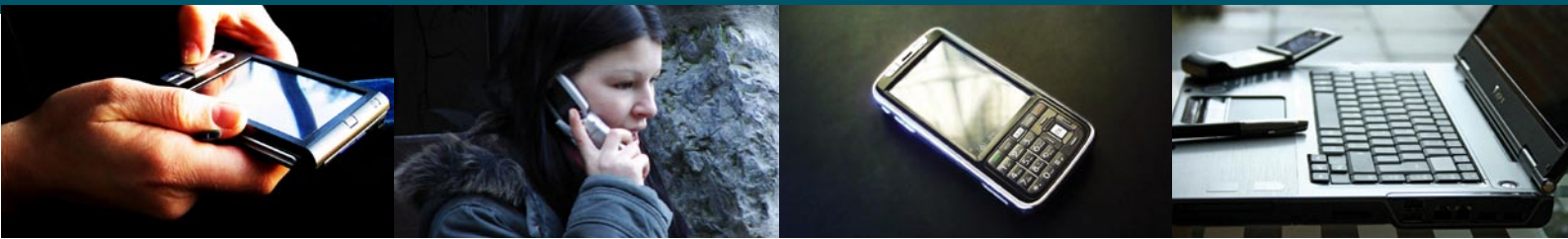


[BACKGROUND SERIES]

WEIGHING THE EVIDENCE IN EMF HEALTH RESEARCH



MMF
**Mobile Manufacturers
Forum**





Contents

Have the effects been reported in the scientific peer reviewed literature?	1
Have the reported effects been independently replicated?	1
Is there a credible mechanism of action for the reported effects?	1
Do the reported effects have any health significance?	1
What is the strength of the reported effect?	2
Do the reported effects exhibit a dose-response relationship?	2
Is the study 'hypothesis testing' or 'hypothesis generating'?	2
Have the statistical analyses of the results been conducted properly?	3
Are there more obvious explanations for the reported outcomes?	3
How does this study fit into the total existing research body?	3
Additional Information	4

The scientific method provides the most reliable way to increase our knowledge. Nevertheless, like other human activities, scientific investigation is subject to potential errors, personal opinions and uncertainties. This applies as much to research on potential health effects associated with radio waves, also known as radiofrequency (RF) electromagnetic fields (EMF), as it does to all other areas of science. When weighing up the evidence for potential health effects, scientists consider different aspects before drawing their conclusions. The following questions as well as the additional sources at the end of this information will help to evaluate research studies and reported potential health effects.

Have the effects been reported in the scientific peer reviewed literature?

The added scrutiny of a study by scientific peers is a minimum 'check and balance' requirement. Although not guaranteeing the accuracy of the results, it does nonetheless provide an important element of quality control.

Have the reported effects been independently replicated?

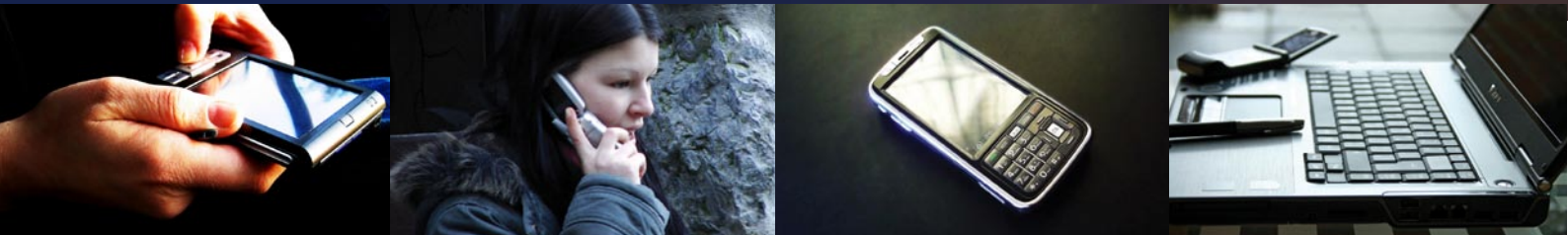
Independent confirmation of new results is important to minimise the influence of experimenter bias and unrecognised sources of error in a particular laboratory setup.

Is there a credible mechanism of action for the reported effects?

If there is no mechanism to convert the energy of RF signal to a biological stimulus there can be no biological response and no health effect can occur. Reported effects could be biological effects, which are measurable responses to a stimulus or to a change in environment, that might but does not necessarily result in a health effect.

Do the reported effects have any health significance?

Effects in human studies are regarded as important for public health policy. In the evaluation of human health risks, sound human data, whenever available, are generally more informative than animal data. Animal and in vitro studies provide support and are used mainly to supply evidence missing from human studies. However, outcomes from cellular and animal studies may be more difficult to interpret, especially if the reported effect is weak or subtle and the response mechanism is not understood.



What is the strength of the reported effect?

It is often useful to compare the scale of a reported effect to other known causes in order to place it in a proper perspective. Weak and subtle effects can sometimes be due to experimental errors or random variability unless there has been careful attention to good laboratory technique. Ideally laboratory investigations should include a “positive control”, which is a control group treated with a well defined stimulus that produces a known response. Thereby the sensitivity of the experimental set-up can be tested and any detected effect can be seen relative to the reaction of the positive control.

Do the reported effects exhibit a dose-response relationship?

A dose-response relationship describes the change in effect caused by differing levels of exposure. An increase in the level of effect with increased exposure is a good indicator of a real effect. Complex responses, including suggestions of *windows* in response levels, are more difficult to interpret without a verified mechanism.

Is the study ‘hypothesis testing’ or ‘hypothesis generating’?

A hypothesis is a provisional idea that requires testing. A scientific hypothesis must be both *testable* and *falsifiable* by experiment or observations. A *hypothesis testing* study will make a specific prediction about the outcome of an experiment and then test that prediction. A *hypothesis generating* study will screen for a range of possible outcomes from an exposure and use the outcomes to propose further specific *hypotheses* for testing.

Have the statistical analyses of the results been conducted properly?

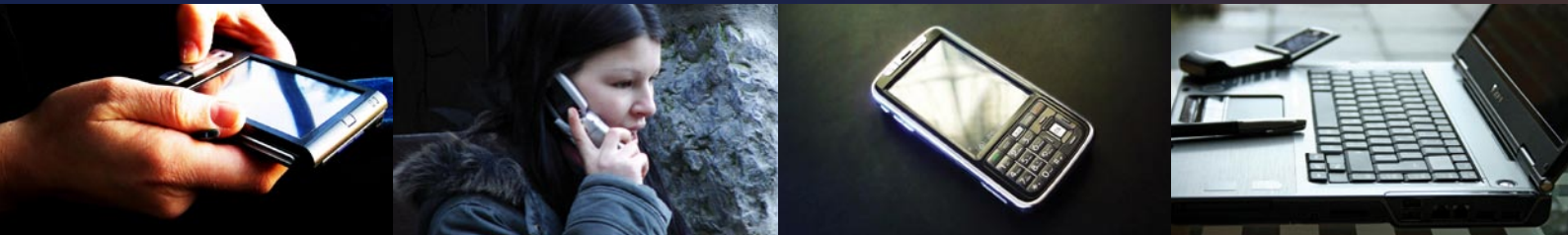
The statistical significance of an experimental result is normally quantified by statistical analysis. A meaningful evaluation of a study requires the competent application of statistical tests and adherence to proper scientific methodology such as randomised experimental design, blinding, and the clear specification of hypotheses before experimental data is collected and analysed. Statistical significance tests show that it is unlikely that a result is due to chance but it does not directly determine the importance of an experimental result for health. *Hypothesis generating studies* test for a wide array of potential endpoints and so the probability of detecting effects due to chance alone increases accordingly. These effects may be *false positives*, and should be verified by more focused hypothesis testing studies that aim to test a specific effect. Sometimes, *hypothesis generating studies* are cited as though they were hypothesis testing, with an exaggerated importance that isn't statistically warranted.

Are there more obvious explanations for the reported outcomes?

Potential sources of bias and confounding should always be considered before accepting unusual outcomes. In many RF studies, it has been later found that reported *athermal* effects were likely caused by RF heating.

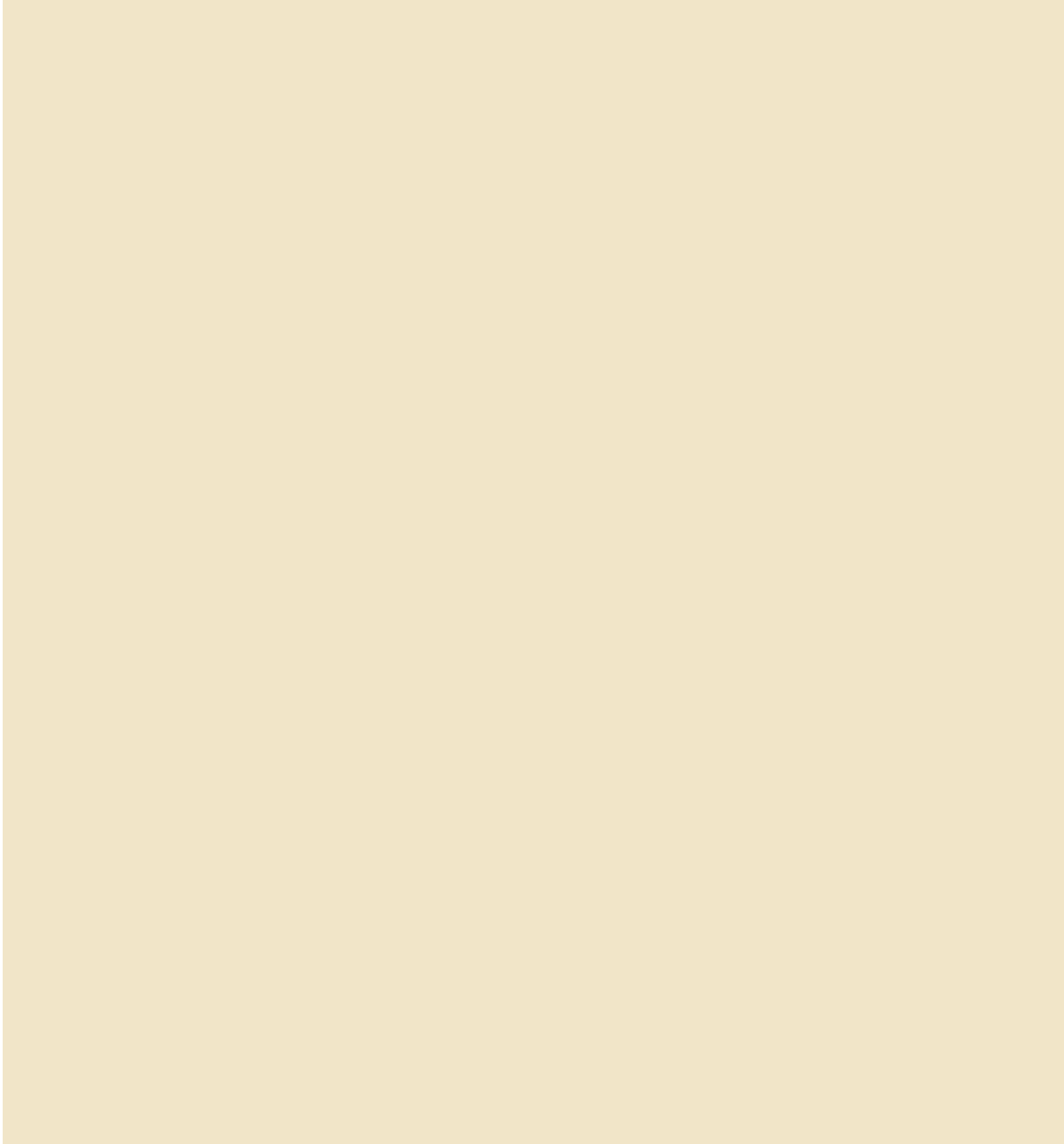
How does this study fit into the total existing research body?

Health risk assessments are performed by a *weight the evidence* approach to the combined body of research studies. The careful work of independent scientific review bodies makes it possible to review the available scientific information, giving weight to each study according to its quality, type and strength of the findings to provide overall conclusions and recommendations. Conclusions drawn from reviews of the total body of evidence are more reliable than the findings of an individual study.



Additional Information

- The Academy of Medical Sciences, Identifying the environmental causes of disease: how should we decide what to believe and when to take action, November 2007: <http://www.acmedsci.ac.uk/p99.html>
- Hill AB (1965). *The environment and disease: Association or causation?* Proceedings of the Royal Society of Medicine. 58, 295-300: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1898525>
- Independent Reviews Listing: <http://www.gsmworld.com/health/links/independent.shtml>
- Preamble to the IARC Monographs (amended January 2006): <http://monographs.iarc.fr/ENG/Preamble/index.php>
- Science Media Centre *Peer review in a nutshell*, 2003: <http://www.sciencemediacentre.org/>
- Sense About Science *I don't know what to believe...:* <http://www.senseaboutscience.org.uk/>
- World Health Organization, Electromagnetic Fields (EMF) website: <http://www.who.org/emf>
- Preamble to the WHO Extremely Low Frequency Fields Environmental Health Criteria Monograph No. 238: <http://www.who.int/entity/peh-emf/publications/Preamble1.pdf>





**Mobile Manufacturers
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The Mobile Manufacturers Forum is an international association of radio communications equipment manufacturers. For more information, please visit the MMF's website at www.mmfai.org.

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The GSM Association (GSMA) is the global trade association representing more than 700 GSM mobile phone operators across 218 countries and territories of the world. In addition, more than 200 manufacturers and suppliers support the Association's initiatives as key partners.

For more information, please visit the GSMA Health & Environment site www.gsmworld.com/health

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