Electromagnetic fields (EMF)

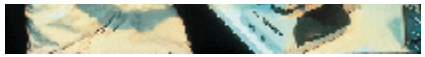
What are electromagnetic fields?

Progress in research

If electromagnetic fields constitute a health hazard, there will be consequences in all industrialized countries. The public demands concrete answers to the ever more pressing question, whether everyday electromagnetic fields cause adverse health effects. The media often seem to have definitive answers. However, one should judge these reports with caution and take into account that the primary interest of the media is not education. A journalist may select and report a story driven by a range of non-technical reasons: journalists compete with one another for time and space and different journals and newspapers compete for circulation numbers. Novel sensational headlines that are relevant to as many people as possible aid them in achieving these goals - bad news is not only the big news, it is often the only news we hear. The large number of studies which suggest that electromagnetic fields are harmless receive little if any coverage. Science cannot provide a guarantee of absolute safety yet but the development of research is reassuring overall.

Different types of studies are needed

A mix of studies in different research areas is essential for the evaluation of a potential adverse health effect of electromagnetic fields. Different types of studies investigate



distinct aspects of the problem. Laboratory studies on cells aim to elucidate the fundamental underlying mechanisms that link electromagnetic field exposure to biological effects. They try to identify mechanisms based on molecular or cellular changes that are brought about by the electromagnetic field - such a change would provide clues to how a physical force is converted into a biological action within the body. In these studies, single cells or tissues are removed from their normal living environment which may inactivate possible compensation mechanisms.

Another type of study, involving animals, is more closely related to real life situations. These studies provide evidence that is more directly relevant to establishing safe exposure levels in humans and often employ several different field levels to investigate dose-response relationships.

Epidemiological studies or human health studies are another direct source of information on long-term effects of exposure. These studies investigate the cause and distribution of diseases in real life situations, in communities and occupational groups. Researchers try to establish if there is a statistical association between exposure to electromagnetic fields and the incidence of a specific disease or adverse health effect. However, epidemiological studies are costly. More importantly, they involve measurements on very complex human populations and are difficult to control sufficiently well to detect small effects. For these reasons, scientists evaluate all relevant evidence when deciding about potential health hazards, including epidemiology, animal, and cellular studies.

Interpretation of epidemiological studies

Epidemiological studies alone typically cannot establish a clear cause and effect relationship, mainly because they detect only statistical associations between exposure and disease, which may or may not be caused by the exposure. Imagine a hypothetical study showing a link

between electromagnetic field exposure in electrical workers of the company "X-Electricity" and an increased risk of cancer. Even if a statistical association is observed, it could also be due to incomplete data on other factors in the workplace. For example, electrical workers may have been exposed to chemical solvents with the potential to cause cancer. Moreover, an observed statistical association may be due only to statistical effects, or the study itself may have suffered from some problem with its design.

Therefore, finding an association between some agent and a specific disease does not necessarily mean that the agent caused the disease. Establishing causality requires that an investigator consider many factors. The case for a cause-and-effect link is strengthened if there is a consistent and strong association between exposure and effect, a clear dose-response relationship, a credible biological explanation, support provided by relevant animal studies, and above all consistency between studies. These factors have generally been absent in studies involving electromagnetic fields and cancer. This is one of the strongest reasons why scientists have generally been reluctant to conclude that weak electromagnetic fields have health effects.

Difficulties in ruling out the possibility of very small risks

"The absence of evidence of detrimental effects does not seem to suffice in modern society. The evidence of their absence is demanded more and more instead". (Barnabas Kunsch, Austrian Research Centre Seibersdorf)

"There is no convincing evidence for an adverse health effect of electromagnetic fields" or "A cause-effect link between electromagnetic fields and cancer has not been confirmed" are typical of the conclusions that have been reached by expert committees that have examined the issue. This sounds as if science wanted to avoid giving an answer. Then why should research continue if scientists have already shown that there is no effect?

The answer is simple: Human health studies are very good at identifying large effects, such as a connection between smoking and cancer. Unfortunately, they are less able to distinguish a small effect from no effect at all. If electromagnetic fields at typical environmental levels were strong carcinogens, then it would have been easy to have shown that by now. By contrast, if low level electromagnetic fields are a weak carcinogen, or even a strong carcinogen to a small group of people in the larger population, that would be far more difficult to demonstrate. In fact, even if a large study shows no association we can never be entirely sure that there is no relationship. The absence of an effect could mean that there really is none. But just as well it could mean that the effect is simply undetectable with our method of measurement. Therefore, negative results are generally less convincing than strong positive ones.

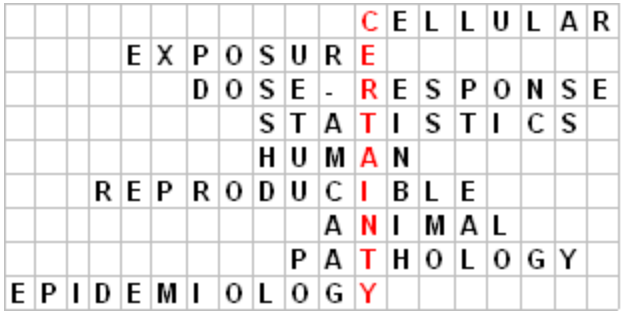
The most difficult situation of all, which unfortunately has developed with epidemiology studies involving electromagnetic fields, is a collection of studies with weak positive results, which however are inconsistent among each other. In that situation, scientists themselves are likely to be divided about the significance of the data. However, for the reasons explained above, most scientists and clinicians agree that any health effects of low level electromagnetic fields, if they exist at all, are likely to be very small compared to other health risks that people face in everyday life.

What's in the future?

The main aim of WHO's International EMF Project is to initiate and co-ordinate research worldwide to produce a well-founded response to public concerns. This evaluation will integrate results from cellular, animal and human health studies to allow as comprehensive a health risk assessment as possible. A holistic assessment of a variety of relevant and reliable studies will provide the most reliable answer possible about the adverse health effects, if any exist, of long term exposure to weak electromagnetic fields.

One way to illustrate the necessity of evidence from different types of

experiments is a crossword. To be able to read the given crossword's solution with absolute **CERTAINTY** nine questions must be answered. Assuming we can only answer three of these, we might be able to guess the solution. However, the three given letters may also be part of a very different word. Every additional answer will increase our own confidence. In fact, science will probably never be able to answer all questions, but the more solid evidence we collect the better will be our guess at the solution.



Key points

1. Laboratory studies on cells aim to determine if there is a mechanism by which electromagnetic field exposure could cause harmful biological effects. Animal studies are essential for establishing effects in higher organisms whose physiology resembles that of humans to a degree. Epidemiological studies look for statistical associations between field exposure and the incidence of specific adverse health outcomes in humans.
2. Finding a statistical association between some agent and a specific disease does not mean that the agent caused the disease.
3. The absence of health effects could mean that there really are none; however, it could also signify that an existing effect is undetectable with present methods.
4. Results of diverse studies (cellular, animal, and epidemiology) must be considered together before drawing conclusions about possible health risks of a suspected environmental hazard. Consistent evidence from these very different types of studies increases the degree of certainty about a true effect

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