

## Electromagnetic Radiation Exposure and Cancer Outcome Comparison between Cancer Alley and Non-Cancer Alley Parishes in Louisiana

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**Abstract:** Radiation from electromagnetic field had been discussed as a potential source of various health hazards for more than the last 30 years. Ionizing fields with frequencies greater than 1015 Hz give rise to free radicals in the human cells by rearranging electrons in the absorbing molecules surface. At low frequencies, especially below 10 MHz, the penetration of electrical fields into tissues increases with an increase in frequency. However, the magnetic fields do not follow the same principle. The absorption of electromagnetic field energy in the human body is highest between 30 MHz and 300 MHz. Studies correlating the exposure to electromagnetic field and occurrence of specific cancers, especially in a dose response way, are scarce. A study by Khan et. al. (2021) emphasized that time of exposure correlates to magnitude of exposure and hence the outcome of the exposure. The results of this study showed hazard ratio was highest (2.86; CI : 1.00 – 8.15) when the subjects were exposed to more than 3 years. The results were particularly consistent for childhood exposure. Occupational exposure to the workers working in close contact to the power lines have been explored in the literature. Underrepresented communities like poor African American communities living closer to the Cancer Alley in Louisiana have few or no access to good healthcare in the Louisiana. They are exposed to radiation due to its proximity to the power lines. The hypothesis of our research is that one potent source of cancer exposure might be electromagnetic fields radiating from the power grids that is present in higher numbers in Cancer Alley than the rest of Parishes in Louisiana. This might be contributing to the higher cancer cases in Cancer Alley. Through a literature survey and cancer registry database, we aim to compare and contrast between the ‘Cancer alley’ and non-cancer alley parishes for the exposure to electromagnetic radiation coming from the power lines. We aim to compare and contrast cancer cases (especially cancer of the reproductive organs and breast tissue between areas that have high and low density of electrical power lines. The research aims to benefit the Louisiana residents, especially the working population communities residing in the Cancer Alley region of Louisiana. The research aims to focus on the electric grid miniature versions which are called microgrids that have self-storage capacity. Unlike electrical power lines, they do not emit hazardous radiation.

*Keywords:* cancer, power line, microgrid, renewable, Louisiana

## 1. Introduction

Electromagnetic fields can damage the DNA inside the cells and start damaging healthy cells by triggering cell apoptosis. The rapid expansion of wireless systems needed for cellular data usage and larger coverage thus triggers the outcome of deadly diseases like cancer. This issue needs a solution, and some literary sources point towards the reduction of reactive oxygen resources (Sailev, 2019). The effect of electromagnetic fields has been exploited for medical purposes to diagnose cancer (Bergandi, 2019 (4-10) reference). The study by Bergandi et al. (2019) has shown that two cancer cell lines exposed to ELF frequencies manifest increased proliferation rate. This phenomenon has been long debated in the literature regarding the absorption of electro-magnetic radiation into the cells through high voltage power lines. So far, there has been an inconclusive conclusion regarding the extent of cellular damage regarding the exposure to electromagnetic radiation (Olorunsula, 2021).

Radiation from base stations and high voltage power lines have been linked to cancer (Crespi, 2016; Frei, 2013; Olorunsula, 2021). These studies have emphasized that leukemia, brain and prostate cancers were the most common cancers found in people exposed to electromagnetic radiation.

Cell phone usage has been linked with blastoma, glioblastoma and neural de-functioning (Interphone, 2010; Coureau et al., 2014; Hardell and Carlberg, 2017; Belpomme, 2018) as well. This has been reported in the literature from the last decade. Parallel to that, childhood leukemia is occurring in children who are topographically located close to the power lines (Michelozzi et al., 2002; Serge-Faure et al., 2013). This is intriguing because leukemia is the unique cancer that is induced by low frequency electromagnetic fields (Ahlbom et al., 2000; Greenland et al., 2000).

### 1.1 Multiple sources of electro-magnetic radiation

It is a bit difficult to establish the straightforward correlation between power lines and cancer, especially in young children. The reason is that power lines are not the only source that emit electromagnetic frequency (EMF) emission. Cell phones, microwave ovens, computers, wi-fi networks, radios, hair dryers, electrical appliances, and many other common household items. This fact that there is a multi-level sources for the electromagnetic emission, makes it difficult to narrow down on one source as the most potent source for cancer exposure. The distance also plays a role, the more distance from the source, least is the risk and vice versa.

#### 1.1.1 Childhood cancer

Several studies have analyzed the combined data from multiple studies of power line exposure and childhood leukemia: A study by Crespi et al. (2016), included 5788 childhood leukemia and 3308 central nervous system (CNS) cancer cases (for comparison) for children who were born in and diagnosed in California (1986–2008). The authors matched to population-based controls by age and sex. Most importantly, the study geocoded birth address and estimated the distance from residence to transmission lines using geographic information systems, aerial imagery, and, for some residences, site visits. Results found that for leukemia, there was a slight excess of cases within 50 m of a transmission line over 200 kV (odds ratio 1.4, 95% confidence interval 0.7–2.7). There was no evidence of increased risk for distances beyond 50 m, for lower-voltage lines, or for cancers related to the central nervous system.

#### 1.1.2 Why monitoring childhood cancer is important for Cancer Alley

Cancer Alley is a term used to describe a heavily industrialized area that stretches along the Mississippi River between Baton Rouge and New Orleans in Louisiana, United States. This region is characterized by numerous chemical plants and refineries, which have had significant implications for both human health and the environment. A study conducted by the Environmental Protection Agency (EPA) found that residents living near this plant had an elevated risk of developing cancers like liver cancer due to long-term exposure to these harmful chemicals (U.S. EPA, 2019). However, majority of the childhood cancers in this area have been identified as blood cancer (Siegel, 2023; Louisiana cancer registry data; Wright, 2023). Also, the children are not among the active working population of this community. Therefore, the sources which exposure the adult of the community for cancer outcome, are least likely to affect the children population. The potential of electromagnetic field in initiating cancer in children have been reported since 1990s (Feychting, 1995). Since childhood cancer is on rise in Louisiana and especially in the Cancer Alley, the sources like electrical power lines which run very close to the chemical factories can be a potent source of cancer. This is the hypothesis of the paper. Currently there are no compliance or risk mitigation strategies that exist to reduce this exposure.

## 2. Advantages of Renewable Energy Microgrid

A microgrid is an aggregation of electrical loads within a confined geographical area supplied by distributed generators like PV, Wind Gas Turbine etc. and the operation and control of the system can be performed with modern techniques such that the stability and reliability of the system is achieved. It can either operate in standalone mode or supply a local load or if required can be connected to the main grid for interchange of power. A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode. Environmental pollutants including volatile emissions and some greenhouse gases which are the negative outcomes of the power lines are largely absent in the renewable micrograms. In the United States, in states like California, the regulatory requirements for renewable energy is to mitigate the negative outcomes to the lowest possible level. Despite these facts, only a few hospitals in the United States have implemented such renewable micrograms (California Energy Commission, 2019).

## 3. Methods

Proximity to industrial facilities (that have a lot of power lines) especially in Cancer Alley in Louisiana in which these populations live might have an effect in the higher-than-average cancer rates in Cancer Alley. Therefore, we would like to investigate the correlation between cancer trends in young and older population (especially lung, bronchus cancer, and prostate cancer in Louisiana) and nearness to the power lines. Our main focus is to compare the cancer alley Parishes (total of 11 Parishes) and non-cancer Alley Parishes (around 53 Parishes) to find out the rate of cancer relative to the distance from the power lines. We have the cancer data from cancer registry and the census data. Our study is going to compare and contrast lung, bronchus and prostate cancers for both African-American and White-Caucasian population.

## 4. Results and Conclusion

The study is ongoing and therefore we cannot show all the results. So far literature has been inconclusive in finding out whether power lines have been a potent source for inducing cancer in general pollution especially young population. More research is needed to conclusively evidence the role of electromagnetic frequency in inducing cancer. More research is needed to fill that gap. This ongoing research is trying to fill that gap.

## 5. References

- Ahlbom A., Day N., Feychting M., Roman E., Skinner J., Dockerty J., Linet M., McBride M., Michaelis J., Olsen J.H., Tynes T., Verkasalo P.K. (2000). A pooled analysis of magnetic fields and childhood leukaemia. *British Journal of Cancer* 83(5):692-8.
- Belpomme D., Hardell L., Belyayev I., Burgio E., Carpenter D.O. (2018). Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective. *Environmental Pollution* 242: 643-658.
- Bergandi L., Lucia U., Grisolia G., Granata R., Gesmundo I., Ponzato A., Paolucci E., Borchiellini R., Ghigo E., Silvano F. (2019). The extremely low frequency electromagnetic stimulation selective for cancer cells elicit growth arrest through a metabolic shift. *BBA - Molecular Cell Research* 1866: 1389-1397.
- California Energy Commission, 2019. 2019 Building Energy Efficiency Standards. <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2019-building-energy-efficiency>
- Coureau G., Bouvier G., Lebailly P., Fabbro-Peray P., Gruber A., Leffondre K., Guillamo J.S., Loiseau H., Mathoulin-Pelissier S., Salamon R., Baldi I. (2014). Mobile phone use and brain tumours in the CERENAT case-control study. *Occupational and Environmental Medicine* 71(7):514-22.
- Crespi C.M., Vergara X.P., Hooper C., Oksuzyan S., Wu S., Cockburn M., Kheifets L. (2016). Childhood leukemia and distance from power lines in California: a population-based case control study. *British Journal of Cancer* 115(1): 122-128.
- Crespi C.M., Vergara X.P., Hooper C., Oksuzyan S., Wu S., Cockburn M., Kheifets L. (2016). Childhood leukaemia and distance from power lines in California: a population-based case-control study. *British Journal of Cancer* 115(1): 122-128.
- EPA, 2019. [www.epa.gov/toxics-release-inventory-tri-program?utm\\_medium=email&utm\\_source=govdelivery](http://www.epa.gov/toxics-release-inventory-tri-program?utm_medium=email&utm_source=govdelivery).
- Feychting M., Schulman G., Olsen G.H., Ahlbom A. (1995). Magnetic fields and childhood cancer—a pooled analysis of two Scandinavian studies. *European Journal of Cancer* 31:2035-2039.

- Feychting M., Ahlbom A. (1993). Magnetic fields and cancer in children residing near Swedish high-voltage power lines. *American Journal of Epidemiology* 138(7):467-81.
- Frei P., Poulsen A.H., Mezei G., Pedersen C., Salem L.C., Johansen C., Roosli M., Schuz J. (2013). Residential Distance to High-voltage Power Lines and Risk of Neurodegenerative Diseases: a Danish Population-based Case-Control Study. *American Journal of Epidemiology* 177(9):1- 970-978.
- Greenland S., Sheppard A.R., Kaune W.T. (2000). A Pooled Analysis of Magnetic Fields, Wire Codes, and Childhood Leukemia. *Epidemiology* 11(6): 624-634.
- Hardell L., Carlberg M. (2017). Mobile phones, cordless phones and rates of brain tumors in different age groups in the Swedish National Inpatient Register and the Swedish Cancer Register during 1998-2015. *Plos One* 4;12(10):e0185461.
- Interphone Study Group (2010). Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *International Journal of Epidemiology* 39(3):675-94.
- Khan M.W., Juulainen J., Naarala J., Roivainen P. (2021) Residential extremely low frequency magnetic fields and skin cancer. *Environment* 79:1
- Michelozzo P., Capon A., Kirchmayer U., Forastiere F., Biggeri A., Barca A., Petrucci C.A. (2002). Adult and Childhood Leukemia Near a High Power Radio Station in Rome, Italy. *American Journal of Epidemiology* 155 (12): 1096-1103.
- Olorunsola A.B., Ikumapayi O.M., Oladapo B.I., Alimi A.O., Adeoye A.O.M. (2021). Temporal variation of exposure from radio-frequency electromagnetic fields around mobile communication base stations. *Scientific African* 12: e00724.
- Sailev T., Begimbetova D., Masoud A.R., Matkarimov B. (2019). Biological effects of non-ionizing electromagnetic fields: Two sides of a coin. *Progress in Biophysics and Molecular Biology* 141: 25-36.
- Sigel R.L., Miller K.D., Wagle N.S. (2023). *Cancer Statistics. CA: A Cancer Journal of Clinicians* 73:17–48.
- Sermage-Faure C., Demoury C., Rudant J., Goujon-Bellec S., Guyot-Goubin A., Deschamps F., Hemon D., Clavel J. (2013). Childhood leukaemia close to high-voltage power lines--the Geocap study, 2002-2007. *British Journal of Cancer* 108(9):1899-906.
- Wright MD., Buckley AJ., Mathews JC., Shallcross DE., Henshaw DL. (2023). Overhead AC powerlines and rain can alter the electric charge distribution on airborne particles – Implications for aerosol dispersion and lung deposition. *Environmental Research* 228: 115834.