1.30	0.70	2.10							1.50	0.90	2.40
28	Tornqvist et al.	RC(M)	86	occ.	power station operator	1.00	0.60	1.50							1.00	0.60	1.50
29	Magnani et al.	CC	87	occ.	potential exposure to EMF										0.90	0.60	1.30
	Magnani et al.	CC	87	occ.	electrical and electronic workers										1.30	0.70	2.50
30	McLaughlin et. al	RC(I)	87	occ.	electricians and electronic workers										0.90	0.70	1.10
31	Thomas et al.	CC	87	occ.	electrical and electronics jobs										1.60	1.00	2.40
32	Cartwright et al.	CC	88	occ.	electrical workers				2.40	0.95	6.00						
33	Lin	RC(M)	88	occ.	occupations										2.40	0.80	5.60
34	Linet et al.	RC(I)	88	occ.	electrical workers	1.00	0.90	1.30				1.20	0.90	1.60			
35	Milham	RC(M)	88	occ.	amateur radio operators	1.24	0.87	1.72	1.76	1.03	2.85	1.09	0.40	2.38	1.39	0.93	2.00
36	Obrams	CC	88	occ.	telephone linemen	0.90	0.60	1.40	0.80	0.50	1.40						
37	Speers et. al	CC	88	occ.	prob, definite vs. possible, none										4.57	1.65	12.6
38	Tola et al.	RC(I)	88	occ.	welders(shipyard and machine shop)	0.99	0.24	4.20									
39	Guberan et al.	RC(I)	89	occ.	census data on occupations	1.25	0.10	4.50							1.20	0.10	4.30
	Guberan et al.	RC(M)	89	occ.	census data on occupations	1.43	0.20	5.20							1.50	0.20	5.60
40	Schlehofer	CC	90	occ.	job activities										1.87	0.9	4.1

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41	Matanoski et al.	RC(I)	89	occ.	line workers	0.90	0.40	1.70				1.20	0.20	3.40	0.70	0.30	1.50
42	Pearce	CC	89	occ.	electrical workers	1.39	0.71	2.71	1.21	0.38	3.85	3.36	1.27	8.89	0.80	0.40	1.60
43	Preston-Martin et al.	CC	89	occ.	electric occ. over 5 yrs(Gliomas)										1.80	0.70	4.80
44	Preston-Martin et al.	CC	89	occ.	electric occ. over 5 yrs(Meningiomas)										0.70	0.10	5.80
45	Preston-Martin et al.	CC	89	occ.	electric occ. over 5 yrs(Astrocytomas)										4.30	1.20	15.6
46	Reif et al.	CC	89	occ.	electrical workers										0.78	0.39	1.59
47	Bastuji-Garin et al.	CC	90	occ.	EMF exposure based on occ. history				3.20	1.20	5.30						
48	McMillan et al.	PM	83	occ.	job activity (welders)										1.00	0.25	4.00
49	Gallagher et al.	PM	90	occ.	9 occupations(20 yrs and older)	1.17	0.90	1.53									
	Gallagher et al.	PM	90	occ.	9 occupations(20-65 yr)	1.26	0.87	1.82									
50	Garland et al.	RC(I)	90	occ.	electrician's mate, electronic technician, radiome	1.50	0.90	2.60									
51	Juutilainen et al.	RC(I)	90	occ.	electrical workers	1.85	1.00	3.50	1.47	0.50	4.70				1.31	0.70	2.30
52	Lewis	CC	90	occ.	electrical occupations										0.65	0.40	1.09
	Lewis	CC	90	occ.	electrical occupations(CNS tumors)										1.78	0.70	4.51
53	Loomis & Savitz	CC	90	occ.	electrical workers	1.00	0.80	1.20	1.10	0.70	1.70	0.60	0.30	1.10	1.40	1.10	1.70
54	Loomis & Savitz	CC	91	occ.	electrician & elec. pow. installer	0.90	0.70	1.10									
55	Mack et al.	CC	91	occ.	Workers exposed to EMF										1.10	0.60	1.80
56	Robinson et al.	PM	91	occ.	11 electrical occupations	1.19	1.02	1.37	1.14	0.85	1.50						
57	Spinelli et al.	RC(M)	91	occ.	aluminium reduction plant workers	1.75									2.17	1.10	2.60
	Spinelli et al.	RC(I)	91	occ.	aluminium reduction plant workers	0.76									1.94		
58	Tornqvist et al.	RC(M)	91	occ.	11 electrical occupations	1.16	1.03	1.30	1.29	0.99	1.69	1.19	0.98	1.46	1.03	0.91	1.17
59	Richardson et al.	CC	92	occ.	Electric and Magnetic fields				4.83	1.48	15.80						
60	Tynes et al.	RC(I)	92	occ.	10 or more economically active yrs	1.41	1.10	1.80							1.14	0.90	1.40
61	Ciccone et al.	CC	93	occ.	ELF electromagnetic fields				2.10	0.20	19.30						
62	Floderus	CC	93	occ.	EMF exposure:jobs before diagnosis	1.60	1.10	2.40	1.00	0.60	1.90	3.00	1.60	5.80	1.40	0.90	2.10
63	Guenel et al.	RC(I)	93	occ.	occ. with prob. exp. to EMF(men; intermittent)	0.94	0.84	1.06							0.94	0.85	1.05
64	Guenel et al.	RC(I)	93	occ.	occ. with prob. exp. to EMF(women; intermittent)	0.92	0.75	1.13							1.07	0.93	1.23
65	Guenel et al.	RC(I)	93	occ.	occ. with prob. exp. to EMF(men; continuously)	1.64	1.20	2.24							0.70	0.40	1.00
66	Guenel et al.	RC(I)	93	occ.	occ. with prob. exp. to EMF(women; continuous)	0.56	0.07	2.03							1.23	0.56	2.34
67	Matanoski et al.	CC	93	occ.	telephone linemen	2.50	0.70	8.60									
68	Sahl et al.	CC	93	occ.	electric utility workers	1.07	0.80	1.45							0.81	0.48	1.36
69	Sahl et al.	RC(M)	93	occ.	electrical workers	1.09	0.51	2.29							1.09	0.44	2.69
70	Amstrong et al.	CC	94	occ.	electric utility workers(median)	0.69	0.40	1.17	0.50	0.21	1.21	0.48	0.14	1.61	0.85	0.47	1.50
	Amstrong et al.	CC	94	occ.	electric utility workers(90th percentile)	0.80	0.19	5.25	1.02	0.08	13.04	2.98	0.21	41.6	1.90	0.48	7.58
71	London et al.	CC	94	occ.	electrical occupations(acute non-lymphocytic leu	1.30	1.10	1.60	1.20	1.00	1.60	1.30	1.00	1.80			
	London et al.	CC	94	occ.	electrical occupations(>1.7mG)	1.28	1.03	1.58	1.00	0.67	1.50	0.94	0.58	1.50			
72	Theriault et al.	CC	94	occ.	electric utility workers(>3.1uT-yrs)	1.54	0.90	2.63	3.15	1.20	8.27	1.48	0.50	4.40	1.54	0.85	2.81
	Theriault et al.	CC	94	occ.	electric utility workers(>15.7uT-yrs)	1.75	0.71	3.96	2.68	0.50	14.50	1.71	0.44	6.66	1.95	0.76	5.00
73	Tynes et al.	CC	94	occ.	railway workers(electrical vs non-electrical)	1.07	0.30	3.87							0.97	0.24	4.01
	Tynes et al.	CC	94	occ.	railway workers(>310uT-yrs)	1.74	0.84	3.60							0.96	0.47	1.98
	Tynes et al.	CC	94	occ.	railway workers(>1900uT-yrs)	0.92	0.56	5.37							0.93	0.26	3.42
74	Savitz & Loomis	RC(M)	95	occ.	electric utility workers(SMR)	0.76	0.64	0.88							2.95	0.81	1.12
	Savitz & Loomis	RC(M)	95	occ.	electric utility workers(cumulative)	1.11	0.57	2.14	1.62	0.51	5.12				2.29	1.15	4.56
115	Guenel	CC	96	occ.	electric utility workers (French)										3.08	1.08	8.74
75	summary(MH)					1.11	1.06	1.15	1.38	1.24	1.52	1.27	1.13	1.44	1.09	1.04	1.14

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76	summary(D-L)					1.15	1.08	1.22	1.55	1.29	1.85	1.37	1.09	1.72	1.19	1.08	1.31
	<i>Residential studies</i>																
77	Wertheimer & Leeper	CC	79	res.(ch)	wire code	2.97	1.78	4.99							2.40	1.15	5.01
78	Fulton et al.	CC	80	res.(ch)	wire code	1.08	0.62	1.88									
79	Wertheimer & Leeper	CC	82	res.(ad)	wire code	0.95	0.44	2.02									
80	Myers et al.	CC	90	res.(ch)	distance	0.88	0.39	1.96							1.19	0.52	2.72
81	McDowall	RC(M)	86	res.(ad)	distance(men)	0.61	0.07	2.19									
	McDowall	RC(M)	86	res.(ad)	distance(women)	1.54	0.42	3.94									
82	Tomenius et al.	CC	86	res.(ch)	spot measurement(>3.0)	0.34	0.10	1.09							3.86	1.09	13.7
83	Savitz et al.	CC	88	res.(ad)	spot measurement(high)	1.41	0.57	3.50							0.82	0.23	2.93
	Savitz et al.	CC	88	res.(ad)	spot measurement(low)	1.93	0.67	5.56							1.04	0.22	4.82
84	Severson et al.	CC	88	res.(ad)	calculated field	1.12	0.60	2.08									
	Severson et al.	CC	88	res.(ad)	spot measurement(high)	1.25	0.35	4.48									
	Severson et al.	CC	88	res.(ad)	wire code	1.48	0.80	2.73									
85	Coleman et al.	CC	89	res.(ad)	distance(power lines)	1.86	0.37	9.24									
86	Coleman et al.	CC	89	res.(ad)	distance(substations)	1.00	0.77	1.30	0.81	0.53	1.26	1.14	0.79	1.64			
	Coleman et al.	CC	89	res.(ch)	distance(substations)-Bromley only	1.68	0.77	3.68									
87	Lin & Lu	CC	89	res.(ch)	distance	1.31	0.78	2.21							1.09	0.50	2.37
88	London et al.	CC	91	res.(ch)	24hrs measurement(>2.68)	1.68	0.78	3.64									
	London et al.	CC	91	res.(ch)	spot measurement(>1.25)	1.15	0.51	2.59									
	London et al.	CC	91	res.(ch)	wire code	1.68	1.14	2.48									
89	Lowenthal RM et al.	CC	91	res.(ch)	distance	2.00	0.07	60.0									
90	Pachocki & Gajewski	CC	91	res.(ad)	(not known)	1.23	0.71	2.13	2.00	0.77	5.23	0.62	0.26	1.46			
91	Youngson JHAM et al.	CC	91	res.(ad)	calculated field(>1.0)	3.02	0.82	11.2									
	Youngson JHAM et al.	CC	91	res.(ad)	distance	1.18	0.74	1.87									
92	Ryan et al.	CC	92	res.(ad)	high elec. current(Gliomas)										0.93	0.39	2.24
93	Ryan et al.	CC	92	res.(ad)	high elec. current(Meningiomas)										1.70	0.32	9.15
94	Fajardo-Gutierrez et al	CC	93	res.(ch)	distance(dist. lines)	2.63	1.26	5.36									
	Fajardo-Gutierrez et al	CC	93	res.(ch)	distance(trans. lines)	2.50	0.97	6.67									
95	Feychting & Ahlbom	CC	93	res.(ch)	calculated field	2.49	1.04	5.98							0.71	0.17	3.07
	Feychting & Ahlbom	CC	93	res.(ch)	distance	2.87	1.12	7.33							0.48	0.06	3.60
	Feychting & Ahlbom	CC	93	res.(ch)	spot measurements	0.78	0.26	2.36							1.09	0.39	3.03
96	Olsen et. al	CC	93	res.(ch)	calculated field(>2.5)	1.50	0.33	6.73							1.00	0.20	4.97
97	Petridou E et al.	CC	93	res.(ch)	distance(power lines)	1.00	0.78	1.28									
98	Petridou E et al.	CC	93	res.(ch)	distance(substations)	0.35	0.12	1.08									
99	Savitz & Kaune	CC	93	res.(ch)	modified wire code(LWC vs. HWC and MWC)	1.61	1.01	2.58							1.49	0.85	2.64
	Savitz & Kaune	CC	93	res.(ch)	modified wire code(HWC)	2.85	1.47	5.53							2.48	1.12	5.50
	Savitz & Kaune	CC	93	res.(ch)	modified wire code(MWC)	1.25	0.74	2.11							1.21	0.64	2.28
	Savitz & Kaune	CC	93	res.(ch)	wire code	1.52	0.89	2.60							2.05	1.10	3.81
100	Schreiber et al.	RC(M)	93	res.(ad)	distance(<100m)	1.32	0.27	3.86							1.96	0.40	5.74
101	Verkasalo et al.	RC(I)	93	res.(ch)	calculated field(>2.0)	1.60	0.32	4.50							2.30	0.75	5.40
	Verkasalo et al.	RC(I)	93	res.(ch)	cumulative field(>4.0mGyr)	1.20	0.26	3.60							2.30	0.94	4.80
102	Feychting & Ahlbom	CC	94	res.(ad)	calculated field	1.05	0.66	1.66	1.72	0.83	3.58	0.68	0.31	1.50	0.69	0.37	1.28
	Feychting & Ahlbom	CC	94	res.(ad)	cumulative field(>20mGyr)	1.51	0.96	2.39	0.98	0.47	2.05	1.27	0.64	2.54	0.65	0.32	1.33

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	Feychting & Ahlbom	CC	94	res.(ad)	cumulative field(>30mGyr)	1.47	0.85	2.56	1.76	0.68	4.59	1.13	0.47	2.71	0.66	0.28	1.56
	Feychting & Ahlbom	CC	94	res.(ad)	distance	1.18	0.73	1.90	1.10	0.43	2.81	0.96	0.45	2.03	0.99	0.55	1.79
	Feychting & Ahlbom	CC	94	res.(ad)	spot measurements	1.18	0.78	1.79	1.09	0.49	2.45	0.86	0.45	1.67	0.76	0.46	1.26
103	Lin & Lee	RC(I)	94	res.(ch)	power lines over campus	1.49	1.16	1.91									
104	<u>summary(MH)</u>					1.27	1.14	1.40	1.08	0.76	1.53	0.97	0.71	1.33	1.30	1.01	1.67
105	<u>summary(D-L)</u>					1.30	1.12	1.51	1.54	0.50	4.76	0.76	0.28	2.11	1.30	1.00	1.69

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<u>remarks</u>									
(fr. ORAU)									
(fr. Bates)									
(fr. Bates)									
(fr. ORAU)									
(fr. Aldrich & Easterly)									
(fr. Aldrich & Easterly)									
(fr. ORAU)									
(fr. ORAU)									
primary brain tumor(glioma/astrocytoma)									
(fr. ORAU)									
SMR									
SMR									
SMR									
intracranial gliomas									
(fr. ORAU)									
(fr. ORAU)									
(fr. ORAU)									
Glioma only									
SIR(m-h)									

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(fr. ORAU)									
age 20-64									
Gliomas									
Meningiomas									
Astrocytomas									
exposed cases and control only									
adjusted values									
20 yr and older									
20-65 yr									
CNS tumors									
elect. vs non-elect.									
definite probability of emf exposure									
(fr. ORAU)									
(fr. ORAU)									
>=0.29 uT; est. of daily mean									
men; intermittent									
women; intermittent									
men; continuously									
women; continuously									
central tendency mean exposure									
mean(250 mG-year)									
median(11.08 weighted years);PEMFs									
90th percentile(19.98weighted-yrs);PEMFs									
acute non-lymphocytic leukemia									
acute non-lymphocytic leukemia, >1.7 mG									
(>3.1uT-yrs)									
(>15.7uT-yrs)									
elect. vs non-elect. railway									
>310 uT-years									
>1900 uT-years									
SMR									
cumulative; >= 4.3uT-yrs(vs. <0.6uT-yrs)									

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>=3.0ut-yr									

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