



Mobile Communications and Health Research Program



The GSM Association (GSMA) supports an active program of research addressing possible health risks from the radio signals used to provide mobile services. The program includes biological, epidemiological and social studies as well as engineering analysis. Since the year 2000, approximately 10 million has been committed to independent research.

Studies are designed to follow good research practice including carefully controlled exposure conditions and the use of expert scientific advisors to monitor progress. We ensure independence by partnering with governmental authorities whenever possible and by the use of contract firewalls in biological studies. Our contracts provide researchers with the independence to interpret their findings and we encourage them to publish in peer reviewed scientific journals so that results are available for expert reviews.

GSMA also encourages scientific debate through support for scientific meetings and workshops.

The most up-to-date information on scope and outcomes is available here: www.gsmworld.com/health

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1—Background

Research into the safety of radio signals has been underway for more than fifty years. This body of evidence has contributed to the development of human exposure standards with substantial safety factors that provide protection for all persons against all established health risks.

In the area of biological effects and medical applications of non-ionizing radiation approximately 25,000 articles have been published over the past 30 years. Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. However, some gaps in knowledge about biological effects exist and need further research. – World Health Organization

The World Health Organization (WHO) established the International EMF Project in 1996 to assess health and environmental effects of exposure to electromagnetic fields (EMFs) from all sources. As part of this function, the WHO reviews on-going research and provides recommendations for research to support health risk assessments.

The WHO estimates that since 1997 over \$200 million has been spent addressing EMF research recommendations.

Since the 1990s there has been an extensive program of research specifically investigating the safety of mobile phone use and living near base stations. There have been major research activities in Australia, Canada, Denmark, Finland, France, Germany, India, Italy, Japan, Netherlands, South Korea, Sweden, Switzerland, United Kingdom and United States of America. The European Commission continues to fund projects involving laboratories from many European countries and there are individual projects in other countries.

The GSMA research priorities have been guided by the WHO research recommendations and expert reviews from around the world. We have aimed to support the needs of the health risk assessments, the development of safety standards and to provide information to inform policy development.

Studies are conducted at independent institutions, follow good laboratory practice and are governed by contracts that encourage open publication of findings in the peer-reviewed scientific literature. Whenever possible the GSMA partners with governmental authorities as a further guarantee of scientific independence. Since 2000, the GSMA has committed €10 million to this research program.

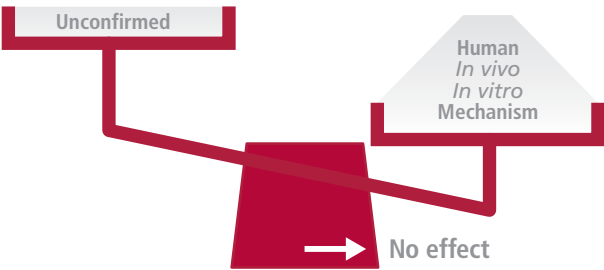
2—Scientific Process

Researchers follow the scientific process in their studies. The researcher formalises an idea to test as a hypothesis, a theory used to make predictions that can be tested by experiment. A well-designed experiment should minimise the effects of confounders, external factors that could also influence the outcome (for example, temperature in biological studies) and ensure blinding, this means that the person conducting the analysis should not know the exposure status until after the data is analysed. The study must also be large enough to have sufficient statistical power to test the hypothesis.

Researchers may report preliminary findings at conferences to share knowledge and obtain feedback. Subsequently the final results are submitted for peer review where the study design and results are critically examined by anonymous reviewers with expertise in the subject. Reviewers may recommend acceptance, amendment or rejection of a research paper. The process of submission, review, amendment and resubmission may take several months.

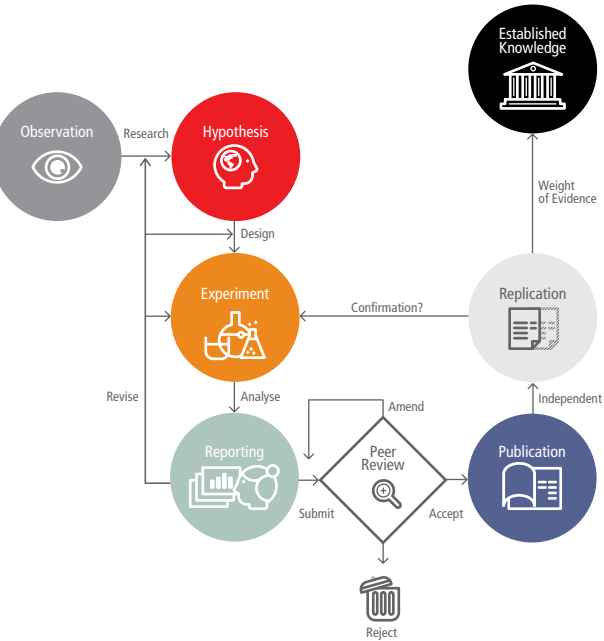
Publication provides some confidence that the study has been well conducted and many public health risk assessments use this as a threshold before considering scientific evidence. However, not all published research is without flaws and the quality of peer review varies across journals.

3—Health Risk Assessment



Published results are examined by the wider scientific community and other scientists may try to confirm the study claims by independent replication. This is essential to minimise the effects of potential experimental bias. If the original results are confirmed then greater weight is given to the hypothesis. In the evaluation of human health risks, data from human studies (epidemiology or volunteer studies) are generally regarded as more informative than *in vivo* (animal) data. Animal and *in vitro* (cell) studies provide supporting evidence and are used where the human data is unclear or where studies are not possible in humans. The evidence for an effect is stronger where the results from different types of studies point to the same conclusion.

There is no such thing as ‘zero risk’ and science cannot prove absolute safety.



The results of many experiments are compared through a weight of evidence approach. This is not simply a case of counting publications, individual studies are examined and their strengths and weaknesses noted. These include the quality of methods, ability of a study to detect adverse effects, consistency of results across studies, and biological plausibility of cause-and-effect relationships. This allows overall conclusions to be formed about the strength of the evidence for a reported effect leading to the established knowledge about a subject. However, science is not static and even established theories may be challenged by new experimental findings. Comprehensive scientific health risk assessments are used to set human exposure standards and assist national authorities to make risk management decisions.

4—Human Studies

Human studies may be observational, for example, looking at the effects of some factor on disease rates in a population and these are termed epidemiological studies. If the effect under study is short term then a provocation study may be possible where people are exposed to an agent (for example, noise) and their response measured.

Epidemiological Studies

There have been several epidemiological studies of mobile phones and brain tumours. A 2008 review for the GSMA by the Australian Centre for Radiofrequency Bioeffects Research (ACRBR) concluded that existing studies overall provide no evidence of an association between mobile phone use and brain cancer. They noted that many of the studies had small statistical samples and other technical limitations.

Epidemiology is the study of the cause and distribution of diseases in human populations. Such studies can test for associations but not direct causation, which requires supporting evidence from other types of scientific investigations.

The INTERPHONE project is a 13 country epidemiological study involving more than 14,000 subjects and coordinated by the International Agency for Research on Cancer (IARC), an agency of the WHO. It aimed to test whether up to 10 years of using mobile phones was associated with an increase in the risk of certain cancers of the head and neck. To test for an association, subjects with and without the diseases of interest were asked about their past mobile phone use.

INTERPHONE
Countries: Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden, UK
Study population 30 to 59 years old.
Cases – 6,420
Controls – 7,658
Exposure assessment based on subjects’ recall of phone usage.

The GSMA funding is administered by the International Union Against Cancer (UICC) in order to ensure scientific independence. The sponsors of the INTERPHONE project do not have access to any results of the studies before their acceptance for publication.

The main data collection for INTERPHONE was completed by 2004 so only about 10% of INTERPHONE subjects were long term users. Validation studies have shown significant uncertainty in recall of past phone usage and evidence of different participation rates among cases and controls.

While some national and regional analyses have been published, it is the full pooled data analysis will provide the most information.

INTERPHONE did not include children because there were few users when the study was established and the follow-up period was 5 to 10 years. Studies are currently underway that include children. Additionally, the long-term health of mobile phone users will be assessed in a multi-country study that plans to follow 250,000 mobile phone users for long periods of time.

Human Neurophysiology Study

Human volunteer studies can be used to test direct effects, such as whether mobile phones affect brain function, where if there is any impact the effect is expected to be temporary. Such studies are subject to strict ethics procedures.

The GSMA supported the ACRBR and Swinburne University of Technology (Melbourne, Australia) to investigate possible effects of mobile phone (GSM and 3G) signals on EEG (brain waves) or cognitive performance of groups of 13-15 year olds; 20-45 year olds and >55 year olds. The objective was to examine both whether there were any signal specific findings or any differences in response across the age groups. The testing is now complete and papers have been submitted that describe the findings.



5—Animal Studies

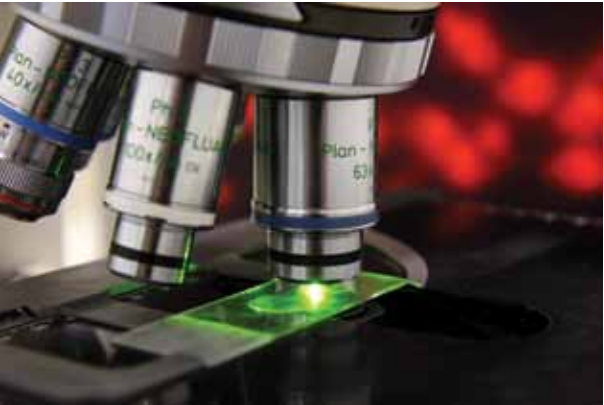
When public health agencies assess the safety of chemicals and other agents they often rely on the evidence of long-term animal studies. These standardised studies use large groups of animals and expose them to the substance of interest under controlled conditions for extended periods, which for rodents is up to two-years for their full life-span. Shorter duration studies may be used to look for effects on behaviour, physiology or reproduction. All animal studies are subject to the ethics procedures of the laboratories conducting the studies.

Cancer

The GSMA supported a program of animal studies to assess whether exposure to radio signals at a range of power levels could cause or increase cancer in animals. The projects also received funding from the European Commission, national authorities in Austria and Switzerland, the Mobile Manufacturers Forum (MMF) and Elettra2000 (Italy). The exposure systems were developed by Foundation for Research on Information Technologies in Society (IT²IS) (Switzerland) and the Aristotle University of Thessaloniki (Greece). The University of Helsinki coordinated the programme and provided a firewall between the sponsors and the researchers.

Studies in Austria and China tested whether radio signals could accelerate the growth of chemically induced tumours. An Italian study assessed whether exposure affected cancer in genetically modified mice.

Overall these studies found no consistent evidence that exposure had any adverse health effect or any influence on the incidence, severity or time of appearance of tumours.



STUDY TYPE	LONG-TERM BIOASSAY		CHEMICALLY INDUCED TUMOUR	GENETICALLY MODIFIED
Animals	1,170 B6C3F1 mice, male & female	1,170 Wistar rats, male & female	500 female Sprague-Dawley rats DMBA carcinogen	500 male & female Eμ-PIM 1 transgenic mice
Health Measures	Chronic toxicity indicators: morbidity, mortality, body weight, food consumption, cancer signs		Mammary tumour incidence	Lymphoma incidence
Radio Exposure	900 MHz GSM and 1800 MHz GSM 2hours/day, 5 day/week, up to 24 months		900 MHz GSM 4 hours/day, 5 days/week 6-12 months	900 MHz GSM 1 hours/day, 7 days/week Up to 24 months
Laboratory	Fraunhofer ITA (Germany)	RCC Ltd (Switzerland)	ARCS (Austria) Zhejiang U. (China)	RBM (Italy)

6—Non Cancer

In the 1980s and 1990s a series of US studies reported effects on rat behaviour and memory following exposure to a pulsed 2450 MHz signal similar to radar systems. The GSMA, the MMF provided funding through the University of Helsinki firewall and with national authorities for the National Radiological Protection Board (now Health Protection Agency – UK) and the University of Louis Pasteur (France) to investigate the reports. They were unable to confirm the original findings.

The Russian safety standards for radio signals are primarily based on studies conducted in Russia and Ukraine but not reported internationally. Papers published between 1975 and 1986 reported microwave effects on the immune system and offspring of rats.

The WHO encouraged a joint French-Russian attempt to replicate these findings and research teams from Russia (Institute of Biophysics in the State Research Centre, Moscow) and France (École Nationale Supérieure de Chimie et de Physique de Bordeaux) developed a common protocol. The project was supported by the CNRS (France), the French Health and Radiofrequency Foundation, the MMF and the GSMA. The study was monitored by an independent scientific oversight committee established by the WHO and the University of Helsinki provided the firewall.

The studies began in late 2005 in both Moscow and Bordeaux and the biological phase was completed in 2007, to be followed by analysis and peer-reviewed publication.

7—Confirmation Studies

Within the scientific process new findings are accepted when they have been confirmed by other independent researchers. These follow-up studies may be direct replications that closely follow the original study or confirmations that improve on the original study design to provide greater confidence in the findings.

The WHO identified some *in vitro* (cell studies) reporting genetic damage and changes in cell chemistry that required further investigation to support better health risk assessments. The GSMA and MMF set up a program (PERFORM-B) with collaborating pairs of laboratories from different institutions conducting follow-up studies in parallel to test the earlier reports. Exposure systems and engineering support was provided by IT’IS (Switzerland). Funding was received from the MMF, the GSMA, Elettra2000 and national authorities from France (CNRS), Italy (ENEA), the UK (NRPB now HPA) and Finland (TEKES).

Initially research groups at the NRPB (National Radiological Protection Board – UK) and the ENEA (Italian National Agency for New Technologies, Energy and the Environment) intended to investigate a 1997 Belgian study that reported increased genetic damage when mobile phone type signals were combined with a chemical (mitomycin C) known to cause genetic damage. Before the NRPB/ ENEA project commenced the original researchers reported that they could not reproduce their findings so the UK and Italian laboratories tested whether radio signals could increase damage caused by x-rays. They found no effects of radio signals alone or when combined with x-rays.

Another pair of laboratories the University of Bordeaux (France) and the University of Kuopio investigated a US report of a temporary increase in ornithine decarboxylase (ODC) levels in tumour cells following exposure to modulated radio signals ODC is indicator of cell proliferation. The research groups used a range of different radio signals and exposure levels but found no effects. They also identified possible flaws in the earlier studies, for example, the true exposure level in the original ODC experiments was higher than reported and there were substantial temperature rises that could explain the results.

8—Mobile in Society

These research projects are aimed at investigating how mobile communications provides health and safety benefits to young people, families and society.

Family Relationships

This project by the Trust for the Study of Adolescence (now Young People in Focus) in the UK examined how mobile phones (including texting) are used in communications between young people and their parents/ carers. A particular focus was on how mobiles are used by parents and young people in relation to safety. The project involved qualitative research with 60 families containing young people aged 11-16.

AGE	MUM/DAD/CARER	FRIENDS/BOYFRIENDS/GIRLFRIENDS	OTHER FAMILY	OTHERS	TOTAL CALLS/TEXTS
11, 12 years	6	6	0	0	12
13,14 years*	58	173**	2	2	235
15,16,17 years	12	96	3	0	111
Total calls/texts	76	275	5	2	358

Number of calls and texts made by young people in an average week.
*Two males in this group did not provide data. **Almost half this number was due to texting by one girl to friends. When excluded the group total was 89.

Overall, young people and parents were very positive about mobile phones, viewing them as a ‘lifeline’ and a key way of keeping young people safe. Most young people first get a mobile phone at the age of 11 or 12, because of their growing independence. Usage for calls or text is initially low and increases with age (14 and upwards). Parents and young people had similar concerns about mobile phones – theft and mugging, bullying, expense, and peer pressure to have the ‘right’ phone.

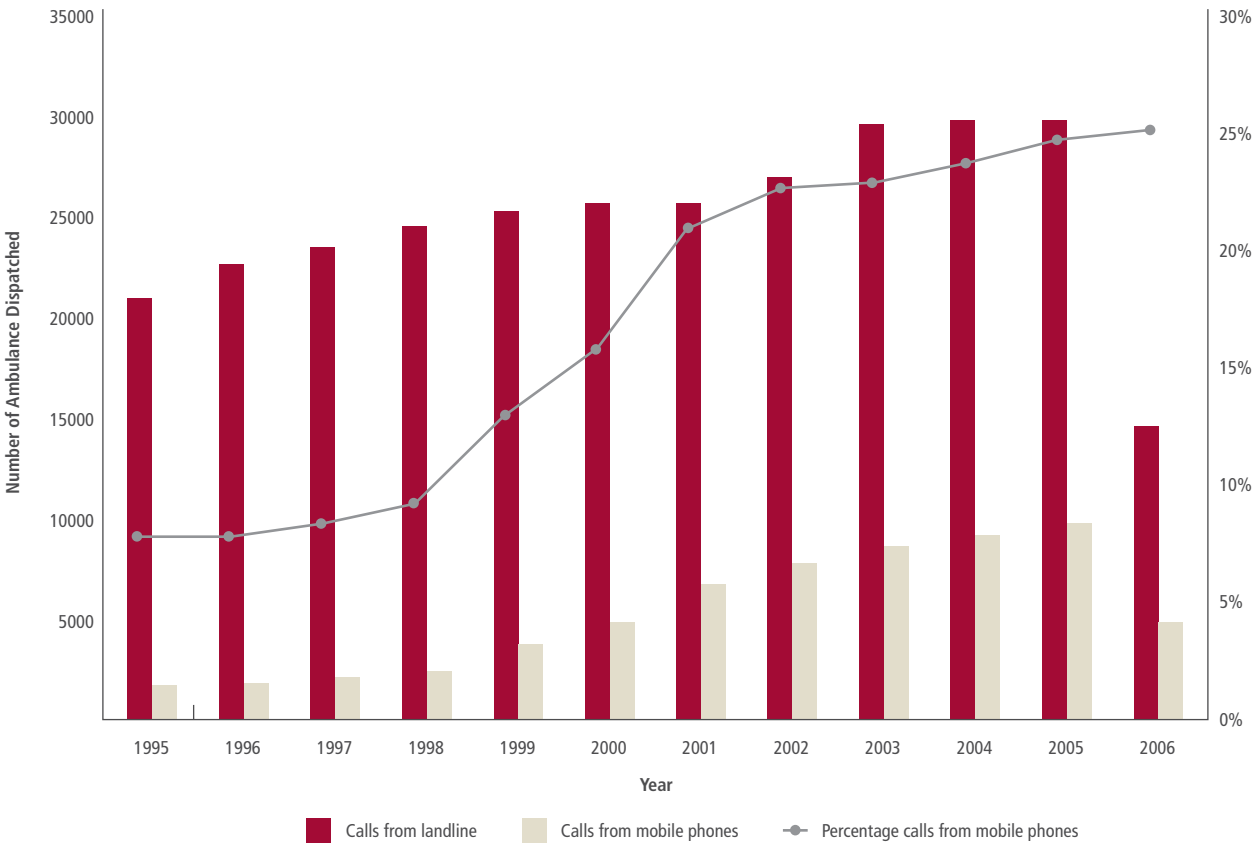
The Golden Hour

The GSMA asked the York Health Economics Consortium (YHEC) to identify literature on the use of mobile phones for calling ambulance services and on the ‘golden hour’, the critical period for medical care following an accident or emergency.

The review found that there is a need for a quick response to traumas but the response time ranges from 10-15 minutes for heart attacks to up to 8 hours for pneumonia. Mobile phones have been shown to be used to call ambulance services but there is no information as to the health benefits this provides. There is scope for mobile phone technology to be used by pre-hospital staff to reduce symptom-to-treatment times and research should focus on these areas.

Emergency Care and Health Outcomes

The GSMA, Telefónica O2, T-Mobile, Vodafone and the MMF are supporting a study based at the Kadoorie Centre for Critical Care Research and Education (UK) with researchers from the University of Glasgow and the University of Oxford to determine whether initial contact with emergency services via a mobile phone in life threatening situations is associated with increased survival or reduced length of hospital stay when compared to contact via a landline. A pilot phase in 2004-2005 showed that it was feasible to construct a linked database using data from the local ambulance service and major local hospitals. The data gathering and analysis phases are now complete a paper has been submitted for peer-review publication.



9—Risk Perception

Improving understanding of risk perception and the process of risk communication strengthens the ability of the mobile industry to respond to public concerns.

Public Perceptions in the UK

In 2004, the GSMA and MMF working with the UK Mobile Operators Association (MOA) commissioned Market and Opinion Research International (MORI) to analyse trends (1999 to 2003) in the British public’s awareness and perceptions of the alleged health risks and assess the effect of media coverage. The analysis found that fears about possible health-related dangers from mobile phone handsets or masts are a “top-of-the-mind” concern for only about 1 in 20 of the population. However, when prompted, between 1 in 4 and 1 in 5 of the public express themselves concerned. There was a consistent downward trend in the belief that handsets pose a risk, which probably reflects increasing familiarity with the devices but no corresponding falling-off in suspicion of masts.

Impact of Knowledge

The Institute for Environmental Decisions at the ETH Zurich (Switzerland) conducted a study led by Prof. Dr. Michael Siegrist that explored the impact on risk perception of two factors: first, the effect of information on how the location of mobile antenna sites affected the power transmitted by handsets; and second, the impact of voluntary precautionary recommendations for handsets. Four different information booklets were tested with a sample of Swiss citizens and the results have been submitted for publication.



International Study of Precautionary Measures

Dr. Peter M. Wiedemann from the Forschungszentrum Juelich (Germany) is coordinating an international study involving investigators from Australia, Brazil, Germany, India, Japan, Netherlands, South Africa, the United Kingdom and the USA that is testing whether providing information about precautionary measures affects perceived risk regarding mobile phones or base stations.

Previous studies in Germany, Switzerland and the UK have found that information on proposed precautionary measures was associated with increased public concern. The survey has been developed and data collection followed by analysis and publications are underway.

Cross-Cultural Assessment

Prof. Dr. Lynn Frewer from the Wageningen University (Netherlands) is conducting a study that will first analyse current knowledge regarding effective risk-benefit communication associated with technology and then develop a survey that will be applied in the Netherlands and Bangladesh. The results were published in 2010 and found perceived benefits of mobile phones in Bangladesh included the ability to receive emergency news about floods, cyclones, and other natural disasters. Regarding base stations, these were seen as a symbol of societal advance.

10—Technology

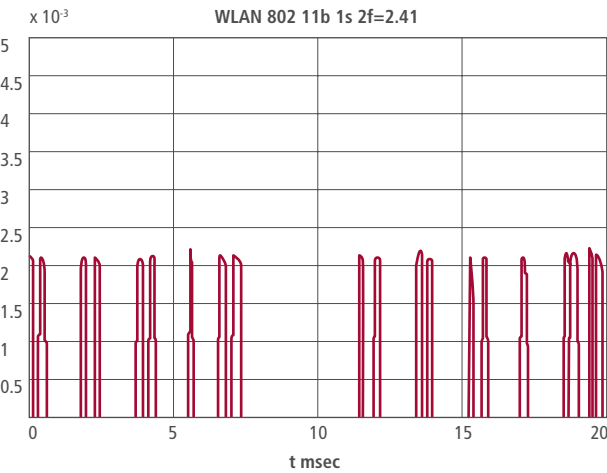
The GSM family of technologies includes GSM, GPRS, EDGE and 3G/WCDMA, HSPA and LTE. The GSMA research program covers assessment of exposure from new wireless technologies and whether they can cause interference to other electronic devices.

Assessment of Exposures

The GSMA commissioned Aalborg University (Denmark) to produce two reports on the evolution of mobile technologies. The 2001 report examined the frequencies, power levels and modulation of 3G/WCDMA signals and found that for most 3G users, handsets will operate well below their maximum level except near cell edges. The 2007 report updated and expanded the information to include GPRS, HSPA and WLAN. The HSPA simulations showed that the cell size was more important than the data rate for the device output power.

Wireless Networks

The GSMA and WiMAX Forum commissioned IBBT (Belgium) to conduct measurements in Belgium, the Netherlands and Sweden of environmental levels of radio signals from wireless networks (GSM, 3G/WCDMA, HSPA, LTE and WiMAX) and other services, such as broadcast radio and TV. Measurements were made at a representative sample of locations covering urban/rural/industrial and indoor/outdoor environments. Both short-term and 4-day measurements were made to examine how exposures change over time. Measurements were completed in early 2010 and publications are being prepared.



WLAN: Time variation of the power from uploading a file from laptop.

3G Phones and Mobile Data Services

Orange Labs (France) conducted a two-part study for the GSMA. First, they measured the power of a 3G mobile phone during real use conditions and also assessed the effect of factors such as different data services. They found that in typical use a 3G handset operated at about 1% of the maximum power. The second study assessed the exposure of adults and children during voice calls, texting and sending an MMS. They found that relative to when the phone was against the head, the exposure in a viewing position (at 10 cm) is about 10 times lower and when texting (at 40 cm) about 100 times lower.

Consumer and Medical Electronics

Telstra Research Laboratories (Australia) investigated the compatibility of mobile communication signals with a sample of consumer electronics and common medical devices. For many devices there was little chance of interference when the mobile phone was separated by greater than a couple of metres. As 3G phones generally use lower power they were less likely to cause interference. In the case of medical devices, interference was unlikely at separations of more than 1 to 2 metres.

Hearing Aids

The GSMA is supporting work by the House Ear Institute (USA) on compatibility of a range of wireless technologies with hearing aids. Current requirements in some hearing aid compatibility standards are based on a limited pool of data that may be unrepresentative of the full range of hearing aid users. The work by House Ear Institute aims to obtain more robust measures of audio signal-to-interference ratios that affect usability from a representative sample of hearing aid users. The results will contribute to the on-going development of hearing aid compatibility standards in the US and internationally.

11—Standards

Mobile network antennas and devices are subject to compliance standards to ensure that they satisfy the relevant safety recommendations. It is important that compliance standards maintain pace with technology evolution.

Devices Used Close to the Body

This is a two phase study by ARC Seibersdorf research GmbH (now Austrian Institute of Technology – AIT) and the University of South Carolina (USA) investigating the relationship between radio characteristics of wireless devices and the basic restrictions of the safety recommendations. The first phase examined antennas up to 20 mm from the body and the second phase will assess antennas at separations of 25 to 200 mm. It is expected that the results will provide a scientific rationale for determining compliance of certain low power devices without the need for full SAR (specific absorption rate) measurements.

Modelling Antenna Exposures

The Tbilisi State University (Georgia) used computational techniques to study exposures from nearby base station antennas. They reported that the level of the radio signals inside a room can vary by almost 90% due to reflections and that outside, obstructions such as hills and walls scatter the radio signals leading to complex exposure situations.

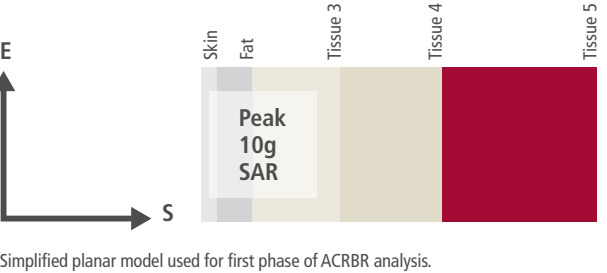


Measuring Mobile Networks

This study was linked to the EUREKA project BASEXPO and had the aim of developing scientifically sound procedures to assess exposure near to mobile communication base stations. The study was coordinated by AIT and included institutions from Sweden, Greece, France, Belgium, and Switzerland. It was found that exposures from base stations in public areas are typically very low, however, real environments can be complex. It also showed that there is a need to adequately account for the range in heights of people to ensure that compliance levels are adequately conservative.

Exposure Metrics 1-10 GHz

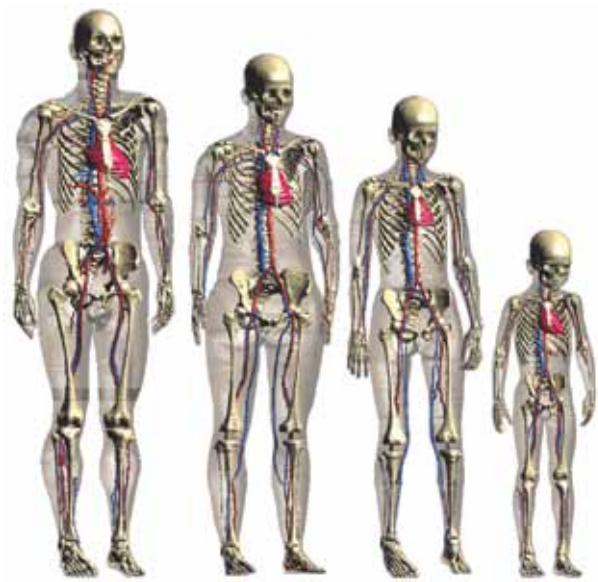
The Australian Centre for Radiofrequency Bioeffects Research (ACRBR) investigated whether the localised energy absorption or the incident power flux density was a better RF safety exposure metric in the frequency range of 1-10 GHz based on limiting the maximum tissue temperature rise. They concluded that SAR was more directly correlated to temperature up to 6 GHz and power density was better above this frequency.



Simplified planar model used for first phase of ACRBR analysis.

Virtual Family Models

The basis for both safety standards and biological experiments is accurate knowledge of radiofrequency exposures. The Foundation for Research on Information Technologies in Society (IT’IS – Switzerland) and the Food and Drug Administration Center for Devices and Radiological Health (USA) were tasked with developing four high-resolution anatomical models. These were derived from magnetic resonance imaging scans of a 26-year-old female adult, a 34-year-old male adult, 11-year-old female child and a 6-year-old male child. The models are available to the scientific community for research purposes.



Virtual family whole body models.

Advanced Base Station Antennas

One of the approaches to achieving higher data rates from wireless communication technologies is the use of MIMO (multiple input, multiple output) antenna technologies, where multiple antennas are used at both the source (transmitter) and the destination (receiver). Swinburne University of Technology (Australia) is studying how these more complex antenna configurations can be assessed for compliance with safety recommendations.

Thermal Effects Literature

The only established health effects from radiofrequency exposures are related to temperature rises in exposed biological tissues. Researchers at Duke University Medical Center and Temple University Medical School (both USA) have been commissioned to review the scientific literature on thresholds for thermal injury to a range of tissues. This will contribute to greater understanding of the safety margins in existing radiofrequency exposure standards and their future development.

Thermal Parameters Database

The Swinburne University of Technology (Australia) is compiling a database of thermal parameters for a range of biological tissues. This will be used to analyse the effect of varying each parameter on RF exposure-related temperature rise in the frequency range 1 to 10 GHz. They will also examine the effect of the shape of the averaging volume on the calculated temperature rise.

International Compliance Standard for Base Stations

An international consortium involving the IT’IS Foundation (Switzerland), Ghent University (Belgium), Helsinki University of Technology (Finland), Orange Labs. (France), Hokkaido University (Japan), EM Software & Systems (South Africa), ARC (Austria) and the FDA (USA) conducted large-scale numerical evaluations of human body models exposed to radio signals from mobile communication base station antennas. These assessed the variability and uncertainties associated with differences in human anatomy and posture. This will assist the development of a harmonised international standard for compliance assessment of mobile communications base stations.

Temperature Based Assessment

The University of South Carolina (USA) and Tbilisi State University (Georgia) are working to develop a scientifically robust assessment for low power wireless transmitters based on temperature rise in nearby tissue. The study will aim to relate the basic characteristics of a wireless device (frequency, bandwidth, antenna gain and separation distance) to the maximum temperature rise. When complete, this project will provide a basis to develop practical rules for testing of low-power RF devices.

Resources

EMF-Portal
www.emf-portal.de
World Health Organization International EMF Project
www.who.int/emf

Abbreviations

3G/WCDMA = Third Generation/Wideband Code Division Multiple Access
ACRBR = Australian Centre for Radiofrequency Bio-effects Research
AIT = Austrian Institute of Technology
CNRS = National Center for Scientific Research (France)
EEG = Electroencephalogram: graphical record of brain electrical activity
EDGE = Enhanced Data rates for GSM Evolution
EMF = Electromagnetic Field
ENEA = National Agency for New Technologies, Energy and the Environment (Italy)
FDA = Food and Drug Administration (USA)
GPRS = General Packet Radio Service
GSM = Global System for Mobile communications
HPA = Health Protection Agency (UK)
HSPA = High Speed Packet Access
IARC = International Agency for Research on Cancer
IBBT = Interdisciplinary Institute for Broadband Technology (Belgium)
IT’IS = Information Technologies in Society (Switzerland)
LTE = Long Term Evolution
MIMO = Multiple Input, Multiple Output
MMF = Mobile Manufacturers Forum
MOA = Mobile Operators Association
MORI = Market & Opinion Research International (UK)
NRPB = National Radiological Protection Board (UK)
ODC = Ornithine Decarboxylase: a marker of increased cell proliferation
UICC = International Union Against Cancer
RF = Radiofrequency
SAR = Specific Absorption Rate
TEKES = Agency for Technology and Innovation (Finland)
WHO = World Health Organization
WLAN = Wireless Local Area Network
YHEC = York Health Economics Consortium (UK)

More details are available on technology and science terms:

<http://www.gsmworld.com/technology>
<http://www.gsmworld.com/health>



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