

Because no comparison groups were included, results from these studies on subjective symptoms cannot constitute a solid basis to claim that the health effects were caused by the use of mobile phones.

III. Tumors

A case-control study by Hardel et al.¹⁷ was triggered by case reports of brain tumors in users of cellular telephones. They recruited patients with histopathologically verified brain tumors living in the Uppsala-Orebro region from 1994 to 1996 and Stockholm region from 1995 to 1996 who were aged from 20 to 80 years at the time of diagnosis and were alive at the start of the study. In total, 233 cases were included, and two controls matched for sex, age, and study region were selected from the Swedish Population Register for each case. Exposure was assessed by a questionnaire interview over the phone. As a result, a non-significantly increased risk was observed for tumors in the temporal or occipital lobe on the same side as the mobile phone was being used. The increased risk was found only for the use of the NMT system.

Peter et al.¹⁸ conducted a case-control study between 1994 and 1998 and enrolled 782 patients and 799 controls through hospitals in Pittsburgh, PA. Among the cases, 489 had histologically confirmed gliomas, 197 had meningiomas, and 96 had acoustic neuromas. The controls were selected from the same hospitals with a variety of nonmalignant brain tumors. The relative risk associated with a cumulative use of a mobile phone for more than 100 h was 0.9 for gliomas, 0.7 for meningiomas, 1.4 for acoustic neuromas, and 1.0 for all types of tumors combined. As none of the relative risks was statistically significant, the study did not support the hypothesis that the use of hand-held cellular telephones can cause brain tumors.

From 1982 to 1995, Johansen et al.¹⁹ conducted a retrospective study in Denmark, including 420,095 cellular telephone users identified from two companies. The Danish Cancer Registry provided data on the cancer incidence, and the results showed no excess leukemia or cancers of the brain or salivary glands. This study is the first nationwide cancer incidence

study on mobile phone users in the English literature. The average follow-up period of the study was 3.1 years; the latency may be too brief to detect an early-stage effect or an effect on more-slowly growing brain tumors.

Muscat et al.²⁰ conducted a case-control study to evaluate whether using handheld cellular telephones is related to the risk of primary brain cancer. From 1994 to 1998, 469 men and women aged from 18 to 80 years with primary brain cancer and 422 matched controls without brain cancer in five medical centers in the US were interviewed using a structured questionnaire. No association with brain cancer was observed for the use of handheld cellular phones by hours of usage per month or by years of usage.

Whereas all these studies on brain tumors failed to observe a carcinogenic effect of mobile phone usage, none had a follow-up period of longer than 20 years after the use of mobile phones, and therefore further studies are needed to account for longer induction periods, especially for slow-growing tumors with neuronal features. There have been substantial changes in wireless communication technology since 1993; digital communication systems, which emit stronger energies, have replaced the old analog systems. Therefore, future studies on the new systems are needed to obtain data that are more applicable to real-life experience. It should also be noted that the use of mobile phones is associated with a higher socio-economic status, particularly in the earlier years of this technology, when mobile phones were very expensive. A high socio-economic status is associated with a better health status in general, and therefore an underestimation of cancer risks among cellular phone users might have been introduced in these studies. For example, the study in Denmark, in fact, observed lower risks of cancer in male cellular phone subscribers.

IV. Effects on the CNS and hormone secretion

To evaluate the potential adverse effects of EMFs emitted by mobile phones on the central nervous system (CNS), Urban et al.²¹ carried out a pilot experimental study of the influence of a single short acute