Electric and Magnetic Field Exposures for People Living near a 735-Kilovolt Power Line

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The purpose of this study was to assess the effect of a 735-kV transmission line on the electric and magnetic field exposures of people living at the edge of the line's right of way. Exposure of 18 adults, mostly white-collar workers, living in different bungalows located 190–240 feet from the line (exposed subjects) was compared to that of 17 adults living in similar residences far away from any transmission line. Each subject carried a Positron meter for 24 hr during 1 workday, which measured 60-Hz electric and magnetic fields every minute. All measurements were carried out in parellel for exposed and unexposed subjects during the same weeks between September and December. During measurements the average loading on the line varied between 600 and 1100 A. The average magnetic field intensity while at home was 4.4 times higher among exposed subjects than unexposed (7.1 versus 1.6 mG, $p = 0.0001$) and 6.2 times higher when considering only the sleeping period (6.8 versus 1.1 mG, $p = 0.0001$). Based on the 24-hr measurement, average magnetic field exposure was three times higher among the exposed. Electric field intensity was also higher among the exposed while at home (26.3 versus 14.0 V/m, $p = 0.03$). Magnetic field intensity among the exposed was positively correlated with the loading on the line ($r = 0.8$, $p = 0.001$). Percentage of time above a magnetic field threshold (2 mG or 7.8 mG) was a good indicator to distinguish the two types of exposure. Percentage of time above 20 V/m was significantly different, but percentage of time above 78 V/m was rare and comparable for the two groups. Variability of exposure was very low. This study demonstrates that a 735-kV line contributes significantly to residential 60-Hz magnetic field exposure and, to a lesser extent, electric fields for people living at the edge of the right of way. Because of the limited size of our sample, caution is recommended before generalizing these results. Nevertheless, due to the uncertainty on the risks associated with such an unusual high residential exposure, research is needed on its possible effects. *Key words*: electrical fields, electromagnetic fields, high-voltage power lines, magnetic fields. *Environ Health Perspect* 103:832–837 (1995)

The potential health effects of power frequency electric and magnetic fields (EMF) have been and are still the subject of numerous studies (*1–5*). The risk of cancer is under particular scrutiny, especially for workers highly exposed during their work, and for people living in the vicinity of distribution and transmission lines (*6,7*). Although transmission lines are a well-known source of residential exposure to magnetic fields, few studies have been done on the personal exposure of people residing close to these lines (*8,9*). Several epidemiological studies have considered fields produced by the distribution lines, but few have measured the specific exposure from transmission lines. Feychting and Ahlbom (*10,11*) performed spot measurements inside houses but could not predict the specific impact of the lines on personal exposure. McMahan et al. (*12*) performed only spot measurements at the entrance of houses and found that those living along the easement of 220-kV lines had much higher-than-average magnetic field levels than those living one block away. Kavet et al. (*13*) published the first study using personal exposure measurement to assess magnetic field exposure from high-level power lines. They found that people living close to 345-kV power lines had higher at-home exposures, and higher average 24-hr exposures than people living far away, but no attempt was made to separate the exposure during sleep from that during residential daytime activities. Morever, work exposure was not specifically assessed and few people were evaluated.

Magnetic fields emitted from power lines have received great attention because of their capacity to penetrate structures, but electric fields emitted from such lines have not been emphasized because they are usually shielded by buildings. Nevertheless, some reports found higher levels of electric fields in houses located near a high-voltage line (*8*). In fact, some people perceive transmission lines as one of the major environmental threats, and transmission lines are the focus of nearly all litigation on EMFs (*14,15*). Thus, a better understanding of their role in determining exposure of nearby residents is useful.

The objectives of the present study were to assess the impact of a 735-kV power line on the 60-Hz electric and magnetic fields exposure of working people living close to the line. Specifically, we examined the effect of the line on exposure during the time spent at home (wake and sleep periods) and on total exposure over a 24-hr period. We compared residential and occupational exposures and evaluated the use of the simplified version of the Wertheimer-Leeper wire coding scheme, developed by Kaune and Savitz (*16*), for this type of residential exposure to EMFs.

Methods

We identified single-floor bungalows located at the edge of a 735-kV line crossing a suburb of Québec City by visiting the study area. Another part of the suburb was selected as the unexposed area because of the presence of similar homes with identical exterior characteristics but without a transmission line nearby. In all, 63 exposed residences, located less than 250 feet from the transmission line, were registered, as well as 141 homes located more than 1200 feet from the line (unexposed group). All exposed residences and a random sample of the 115 unexposed residences were selected. We then dropped a letter in the mailbox of these residences inviting the occupants to participate in the study. Residents were then called by telephone to evaluate their interest in participating, and to check for the following selection criteria: occupants had to own the house, and participants had to work at least 4 hours per day away from their home. If more than one person was eligible per house, the participant was chosen at random using the following criteria: equal representation of both genders was desired and 50% of all participants had to be under 40 years of age. Twenty exposed and 20 unexposed persons who fulfilled our criteria and elected to participate were finally selected for the study. We had to exclude after the measurements two exposed and three unexposed persons because they had

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worked at home during the measurement periods. The final group included 18 exposed and 17 unexposed participants.

A technician visited each participant at home to explain how to wear the meter. Personal exposure to 60-Hz electric and magnetic fields was measured using six Positron model (Montréal) 378108 personal exposure monitors. This meter measures the three components of the magnetic and the electric field perpendicular to the body surface, at a specific rate, and stores measurements in memory (*17,18*). Meters were worn in a pocket, and measurements were done every minute. During sleep, subjects were asked to place the instrument close to their bed but far away from any electric outlet or electrical device. Exposure assessment was done for 24 hr during 1 workday. The six meters were randomly assigned to exposed and unexposed subjects. An equal number of exposed and unexposed subjects was assessed every week from September to mid-December 1993. Subjects were asked to fill out a log sheet of their main activities during the exposure period to separate the 24-hr period in three subperiods: the at-home period, the at-work period, and the period away from home and work. The at-home period, was then subdivided into waking and sleeping periods.

Meters were calibrated from the start and quality control procedures were ensured during the study. Accuracy of magnetic field measurements were assessed with different levels of emitted magnetic fields.

The data stored in the meters were copied to a microcomputer and arithmetic means of the electric and magnetic field measurements were calculated for each time period and for each subject. We then calculated geometric means of the arithmetic means to compare exposure levels between the two groups of subjects. All statistical analyses were done using the SAS system (*19*). Fisher's exact test was used to compare proportions, and Student's *t*-tests were used to compare the geometric means between the exposed and unexposed groups. We calculated 95% confidence intervals for the geometric means. Percentage of time above specific thresholds for electric and magnetic fields were calculated according to Armstrong et al. (*20*). Variability of exposure was estimated using the jagged metric proposed by Wenzl et al. (*21*).

Results

Characteristics of the participants are presented in Table 1. Exposed and unexposed subjects had similar characteristics. Age and gender were comparable by design, and there was also good comparability for the time spent at home and the time spent at work. Most of the participants were white-collar workers and only two in each group were potentially exposed at work based on recent occupational exposure data (*6,22*).

Characteristics of the residences of the participants are presented in Table 2. Age, purchase value, electrical heating, and roof characteristics were comparable between the two groups. Exterior metal covering was more frequent in the unexposed group (6/17 versus 1/18), and duration of ownership was shorter in the exposed group (13 years versus 20 years). The minimum temperature during the days of measurement was comparable between the two groups: average minimum of -4.3°C with a range of -13.6–0.6°C for the exposed, and -2.4°C with a range of -10.3–2.1°C for the unexposed.

Results of magnetic field measurements are presented in Table 3. Exposed and unexposed subjects had similar average magnetic field exposures for the at-work (1.1 versus 1.2 mG) and the away periods (1.8 versus 1.7 mG). In contrast, the average at-home exposure was significantly higher for exposed than for unexposed subjects (7.1 versus 1.6 mG, p = 0.0001). This difference was still statistically significant during the 24-hr average (4.9 versus 1.7 mG). The range of values at home for exposed subjects was 4.6–11.4 mG, whereas it was 0.4–3.8 mG for unexposed subjects. Average magnetic field exposure was higher during the waking period: 7.5 mG for the exposed versus 2.2 mG for the unexposed. However, the difference between exposed and unexposed subjects was higher during the sleeping period: average magnetic field of 6.8 mG for exposed and 1.1 mG for unexposed. In summary, the average at-home magnetic field exposure was 4.4 times higher for the exposed subjects. Based on the average 24-hr measurement, magnetic field exposure was 2.9 times higher in the exposed group than in the unexposed group. These values were not different when considering only residences without metal covering.

Electric field exposure was quite similar between exposed and unexposed subjects during the at-work and away periods. In contrast, the at-home exposure was 1.9 times higher for the exposed subjects (26.3 versus 14.0 V/m, p = 0.03; Table 4). The difference between exposed and unexposed subjects was maximum during the sleeping period, when electric fields were 2.8 times higher for exposed (p = 0.03). These differences were slightly lower when considering only residences without metal coverage: the ratio of geometric means of exposed to unexposed fell from 2.8 to 2.0 for the sleep period and from 1.9 to 1.7 for the total at-home periods.

Exposed residences were located between 190 and 240 feet from the middle of the power line, but no correlation was found between magnetic field measurements and these short distances from the line. Hourly loadings on the line were obtained for the period of measurements. Average loading of the current in the line during the at-home period was positively correlated with the magnetic field measurements (Fig. 1).

Table 1. Characteristics of exposed and unexposed subjects

	Exposed (n = 18)	Unexposed (n = 17)	p
Mean age (years)	42.5[a]	43.2	0.86
Female (%)	55.6	64.7	0.73
Mean time at home (hr)	14.4	14.2	0.81
Mean time at work (hr)	6.8	7.0	0.77
Possibly exposed at work (%)	11.1	11.8	1.00

[a]One missing value.

Table 2. Characteristics of exposed and unexposed residences

	Exposed n = 18	Unexposed n = 17	p
Mean age (years)	33.5[a]	31.3	0.21
Electrical heating (%)	55.6	64.7	0.73
Metal roof (%)	0.0	5.9	0.49
Metal exterior coverage (%)	5.6	35.3	0.04
Mean purchase value (× $1000)	95.1	103.1	0.20
Mean (years) duration of the ownership	13.0	20.1	0.04

[a]One missing value.

Table 3. Personal exposure to 60-Hz magnetic field (mG), geometric mean

Period of exposure	Group			
	Exposed	Unexposed	Ratio[a]	p
At work	1.1 (0.7–1.6)[b]	1.2 (0.8–1.7)	0.9	0.65
Away	1.8 (1.3–2.5)	1.7 (1.2–2.4)	1.1	0.83
At home				
Awake	7.5 (6.5–8.6)	2.2 (1.6–2.9)	3.4	0.0001
Asleep	6.8 (5.9–7.8)	1.1 (0.8–1.6)	6.2	0.0001
Total	7.1 (6.3–8.0)	1.6 (1.2–2.2)	4.4	0.0001
24 hr	4.9 (4.3–5.5)	1.7 (1.3–2.2)	2.9	0.0001

[a]Ratio of means of the exposed group over the unexposed group.
[b]95% confidence intervals in parentheses.

Electrical wires around the residences were coded according to the modified Wertheimer-Leeper method proposed by Kaune and Savitz (*16*). This coding considers transmission lines only if they are located less than 150 feet from a residence, but it can be used to assess the characteristics of the distribution system for the two groups. Among the exposed subjects 6 residences were coded high, 6 medium, and 6 low, but this was not the case for the unexposed subjects, where 16 residences were coded medium and 1 high. However, no difference was found among the exposed subjects for the average magnetic and electric fields at-home measurements between high, medium, and low categories of the modified Wertheimer-Leeper coding, as shown in Table 5.

Following Armstrong and colleagues (*20*), we calculated the percentage of time above a lower threshold (>20 V/m, >2 mG) and a higher threshold (>78 V/m, >7.8 mG) for the two groups. Results, shown in Table 6, demonstrate that the exposed subjects spent longer periods of time than the unexposed at levels above these thresholds. Especially during the at-home period, more than 50% of the exposed subjects spent at least 60% of their time above 20 V/m and 99% of their time above 2 mG. The higher threshold for magnetic fields (7.8 mG) was also exceeded by more than 50% of the exposed subjects at least 26% of the time. The proportion of time above these thresholds during the 24-hr period is still higher for the exposed subjects than the unexposed.

Exposure variability was assessed using the jagged metric proposed by Wenzl et al. (*21*) because the biologically active component of these fields may be their moment-to-moment variability. Because the Positron meter stores field measurements into 16 logarithmically scaled bins, with an interbin ratio of two (*18*), we modified the proposed Wenzl metric as follows: percentage of adjacent minutes with exposure measurements differing by at least one bin and with fields above 5 V/m or 2 mG. Values of this index of variability among exposed and unexposed subjects for the at-home period, subdivided into waking and sleeping periods, are presented in Table 7. Variability as measured by the jagged metric is low and mainly present for the electric field during the waking period. No significant difference was found between the two groups.

Discussion

Exposure to 60-Hz electric and magnetic fields is prevalent in modern societies, but few characterizations of personal exposure of the general population to these fields have been carried out. Much of the focus has been on assessing high exposure at workplaces, especially in electrical utilities (*8,9,17,22,23*). Because residential exposure to 60-Hz electric and magnetic fields can be influenced by the use of electrical appliances inside the house, our research protocol was designed to separate exposure during waking and sleeping periods. As 24-hr exposure might be influenced significantly by occupational exposure, our methodology seeked to assess the contribution of occupational exposure separately. Efforts were also made to have two groups

Table 4. Personal exposure to 60-Hz electric field (V/m), geometric mean

Period of exposure	Group: Exposed	Group: Unexposed	Ratio[a]	p
At work	5.0 (3.2–8.0)[b]	4.1 (2.5–6.7)	1.2	0.51
Away	4.9 (3.0–7.9)	6.0 (3.3–10.9)	0.8	0.56
At home				
Awake	19.8 (15.6–25.2)	13.2 (9.8–17.7)	1.5	0.03
Asleep	27.3 (16.3–45.7)	9.9 (4.6–21.4)	2.8	0.03
Total	26.3 (18.4–37.6)	14.0 (8.9–22.1)	1.9	0.03
24 hr	18.9 (13.7–26.1)	11.4 (7.5–17.4)	1.7	0.05

[a]Ratio of means of the exposed group over the unexposed group.
[b]95% confidence intervals in parentheses.

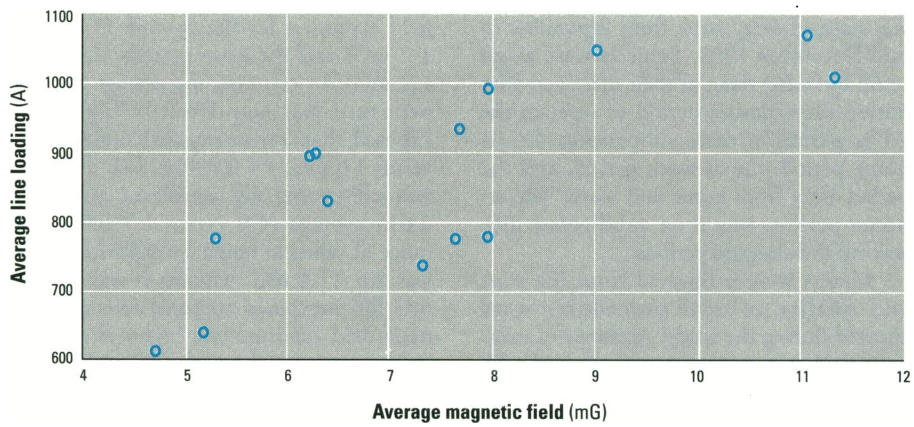

Figure 1. Correlation between the average magnetic field personal exposure at home and the average current loading in the power line during the measurement period for the exposed group (n = 14); r = 0.80; p = 0.001.

Table 5. Geometric means of intensity of electric and magnetic fields for the exposed group during at-home periods according to the coding of the distribution system[a]

	High	Medium	Low
Electric field (V/m)	27.7 (11.1–85.0)[b]	23.4 (6.4–79.8)	28.1 (10.5–71.0)
Magnetic field (mG)	7.5 (5.2–11.4)	6.2 (4.6–7.6)	7.8 (5.2–11.1)

[a]Modified Wertheimer-Leeper coding (*16*).
[b]Ranges in parentheses.

Table 6. Percentage of time above lower and higher thresholds and peak values for electric and magnetic fields during the at-home period

		Electric field: Median	Electric field: Min	Electric field: Max	Magnetic field: Median	Magnetic field: Min	Magnetic field: Max
% of time above lower threshold (>20 V/m, >2.0 mG)	Exposed	60.3	5.7	83.9	99.3	71.5	100.0
	Unexposed	13.2	1.6	98.1	17.7	0.6	85.3
% of time above higher threshold (>78 V/m, >7.8 mG)	Exposed	1.1	0.1	62.5	26.2	0.2	90.5
	Unexposed	0.4	0.0	58.4	0.4	0.0	8.2
Peak (V/m, mG), range of the values of the bin	Exposed	156.3–312.5	78.1–156.3	5,000–10,000	15.6–31.3	7.8–15.6	250.0–500.0
	Unexposed	78.1–156.3	19.5–39.1	312.5–625.0	7.8–15.6	3.9–7.8	125.0–250.0

of residences and two groups of subjects with similar characteristics, with the exception of exposure to the transmission line. The distribution system was not comparable for the two groups, but this did not lead to a bias because the distribution system appeared to have no influence on the fields measured inside the houses of exposed subjects. Exterior metal covering of homes was more common in the unexposed subjects but this was taken into account in the analysis and did not substantially affect our findings. Conditions of measurements were similar between the two groups, particularly for the minimum outdoor temperatures during the measurement periods.

Our results demonstrate that such a 735-kV line is a significant contributor to residential 60-Hz electric and magnetic field exposures for people living in residences located at the edge of the right of way (i.e., 190–240 feet from the line). The influence of the magnetic field exposure was considerable because the at-home measurement of the exposed group was 4 times higher, and the 24 hr exposure was 3 times higher than that of the unexposed subjects. The magnetic field exposure at home of the unexposed group (1.7 mG) was slightly higher than the usual residential exposure (≤1 mG) measured in the United States (*8*). The at-home magnetic field exposure for the exposed group was much higher than measured by Kavet et al. (*13*), who found a mean of 3.2 mG for personal exposure of five people living close to a 345-kV line. Our measurements were also higher than those of McMahan and colleagues (*12*), who found mean magnetic fields of 4.8 mG at the front door of 76 houses located at the edge of two 220-kV lines and two 66-kV lines. At-home average magnetic field exposure of exposed subjects was, in fact, in the range of the mean occupational exposure of many electrical workers (*17,22,23*).

Magnetic field exposure for the exposed group was only slightly lower during sleeping periods than during waking periods. This is in contrast with the unexposed group, for whom exposure during sleeping periods was half that of the waking period. These data support the hypothesis that an important part of the magnetic field exposure among unexposed subjects is related to activities during the waking period (directly by using electrical appliances or indirectly from distribution lines). For the exposed group however, exposure from the transmission line dominated during the waking and sleeping periods. At-home magnetic field exposure for the exposed subjects was also highly correlated with the loading of the current in the line. This was not surprising because magnetic fields are directly produced by the current in the line (*9*). The lack of correlation between the magnetic field exposure in the homes and the distance of the houses from the line could be explained by the low range of distances separating the exposed houses from the line (190–240 feet). Electric field exposures during the at-home period were also higher for the exposed subjects compared to unexposed. Although the at-work and away periods were comparable for the two groups, the average electric field exposure during the at-home period for exposed subjects was twice that of unexposed subjects. This was only slightly reduced when considering only houses without exterior metal covering. As stated earlier, our mean electric fields values for the exposed group are in the range of the mean occupational exposure of many electrical workers (*17,22*). There is no reason to believe that such a difference could be due to uncontrolled factors. Exposure in the yard near the home could be different between exposed and unexposed subjects, but this should not be the case here given the study season. Morever, this possibility could not explain the difference between our two groups during the sleeping period. Because of the comparability between our two groups for subject characteristics and residences, there is no reason to believe that the difference observed could be due to varied use of electrical appliances. In fact, the causal role of the transmission line seems possible, but this has not been investigated much previously (*8*).

The influence of the at-home exposure from the line for the 24-hr average exposure is not surprising because most of the subjects spent more than 60% of their time in their homes. Few studies have considered the effect of a specific source on the 24-hr exposure of people. Kavet et al. (*13*) found some persistent effect of the at-home magnetic field exposure on the 24-hr exposure, but few subjects were considered and no details were given on the time spent at home by their subjects. Deadman et al. (*17*) studied the overall weekly time-weighted (TWA) average for a pilot group of utility workers. The geometric mean of magnetic field exposure (weekly TWA) was 6 mG for the exposed workers compared to 1.7 mG for unexposed workers (*17*), which is comparable to our 24-hr results.

Sussman (*8*) and Kaune (*9*) recently argued that average exposure might be similar for completely different profiles of exposure. Accordingly, we studied other indices of exposure. The distribution of percentage of time above a certain threshold between the two groups was compared as in the Armstrong et al. study (*20*). The median percentage of time spent above 2 mG at home was 99.3% in the exposed compared to 17.7% in the unexposed. The median percentage of time above 7.8 mG was 26.2% in the exposed group compared to 0.4% in the unexposed. These two thresholds seem to distinguish quite clearly the exposed from the unexposed. In regard to electric fields, only the percentage of time above 20 V/m at home was significantly different: median 60.3% in the exposed group compared to 13.2% in the unexposed group. Percentage of time above 78 V/m was rare in the two groups. The magnetic field exposure according to these criteria was comparable to that of many electrical utility workers and even higher than the utility workers studied by Armstrong et al. (*20*). In contrast, electric field exposure was lower; especially peak exposure and percentage of time above 78 V/m are much higher among electrical utility workers.

Using the modified Wenzl metric showed little variability for magnetic fields. Only a small variation was found among unexposed subjects during the waking period. The variability was more frequent for the electric field but only during the waking period and with the same intensity for the exposed and unexposed. The cause of this variability is possibly related to short and intense electric field exposures from electrical appliances (*8,9*), but we also have

Table 7. Percentage of adjacent minutes with field measurements differing by at least one bin during the at-home period[a]

		Electric field			Magnetic field		
		Median	Min	Max	Median	Min	Max
Total home period	Exposed	3.9	0.7	17.3	0.1	0.0	1.8
	Unexposed	2.9	0.1	9.9	1.5	0.2	4.5
Sleeping period	Exposed	0.2	0.0	23.9	0.0	0.0	0.2
	Unexposed	0.2	0.0	11.4	0.0	0.0	4.1
Waking period	Exposed	7.6	2.6	12.8	0.4	0.0	3.1
	Unexposed	6.7	0.3	10.3	2.1	0.6	13.3

[a]With electric field above 5 V/m and magnetic field above 2 mG.

to consider that variability during the waking period is expected due to body movements which modified the electric field measurements (*18*).

Our measurements were made at the beginning of the winter when the average loading on the line varied between 600 and 1100 A. It is likely that exposure could be higher during the colder days of the winter, but from the line-loading data obtained during a year, the mean loading during the measurement period is representative of the range of daily means during a complete year.

We used a modified version of the Wertheimer-Leeper (W-L) coding because it is simpler to apply than the original W-L coding scheme and has shown good validity in classifying residences according to their magnetic fields (*16*). However, the coding scheme disregards transmission lines farther away than 150 feet, and in our sample of homes it failed to distinguish the exposed and unexposed homes. This would suggest that the 150-feet cutoff is not appropriate for a 735-kV transmission line. Indeed, magnetic field levels of about 6 mG can be measured at a distance of 230 feet from a 735-kV line. Thus, in our study the coding scheme characterized homes only by the distribution lines. An interesting pattern was observed: all three categories (high, low, medium) were found among our exposed homes, whereas most of the unexposed residences were classified into the medium category, due to a three-phase primary line passing within 150 feet. As houses were selected randomly however, we can think of no explanation, other than chance, for this pattern, and it does not appear to affect our findings.

Exterior metal siding was more common among the unexposed homes. Residences were quite comparable for their age and purchase value, but renovation may have been more frequent in the unexposed, since average duration of ownership was slightly longer among the unexposed. This did not, however, alter the results; the difference in electric field exposure remained substantial even when only houses without metal covering were considered.

The field intensities measured, while higher among the exposed than the unexposed, are still far from the maximum acceptable exposures for the general public of 5000 V/m (unperturbed root mean square) and 1000 mG, proposed by the International Radiation Protection Association (*24,25*). These guidelines are based on the effects of currents induced in the human body by acute exposures, with safety factors applied to the "low observed effect levels" to account for uncertainty in the estimates of risk for long-term exposure.

The risk of long-term exposure to elevated power-frequency magnetic fields, such as those observed here, is possible, but not proven (*3,6,26,27*). It is clear, though, that the exposures seen here are markedly higher than those found in most epidemiological studies of residential exposures, in which excess risks of certain cancers have been observed. Such exposure is present during at-home periods, especially for magnetic fields at night. This sleeping time is essential for the biological rhythm of the human body and some laboratory research on animals has found effects of such fields on the secretion of the pineal gland (*28*).

Nevertheless, there is no clear biologically established exposure metric that can be used to evaluate an internal effective dose. Recent experimental studies indicate that repeated short-term exposures could be more hazardous than constant exposure (*29,30*). Therefore, a cumulative exposure or a TWA may not be the most appropriate measure of exposure. The jagged metric we used here showed little variability of exposure from the line, but this may not be the appropriate measure of effective dose. Percentage of time above 2 mG or 7.8 mG was remarkably different between the two groups, but there is no biological basis to use such levels as thresholds. Finally, we have to consider that these results were generated by the study of only a limited number of subjects and that one has to be cautious before generalizing such findings to other populations.

Conclusion

Exposure to 60-Hz magnetic fields (and to a lesser extent electric fields) from a 735-kV power line appears to be significant for people near it. Mean levels of magnetic fields as well as percentage of time above 2 mG and 7.8 mG are considerably more important for the people living near a line. These levels are in the range of the occupational exposure of many workers. However, some characteristics of the exposure are different: peaks in electric fields were much lower, and the exposure appears more constant. Furthermore, in contrast to occupational exposures that cease or diminish after work, residents near transmission lines are continously exposed while at home and expecially during the night. Although it is unclear if these characteristics imply a lower risk, it appears that such exposures are unusually high for residential areas. It is not currently possible to estimate precisely any risk (*26*). Because few people live close to such a line, the possible attributable risk from this exposure in the general population is probably low, but the relative risk for the few exposed people might be important. Prudence is suggested in generalizing these results to other populations because of the relatively small sample size, but our results indicate the need to study the possible risk associated with such an unusual high residential exposure.

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