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Health Effects of Exposure to EMF

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Terms of reference

- To **update** the SCENIHR opinion of 21 March 2007 in light of newly available information
- To provide a **methodological framework** and corresponding guidelines to evaluate available scientific evidence in order to ensure the best possible quality for risk assessment

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Structure of the opinion

- Scientific rationale
- Frequency bands
  - Radiofrequency 100 kHz–300 GHz
  - Intermediate frequency 300 Hz–100 kHz
  - Extremely low frequency 1-300 Hz
  - Static (0Hz)
- Sources and exposure to the population
- Discussions of outcomes (human, in vivo, in vitro)

- Methodological framework

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Conclusions of the opinion

- Frequency bands – human health
- Environmental aspects
- Research recommendations

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Radiofrequency (RF) fields

- Sources and exposure
  - Wireless communication
  - Broadcasting
  - Medical and industrial applications
- Conclusions regarding cancer
  - Three independent lines of evidence (epidemiological, animal and in vitro studies) indicate that exposure to RF fields is unlikely to lead to an increase in cancer in humans
  - Since common long-term exposure of humans to RF fields from mobile phones is shorter than the induction time of some cancers, further studies are required to identify if considerably longer-term human exposure to such phones might pose some cancer risk

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Radiofrequency (RF) fields (cont´d): non-cancer outcomes

- No support for an effect of RF fields on self-reported symptoms. A nocebo effect (an adverse non-specific effect that is caused by expectation or belief that something is harmful) may play a role in symptom formation.
- There is some evidence that RF fields can influence EEG patterns and sleep in humans. The health relevance is uncertain.
- Other studies on functions/aspects of the nervous system, show no or no consistent effects.
- Recent studies have not shown effects from RF fields on human or animal reproduction and development. No new data has appeared that indicate any other effects on human health.
- Information on possible effects caused by RF fields in children is limited. Furthermore, there is a lack of information on diseases other than those discussed in this report.

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Intermediate frequency (IF) fields

- Sources and exposure
  - Increasing number of primarily occupational applications
  - e.g. anti-theft devices, induction heaters, hot plates, welding, medical applications, VDT´s, CFL´s
- Conclusions
  Very little research on IF and health risks in occupational settings or for the general public have been presented since the previous opinion and no epidemiologic study has appeared. Consequently, the data are still too limited for an appropriate risk assessment.

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Extremely low frequency (ELF) fields

- Sources and exposure
  - Distribution and use of electricity
  - Transmission lines and household appliances, transport (domestic)
  - Electric power installations, welding, induction heaters, transport (occupational)

- Conclusions regarding cancer:
  The few new epidemiological and animal studies that have addressed ELF exposure and cancer do not change the previous assessment that ELF magnetic fields are a possible carcinogen and might contribute to an increase in childhood leukaemia.

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Extremely low frequency (ELF) fields (cont´d): non-cancer outcomes

- No new studies support a causal relationship between ELF fields and self-reported symptoms
- New epidemiological studies indicate a possible increase in Alzheimer's disease arising from exposure to ELF fields
- Recent animal studies provided an indication for effects on the nervous system at flux densities from 0.10-1.0 mT. However, there are still inconsistencies in the data, and no definite conclusions can be drawn concerning human health effects
- Very few recent in vitro studies have investigated effects from ELF fields on diseases other than cancer and those available have very little relevance
- In vivo and in vitro studies show effects at exposure levels to ELF fields that are considerably higher than the levels encountered in the epidemiological studies which showed an association between exposure and diseases

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Static magnetic fields (SMF)

- Sources and exposure
  - Technology development using SMF
  - Implants are sensitive to SMF
  - Process industry, welding, transport systems
  - Magnetic Resonance Imaging (MRI)
- Conclusions
  - Many mixed and contradictory results in studies
  - A lack of adequate data for a proper risk assessment
  - Short term effects have been observed primarily on sensory functions for acute exposure. However, there is no consistent evidence for sustained adverse health effects from short term exposure up to several teslas

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Environmental Effects

- The current data base is inadequate for the purposes of the assessment of possible risks due to environmental exposure to RF, IF and ELF fields.

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Research Recommendations

- RF fields (primarily frequencies relevant for mobile communication)
  - RF exposure and cancer
  - RF exposure in children
  - Exposure assessment total RF exposure
  - Confirmation of important but preliminary findings
- IF fields
  - Investigations of possible health effects
- ELF fields
  - Childhood leukaemia – mechanisms
  - Neurodegenerative diseases
  - Dose-response relationships
- Static magnetic fields
  - Effects in workers
  - Other potential effects
- Additional considerations
  - Mechanistic/mode of action studies
  - Combinations