

# Radiofrequency Electromagnetic Fields (RF-EMF) and Neurodegenerative Diseases: Is there any Connection?

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The electromagnetic spectrum encompasses all electromagnetic radiation and classifies it according to its energy, and hence its frequency, which ranges from the shortest wavelength (higher frequency) radiation, such as gamma rays and x-rays, followed by ultraviolet light, visible light and infrared rays, to electromagnetic waves of greater wavelength (less frequency), such as radio waves. In addition to the division into the indicated major bands, based on the ability to interact with matter, electromagnetic radiation can be divided into ionizing and non-ionizing.

Ionizing radiation is a high frequency radiation which has enough energy to pull an electron away from an atom or molecule (ionize) and can cause damage to organisms, depending on the absorbed dose. On the other hand, non-ionizing radiation is a radiation with lower frequencies that does not have enough energy to pull electrons or cause direct damage to the DNA. However, there is controversy about the potential health effects of non-ionizing radiation.

The evolution of our species has allowed us to adapt to life in an environment with low frequency electromagnetic waves and low intensity from natural sources: from the sun and storms. In addition, we have become accustomed to the earth's weak magnetic field, which is practically stationary. However human activity has altered this natural balance with more intense electromagnetic fields with a very different spectral distribution of frequencies.

During the last few decades, the emission of waves produced by radiofrequency electromagnetic fields (RF-EMF) has undergone significant growth. Simultaneously with the increased exposure to RF-EMF, the population's concern in relation to potential health effects has risen. Among the emission sources, the number of mobile phone base stations, which have been the subject of numerous studies, has climbed significantly.

Recently, the development of personal exposimeters has facilitated detailed descriptions of the spectrum of the electromagnetic radiation to which the population is exposed and the contribution of each frequency band: radio, television, mobile telephone antennas, and wireless telephony or Wi-Fi networks in various European cities.

In this context, spatial epidemiology combines Epidemiology, Statistics and Geographic Information Systems (GIS), and can provide a new path of analysis.

In recent years, our team has conducted several epidemiological studies about the possible association of RF-EMF and adverse health effects [1,2]. Fundamentally, our work has focused on the search of spatial clusters of disease and its potential correlation with specific environmental factors. The fact that the geographical grouping can lead to the identification of the cause is well founded and is the basis of modern epidemiology [3]. Therefore, it is interesting to continue research into potential environmental risk patterns. Accordingly, it is necessary to consider time and spatial components in a systematic and controlled way.

There are not many studies on the potential relationship between

RF-EMF and neurodegenerative diseases. Some studies have been based on self-report exposure however such information is often biased. Savitz and colleagues performed a mortality study on United States utility workers and a case-control study of the neurodegenerative disorders, Parkinson disease, Alzheimer disease, and ALS in these same workers. Both studies found weak associations between ALS and the extent of EMF exposure [4,5]. Other studies found no association [6]. Due to the characteristics of the neurons, we consider that their possible interaction with RF-EMF is an interesting line of research that should be analyzed in depth.

Currently, there is no known mechanism by which exposures to electromagnetic fields can cause neurodegenerative diseases. However, Alzheimer's disease, Parkinson's disease and ALS share common factors: they are chronic, progressive and, to date, have no cure. In addition, the majority of the cases of Alzheimer's disease, Parkinson's disease and ALS are sporadic, which implies that environmental (i.e., non-genetic) factors play an important role in the development of these diseases. Understanding modifiable risk factors could therefore provide opportunities for prevention [7,8]. It must not be forgotten that these neurodegenerative disorders (Parkinson disease, Alzheimer disease, and ALS) are considered to be the result of environmental risks and the time period which act on a pre-existing genetic load and its etiology is currently unknown.

On many occasions, the study of the etiology of the diseases has been carried out with a double approach, analyzing environmental factors or from the genetic point of view. The search for a connection between these two points of view will be important for the future and perhaps the key to modern epidemiology.

## References

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