# Exposure to electromagnetic fields and risk of childhood leukemia: a population-based case-control study in two Italian provinces

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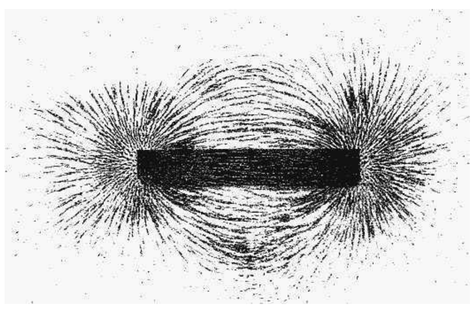
## Introduction

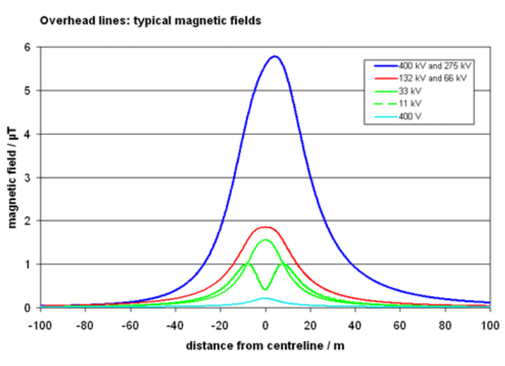
Exposure to electromagnetic fields has been suggested as risk factor for childhood leukemia.
We carried out a population-based case-control study evaluating the risk of childhood leukemia in children living near sources of electromagnetic fields, including high-voltage power lines and electrical transformers.

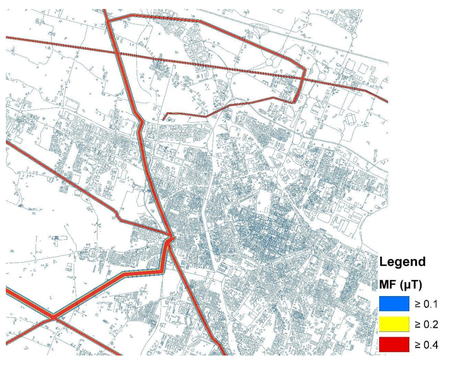
## Methods

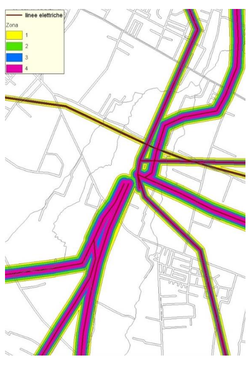
We identified all newly-diagnosed childhood leukemia cases in the Northern Italy provinces of Modena and Reggio Emilia (population around 1,200,000) from 1998 to 2013. For each case, we randomly selected four population controls matched by sex, age, province of residence, and calendar year. Using a Geographical Information System (GIS), we geocoded children's address of residence. We also identified and geocoded corridors along high-voltage power lines and around indoor electrical transformers operating in the two provinces. We computed the odds ratio (OR) and its 95% confidence interval (CI) of CL using conditional logistic regression analysis according to the distance between children's residence at the time of case diagnosis to the nearest power line or to the nearest transformer room.



## High voltage power lines

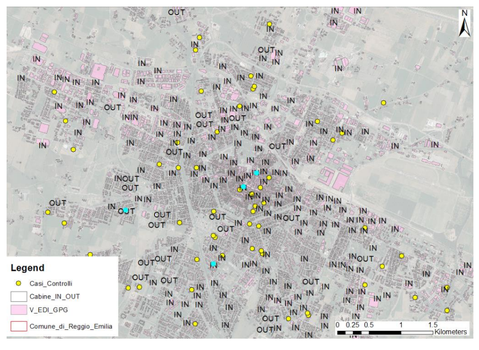


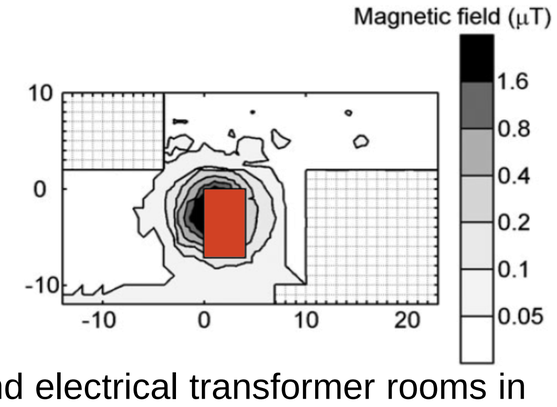



Magnetic field exposure (in microtesla - µT) at increasing distance from overhead power lines and example of their location and georeferencing in the Reggio Emilia province.

## Electrical transformers rooms




Example of georeferencing of subjects and electrical transformer rooms in the Reggio Emilia province and example of magnetic field exposure (in microtesla - µT) from an electrical transformer room (red rectangle). Distance from centroid of electromagnetic field reported in meters.

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## Results

We included 132 cases and 538 controls when exposure to high-voltage power lines. ORs for childhood leukemia were 0.6 (95% CI 0.3-1.6), 1.2 (95% CI 0.4-3.7), 0.5 (95% CI 0.1-4.2) and 7.3 (95% CI 0.7-81.5) for children living respectively 200-400 m, 100-200 m, 50-100 m and less than 50 m from the nearest electrical power line compared to those residing further than 400 m (Table 1).
Similarly, we included 116 and 464 cases and controls respectively when evaluating risk due to residing near transformer rooms. Compared to children residing beyond 200 m, we found an excess CL risk for children living respectively at 50-200 m (OR 1.2, 95% CI 0.7-2.1), at 50-20 m (OR 1.8, 95% CI 0.6-4.9) and less than 20 m (OR 2.1, 95% CI 0.4-12.1) from an indoor transformer (Table 2).

**Table 1.** Odds Ratio (OR) and 95% confidence interval (CI) of risk of childhood leukemia in relation to distance from overhead power lines.

| Distance (m) | Cases/ Controls | OR | 95% CI |
|---|---|---|---|
| >400 | 111/433 | 1.0 | - |
| 200-400 | 12/58 | 0.6 | 0.3-1.6 |
| 100-200 | 5/26 | 1.2 | 0.4-3.7 |
| 50-100 | 2/9 | 0.5 | 0.1-4.2 |
| <50 | 2/2 | 7.3 | 0.7-81.5 |

**Table 2.** Odds Ratio (OR) and 95% confidence interval (CI) of risk of childhood leukemia in relation to distance from electric transformer rooms.

| Distance (m) | Cases/ Controls | OR | 95% CI |
|---|---|---|---|
| >200 | 68/266 | 1.0 | - |
| 200-50 | 39/167 | 1.2 | 0.7-2.1 |
| 50-20 | 7/25 | 1.8 | 0.6-4.9 |
| <20 | 2/6 | 2.1 | 0.4-12.1 |

## Conclusions

In our study we investigated the possible risk childhood leukemia between in relation to magnetic field exposure from overhead power lines and for the first time from the indoor electrical transformer rooms.
Although our results are statistically imprecise due to low number of exposed subjects and should be interpreted with caution due to possible exposure misclassification, the magnitude of the ORs and the dose-response relations clearly suggest an excess childhood leukemia risk due to electromagnetic field exposure exposure, as assessed by living close to overhead power lines or to indoor transformers rooms.

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