# The Faroe, Orkney and Sardinia islands are pointing the dielectrophoretic force in the etiology of multiple sclerosis

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**Abstract**

This study aims to explain the cause of prevalence of multiple sclerosis (MS) disease in the Faroe, Orkney and Sardinia Islands, by pointing the dielectrophoretic force in the etiology of MS. Initially, the geographical and geophysical specifications of these places have been investigated and then, the results were interpreted by considering the effects of the dielectrophoretic force, which is the essential cause of MS disease in the human body. These islands have very suitable conditions in terms of the geographic environment and the constitutive relations to transmit the electromagnetic field lines, compared to the other places. As a result of this study, it has been found out that direct correlation between the electromagnetic fields on the islands and the prevalence of MS disease. In order to support these claims, several geographical/geophysical data, calculated results and reviews by the author in his previous articles have been used.

**Keywords:** Causal factor, dielectrophoretic force, Faroe islands, multiple sclerosis, Orkney islands, Sardinia island.

## 1. INTRODUCTION

Multiple sclerosis (MS) is one of the most common neurological disorders whose symptoms occur as a result of the inflammation and breakdown in myelin. Myelin is made of lipids of proteins, tau cells and protective layers of nerve fibers. It insulates the nerve fibers found in the central nervous system (CNS) and the peripheral nervous system(PNS) by surrounding them. This properties may be likened to the loss of insulating material around an electrical wire. Demyelination is a degenerative process that erodes the myelin sheath. The myelin basic proteins (MBPs) and other particles which are separated from myelin sheath accumulate in the plaque-like debris form in some specific regions of the brain and the spinal cord (Canbay, 2010). The intensity of electrical signals, traveling along the nerves, decrease and become noisy. A patient affected from MS disease may experience progressive disorders of the functions that are controlled by the CNS, such as vision, speech, walking, writing, attention and memory.

The dielectrophoretic force has been found as the essential cause of MS disease, which is one of the most common neurological disorders. In this study, the correlation between MS and the electromagnetic fields has been shown by nine different ways and their arguments. One of them RIS (Radiolagically Isolated Syndrome) occurs following MRI (Magnetic Resonance Imagining) examinations. In a recent study, it was explained that both, RIS (radiolagically isolated syndrome) and MS (multiple sclerosis) disease occur as a result of dielectrophoretic force. In fact, the study (Canbay, 2014) about RIS was the evidence that RIS should not be named as an individual concept, since it's just an accelerated form of demyelination phenomena due to dielectrophoretic force which is exactly the same phenomena due to the same force that causes MS disease. Frequent MRI applications and improper selection of the operating frequency of MRI scanners can lead to occurring of MS-like syndromes in the brain. A study from 1999 has very interesting results about the demyelination. In that study, the researchers, systemically, injected reactive T cells to a non-neural antigen (ovalbumin) of Lewis rats and caused those T cells to accumulate in thoracic dorsal column by a prior injection of ovalbumin. According to their findings and interpretations, a more profound conduction block and more plaque-like regions of demyelination were observed in the animals. However, they were not able to explain the main cause of this result. If the researchers had taken the dielectrophoretic effect on the myelin into account, they would be able to explain not only the main cause of occurred demyelination and plaque-like structure but also the motion of the T cells in a dielectrophoretic force field, like in the author's studies (Canbay, 2015) (Heida T, Rutten WL, Marani E, 2001). Moreover, the stimulator had not been applied on the rats, the plaque-like formations due to geometric properties of rats would not be able to observe.

This study proves the correctness of the author's hypotheses which shows the relationship between MS and the electromagnetic field distribution all around the world. Especially, Faroe, Orkney and Sardinia Islands are widely known as the places with a high prevalence of MS disease of the world. And this statistical data about the prevalence of MS disease in these regions, directly overlaps the interpretations which were made by considering the electromagnetic field in the same areas, since dielectrophoretic force arises due to electromagnetic fields and cause demyelination which leads to MS disease (Canbay, 2010) (Canbay, 2013) (Canbay, 2014), (Canbay, 2015). The researchers have been trying to detect the causal factors for the increasing of MS disease in this distinct region which is consisted of Faroe, Orkney and Sardinia islands. Some researchers underline of the effect of industrial changes and occupation on the islands. For some researchers, birthplace is considered as an indicator of MS disease (Lauer, 1986). The Sardinian cohort has been observed for a long time to find out the relation between the early multiple sclerosis and retrovirus (Sotgiu, et al., 2006). In the recent years, researchers and the national and international organizations have focused on the effect of the genetics (Ramagopalan, McMahon, Dyment, Sadovnick, Ebers, & Wittkowski, 2009) (Wang, et al., 2011), the immune system (Bates, Feix, Boggs, & Harauz, 2004), the environmental factors (Canbay, 2010) on MS disease. Some researchers have put forward that the high intake of vitamin D, which is proportional to the solar radiation, is associated with lower prevalence rates of the multiple sclerosis (Schwarz & Leweling, 2005). And some others have been against to this assumption.(Beebe, Kurtzke, Kurland, Auth, & Nagler, 1967). In a study, it is proposed that multiple sclerosis may be transmitted chiefly by sexual contact. Higher prevalence rate of multiple sclerosis on the Orkney islands has been described by the increase in the number of troops on the island during the Second World War (Hawkes, 2002). Even though, all these studies which were made by different researchers, give parallel results to the results of my approach; any of these studies, except my studies, are not able to offer the main reason of MS disease by using provable and powerful arguments but they just collect the prevalence rate data like a statistician and make some baseless assumptions about the causes of these rates without stating any linked, credible and scientific proof (Canbay, 2010) (Canbay, 2013) (Canbay, 2014) (Canbay, 2015). The author's comparative study, between the keraunic map of the world (prepared by IEEE) and the common reports of WHO (World Health Organisation) and MSIF (Multiple Sclerosis International Federation) in 2008 and

2013, has given the answer to the question of "Why some regions of the world have a higher risk of MS disease than others?" (Canbay, 2010) (Canbay, 2014).

## 2. SUMMARY OF THE AUTHOR'S HYPOTHESES ON THE ETIOLOGY OF MULTIPLE SCLEROSIS DISEASE

In the author's previous studies, it has been shown that the dielectrophoretic force is the main cause of MS disease through various approaches. To contribute to a better understanding of this issue, these approaches can be summarized as follows:

1-The effect of the dielectrophoretic force on Myelin Basic Protein (MBP) was determined in white matter, grey matter and cerebrospinal fluid (CSF) by use of Clausius-Mossoti (CM) equation as shown in Figure 1, Figure 2. Since the MBP, has a molecular weight of 18.5 kDa, a radius of 1.525 nm and an adhesion force of 0.05 mN/m between MBP and the nerve cell, the dielectrophoretic force at some frequencies and under long term exposure conditions, pulls the MBP off from the nerve cell (Canbay, 2010) (Canbay, 2014). The data in Figure 1 has been calculated by CM equation, by taking into account the dispersive properties of all constitutive relations of human brain. In this case, the results become parallel to possible experimental results. When the phenomena is viewed in the terms of relation between MBP and dielectrophoretic force, this graph explains many things. The extra low frequency-electromagnetic fields (ELF) create significant effects which lead to MS disease. As seen on the graph, even when there is no artificial electromagnetic field source, dielectrophoretic force appears due to natural electromagnetic field of the planet, thus, MS disease also appears (check Schumann resonance frequencies and history of MS disease). Today, living things live under the influence of both natural and artificial electromagnetic fields. Some of the important artificial electromagnetic field sources are the electrical power distribution systems (50-60 Hz), MRI scanners (63 MHz, 125 MHz ..), base stations, mobile phones and others.

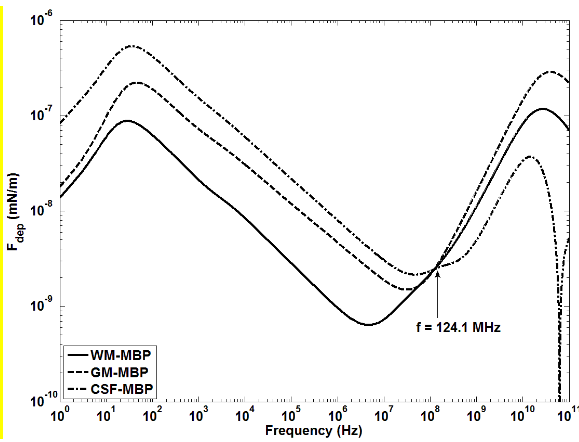


**Figure 1.** Variations of dielectrophoretic force, affecting MBP in white matter, gray matter and CSF with respect to frequency, ($10^0$-$10^{11}$) Hz (Canbay, 2014).

As seen in Figure 1, the MRI scanners working in 1.5 Tesla (63 MHz) and 7 Tesla (298 MHz) may cause the protein leakage into the CSF. However, for the brain MRI scanners working in 3 Tesla (125 MHz) do not lead a problem in terms of MS disease. It can be decided using the author's hypotheses whether MRI scans have any hazardous effect or not on human brain without making a test.

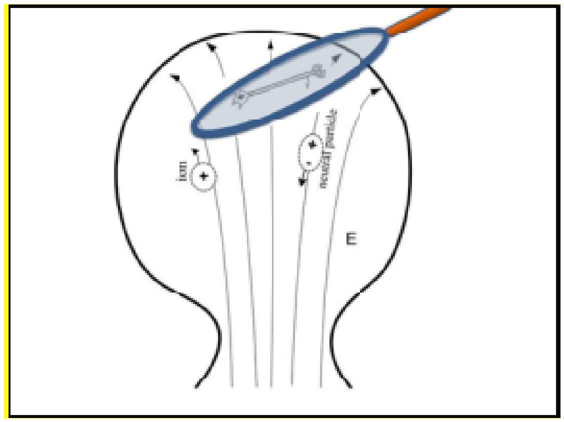


**Figure 2.** Dielectrophoretic field affecting an ion and a dielectric particle in schematic representation of human brain (Canbay, 2010).

2-Electromagnetic field distribution, which results from natural electromagnetic field resources, even when there is no artificial electromagnetic field resource, induces an electromagnetic field in the human body. It can be said that lightnings, which form the final structure of electrosphere, lead to an electromagnetic field distribution which is released at Schuman frequencies in the electrosphere. The Schumann Resonance is a set of spectrum peaks in the ELF portion of the Earth’s electromagnetic field spectrum. The nominal average Schumann Resonance frequencies are observed as 7.8, 14, 20, 26, 33, 39, and 45 Hz with slight diurnal variations. The maximum dielectrophoretic force in the human brain occurs at the frequency values around of the Schumann Resonance frequencies (Figure 1). When the Schumann Resonance frequencies are compared to the results of Clausius-Mossotti equation as shown in Figure 1, it is clear that the history of MS disease is as old as the history of humanity (Canbay, 2010) (Canbay, 2014).

3-After a lightning, the local electric field intensity approaches to the electirc field intensity level of the fair air. Thus, a relaxed medium occurs with minimum potential difference. The fair air conditions lead to minimum electric field intensity in the enviroment. On the contrary, cloudy weather conditions lead to higher electric field intensities in the medium of the enviroment. The answer to the question of "Why some areas of the world have a higher risk of MS disease than others?" can be found in the author's comparative study, between the keraunic map of the world (prepared by IEEE) and the common reports of WHO (World Health Organisation) and MSIF (Multiple Sclerosis International Federation) in 2008 and 2013 (Canbay, 2014). Figure 3 and Figure 4 show that the prevalence of Multiple Sclerosis disease inversely proportional to the number of annual lightning. For instance, there is no need to investigate the prevalence of MS disease in South America and Africa. According to my hypotheses, most of the countries in these continents had to be painted in blue and dark blue colors -which represent the lowest prevalence rates of MS disease (Canbay, 2010). The comparison of the keraunic map (Figure 3) to the epidemiological map (Figure 4) and all collected data from any research related to MS or electromagnetic field distributions, support my hypotheses. Distribution of the electromagnetic field in the earth's atmosphere is influenced by solar winds. This interaction mechanism may be described by Faraday's law. An interesting result occurs when compared the annual variations of the sunspot numbers with the results about Kurtzke's annual incidence rates per 100.000 people in Faroe and Orkney islands (Kurtzke, 2006).

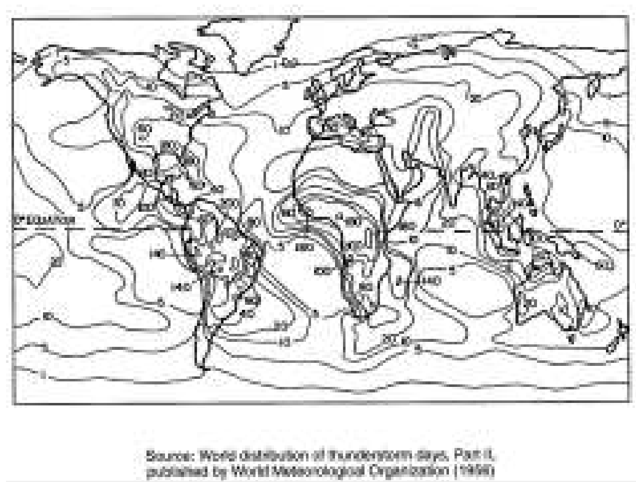


**Figure 3.** The keraunic map (Canbay, 2010).

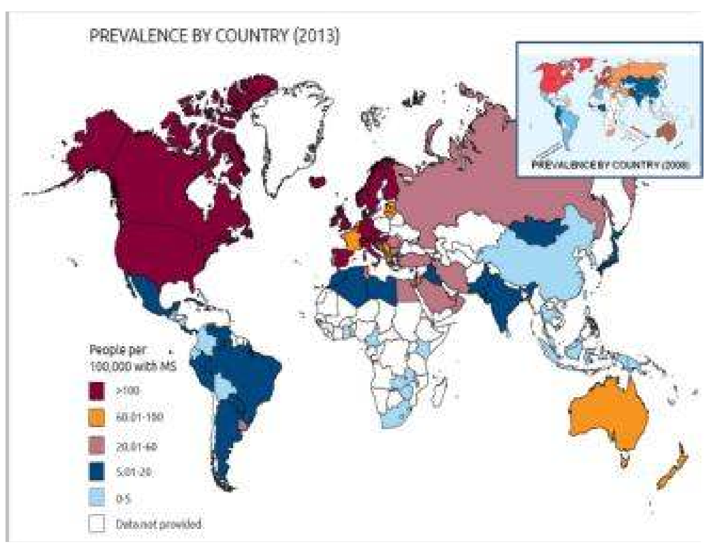


**Figure 4.** The distribution of MS in the world (Canbay, 2014).

4-The dielectrophoretic force is capable of separating lipids of proteins from the nerve cell and accumulating the separated protein particles at specific regions where the gradients of the square of the electric field reach their maximum values in the human body. MS symptoms also can be observed in the same places (Canbay, 2010). Since the gradients of square of electric field in the brain of animals with four legs or without legs is approximately equal to zero. MS disease is not observed in these animals. MS is a human disease and will remain so in the future as well. There will not be any advantage of animal studies concerning MS, without taking the author's hyptotheses on the etiology of MS disease into account. A passive (not induced) mouse would not show any MS-related symptoms because its geometry does not let the occurance of dielectrophoretic force in its brain even under the effect of natural or artificial electromagnetic fields.

5-The connection between electromagnetic pollution and asthma, diabetes, multiple sclerosis, chronic fatigue, fibromyalgia has been investigated in a study (Havas, 2006). In this study, GS (Graham/Stetzer) filters, microsurge meters operating at ELF and RF frequencies were used to reduce and monitor the dirty electricity inside the building where the patient lived. The observation results show that the symptoms of these disorders reduced.

6-The interaction between the neurons and electromagnetic fields can be investigated by in vitro experiments. For example, as shown in Figure 6 and Figure 7, the fetal cortical rat neurons were trapped in the center of an electrode arrangement which is operated at different amplitudes and frequency ranges (Canbay, 2014).

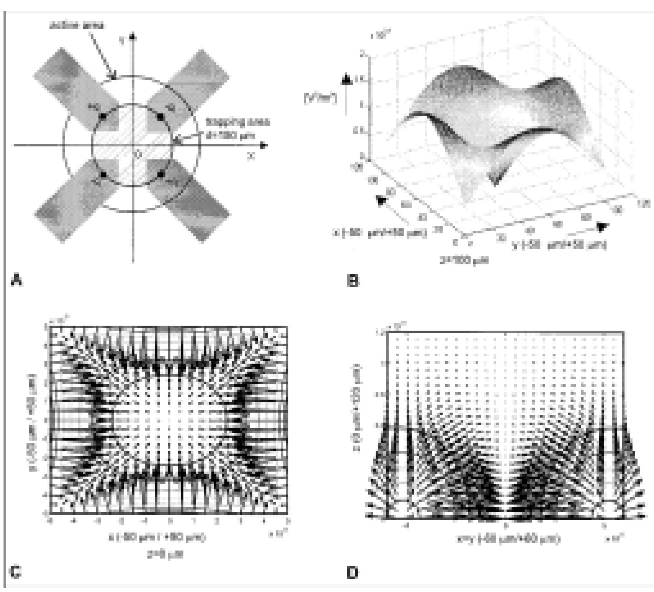


**Figure 5.** (A) The electrode structure represented by four point charges. The point charges are located at 100 µm from the center and are given such a value that the potential at a distance R = 50 µm (a distance equal to the “diameter” of the electrode tips) from these points is 5 V (or -5 V). (B) The relative dielectrophoretic force in the xy plane at z = 100 µm. The square of the electric field (the solid lines, contours, give the iso-electric field lines) and the gradient of this field (arrows) in (C) the xy plane at z = 0 µm, and (D) the (x = y)z plane at z = 0 µm (Heida T, Rutten WL, Marani E, 2001).

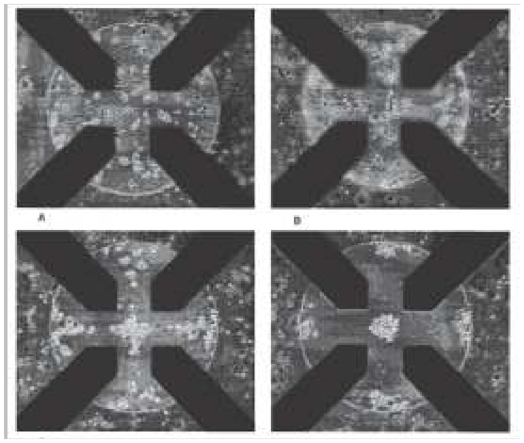

**Figure 6**. Image nr. 180 of several experiments by using different amplitudes (i.e., the situation after 30 min. of field application). (A) No input signal (reference experiment), (B) 1 V/12 MHz, (C) 3 V/12 MHz, and (D) 5 V/12 MHz (Heida T, Rutten WL, Marani E, 2001).

7-A volcano in Iceland erupted in March of 2010. The lavas, volcanic ash plumes and the highest concentration of aerosols (tiny airborne particles, sulphur dioxide) in the ash plume spread into the atmosphere. As shown in Figure 15, the sulphur dioxide plumes located at higher altitudes are less affected by winds and concentrate on a strip over Faroe and Orkney Islands. The reason for higher concentration of aerosols on this strip over the Faroe and Orkney Islands is the dielectrophoretic force over this region, just as in the brain, as conceptually expected to be by the author (Canbay, 2013).

8- SARR-MS-MRI-RIS relationship

In MRI scanners, time varying magnetic field gradients may stimulate the nerves by inducing the gradient of the electric fields in the human body. The movement of a dielectric particle within the liquid containing any electric field gradient, depends on the radius of particle, the dielectric permittivity of the liquid and particle, and the electric field intensity. The CM equation can be used to find the force that acts on a dielectric particle. In MRI applications, it is very important to minimize the dielectrophoretic force for MS disease. When $Re[K(\omega)] > 0$, particles are attracted to regions of stronger electric field when their permittivity exceed the suspension medium's. This is called as "Positive Dielectrophoresis (p-DEP)". When the permittivity of the suspending medium is greater than the particles', particles start to move towards lesser electric field ($Re\ [K()] < 0$), as seen on Figure 6C. This is called as "Negative Dielectrophoresis (n-DEP) (Canbay, 2010).

The general concept of the gradient system in MRI scanners is used to provide the image of a biological slice. The gradient of electrical fields occurs as a result of discontinuity along the interface between two biologic tissues and also as result of the gradient effect based on the electrical field polarization generated by the gradient and the radio frequency (RF) coils. The dielectrophoretic force generated by the gradient and the radio frequency (RF) coils stimulates the MBP and other dielectric particles in the media such as CSF, GM and WM within the human brain and spinal cord (Figure 7). Moreover, this force can also separate these particles from nerve cells under appropriate conditions and provide collecting of them in certain fields. At the same time, the dielectrophoretic force is proportional to the gradient of the Specific Absorption Rate (SAR). The Specific Absorption Rate Ratios (SARR) has been given on the brain and spinal cord model of human (Canbay, 2014). Table 1 denotes the findings of a study that identifies the risk factors for the development of RIS from the first clinical event of RIS subjects in a multinational cohort and provides updates to the original 2009 RIS criteria. As it is seen from their findings, the ratio, for spinal cord lesion is 38.7%, for CSF profiles is, abnormally, 40.9% and for MS observed (in family) is 9.9%.

| Total Subject | Female | Male | The mean age | Standard Deviation | mean clinical follow-up | Standard Deviation | **CSF profiles (abnormal)** | **Spinal Cord lesion** | MS observed (Positive Family History) |
|---|---|---|---|---|---|---|---|---|---|
| 375 | 298 (79.5 %) | 78 | 37.1 | 11 | 4.6 years | 4 % | **40.9 %** | **38.7 %** | 9.9 % |

**Table 1**. The findings of a study to identify the risk factors for the development of MS, based on the first clinical event of RIS subjects in a multinational (US, IR, TR, ITALY) cohort. (Okuda D T, Mowry E M, Beheshtian A, Waubant E, Baranzini S E, Goodin D S, Hauser S L, Pelletier D, 2009)

In the author's recent study (Canbay, 2014), the MRI-RIS-MS connections which demonstrate SARR-Dielectrophoretic force-frequency relationship, were given. In the study, the regions that are possible to be affected by the dielectrophoretic force were computed by using the dispersive medium parameters of the brain tissues, CM and the SARR equations. As shown in Figure 8, the possible lesion regions after the MRI scans were determined as, firstly, the cerebrospinal fluid, secondly, the spinal cord. The graph of the author's calculated results -which is Figure 8- denotes parallel results with the findings of the study that is based on the results of that first clinical event of RIS in a multinational cohort. (Okuda D T, Mowry E M, Beheshtian A, Waubant E, Baranzini S E, Goodin D S, Hauser S L, Pelletier D, 2009).

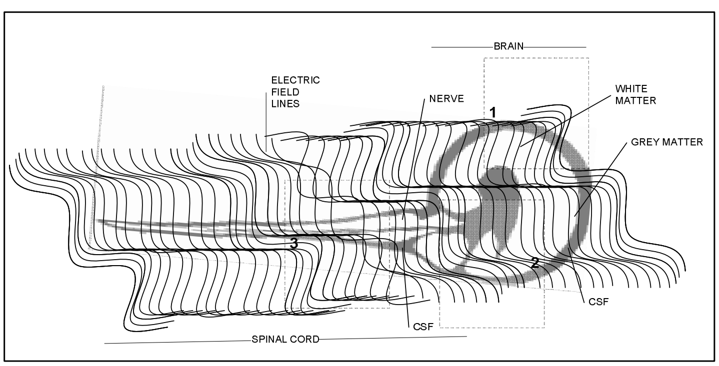


**Figure 7.** Schematic representation of the brain and the spinal cord in the electromagnetic field of an MRI scanner (Canbay, 2014).

The results, as shown in Figure 8, can be found if SAR ratios are calculated by considering the dispersive properties of two media. In case of SARR=1, there will not be any electric field gradient because of the nature of the biological tissues. The gradient electric field in the laboratory experiment (Figure 5) and (Figure 6) and the MRI examinations have a very intensive effect on MBP. MBPs will accumulate in the direction where the gradient of square of the electrical field is at its maximum (like nerve cells, polarized and collected within half an hour in the laboratory conditions). When the brain and spinal cord are located-inside of the natural or artifical electromagnetic fields (Figure 7) as explained in the approach 1, -in the laboratory experiment (Figure 5 and Figure 6),-and inside of the MRI radio frequency coils (Figure 9), it can be said that they are under the similar conditions in terms of the occurence of dielectrophoretic force. The electric field intensity in the brain and spinal cord under normal conditions is lower compared to the electrical field intensity of the brain and spinal cord under the gradient and radio frequency coils of MRI scanners. The accumulation of MBP will also occur over the years if there are suitable conditions which lead to the occurence of dielectrophoretic force, thus, the developing of MS disease. The idea of RIS that was emerged as a result of MRI practices is neither a new symptom which imitates MS nor an anticipated one. Clearly, RIS can be accepted as the laboratory results of the dielectrophoretic force. In this test, as the Clausius-Mossoti factor was Re (K) <0, nerve cells were collected in the direction of decreasing electric field; in other words, in the center of the electrode array. Figure 8 represents the electric field distribution and illustrates where nerves collect and shows the number of nerves based on the exposure time of the electrical field (Canbay, 2014). Similarly, considering that the brain and the spinal cord are placed within the electrical field of the gradient and RF coils of MRI -as shown schematically in Figure 9-, an aggregation of MBPs within the cerebellum and spinal cord based on the gradient of the squared electric field will be ensured. The force which creates MS over several years in direction of CSF-GM-WM, is the same dielectrophoretic force that also creates RIS. However, the electric field intensity and the gradient of the squared electric field in an MRI scanner are much more powerful.

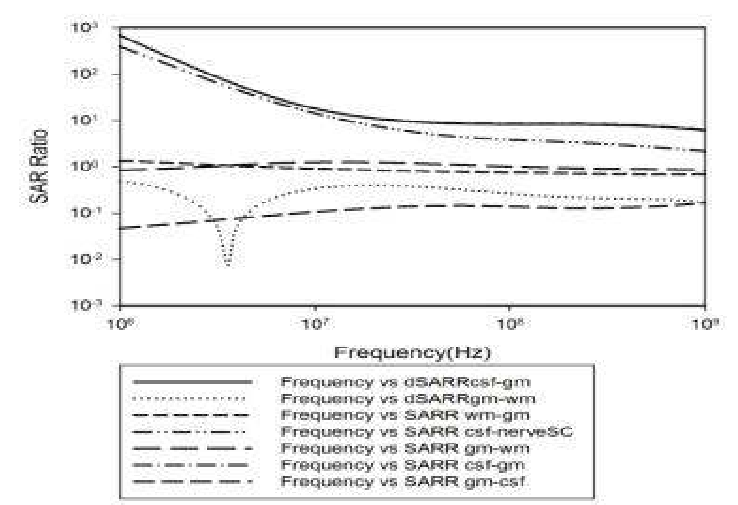

**Figure 8.** SARR versus frequency, ($10^6$-$10^9$) Hz (Canbay, 2014)

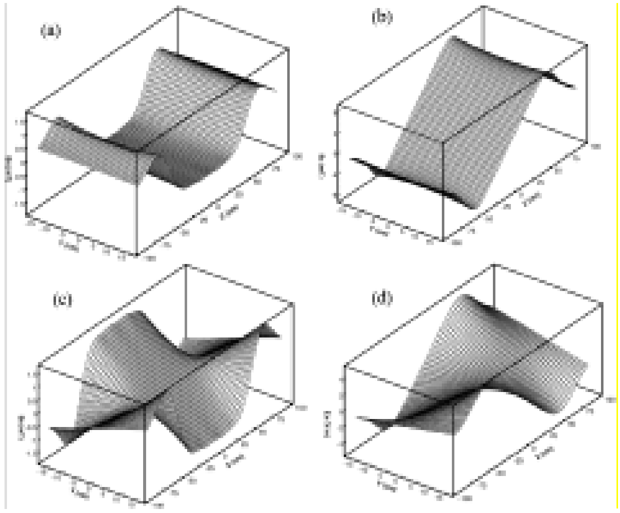

**Figure 9.** The contour of the induced electromagnetic fields produced by cylindrical Z-coils. (a)–(c) Magnetic fields in the X = 0:1 m plane. (d) Electric field (E) in the X = 0 plane (Liu F, H. Zhao H, Crozier S., 2003).

Therefore in the laboratory, the collection or orientation of the MBPs or any dielectric particles within half an hour, where the gradient of the squared intensive electric field is at its maximum occurred because of the same dielectrophoretic force.

9-The breakdown mechanism of the blood brain barrier (BBB) has been explained by the interaction of the myelin basic protein (MBP) with the particles separated from T cells due to the dielectrophoretic force effect on the BBB, the myelin and the particles.

Whereas, inside of a human brain that is under the effect of weak dielectrophoretic force, the collection of MBPs occurs very slowly due to the same reasons, and the observation of symptoms of MS take 20-30 years. No one can ever expect to prove such a long-term process by observation. RIS is an accelerated form of MS disease. There is no such a syndrome. RIS is to be an expected phenomena which is created by a little more intensive dielectrophoretic force effect due to MRI scanner.

## 3. METHOD

The author's hypotheses, which are related to the etiology of MS disease and supported with the scientific evidences, can be clearly applied to the researches about prevalence of MS disease in all around the world. The necessary and sufficient conditions for MS can be investigated by the appraisal of the etiology of MS disease in the light of the impact of the dielectrophoretic force (Canbay, 2010) (Canbay, 2013) (Canbay, 2014) (Canbay, 2015). If there are necessary and sufficient conditions in any place regarding the occurrence of MS disease, the prevalence of probable MS will be more with respect to the other places. For the study , the necessary and sufficient conditions for MS disease to occur is directly related to the conditions of the inhabited places during the growing ages, namely until the ages around 20. At any place, where the frequency of occurrence of MS disease is higher, the environmental conditions are as follows:

a- The average number of the lightning in a year at that residential area is too small (except deserts).

b- The average annual number of the cloudy days at that residential area is too high.

c- The residential area is placed on the high mountains and hills.

d- The residential area is located far from the large-scale conductive structures.

e- As mentioned previously, the residential area contains some kinds of natural and artificial electromagnetic field sources or very close to them.

f- Stress and contraction of the muscles, as required the principle of piezoelectric effect, generates the internal electric field intensity in the human body. (This subject is related to the person's psychology and the person's social and physical environment.)

g- The increase of the dense and frequent use of the Magnetic Resonance Imaging (MRI) device, which plays a significant role in the diagnosis of Multiple Sclerosis disease, has brought along new concerns (Canbay, 2014) (Canbay, 2015). Additionally, increasing of stress has also an effect (as a factor of inner dynamic, stress is a placebo equivalent of mechanic stress) that can be assumed as the source of dielectrophoretic field in the human body on MS. Yawning-Stretching movements are a behavioral syndrome associated with transcranial application of electromagnetic fields for MS (Sandyk, 1998) because of eliminating polarized charges by the electromagnetic fields in the human body.

Figure 10 denotes two persons standing on the homogeneous ground in the fair air condition. In this case, the electromagnetic field distribution in the ground and the air has the regular electrical field distribution. Therefore, the persons are under the same electromagnetic field effect. But still the induced electromagnetic fields in the bodies of the two persons may be different from each other.

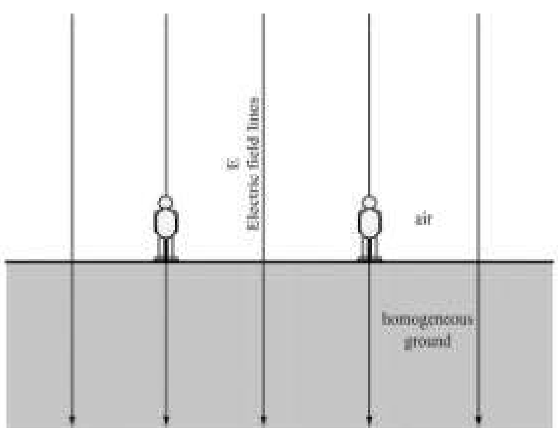


**Figure 10.** Two persons in the regular electromagnetic field distribution.

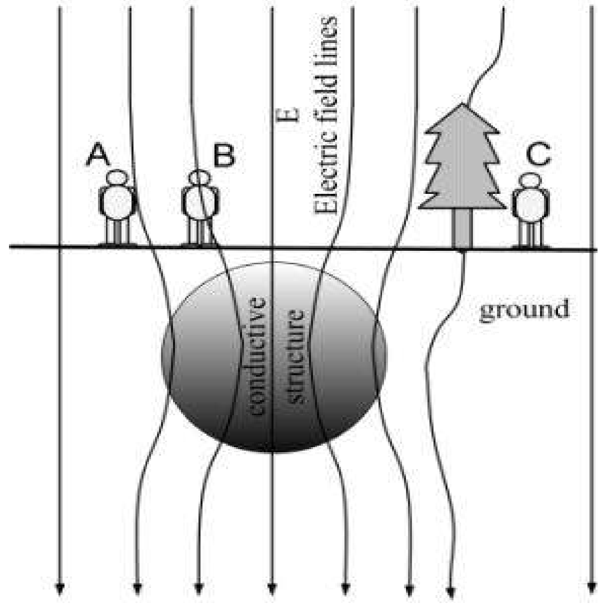


**Figure 11.** Three persons in the irregular electromagnetic field distribution.

As shown in Figure 11, if there are conductive structures, such as trees, the buried large metal materials, and the metal towers close to human body, the lines of natural and artificial electromagnetic fields flow on these conductive structures. As a result of this interpretation, the amount of electromagnetic field lines flowing on the human bodies varies spatially and so does the risk of MS for some individuals. Especially, as shown in Figure 11, while the conductive structure provides advantageous for the persons located at point A and C, contrary disadvantageous for the person at point B. However, the tree provides an additional advantage for the person at point C in terms of the electromagnetic effect. This result shows us that everybody sharing the same environment can not be regarded as a nominate for MS. A person who nominates for MS should have stayed under the necessary and sufficient conditions for MS disease for a long time during her/his growing ages. In the literature, there are many studies expressing the genetic and immunological reasons, and the correlation between the occurrence of relapses and the seasonal environmental factors, infections (Hawkes, 2002) and serum vitamin D levels, and convincingly speculated regarding the people with MS disease living on these islands. In fact, it should have been assumed that their findings are the results of electromagnetic fields and the effect of dielectrophoretic force. The essential cause of the maximum prevalence of MS disease is the existence of the suitable conditions because of the natural and the artificial electromagnetic field distribution on these islands. This study aims, both to give a new material support for the previous studies and to find the answer to the question, "why these islands have risk factors in terms of multiple sclerosis disease?" and to prove that the MS disease is not only an old disease but also a modern day disease. Moreover, to state that MS disease has increased depending on the uncontrolled electromagnetic technologies and the sources.

**4. GEOGRAPHICAL AND GEOPHYSICAL STRUCTURE OF THE ISLANDS**

Faroe Islands (62º N, 7º W) have a total area of 1400 km$^2$, an average height of 300 m above sea level and are formed a part of the North Atlantic Brito-Arctic Cenozoic Igneous Province that extends from the British Isles to Greenland. Faroe and Orkney islands share geographic, ethnic (is not taken into account in the present study), and environmental similarities with other North Sea and Canadian countries of high MS incidence. The prevalence of MS per year in Faroe and Orkney Islands are 66(1998) and 193 (1983), respectively (Pugliatti, Sotgiu, & Rosati, 2002). **Faroe Islands are the most sunless region in the World, having an entirely cloudless sky only, averagely, five days in a year. As a consequence of that, there is very little summer heat. At the same time, the number of days with lightning (keraunic level) on each island is really low, approximately equals 1** (Canbay, 2010)**.** Since the warm period is really short, the sprouts of the trees ripe really hardly, and only a very few kinds of trees can survive the winter. The trees make little progress in their effort upwards. Faroe Islands lie on a continental fragment, which has a total thickness of about 10-15 km of igneous rock added as extrusive lavas at the top. In addition to the zeolites which have (0-2) S/m conductivity, native copper (at 20 Cº 2.4 x10$^6$ S/m) and pyrite deposits (1-10$^5$) S/m were found in different places on Faroe Islands (Larsen, Knudsen, Frei, Frei, Rasmussen, & Whitman, 2006) (White, 2008) (Jørgensen, 2006). Figure 12, Figure 13 and Figure 14 show the representative distribution of electric fields on an island under the three different conditions. Figure 12 denotes the distribution of electric fields on the island in the fair air condition. As shown in Figure 12, the electric field line density over the island changes depending on the topographical structure and electrical parameters of the island. However, as shown in Figure 13, the electric field line density over the mine deposits is higher than the first situation. As shown in Figure 14, the electric field intensities over some places on the island are very higher compared to the electric field intensities of the other situations (Figure 12 and Figure 13).

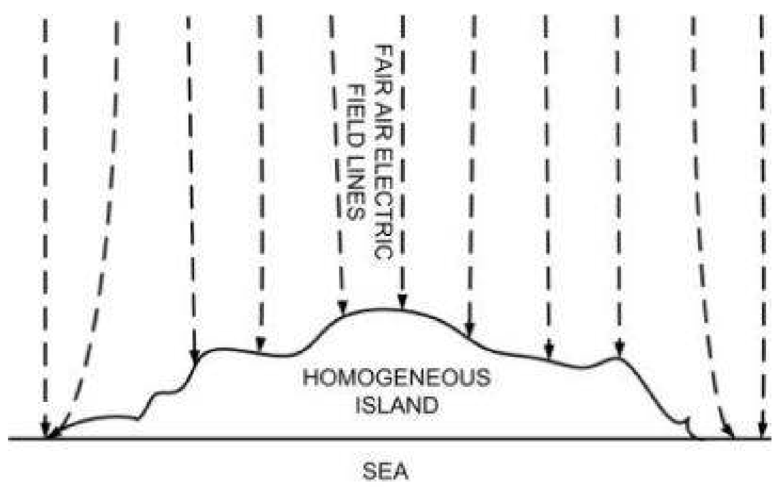


**Figure 12.** Schematic representation of the distribution of electromagnetic field on an island in case of fair air and homogeneous island.

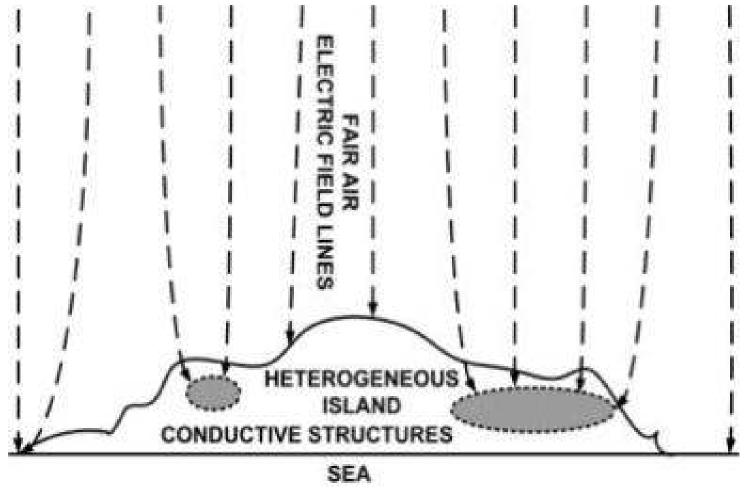


**Figure 13.** Schematic representation of the distribution of the electromagnetic field on an island in case of the fair air and heterogene island.

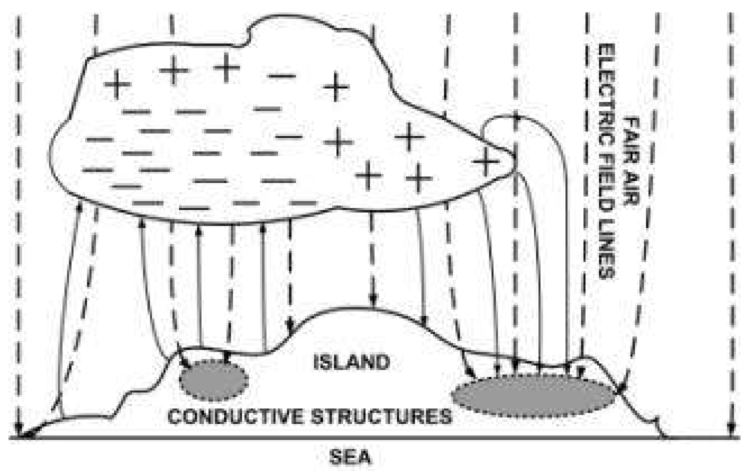


**Figure 14.** Schematic representation of the distribution of electromagnetic field on an island in case of the cloudy day and heterogene island.

The causes of the variations of the electric field line densities over the island are; the effects of electrically charged cloud over the island and the properties of electrical parameters of the underground of the island.

The explanation of the causes of higher prevalence of MS disease on the islands is interesting. I was thinking about the accumulation of the dielectric particles in the form of the plaques in the human brain due to the irregular electromagnetic field distribution. As known, Eyjafjallajökull volcano in Iceland erupted in March of 2010. Suddenly, I wanted to expect dual relations between the brain and our globe. As I expected, the tiny particles spread into the atmosphere due to Eyjafjallajökull volcano eruption should be collected onto Faroe Islands (because of the dielectrophoretic force effect on them).

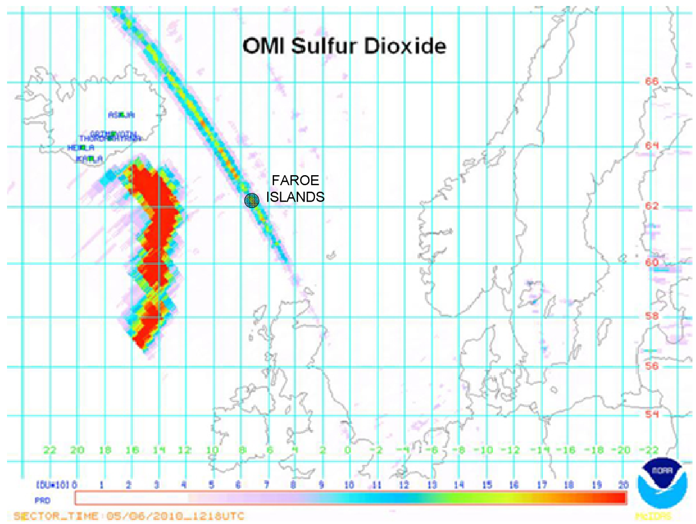


**Figure 15.** Distribution of the sulfur dioxide plumes in the electrosphere (NOAA Office of Satellite and Product Operations)

I have investigated the behavior of the sulfur dioxide plumes (very tiny airborne particles compared to volcanic ash) from Eyjafjallajökull volcano eruption in black southeast of Iceland. The lavas, volcanic ash plumes and the highest concentration of aerosols (tiny airborne particles, sulfur dioxide) in the ash plume spread into the atmosphere. NASA's Goddard Space Flight Centre, Greenbelt, Md. has used the data from the Ozone Monitoring Instrument (OMI) to create satellite image updated on volcanic ash and sulfur dioxide plumes. The image, in Figure 15 from the Washington Volcanic Ash Advisory Center on May 6 (NOAA Office of Satellite and Product Operations), shows the highest concentration of tiny airborne particles in the ash plume from the Eyjafjallajökull volcano in black southeast of Iceland. As shown in Figure 15**,** the sulfur dioxide plumes which are located at higher altitudes are less affected by winds and concentrate on a strip over Faroe and Orkney Islands. The cause of the higher concentration of aerosols on this strip over Faroe and Orkney Islands is dielectrophoretic force over this region, just as in the brain, as conceptually expected to be by the author.

Sardinia is the second greatest island of the Mediterranean region: the surface area is measured as 24.090 km$^2$, it is located between 38º 51' 52 " and 41º 15' 42" of latitude North and 8º 8' and 9º 50' of East longitude. The coasts of Sardinia (1.849 km long) are generally high and rocky, rectilinear for kilometers with vast and deep bays and fjords surrounded by smaller atolls. **The number of lightning days per year (keraunic level), is relatively lower compared to the other places in the same latitude, is between about 1-5. This situation is unexpected for Sardinia Island and very crucial.** The reasons for decreasing of the lightning occurrence over Sardinia island has been explained in a study (Dietrich, Casella, Paola, Formenton, Mugnai, & Sano, 2011). The main deposits among the ore deposits of the Cenozoic volcanics under the Sardinia Island are kaolinite, bentonite, and pyrite which have electrical conductivities (0.4-1) S/m, (2-5) S/m, and average conductivity ($10^3$) S/m, respectively (Palomba, Padalino, & Marchin, 2006) (Stewart, 1937) (Cita, Santambrogio, Melillo, & Rogate, 1990) (Carozzo, et al.,

1997) (Shuey, 1976). These constitutive relations vary depending on the dispersive properties from their water and NaCl content, temperature, pressure, and frequency point of view. People living on Sardinia Island can be considered to be living very close to the conductive ground due to the sea water and also due to the existence of the ore deposits under the ground. As a result, the electric field lines over the islands are especially concentrated on mine deposits. Therefore, this concentrated electric field lines on Sardinia Island triggers MS disease in this region.

## 5-RESULT

The dielectrophoretic force has been found as the essential environmental cause of the most common neurological disorder, Multiple Sclerosis (MS) (Canbay, 2010). Moreover, the locations of the maximum gradient of squared electrical field in the parts of human body have been determined as possible regions where the MS symptoms can be observed. Faroe, Sardinia and Orkney islands have the special properties for providing the background of the electromagnetic field gradients in/on/over their enviromental conditions, compared to other places in the world. The places, such as sea, lake and river shores may be suitable locations for MS patients. In this study, it has been shown that the prevalence of MS disease on Faroe, Orkney and Sardinia Islands related to the dielectrophoretic force, by taking into account all the findings and the results of the author's previous studies. The RIS-MRI-MS connections are the most important quasi experimental evidences confirming the close connection between MS and the dielectrophoretic force. The dielectrophoretic force is the crucial factor for the etiology of MS disease (Canbay, 2015). Considering the author's hypotheses, it can be understood why the prevalence of MS is higher in these islands.

## CONCLUSION

In any living environment, the necessary and sufficient conditions to cause MS disease are as follows:

a- The residential area in the region has too high number of cloudy days, too low number of lightning days, in a year.

b- The ground surface and/or underground structure are conductive compared to adjacent places.

c- To live a long time in a higher place, which has too high number of cloudy days, too low number of number of lightning days in a year.

d- To live far from the conductive structures on the ground surface, such as trees, the large metal materials etc.

e- To live close to the electromagnetic field sources, which operating at the aforementioned conditions.

a'- Faroe Islands are the most sunless region in the world, having an entirely cloudless sky only, averagely, five days a year. The electric field intensity increases and remains approximately constant at high level during the cloudy days. Orkney islands have the geographical and environmental similarities with Faroe Islands. The annual number of days with lightning (keraunic level) on each island is lower, approximately equals 1 (Canbay, 2010).

b'- As mentioned before, these islands have a quite good electrically conductive ground surface or underground structure.

c'- The islands have higher altitude with respect to the sea level.

d'- There are no large trees on Faroe and Orkney islands.

e'- Faroe, Orkney and Sardinia islands are situated far away from the mainland. Therefore, all electromagnetic sources such as the base stations, the TV transmitters, the high voltage transmission lines have to be place around the residential area on the islands. In addition, the natural electromagnetic features of the islands in terms of the appropriateness for the occurence of MS disease were tested. Also, the stress of a living person in a region like Faroe, Orkney islands which has sunshine only five days in a year, can be compared with others. Learning of the electromagnetic properties is as vital as determining the weather reports, not just for these islands but for all around the world. Therefore, the maps, showing the distribution of electromagnetic field, covering the entire electromagnetic spectrum, will be important for the protection of the health of the living things and the environment. After this approach, MS disease will not remain as an unsolved mystery for Faroe, Orkney and Sardinia Islands anymore.

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