

## Mobile Phones Use and Cerebral Tumor: New Concepts

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### Abstract

The use of mobile phones nowadays is essential in today's world, the number of cellphones has increased considerably year by year; over 80% of the population in industrialized countries use them. In 2011 it was reported 4.6 billion mobile phones worldwide 1; at 2014 it was reported in Mexico 103.6 million devices in service alone. The cell-phone use exposes the user to radio frequencies (RF) and electromagnetic fields (EMF), when these waves are placed near the skull during calls, there might be damage to the brain by these non-ionizing radiation as a risk factor for brain tumors, so can these waves do damage during pregnancy or could harm the body in general. Multiple authors report an association between mobile phones and brain tumors. This article attempts to clarify the controversial issue and makes a review of articles and indexed journals considered important. The consequences are not discarded but prospective investigations are needed.

**Keywords:** Mobile phone; Cerebral tumor; Electromagnetic fields (EMF); Radiofrequency (RF); Children; Animal experimentation

### Introduction

Electromagnetic waves (especially non ion) emitted by a diverse group of products such as smart phones, even though they are somewhat new, they take a lot of time of our daily lives as humans, and everyone thought they didn't cause any harm to us; nevertheless because of the technologic advancements, we use our cell phones way more than we used too, that increase in usage has brought some concerns with the relation on amount of time we are usually exposed to these kind of Radio Frequency (RF) and the electromagnetic waves on our health, this is why researchers started investigating on this manner.

Among the first reports ever recorded about the effects of electromagnetisms on our health, we can highlight the ones made by Omura et al. [1] from 1992 to 1993, this study found the non-conclusive relation between the distance with the body and the source of radiation with also the amount of time someone is exposed. In 1996 Rothman et al. [2] from Cambridge University wrote about the probable harmful effects of the electromagnetic waves, and the Radio-frequency (Rf) emitted by our cell phones. In the year 2000, Muscat et al. [3] published an article with the conclusion that there is no relation with the use of cell phones and the development of a brain tumor, even though we do need longer studies that can assure this is true.

The usage of cell phones has increased considerably in different age groups. In 2011, the: International Telecommunication Union" reported that worldwide there are 4,600 million cellphones in use. In Mexico, in 2014, it was reported that there are 103.6 million cellphones in use [4]. The risks are not known completely, but it has been found that there is a relationship between Electromagnetic waves and RF that these phones send off and their possible harmful effects on our health, especially in the Central Nervous System (CNS).

There exist multiple studies on experimental animals about the type and amount of Electromagnetic waves and RF emitted and their relation with the development of tumors; but these studies have not been conclusive and need further and posterior evaluation.

In the last couple of years, around the world there have been Different articles published that show a positive relationship between these two variables. In the other hand, there are some articles that show the contrary [5].

The purpose of this study is to do a bibliographic study on the new concepts related to this issue, the risks on our health and some things still being studied, especially the ones on brain tumors and CNS diseases.

### Basic information on CEM and Rf

Electromagnetic radiation that our cellphones send off are known as no ionizing and of high frequency waves that are

able to transmit our voice and our data, they also generate low frequency waves. These levels of emission can be compared as follows: 1 MHz the radio on AM, 450-900 MHz the analog phones, 900-1800 MHz phones with GSM (Global System for Mobile Communication), from 1900 to 2200 MHz phones with 3G, and the highest emission the X-Rays (1,000,000 MHz). These waves move around high frequency in between particles, this is why we cannot sense them in our body [6].

The Specific Absorption Ratio (SAR) is a way we can measure the absorption in our body. The FCC (Federal Communication Commission) has established the maximum values of SAR since 1996, the FCC, has established that the highest value of the SAR on cell phones is of 1.6 watts per kilogram, on average is about 1 gram of tissue. Each phone model has a different SAR and has to be approved before it can be shipped for its sell to the public and has to assure that the exposure is less than the established limit [7].

### Effects on health

Multiple associations have been reported on the effects that could cause on our health the over exposure of Electromagnetic Waves and RF, to mention some effects we have the secretion of cortisol with secondary suppression of the immunologic system, a rise in glucose and insomnia, also the effects of the long term exposure of cortisol like irritability, fatigue, anger, high blood pressure, possible thyroid disease and weight gain [8].

The genotoxic effect is associated with aneuploidy of chromosome 17. It has been shown the effect on chromatin of lymphocytes and also on protein 1 receptor suppressor of tumors p53, favoring the development of tumors, including glioblastomas. The electromagnetic radiation caused by GSM, has been associated to alteration in the blood brain barrier, with a pass of albumin to the brain parenchyma, causing damage to the cortex, hippocampus and basal ganglia [9].

The effect in kids it's even more harmful, since the bones in our cranium have not finished growing until we are 22 years of age, this causes for the internal tissues to be less protected than the ones of an adult. In 1997 Dr. Om. Ghandi in the University of Utah made a study that showed how the radiation penetrates the cranium. The thickness of the cranium is significantly less than the ones in adults, making them more susceptible to the penetration of radiation and subsequently, the accumulation of radiation [10].

### Effects on the CNS

In different studies where they evaluate the possible association between tumors and the exposure of waves made by our phones, they have established an association with tumors and specific places, meanwhile in others they haven't found this association [11].

In patients already diagnosed with multiform glioblastoma, which is the brain tumor with the worst prognosis, the usage of cellphones longer than 3 hours a day has been related with

a higher chances of medication resistance, also with mutations on p53 with cell cycle abnormalities [12].

In 2007, the International Journal of Cancer, published an article that evaluated the exposure to the electromagnetic waves and RF in 5 countries in Europe and their relation with a higher risk of an acoustic neurinoma, they found that there wasn't a higher risk during the first decade of exposure even though they did find a higher risk (non-conclusive) in the ipsilateral hemisphere (with no lobar predisposition) after the first decade of exposition but needs further studies [13]. Other study made in 2007 by Inskip et al. in the United States of America, in the National Institute of Health, they tried to find a tendency that has a relationship of the use of cellphones with brain tumors, finding a light increase in developing tumors in the frontal lobe [14].

In a metanalysis about the issue by Lagorio and Rööslı et al. of the National Institute of Health in Italy, the Swiss Institute of public health and the the Basel University in Switzerland published in 2014 [15], involved studies about gliomas, meningiomas, acoustic neurinoma, finding a higher estimated risk on gliomas and acoustic neurinoma, but it was attributed to methodical differences in the group study, they ended up concluding that there is no evidence that the hypothesis is true; nevertheless, recognizes that this can be attributed to other factors and recommends epidemiological vigilance [16].

For the other part, some recent studies, like the one published in the Occupational and Environmental Medicine Journal in 2014 [17] made in France, found a positive relation that has positive statistical significance between a prolonged use of phones (more than 896 hours accumulated in 5-10 years) and the development of gliomas in the temporal lobe. Unfortunately, there was no strong association for regular usage of cellphones compared to the non-users [18].

The most affected brain lobe associated to the usage of cellphones is the temporal lobe, this has been shown in other studies as well [19].

### Studies in animals

There is a lot of questioning on the possible association between radio frequency waves emitted by our mobile phones and brain tumors that have given the chance to start experimental studies on animals to evaluate if there is a relationship between these two [20]. Unfortunately, the literature is still low on this, and the existent results are non-conclusive or contradictory [21].

In a study published in 2007, they pretended to evaluate the exposure to electromagnetic waves of cellphones with the development of tumors in the CNS on rats; unfortunately, the results showed that the exposure did not accelerate nor affected the tumor genesis [22]. Other systematic evaluation showed in 2012 by Repacholi et al. came up to the conclusion that the evidence is inconsistent or not statistically important and that there is no available data to evaluate the exposure on kids and its prolonged usage more than 10 years, this has already been proposed by a published literature by Elder in 2003 [23].

In 2012, other study published by the Electromagnetic Biology Medicine Journal showed some alterations in the protein expression in animal brains after being exposed to radio frequency waves, even though this is non consultivo, it opens up the possibility that this said alteration could induce tumor genesis in humans after similar exposure [24]. Similar studies found a small increase in the tumor incidence after two years of exposure in rats; unfortunately, they concluded that the evidence was not conclusive and needed further research since the results lacked statistical significance and or biological by different motives [25]. There are some studies that show tumor incidence and an increase in mortality in exposed animals, these have not been replicated by other researchers [26]. Other studies were able to demonstrate functional brain abnormalities in rats showing a relationship in the Radio-frequency exposure non-related to cancer, but behavior changes [27].

### Today's normativity

With the arrival of cellphones and new technologies that work with electromagnetic waves and Radio-frequency brought with them the need to have norms that establish the maximum exposure values in a human without having health issues. These norms are a work that should include different institutions that are not only sanitary ones [28].

In Latin America, Argentina, Bolivia, Brasil, Chile, Colombia, Costa Rica, Ecuador, Perú and Venezuela they all count with this type of norms or laws to regulate the exposure in humans on Electromagnetic waves and RF. In Mexico there is an initiative by the Centro de investigacion y de Estudios Avanzados (CINVESTAV) and the Comision Federal para la Protection contra Riesgos Sanitarios (COFEPRIS) who showed a project for the Norma Oficial Mexicana (NOM) (NOM-126-SCT1-SSA1-2012 that its objective is to restrict the exposure and the emission of the Electromagnetic waves and RF of cell phones [29].

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) was in charge by the WHO to establish acceptable limits on the exposure of emitted radiofrequencies [30]. The ICNIRP norm on exposure limits to RF for humans indicates one recommended maximum exposure of 10 MHz to the general public [31].

### Discussion

The use of cellphones has had an important increase worldwide, all the way from infants to adults. Technology that uses RF and Electromagnetic waves could have harmful effects on our health, they are all being under research. The ones that have a higher significancy by the anatomical region that is the most exposed, were found the CNS tumors. Even though the diverse studies that have been made in different parts of the world have found a relationship, this has not yet been proven, even though the use of cellphones is a big factor in tumor genesis. The studies in experimental animals exposed to these kinds of waves have not shown big effects on health.

There are different norms in different countries worldwide, that have been in use now for a couple of years; nevertheless, in Mexico, there is still yet to be an approved norm, this is still in process. The different studies that show a high risk of cell phone usage should be a wakeup call to phone companies that develop or make these certain phones, they should also be doing research, projects and norms to reduce or minimize emissions that could bring some harmful effects on our health.

We cannot rule out a possibility in the future to find a relationship of these waves and brain tumors and other health problems.

### Conclusions

We have yet to find a significant relationship between the use of cellphones and the development of brain tumors in humans. The evidence is inconsistent or not statistically important. There are still no available data to evaluate the exposure in kids and its prolonged use for more than 10 years.

The experimental studies on animals, have not found a significant relationship.

We can not rule out other effects that the cellphone use could cause, and even with this we still need more studies with longer exposure that evaluate the relationship between the use of phones and brain tumors.

There should be a limit in usage of cell phones in children, since the waves penetrate more than adults.

### Recommendations

1. Avoid the use of cell phones inside metallic structures such as cars, trains and busses, especially when they are moving since the emissions intensify in these circumstances.
2. Dont use cell phones when there is a weak signal, since this makes the phone need more power to be able to maintain its connection.
3. Use the cell phone in open areas.
4. Maintain all electronic devices like watches, radios, wireless phones and mobile at least 2 m of distance from your head while sleeping.
5. Use earphones or a hands-free method, like a text.
6. Have shorter Calls
7. Have the phone far from the body even when on a call. Cell phones emit signals during sleep mode.
8. Ask the government to propose or to implement the laws, finance research studies and show recommendations on public health on electromagnetic waves.
9. Reduce the exposure time to kids and to teach them to not use cell phones for a long period of time.
10. Make more studies that evaluate if the findings that have been found have any clinical significance in todays world.

11. Inform our selfs and other on the waves on phones and demand for these to have less wave emissions.

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