Cell Phone Use Leads to Brain Tumors

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ABSTRACT

Wide concerns have been raised that the use of cell phones could increase brain tumors. This paper systematically reviews the scientific evidence regarding the associations between cell phone use and brain tumors. The authors’ review suggests two conclusions. First, it is still controversial in regard with the significant associations between cell phone use and increased risk of brain tumors. Second, there exists extensive evidence that the amount of exposure to cell phone radiation plays a key role in determining the significant associations between cell phone use and gliomas, acoustic neuroma, and meningiomas. In general, those who use cell phones for more than ten years, using cell phones more than 20 minutes per day, or cumulative call time for more than 700 hours, or RF-EMF absorption for more than 3000 joules/kg have higher risks to develop brain tumors, whereas those who use cell phones for less than one year have lower risks.

Keywords: Acoustic Neuroma, Brain Tumors, Cell Phone Use, Glioma, Meningioma, Mobile Phone Use

INTRODUCTION

In 2011, there were 6 billion mobile subscriptions, equivalent to 87% world’s population (The International Telecommunication Union, 2011). Mobile subscribers in developed countries have reached a saturation point with at least one cell phone subscriptions per person, while mobile subscriptions in developing countries grow rapidly. The United Nations reported that cell phones have spread faster than any other information technologies and can improve the living standard of the poorest people in developing countries (Lynn, 2010).

However, people have been concerned about whether the radio frequency waves emitted by cell phone would bring adverse effects to human health, especially brain cancers (International Agency for Research on Cancer, 2011). According to the Central Brain Tumor Registry (CBTRUS, 2012), the incidence of both benign (i.e., curable) and malignant (i.e., hardly curable) brain tumors was 13.4 per 100,000 in 1995 and increased to 19.9 per 100,000 in 2008. Questions were thus raised to consider whether fast increasing cell phone use indeed increases the risk of brain tumors. In particular, over 75% of American adolescents aged between 12-17 had cell phones in 2009, while only 45% had cell phones in 2004 (Lenhart et al., 2009). Young people will have longer time to expose to cell

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phone radiation and might have a higher risk of developing brain tumors.

**Cell Phone Radiation**

Cell phones emit a special type of radiation concerning radio frequency electromagnetic field (RF-EMF) in the microwave range (Corle et al., 2012; Feychting, Ahlbom, & Kheifets, 2005). RF-EMF is the combination of the electric field and magnetic field. When an electric current flows in a conductor, like an antenna or a circuit inside the cell phone, it generates RF-EMF. RF-EMF is strongest at the source and weakens exponentially in regard to the distance from the source. It belongs to non-ionizing radiation, which means not having sufficient energy to ionize an atom. RF-EMF has enough energy to change the rotational, vibrational, or electronic valence configurations of molecules and atoms. When a person uses a cell phone, RF-EMF is highly concentrated on the temporal lobe, an important brain region dealing with auditory perception and memory, on both sides of head near ears, especially the same side of head with a cell phone use (i.e., ipsilateral). Hence, cell phone use is considered having a higher risk of absorption of RF-EMF than radio, television, and computer use because cell phone is close to one’s head (Corle et al., 2012).

Specific absorption rate (SAR) is used to measure the rate at which cell phone radiation is absorbed by the human body (FCC Encyclopedia, n.d.; Mobile Phones UK, n.d.). Many countries have set maximum levels for cell phones. In the U.S.A., the Federal Communications Commission (FCC) has set a SAR limit of 1.6 watts per kilogram (1.6W/kg), averaged over a volume of 1 gram of tissue for the head. In Europe, the limit is set to be 2 W/kg, averaged over a volume of 10 grams of tissue for the head.

**Brain Tumors**

Tumors are abnormal growths of extra cells in the human body and can be either benign (not cancerous and generally curable) or malignant (cancerous and hardly curable). Brain tumors include any tumor that starts in the brain, from brain cells, the membranes around the brain (i.e., meninges), nerves, and glands or sometimes spreads from other part of the body (A.D.A.M. Medical Encyclopedia, 2011). Brain tumors are classified based on the location of the tumor, the type of tissue involved, whether they are noncancerous (i.e., benign or slow growing) or cancerous (i.e., malignant or fast growing), or other factors. Among various brain tumors, gliomas, acoustic neuroma, and meningiomas have been most studied in the cell phone health literature.

Gliomas are a major type of brain tumors that are malignant and rarely curable, consisting of more than 60% of central nervous system tumors (Hardell et al., 2009). A brain glioma can cause headaches, nausea, vomiting, seizures, and cranial nerve disorders. A glioma of the optic nerve can cause visual damage and even blindness. Spinal cord gliomas can cause pain, weakness, or numbness in the extremities (A.D.A.M. Medical Encyclopedia, 2011).

Acoustic neuroma and meningiomas are two other types of brain tumors that are benign and generally curable (A.D.A.M. Medical Encyclopedia, 2011). Acoustic neuroma grows near the auditory and vestibular portions of the brain. Symptoms of acoustic neuroma include ipsilateral deafness, dizziness, nausea, vomiting, pressure in the ear, and tinnitus (i.e., hearing high-pitching ringing sound). Meningiomas arise from the meninges, the membranous layers surrounding outer layers of the brain and produce characteristic bony changes in the skull. While these two tumors are benign, but still may cause serious complications and even death. These two types of tumors occur most often between ages 40 – 70. Acoustic neuroma affects both genders equally whereas meningiomas are more common in women.

The International Agency for Research on Cancer (IARC) classified cancer-related agents, mixtures, and exposure into five levels with Level 1 as the severest: (1) carcinogenic to humans (i.e., causing cancer to humans), (2) probably carcinogenic to humans, (3) possibly carcinogenic to humans, (4) not classifiable as...
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