

Conclusions from the Workshop on Long term effects:

1. What was the situation like before the start of the DMF?

There were indications from unreplicated studies in vitro and in vivo that there may be adverse effects of RF-EMF on the blood brain barrier and on neurons.

There were indications from an in vivo study, that chronic exposure at 900 MHz may increase the lymphoma incidence in mice.

There were complaints from the public about hearing damage and tinnitus due to electromagnetic fields, as well as few publications showing possible physiological effects of RF fields on the acoustic system which includes the highest exposed organ during a mobile phone call.

There were indications from unreplicated studies in vivo that there may be adverse effects of RF-EMF on learning and cognition.

Long-term studies covering more than one generation were lacking, especially for the new mobile phone system UMTS, whose signal characteristics differ significantly from the GSM type signal.

There were indications from an epidemiological study, that RF-radiation may enhance the risk of developing uveal melanoma.

There were indications from epidemiological studies, that use of mobile phones may enhance the risk of developing intracranial tumors, even after short use (less than ten years)

There were indications from epidemiological studies, that RF-radiation from radio and television transmitters may be associated with an increased risk of childhood leukaemia.

There was a general concern, that children may be especially vulnerable to adverse effects of RF-EMF.

2. What has been achieved by the projects? What are the lessons learned?

Results from the Salford group concerning effects on the blood-brain barrier or induction of "dark neurons" caused by low level exposure below safety limits (GSM and UMTS) could not be confirmed. No effect was found in a 3 generation study in rats, neither on BBB-permeability nor on CA1-neurons.

But:

An effect was observed at repeated head-only exposures of 13 W/kg, GSM 1800. This finding has to be independently confirmed. Complete RT-PCR analysis from an

in vitro study have to be awaited before the final discussion of possible effects on gene expression

No adverse effects on cognition, stress- and immune response were found in a 3-generation study in rats.

No induction of tinnitus in rats was found, neither by behaviour tests nor by molecular investigation (expression of specific target genes).

After long term exposure to GSM or UMTS 0.4 W/kg no effects on survival or development of lymphomas in AKR/J mice, an animal model prone to develop leukaemia was found.

Results of the ongoing metabolism study have to be awaited before the final discussion of the so far observed weight gain in GSM-exposed animals

No indications for adverse effects of UMTS on fertility or fertility related parameters was found in a 4-generation study in mice (preliminary results!).

Preliminary results from an ongoing dosimetric study in anatomical head models of children indicating higher SAR in certain regions of a child head model compared to an adult model need validation. Final results have to be awaited.

An occupational cohort highly exposed to RFR could not be established.

Participation in the international prospective cohort study on mobile phone users (COSMOS) was not possible within the DMF-research programme. Due to a feasibility study it would have been too costly and too intricate (complex exposure assessment, extremely low participation rate, difficulties in follow-up for specific endpoints such as neurodegenerative diseases).

Epidemiological studies like INTERPHONE have added valuable information. They show consistently that there is no enhanced risk of brain cancer for mobile phone use up to 10 years.

Pooled analysis of long-term user group (>10 years) has to be awaited for final discussion.

For the first time an improved study design for investigating the risk of childhood leukaemia and proximity to radio and television transmitters was developed, yet results of the case-control study have to be awaited.

“Is science currently able to provide essential further information for radiation protection?” – Has everything been done that can reasonably be done with scientifically sound methods?

There was no clear answer to this question. In any case, before committing further research, there is a need to sum up and evaluate existing results thoroughly.

3. Where do we still have gaps?

The need for appropriate risk communication and the necessity to improve knowledge in the public was considered as an important area of future work.

Regarding epidemiology it was recommended by some participants to rather spend money for improvement of registry systems than for further research.

Further research on gene expression e.g. in BBB-Model or in neuronal networks was discussed.

However, in the absence of clear evidence of health relevant effects this research should be considered to be fundamental research and not directly addressed at assessing possible health risks.

Overall exposure by multiple sources will remain an issue. Some participants argued that it is not possible to extrapolate from one type of exposure to another and that, therefore, each frequency or new exposure characteristic has to be tested separately, even if there are only small differences like for example between GSM and UMTS exposure. This is based on the general possibility of an unknown mechanism.

Other participants argued that the established dosimetric measure of biological significance, the SAR, allows one to extrapolate across different exposures from multiple sources, at the present state of scientific knowledge. It is difficult to predict whether a scientific breakthrough will occur that will identify mechanisms that would prevent extrapolation across exposure types but, given the extensive work on the subject to date, some participants were not optimistic that such a breakthrough would occur..

Age dependent effects on children will remain an issue as well as possible long term effects of both low level exposure from fixed radio transmitters as well as long term use of mobile phones or other sources close to the body.

4. Can we define minimum standards for future work?

It should be kept in mind, that biological effects, in particular isolated effects such as expression of a certain gene or effects on DNA-Level in certain cell types in itself are not necessarily adverse to health. The physiological relevance has to be discussed and if necessary be uncovered by further studies aimed at following up positive findings.

A high quality of statistical methods is a prerequisite to assess the possibility of false positives or false negative results.

5. Are there findings that have an impact on guidelines or on standard settings?

Not so far, but results of ongoing studies should be awaited.