

## ATHEM-2 Executive Summary

The ATHEM-2 research project (Athermal effects of electromagnetic field exposure associated with mobile communication) continues earlier research of the ATHEM-1 project (2002-2008). Mobile phones receive and emit radio frequency electromagnetic fields (RF-EMF). Everyone using such phones is exposed to these fields. The ATHEM-2 project investigated cognitive effects of so called athermal intensity RF-EMF exposure and, in particular, possible genotoxic effects of this exposure on human cells. One project focus was on in vitro (laboratory) experiments designed to reveal possible mechanisms of interaction with and damage of the genome. The study protocol was reviewed and approved by external experts. All experiments were performed under double-blind conditions in order to generate data of the highest possible quality. Neither the tested volunteers, nor the scientific personnel were aware of the exposure conditions used during experimentation and during sample analysis.

Experiments on human test subjects involved exposure of the cheek mucosa to RF-EMF for a two hour period on five consecutive days. The opposite cheek served as a source of control material. Cognition tests performed during exposure revealed a decreased reaction time and an increased error rate. For more complex tasks such as memory tests, both reaction time and error rate were observed to be increased.

Moderate genotoxic and cytotoxic effects were found in mucosal cells harvested two and three weeks after RF-EMF exposure. Relating the data to records of pre-study exposure suggested, in addition, a possible accumulation of such effects.

In vitro experiments on genotoxicity confirmed the existence of two types of cells – those that are sensitive to non-ionizing radiation, and those that are not. In addition, the present experiments confirmed the existence of a latency period (time between beginning of exposure and first incidence of effects).

In sensitive cells DNA damage was shown to be caused by RF-EMF-induced oxidation of DNA, which is associated with an increased likelihood of DNA strand breaks. These effects were particularly pronounced in cells under additional metabolic stress. Furthermore, we observed triggering of very specific DNA repair pathways by RF-EMF exposure. On one hand, this confirms the presence of DNA damage, while at the same time it indicates that the damage may be repaired to some extent. As a matter of fact, induced DNA damage was undetectable two hours after cessation of RF-EMF exposure.

Our observations do not indicate any acute adverse health effects of RF-EMF exposure. Nonetheless, a potential long term risk cannot be excluded. Therefore, several preventative measures for reduction of exposure and associated risks are specified. The two most prominent recommendations are to transport a mobile phone in a bag rather than directly on the body, and to reduce the exposure of the head by using a headset or hands-free equipment whenever possible.