

# 2.12 Electromagnetic Radiation

## Summary

>Extremely low frequency electromagnetic fields generated by electrical power transmission have been associated with an increased risk of childhood leukaemia, but the findings are not conclusive. Even if this association is real, the number of excess cases is likely to be very small

>Radiofrequency radiation emitted by mobile telephones has been investigated in a number of studies. There is some evidence that long-term and heavy use of mobile/cellular phones may be associated with moderate increased risks of gliomas, parotid gland tumours, and acoustic neuromas; however, evidence is conflicting and a role of bias in these studies cannot be ruled out

>With reference to radio frequency, available data do not show any excess risk of brain cancer and other neoplasms associated with the use of mobile phones

>With reference to ELF fields, available data allow us to exclude any excess risk of (childhood) leukaemia and other cancers at the levels of exposure likely to be encountered by most (>99%) of the population)

>To date there is no convincing biological or biophysical support for a possible association between exposure to ELF fields and the risk of leukaemia or any other cancer

Although a source of exposure to man for many decades, electromagnetic fields (EMF) have seen an unprecedented increase in the number and diversity of sources in recent years [1], principally extremely low frequency and

radiofrequency fields. Such sources include all equipment using electricity, television, radio, computers, mobile telephones, microwave ovens, anti-theft gates in large shops, radars and equipment used in industry, medicine and commerce. Static fields and extremely low frequency fields occur naturally, and also arise as a consequence of the generation and transmission of electrical power and through the operation of a range of industrial devices and domestic appliances, the latter often at a greater field intensity. Exposure to extremely low frequency fields is mainly from human-made sources for the generation, transmission and use of electricity. Occupational exposure occurs, for example, in the electric and electronics industry, in welding and in the use and repair of electrical motors. Environmental exposure to extremely low frequency fields occurs in residential settings due to proximity to electricity transmission lines and use of electrical appliances. Levels of exposure from many environmental sources are typically low [2].

Exposure to radiofrequency radiation can occur in a number of ways. The primary natural source of radiofrequency fields is the sun. Manmade sources, however, are the main

source of exposure. Radiofrequency fields are generated as a consequence of commercial radio and television broadcasting and from telecommunications facilities. Radiofrequency fields in the home are generated by microwave ovens and burglar alarms. However, mobile telephones are now the greatest source of radiofrequency exposure for the general public.

A major obstacle in conducting epidemiological studies of EMF is the difficulty in accurately measuring the dose and exposure pattern. This is particularly true in the case of mobile telephones, where the dose emitted by phones has been changing between models and over time, and the use pattern of left or right side also varies within individuals. Measuring exposure to total EMF is also fraught with difficulty, and estimating the exposure to individual components of the spectrum involved is extremely difficult to the point of being impossible.

The INTERPHONE study is an ambitious project aiming at assessing the risk of cancer from the use of mobile phones. A number of the individual components have been published [3].

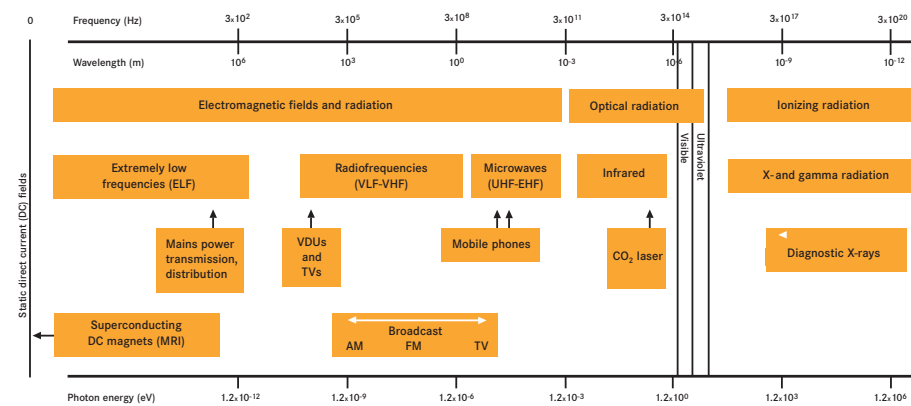


Fig. 2.12.1 The spectrum of electromagnetic fields and their use in daily life

Separate studies have been carried out for acoustic neurinoma, glioma, meningioma and tumours of the parotid gland. The studies used a common core protocol and were carried out in Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden and the UK. Details of the study protocol and procedures have been published [4]. The overall study includes approximately 2600 gliomas, 2300 meningiomas, 1100 acoustic neurinomas, 400 parotid gland tumours and their respective controls. This is by far the largest epidemiological study of these tumours to date. A number of methodological issues have been addressed including study design, participation bias, recall error and exposure assessment that are essential in the interpretation of results from the study.

Results of national analyses of the relation between mobile phone use and risk of specific tumour types in some of the participating countries have indicated that in most studies, the OR related to ever having been a regular mobile phone user was below 1, in some instances statistically significantly. This possibly reflects participation bias or other methodological limitations.

For glioma, although results by time since start of use and amount of phone use vary, the number of long-term users is small in individual countries

and results are therefore compatible. Pooling of data from Nordic countries and part of the UK yielded a significantly increased risk of glioma related to use of mobile phones for a period of 10 years or more on the side of the head where the tumour developed [5]. This finding could either be causal or artifactual, related to differential recall between cases and controls.

For meningioma and acoustic neurinoma, most National studies provided little evidence of an increased risk. The numbers of long-term heavy users in individual studies were even smaller than for glioma, however, and prevent any definitive conclusion about a possible association between mobile telephone use and the risk of these tumours. A pooled analysis of data from Nordic countries and the UK found a significantly increased risk of acoustic neurinoma related to duration of use of 10 years or more on the side of tumour [6]. Again, this finding could either be causal or artifactual, related to differential recall between cases and controls.

For parotid gland tumours, no increased risk was observed overall for any measure of exposure investigated. In a combined analysis of data from Sweden and Denmark [7], a nonsignificantly increased risk of benign tumours was observed for ipsilateral use of 10 years or more, while a decreased risk was seen for contralateral use, possibly reflecting differential recall

between cases and controls. In the Israeli study, where study subjects tended to report substantially heavier use of mobile phones, results suggest a possible relation between heavy mobile phone use and risk of parotid gland tumours. Additional investigations of this association, with longer latency periods and large numbers of heavy users, are needed to confirm these findings. In respect of the work environment, employees working in close proximity to radiofrequency emitting systems may receive high levels of exposure. This includes workers

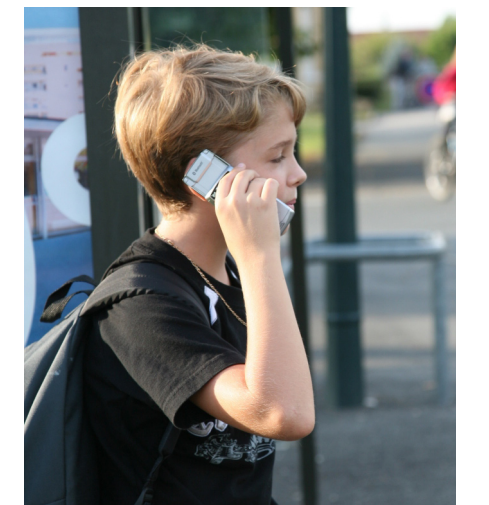


Fig. 2.12.2 Child and cellphone

Frequency	Class	Type of device or service
30 - 300 kHz	LF (low)	LF broadcast and long-range radio
300 - 3,000 kHz	MF (medium)	AM radio, radio navigation, ship-to-shore
3 - 30 MHz	HF (high)	CB radio, amateurs, HF radio communications and broadcast
30 - 300 MHz	VHF (very high)	FM radio, VHF TV, emergency services
300 - 3,000 MHz	UHF (ultra high)	UHF TV, paging, mobile telephones, amateur radios
3 - 30 GHz	SHF (super high)	Microwaves, satellite communications, radar, point to point microwave communications
30 - 300 GHz	EHF (extremely high)	Radar, radioastronomy, short-link microwave communications

Table 2.12.1 Radiofrequency range: class and type of device or service



Fig. 2.12.3 Power line

in the broadcasting, transport and communication industries, and in antenna repair, military personnel (e.g. radar operators) and police officers (utilising traffic control radars). There are also industrial processes that use radiofrequency fields, including dielectric heaters for wood lamination and sealing of plastics, industrial induction heaters and microwave ovens, medical diathermy equipment to treat pain and inflammation of body tissues, and electrosurgical devices for cutting and welding tissues.

### Cancer causation

Several expert groups have recently reviewed the scientific evidence concerning the carcinogenicity of extremely low frequency fields [8-10]. A number of epidemiological studies on childhood leukaemia indicate a possible relationship between risk and exposure to extremely low frequency fields. Studies of adult cancers following occupational or environmental exposures to extremely low frequency fields are much less clear. There is little experimental evidence that these fields can cause mutations in cells. Mechanistic studies and animal

experiments do not show any consistent positive results, although sporadic findings concerning biological effects (including increased cancers in animals) have been reported. IARC has classified extremely low frequency fields as possibly causing cancer in humans (Group 2B), based on childhood leukaemia findings [11].

The evidence for the carcinogenicity of radiofrequency fields is even less clear. A few epidemiological studies in occupational settings have indicated a possible increase in the risk of leukaemia or brain tumours, while other studies indicated decreases. These studies suffer from a number of limitations. The experimental evidence is also limited, but suggests that radiofrequency fields cannot cause DNA mutations. The lack of reproducibility of findings limits the conclusions that can be drawn.

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