# A **Systematic Review Of EHS Related Studies**

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**Introduction:**

The future currently looks bleak for those who are sensitive to digital communications technology especially as manmade pulsed radiofrequencies are ubiquitous and emission levels are continually increasing in our environment. Scientists at the recent ICNIRP and ACEBR workshops held on November 11th 2014 in Wollongong, Australia, are suggesting EHS is a psychosomatic condition based on faulty science and biased opinions. The scientists in question, do not have any substantial accreditations in any medical or biological based sciences and so their claims need to be viewed as their personal opinions only. One scientist in particular, professor Michael Repacholi, suggested that people who claim to be EHS should not try to avoid EMR exposure but instead seek psychological help.

The very same scientists are also trying to support their arguments that it is psychosomatic in nature by claiming this condition is likely to have developed because of fear or concern of the technology or because they have read or seen something suggesting potential risks in a news report. This is of course disingenuous to those who were blissfully unaware of the potential dangers, were early adopters of technology and willingly purchased wireless products for their perceived benefits only to discover that their physiology appears to be incompatible.

There are claims that that there are no studies showing people can accurately perceive whether a device is on or not. This is not fully correct as there are a number of studies that have shown there are some people who have correlated EMR exposure to their symptoms with a high level of accuracy. **Nieto-Hernandez R** *et al*, (November 2008) **Rea W.** *et al,* (1991)

For some people, EHS is potentially disabling and so the non-consensual deployment of smart meters, smart grids, mobile phone base stations, Bluetooth in cars, WiFi in work and public places is introducing a multitude of issues that relate to health, accessibility and discrimination.

“*The first American to publish on the microwave hearing effect was Allan H. Frey, in 1961. In his experiments, the subjects were discovered to be able to hear appropriately pulsed microwave radiation, from a distance of 100 meters from the transmitter. This was accompanied by side effects such as dizziness, headaches, and a pins and needles sensation*.” Source: Wikipedia 31/10/2014

There are studies and reports before and after Allan Frey’s study that provide reasonably consistent “non-specific” symptoms as a result of exposure to affected individuals from a variety of microwave technologies. Headaches, dizziness, pins and needles and other sensations e.g. dysesthesia/paresthesia are the more commonly claimed effects.



We are observing a steady increase in the number of people claiming to be EHS1 and appears to correlate with the deployment of wireless infrastructure into our environment. The symptoms, although not necessarily identical between affected individuals, do fit within a common pool that is well documented and has been known for more than 60 years. Terms such Radar man’s disease, Radiowave sickness, Radiofrequency sickness, Microwave sickness, EHS are labels that have been applied to those who have idiopathic environmental intolerance in the past/present and relate to the technologies that are associated with this health impairment. The common element in all of these technologies is electromagnetic radiation (EMR) but it is not limited to radiofrequencies (RF). Extremely low frequency (ELF) power line frequencies have also been implicated by some studies as being a possible causative agent for some EHS sufferers.

General practitioners and government health department representatives do not have a clear understanding of EHS, its causes or its symptoms. They lack the tools and the methodology to diagnose and treat sufferers effectively. The chance for misdiagnosis and prescription of ineffective and inappropriate medications is high. Many of the aforementioned parties rely on advice from the World Health Organisation (WHO). The WHO definition of EHS could be seen as confusing because they recognise the EHS nonspecific symptomology and that it is potentially disabling but then claim it is not a medical diagnosis, indicate that there is no convincing evidence that links the condition to EMR and offers no advice on how to deal with it sensibly. This incomplete advice unfortunately leaves those who suffer in limbo without any formal recognitions or support (with the exception of Sweden where it is recognised formally as a health impairment).

To obtain a better understanding of the state of science on this contentious issue and to determine whether researchers have a good understanding of EHS to develop sensible and realistic testing protocols a review was performed of 84 Electromagnetic Hypersensitivity related studies which have been categorised as follows:

* 21 Neutral Studies with neither a negative or positive findings
* 25 Negative studies
* 38 Positive studies

Appendix A contains a list of studies covered in this review and includes some details of the study (taken from abstract) and is supplemented with additional review comments.

Appendix B contains a list of nonspecific symptoms that have been associated with EHS.

**Findings:**

84 Studies were reviewed which resulted in the following high level findings:

* 41 studies were survey or review type studies with no actual biological or provocation test data
* 42 studies included biological and/or provocation tests
* 1 positive study was not classified as the abstract contained no information to determine how the study was conducted.
* 14 of the 21 neutral studies were survey or review type studies. No biological or provocation tests were conducted.
* 11 of the 25 negative studies were survey or review type studies. No biological or provocation tests were conducted.
* 16 of the 34 positive studies were survey or review type studies. No biological or provocation tests were conducted.
* 18 Biological and/or provocation studies showed a correlation between EMR and EHS symptoms.
* 21 Biological and/or provocation studies showed no link (14) or were inconclusive (7).

One study found that population health generally improved during the early 1990s but suddenly started to deteriorate from 1997 onwards. This quite dramatic change is not likely to be explained only by improved diagnostics but physical causes need further investigation. A connection with the increasing exposure of the population to GHz radiation from mobile phones, base stations and other communication technologies were suggested as a possibility (i.e. cannot be ruled out). **Hallberg O, Johansson O**, (March 2009)

Many of the studies reviewed neither validates EHS is related to EMF or disputes this. Some studies suggests that there are psychological issues but do not determine whether this developed after a person became EHS or is the cause of EHS. Many of the negative studies are poorly executed and hint at psychological reasons without providing any compelling evidence to support their claim. Cognitive behavioural therapy (CBT) is put forward as a potential solution but not all researchers agree. “*Even comparing those patients who did reconsider their attributions against those who did not failed to identify any significant differences in symptom severity or perceived sensitivity. A similar phenomenon has been observed before in trials of CBT for patients suffering from chronic fatigue syndrome*.” **Rosa Nieto-Hernandez** *et al.* (2008)

One needs to take care when interpreting the above information as not all tests are equal and several studies in all categories (positive, negative and neutral) have fundamental issues that are based on a flawed understanding of EHS characteristics.

Some of these issues are further described below under the headings:

* Psychological aspects and EHS – the cause or the outcome
* Testing Protocol Deficiencies

**Psychological aspects and EHS – the cause or the outcome?**

It would appear that a psychological causation is being suggested by a number of researchers to deal with symptoms that cannot be fully explained by current knowledge and understanding. Unfortunately some of the researchers making these claims are psychologists who do not necessarily have the appropriate qualifications to be making any judgements relating to health issues or biological effects.

A potential question that might not be asked in many of these survey studies is whether the subjects were anxious or worried about the technology prior to using it or whether they developed concerns after they experienced the symptoms the first time. It is important to identify the source of concern and when the concern developed. Questions and studies that need to be investigated by scientists is whether concerns over completely unrelated factors in non EHS lead to the development of similar nonspecific symptoms. One could expect if EHS is purely psychological (i.e. fear of EMF or wireless technology) that we would see similar symptoms with other phobias and anxiety based disorders which is not the case.

It is unfortunate that some international organisations tasked with providing health advice try to take this concern as being a possible contributing factor to EHS symptoms. Many EHS sufferers that I have surveyed, concern only came after the symptoms developed and not before. Perhaps future surveys should consider this and try to develop a question or two to investigate this further.

Common measures taken by EHS sufferers is to avoid exposure if possible and so this essentially means sufferers often become prisoners in their own home. It is however impractical to avoid public places or have neighbours turn off wireless devices so this usually results in additional suffering because there are very few areas in society which are free from manmade RF. When one experiences EHS symptoms over and over again and if the subject is able to associate the symptoms with exposure then psychological consequences will undoubtable develop especially if one has no control over one’s environment and exposure is only getting worse. For many sufferers it is a form of torture and even the most stoic person is going to find it difficult to bare these unprecedented and continuous assaults on their health.

Functional neurologic or psycho-pathologic clinical symptoms such as cognitive impairment, depression, emotivism are prominent in those who are EHS and are often misleading physicians and scientists towards a psychiatric causation. There is a growing number of psychiatrists who acknowledge that many EHS patients have been mis-referred for psychiatric treatment through mistakes and/ or ignorance and in reality the effected individuals are actually not suffering from a psychiatric disorder.

It is important to note that a number of studies suggest that the prevalence of health complaints for sensitive people cannot be fully explained by attributions, concerns or risk perceptions. **Blettner M** *et al*, (November 2008) and **Levallois P** *et al*, (August 2002)

**Testing Protocol Deficiencies**

It would appear many researchers are looking at EHS from the wrong perspective.

A large number of provocation test studies look to see if the test subject can accurately perceive RF emissions and if they don’t, assume that the subjective symptoms claimed are not linked to the signal. Signal perception is irrelevant when comes to trying to determine whether EMR is causing symptoms leading to health impairment. The focus should not be based on perceptions but rather whether the signal induces the symptoms which can occur almost immediately, hours or a day later. The recovery period needs to be considered, can be of varying durations and should be recorded. A test subjects reactions will also depend on signal strength, frequency emitted, modulation pattern and whether the signal is carrying data or not.

Many survey based studies are not designed to establish a causal association between exposure to EMF and symptoms of ill health. They simply categorise the main symptoms and show their prevalence as a %. Although this information is important to help build a more detailed understanding of the symptoms claimed for future studies it does not help those who are suffering in order to receive recognition and support. It is however important to understand that there are a lot of similarities between these survey studies when looking at each symptom occurrence and ranking.

Sleep disorders (43%) and headaches (34%) **Schreier N** *et al*, (2006)

Sleep disorders (58%), headaches (41%), nervousness or distress (19%), fatigue (18%), and concentration difficulties (16%) **Roosli M** *et al*, (February 2004)

Sleep disturbance (23.5%), headache (23.5%), memory changes (28.2%), dizziness (18.8%), tremors (9.4%) and depressive symptoms (21.7%) **Abdel-Rassoul G** *et al*, (March 2007)

70% complained of headache and 20% of dizziness. **Szyjkowska A** *et al*, (October 2005)

Each of us are biochemically and genetically unique so scientists should not have an expectation of consistency with regarding symptom occurrence across the test subjects. It is also important to understand that for some people symptoms and sensitivity changes over time with exposure levels and current state of health.

The probability of adverse effects in relation to EMF exposure depends on the individual constitution, pre-existing disease, duration of exposures, type of electromagnetic radiation (continuous wave and/or modulated) exposures, how sensitized the individual is by prior exposures and intensity among others.

In one study it was found that 32% of EHS cases there was a plausible relationship between EMF exposure and reported symptoms (**Huss** *et al*., 2005). This means that 68% of those who claim to be electromagnetic hypersensitive could, in fact, suffer from other conditions or even have a psychological condition that is responsible for their symptoms. With this in mind, it is should not come as a surprise why some provocation studies with self-reported electromagnetic hypersensitive individuals could not find any association between symptoms and exposure. What is needed is a method to measure “genuine” EHS in order to differentiate this kind of hypersensitivity from other kinds of conditions” **A. Tuengler et al. 2013**

It is also important that genuine EHS sufferers are identified and tested separately to ensure that test results are not contaminated and watered down by those who claim to be EHS but are determined not to be.

Many of the test protocols do not give clear indications of what confounders have been considered. We have no idea whether the sensitive subjects are effected already by other sources prior to the test which can include:

1. Travelling from home to the research facility, test subject may be exposed to a variety of RF sources that they may be sensitive to along the way
2. Research facilities are not always shielded and so the test environment could be contaminated by other external EMR sources
3. Lighting, wiring, power points and even the test device may be emitting EMF (even in sham mode – if it is powered on but not transmitting RF)
4. Delayed onset or recovery from symptoms from a previous test

Looking to see if EHS people can perceive signals demonstrates that scientists are looking at EHS from the wrong perspective. It should not be about whether we can detect a signal but rather do we experience biological effects immediately, hours or a day later. What are those effects being claimed and how consistent are they being claimed? How are confounders being handled such as exposure to external environment EMF/RF triggers? Are they kept in rooms with shielding throughout the whole test period? How long is the testing period and is adequate recovery time being provided before the next test irrespective of whether it is the sham signal or not? What signals are being used and do people claim to be sensitive to them? Do the signals simulate data transmission or simply the carrier wave or beacon signal? What psychological assessments have been performed to back claims that EHS is psychosomatic?

Many negative studies try to associate risk perception (worry and concern) to symptom development (nocebo affect) but a number of studies have shown that being concerned was not sufficient to explain the characteristics of people reporting this disorder. **Levallois P** *et al*, (August 2002) and **Bortkiewicz A** *et al*, (2004)

Many associated syndromes (to EHS) such as Gulf War Syndrome and MCS may relate to damage to the central nervous system, either caused directly by an agent (neuro toxin, EMF or chemical) and/or possibly an auto immune reaction/inflammation triggered by exposure to an agent. Unless researchers can actually look at the state of the CNS and brain it is going to be difficult to make any claims.

**Cellular stress response – a critical component that is not considered in many study designs**

Cells attempt to adapt to alterations in their intra- and extracellular environment via organised alterations to gene and protein expression. Whether cells mount a protective or destructive stress response depends to a large extent on the nature and duration of the stress as well as the cell type. A large number of studies have suggested that radiofrequencies cause oxidative stress which can drive the aforementioned changes and so can have potentially detrimental effects to human health including cancer.

Cell survival requires appropriate proportions of molecular oxygen and various antioxidants. Reactive products of oxygen (ROS) are recognised as one of the most potent threats faced by cells. ROS can cause damage to all of the major classes of biological macromolecules, including nucleic acids, proteins, carbohydrates, and lipids. In extreme cases when the cell’s antioxidant defences are overwhelmed, ROS can induce cell death.

There are many defences at the cells disposal to deal with cellular stress but when subject to stress or stresses that are too strong and too persistent, they can lead to disease.3

Responses to cellular stress ramp up with exposure and can take many hours to return to normal. Depending on the severity and duration of stress encountered, cells either re-establish

cellular homeostasis to the former state or adopt an altered state in the new environment.

Stressors can trigger two types of cellular responses, from within cells and by the immune system. 5

It is quite clear when reviewing the EHS studies below that most researchers have not considered how cells deal with stress and factored this in when developing test protocols. This oversight can lead to researchers designing flawed protocols and coming to incorrect conclusions on the nature of EHS and its cause.

More specific details of deficiencies can be found against identified studies as comments in Appendix A.

**Disconnect between the medical profession and international scientific bodies**

In one study, general practioners (GPs) judged the association between EMF and the symptoms to be plausible in 54% of the cases. GPs often judged the association between the health problems and the suspected exposure to be plausible which is in conflict with mainstream science and health organisations opinions. “*An overwhelming percentage of general practitioners (up to 96%) to some degree, or totally, believe in a health-relevant role of environmental electromagnetic*” **Huss A, Roosli M**, (October 2006). This could be used as evidence to suggest that perhaps scientists who do not have a background in appropriate medical sciences are the ones who are making these international scientific consensus conclusions or worse, they are simply ignoring medical evidence. The latter behaviour is evident when raising EMF health issues to Government authorities and International health organisations.

Dr. Dominique Belpomme, A professor of oncology at Paris-Descartes University who is also President of the French Association for Research in Therapeutics Against Cancer has developed a diagnostic method based on blood tests and a special brain scan (pulsed Doppler echography) to visualize blood flow. “These patients clearly have vascular disorders in the brain, said the oncologist. In addition, our biological tests show that 30% of them have high levels of histamine, 50% have too much stress proteins, most have low levels of melatonin (an potent anti-cancer hormone), and 30% have levels of antibodies and proteins that are tell-tale signs of thermal shock and brain damage.” This would clearly suggest that for some EHS sufferers a psychosomatic claim is invalid.

**Conclusion**

EHS recognition is dismally poor in most countries around the world and sadly for those who are impacted, support is also almost totally absent. No options are provided to allow people to live in an area free from manmade radio waves. WHO recognises the non-specific symptoms but not the cause and as a result EHS sufferers are left in limbo and are at risk of being incarcerated unnecessarily in psychiatric facilities because some scientists believe EHS is psychosomatic in origin.

There is uncertainty about the trigger event(s) and the underlying biological mechanisms that lead to symptoms. This uncertainty has hampered the development of a clinical basis for the diagnosis and treatment of those who are EHS. This is further challenged by significant gaps in understanding within both the scientific and medical communities of EHS and the causes.

Telecommunications is a multi-trillion dollar global industry. Vested interests and conflicts of interests abound. One only needs to read the following statements in the US Defense Intelligence Agency (DIA) study performed in 1976 to understand why there is reluctance to admit that RF is possibly harmful.

“*A strict enforcement of stringent exposure standards (safety regulations), there could be unfavourable effects on industrial output and military functions*.” and “*Recognition of the standard (stringent safety regulations) could also limit the application of new electronic technology by making the commercial exploitation of some products unattractive because of increased costs imposed by the need for additional safeguards*.” 2

It is quite tragic that in today’s world when people are suffering from what is clearly a manmade environmental issue they are expected to continue to be exposed and seek psychiatric support. Suggestions are made by those in the psychiatric profession to use cognitive behavioural therapies to try to help sufferers deal with the problem rather than eliminating the source of the issue. It is often typical of medical sciences today to look for solutions that treat the symptoms and not necessarily the cause.

It is clear scientific uncertainty needs to be addressed as a priority and transparently. To do this we need a dramatic change in the way tests are conducted to focus on health effects rather than signal perception. We need more independently conducted studies to be performed by researchers from a medical and/or biological sciences background rather than psychology, physics or electrical engineering. Better still, studies should be conducted with representatives of all the aforementioned disciplines.

Even though several EHS symptoms cannot be directly implicated as being a health problem (i.e. prickling feelings) “*Annoyance or discomfort may not be pathological per se but, if substantiated, can affect the physical and mental well being of a person and the resultant effect should be considered as a potential health hazard”* **ICNIRP Statement 2002**

Researchers need to recognise that people have different sensitivity to environmental and emotional stress. Some people are empathetic while others are not. Both physiological and psychological parameters may play an important role in determining how people react to their environment and changing health. Of course current state of health, genetic variability and EMR exposure levels a person has been subject to (damage maybe accumulative) all have an important role to play and need to be considered in any future studies.

Finally, it is important to understand that science based evidence is obviously limited to the current understandings held by scientists and the capability of our tools to measure and detect physiological changes. Science based evidence should not be the sole mechanism to validate EHS, it also needs to take into consideration medical evidence which suggests

1. EHS sufferers who remove or minimise their exposure to certain triggering EMF fields/devices see a cessation of their symptoms
2. Military personal who are exposed more to a variety of EMF’s show a higher instance of non-specific subjective symptoms associated with EHS than the less exposed public.2

# APPENDIX A Studies Reviewed

**Neutral Studies**

1. **- Baliatsas C** *et al*, (August 2012) *Idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF): A systematic review of identifying criteria*, BMC Public Health. 2012 Aug 11;12(1):643. [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/22883305)]

Comment: This study simply evaluated and summarized the criteria that previous studies employed to identify IEI-EMF (EHS) participants. It provides no useful information about the validity of EHS itself or its causes.

1. - **Genuis SJ, Lipp CT**, (December 2011) *Electromagnetic hypersensitivity: Fact or fiction?*, Sci Total Environ. 2011 Dec 5. [Epub ahead of print [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/22153604)]

Comment: Reviews sparse literature and provides suggestions to assist health professionals in caring for those who claim to be EHS. No tests performed to verify and validate the EHS condition or the cause.

1. - **Johansson A** *et al*, (January 2010) *Symptoms, personality traits, and stress in people with mobile phone-related symptoms and electromagnetic hypersensitivity*, J Psychosom Res. 2010 Jan;68(1):37-45 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/20004299)]

Comment: A survey based study that assessed prevalence of EMF-related and EMF-nonrelated symptoms to specific EMF sources or to electrical equipment in general (perceived electromagnetic hypersensitivity, EHS). Forty-five participants with MP (mobile phone) - related symptoms and 71 with EHS were compared with a population-based sample (n=106) and a control group (n=63) using self-report questionnaires. The study findings support the idea of a difference between people with symptoms related to specific EMF sources and people with general EHS with respect to symptoms and anxiety, depression, somatization, exhaustion, and stress (strong psychological focus). The results indicate the MP group showed increased levels of exhaustion and depression but not of anxiety, somatization, and stress; the EHS group showed increased levels for all of the conditions except for stress.

Researchers need to understand that some of the symptoms such as depression and anxiety to some degree could be the result of prolonged suffering as well as conditioning without any adequate support or protection. When one experiences EHS symptoms over and over again and if the subject is able to associate the symptoms with exposure then psychological consequences will undoubtable develop. This is especially true if one has no control over ones environment and exposure is getting worse as triggering emitters are being deployed everywhere without consent. For some affected people it is a form of daily torture.

Future studies need to try and distinguish whether the psychological aspects developed as a result of being EHS rather than being the cause.

This study neither validates EHS is related to EMF or disputes this. It suggests that there are psychological issues but does not determine whether this developed after a person became EHS or the cause of EHS.

1. - **Dahmen N** *et al*, (March 2009) *Blood laboratory findings in patients suffering from self-perceived electromagnetic hypersensitivity (EHS)*, Bioelectromagnetics. 2009 Mar 3;30(4):299-306. [Epub ahead of print]Click here to read [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/19259984)]

Comment: A biological test but no provocation. The study tried to see whether there are biological differences between EHS and normals. The study was trying to determine whether somantic health issues were a contributor. The results identified laboratory signs of thyroid dysfunction, liver dysfunction and chronic inflammatory processes in small but remarkable fractions of EHS sufferers as potential sources of symptoms that merit further investigation in future studies. One needs to be careful when interpreting biological test results. Some blood tests can show an abnormality but there may be multiple causes. An example from my own situation was an elevated t.bili (bilirubin) test that can imply a liver problem but was in fact caused by a deficiency of essential minerals and vitamins.

This study did not validate whether EMR is linked to EHS but it did find biological differences between controls and some EHS subjects.

Many studies including this one, as well as statements from the WHO, talk about Electrohypersensitive (EHS) persons attributing a variety of “rather unspecific” or “non-specific” symptoms to exposure to electromagnetic fields. This is not a fully accurate assessment. Symptoms typically do not vary all that much in an affected individual although may vary between sensitive individuals. Symptoms that an individual may experience are usually a small subset of a larger but well defined set of possible symptoms that are not exhaustive. Yes, there are problems of symptom overlap with other unrelated health problems making diagnosis more complicated but not impossible. The same problems may occur in other health problems such as trying to work out whether an infection is viral or bacterial without performing biological tests. Not everyone who has a bacterial infection suffers the same symptoms and depends on immune system, location of infection, current state of health etc.. This where a doctor’s experience can help distinguish what the cause is.

My own blood tests have shown that I have some essential mineral deficiencies and that I was suffering Pyroluria (<http://naturalinsight.hubpages.com/hub/Pyroluria-A-Hidden-Disorder>), which has been attributed to oxidative stress as one of several potential causes. Pyoluria has a significant list of possible symptoms yet I can only associate a small fraction of them to how I feel. Taking Pyrrole primer tables has helped me recover quicker from exposures but not eliminated them entirely. Vitamin D deficiency is another issue that I am working to resolve to see if this will also improve my situation. I still get mild dysaesthesiae (definition - a disagreeable, atypical sensation that can be spontaneous or induced ) after exposure. Antihistamines help manage this but I am reluctant to take pharmaceuticals over a long term for a symptom that also goes away if I avoid electrical equipment and digital RF transmitters.

In regards to somantic health issues refer to study 7. below for additional comments.

1. - **Hallberg O, Johansson O**, (March 2009) *Apparent decreases in Swedish public health indicators after 1997-Are they due to improved diagnostics or to environmental factors?*, Pathophysiology. 2009 Jun;16(1):43-6. Epub 2009 Feb [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/19211231)]

Comment: The study does not look at EHS specifically but health indicators of the population. The study found that population health generally improved during the early 1990s but suddenly started to deteriorate from 1997 onwards. This quite dramatic change is not likely to be explained only by improved diagnostics but physical causes need immediately to be searched for. A connection with the increasing exposure of the population to GHz radiation from mobile phones, base stations and other communication technologies were suggested as a possibility (i.e. cannot be ruled out).

1. - **Nieto-Hernandez R** *et al*, (November 2008) *Can evidence change belief? Reported mobile phone sensitivity following individual feedback of an inability to discriminate active from sham signals*, J Psychosom Res. 2008 Nov;65(5):453-60 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18940376)]

A provocation study to see if the symptoms severity changed. The study suggests that it did find people who could accurately determine a mobile phone was active or not (test was double blind). Apparently 31 were correct and 27 were incorrect. Although the study found people who could accurately determine whether a phone was on, it did not prove that the symptoms were caused by the phone and only looked for changes in severity, not the cause. No changes in severity were observed.

1. - **Landgrebe M** *et al*, (July 2008) *Neuronal correlates of symptom formation in functional somatic syndromes: a fMRI study*, Neuroimage. 2008 Jul 15;41(4):1336-44 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18499479)]

Comment: A sham provocation test using an fMRI to verify brain activity and blood flow to see if EHS is a functional somatic syndrome that is influenced by psychological factors. As a side note, but related, a separate scientific journal described somantic health syndrome as being “*characterized more by symptoms, suffering, and disability than by consistently demonstrable tissue abnormality.* *Although discrete pathophysiologic causes may ultimately be found in some patients with functional somatic syndromes* [like EHS]*, the suffering of these patients is exacerbated by a self-perpetuating, self-validating cycle in which common, endemic, somatic symptoms are incorrectly attributed to serious abnormality, reinforcing the patient's belief that he or she has a serious disease. Four psychosocial factors propel this cycle of symptom amplification: the belief that one has a serious disease; the expectation that one's condition is likely to worsen; the “sick role,” including the effects of litigation and compensation; and the alarming portrayal of the condition as catastrophic and disabling*. <http://annals.org/article.aspx?articleid=712735>”

The suggestion that symptoms may be ongoing and perhaps made worse by personal beliefs is not disputable in some cases, however it is not necessarily correct to pin the original event to a psychological episode nor ongoing events purely to psychological or nocebo effects especially for those who are truly experience symptoms as result of exposure to an irritant (i.e. EHS) and when the sufferers are intermittently being exposed to the irritant on a daily basis. One also needs to question whether the researchers are actually taking appropriate diagnostic tests to validate their claim. Obviously psychiatric support should help resolve these problems but often they don’t. It would appear that a psychological causation is used to deal with symptoms that cannot be explained by current knowledge and understanding. Many of the listed associated syndromes in the study linked in the comment above such as Gulf War Syndrome, EHS and MCS may relate to damage to the central nervous system, either caused directly by an agent (neuro toxin, EMF or chemical) and/or possibly an auto immune reaction triggered by exposure to the causative agent. Unless researchers can actually look at the state of the CNS and brain (autopsy) then one cannot be certain and an MRI may not be capable of giving this level of detail and certainty. It should be noted that an MRI generates large EM fields and RF so the test cannot be really considered to be a sham event for EHS sufferers if the MRI is used during the sham test. The test does not determine whether the psychological factors have developed because of the EHS symptoms or it is the cause. One also needs to account for learned behaviour which is psychological and the result of dealing with past exposure and pain and can impact the test results. All in all I think this is a very poor test and verifies that some researchers don’t have a full grasp of what is happening.

1. - **Lin JC, Wang Z**, (June 2007) *Hearing of microwave pulses by humans and animals: effects, mechanism, and thresholds*, Health Phys. 2007 Jun;92(6):621-8 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17495664)]

This study looks at the mechanism (theory) by which microwave hearing can be attributed to pulsed microwaves. It does not perform any test on subjects or relate to verifying EHS. It does however provide a plausible mechanism to validate claims by those who say they experience tinnitus in the presence of pulsed RF.

1. - **Schrottner J** *et al*, (April 2007) *Investigation of electric current perception thresholds of different EHS groups*, Bioelectromagnetics. 2007 Apr;28(3):208- [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17080457)]

Comment: A study that looked at whether EHS people could perceive a 50Hz field. The study showed that pooled together, hypersensitive persons as a group differ significantly from the general population sample, however with a pronounced overlap with the normal range. They also found that numerous EHS subjects there was no increased ability to perceive low frequency electric or magnetic fields. What does the last statement mean? That there were some who could? The abstract did not provide sufficient details to determine whether someone actually indeed had the capability to detect the field. I believe that looking for perception of signals is the wrong focus. It proves nothing even if someone could perceive a signal as it does not demonstrate it caused a headache. Researchers should instead be conduct provocation tests to see if symptoms are elicited during and after exposure and record them as well as supplementing with biological tests to see if there are biological markers that separate EHS people form normals. Provocation tests on their own are not very useful.

1. - **Eltiti S** *et al*, (February 2007) *Development and evaluation of the electromagnetic hypersensitivity questionnaire*, Bioelectromagnetics. 2007 Feb;28(2):137-51 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17013888)]

Comment: A study that the involved the development of questionnaires that would help identify the key symptoms associated with EHS and determine how often these symptoms occur in the general population of the United Kingdom. Study 2 established the validity of the questionnaire in that EHS individuals showed a higher severity of symptoms on all subscales compared to the control group. This study does not verify EHS is caused by EMF. It would be worthwhile looking at the prevalence of symptoms and how they compare to other subjective studies on EHS in the past to see if there is a correlation. Which are the most common symptoms and do they match findings in other ESH studies in terms of occurrence ranking? It would interesting to understand how EHS symptoms compare between different EMR frequencies and technologies. AM/FM Wireless vs Radar vs Mobile Phones vs Base Stations vs WiFi.

1. - **Schreier N** *et al*, (2006) *The prevalence of symptoms attributed to electromagnetic field exposure: a cross-sectional representative survey in Switzerland*, Soz Praventivmed. 2006;51(4):202-9 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17193782)]

Comment: A survey based study that investigated perceived health risks as well as to assess the prevalence of self-reported symptoms to exposure to EMFs. The most common health complaints among EHS individuals were sleep disorders (43%) and headaches (34%). The researchers concluded that *The large proportion of the population who is concerned or attributes own symptoms to EMF may cause societal conflicts given the ubiquity of EMF in our everyday life*. The conclusion is absolutely true and because EHS sufferers are the minority (significant) they are ignored, ridiculed and in some extreme instances put in mental institutions. This study does not validate whether EHS is linked to EMR. the study suggested 53% were worried about adverse health effects from EMF, without attributing their own health symptoms to them. It is unfortunate that some international organisations tasked with providing health advice try to take this concern as being a possible contributing factor to EHS symptoms. Many EHS sufferers I have spoken with, concern only came after the symptoms developed and not before. Perhaps future surveys should consider this and try to develop a question or two to investigate this.

1. - **Havas M**, (2006) *Electromagnetic hypersensitivity: biological effects of dirty electricity with emphasis on diabetes and multiple sclerosis*, Electromagn Biol Med. 2006;25(4):259-68 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17178585)]

Comment: Prof Havas has made some very interesting observations from some case studies and anecdotal evidence which suggested that there is a possible connection between electromagnetic pollution and a number of disorders including ADHD/ADD, Diabetes, MS, chronic fatigue and fibromyalgia which needs to be investigated and the percentage of people sensitive to this form of energy needs to be determined. I congratulate Professor Havas for recognising that EMF’s are possibly causing a number of disease states that are seeing rapid rises especially in the last 20 years. There is evidence that EMF in general (from ELF all the way up to UHF) could be contributing a large number of health problems in our electrified society. Studies have shown large differences in cancer, autism and allergy incidence between Amish populations (who do not use electrical power or WiFi) and societies that use electricity and electrical appliances.

1. - **Huss A, Roosli M**, (October 2006) *Consultations in primary care for symptoms attributed to electromagnetic fields--a survey among general practitioners*, BMC Public Health. 2006 Oct 30;6:267 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17074080)]

Comment: A survey of Swiss general practitioners in order to assess the frequency of consultations in primary care due to EMF and the GPs' experience with these patients. The findings yielded sleep disorders, headaches and fatigue as the most often reported symptoms and mobile phone base stations, power lines and the own use of mobile phones as the main EMF sources suspected to be associated to symptoms. GPs judged the association between EMF and the symptoms to be plausible in 54% of the cases. GPs often judged the association between the health problems and the suspected exposure to be plausible which is in conflict with mainstream science and health organisations opinions. This could be used as evidence to suggest that perhaps scientists who do not have a background in appropriate medical sciences are the ones who are making these international scientific consensus conclusions.

1. - **Szyjkowska A** *et al*, (October 2005) *Subjective symptoms related to mobile phone use--a pilot study*, Pol Merkur Lekarski. 2005 Oct;19(112):529-32 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/16379318)]

Comment: A survey using a self-reported questionnaire to see if mobile phones may lead to a number of symptoms such as headache, impaired concentration and memory, fatigue subjective symptoms. The results showed 70% complained of headache and 20% of dizziness. Impaired concentration occurred in 56% of respondents. No biological tests performed. The study did not confirm or dispute that EHS is linked to EMR.

1. - **Irvine N** *et al*, (November 2005) *Definition, Epidemiology and Management of Electrical Sensitivity*, HPA-RPD-010 [[View Author's conclusions](http://products.ihs.com/Ohsis-SEO/753948.html)]

Comment: A review of EHS studies. Provides some advice for further studies. EHS sufferers know what causes their issues and are waiting for science to catch up and confirm what they already know. The review was commissioned to identify and appraise the literature in order to describe and define ES, review the information on its course, prognosis and treatments, and examine its overlap with other conditions such as multiple chemical sensitivity. Specifically excluded from the review were attributed health effects in terms of specific disease processes, and examination of the ongoing debate around the aetiology of ES.

There was no typical time period identified from exposure to onset of symptoms. The researcher recognised that there is considerable overlap between ES and other conditions known as symptom-based conditions, functional somatic syndromes or idiopathic environmental intolerances.

1. - **Roosli M** *et al*, (February 2004) *Symptoms of ill health ascribed to electromagnetic field exposure--a questionnaire survey*, Int J Hyg Environ Health. 2004 Feb;207(2):141-50 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/15031956)]

Comment: A health based survey study where a questionnaire was sent to people who complained about symptoms of ill health which they ascribed to exposure to electromagnetic fields (EMF). Sleep disorders (58%), headaches (41%), nervousness or distress (19%), fatigue (18%), and concentration difficulties (16%) were most common complaints. Two thirds of complainants had taken some action to reduce their symptoms. The most common measure was to avoid exposure if possible. The survey was not designed to establish a causal association between exposure to EMF and symptoms of ill health.

1. - **Leitgeb N, Schrottner J**, (September 2003) *Electrosensibility and electromagnetic hypersensitivity*, Bioelectromagnetics. 2003 Sep;24(6):387-94 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/12929157)]

Comment: This study investigated electrosensibility characterized by perception threshold and its standard deviation. By analyzing the probability distributions of the perception threshold of electric 50 Hz currents, evidence found the existence of a subgroup of people with significantly increased electrosensibility (hypersensibility) who as a group could be differentiated from the general population. The presented data show that the variation of the electrosensibility among the general population is significantly larger than has yet been estimated by nonionizing radiation protection bodies, but much smaller than claimed by hypersensitivity self-aid groups. It should be noted that the researchers were not testing for EHS and correlation of symptoms with exposure.

1. - **Levallois P**, (August 2002) *Hypersensitivity of human subjects to environmental electric and magnetic field exposure: a review of the literature*, Environ Health Perspect. 2002 Aug;110 Suppl 4:613-8 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/12194895)]

Comment: A review of literature only. No surveys, no provocation or biological testing. The study makes the following key points “*Hypersensitivity to exposure to electric and magnetic fields (EMFs) has been reported for nearly 20 years; however, the literature on the subject is still very limited. It appears that the so-called hypersensitivity to environmental electric and magnetic fields is an unclear health problem whose nature has yet to be determined. The symptoms often associated with skin disorders are mainly of neurasthenic type and can cover a lot of nonspecific symptoms present in other atypical syndromes such as multiple chemical sensitivity or chronic fatigue. Most of these symptoms are allegedly triggered by exposure to different sources of EMFs, but there have been no valid etiological studies published on this more general syndrome*.” I generally agree with the conclusions because the quantity and quality of studies in this area are quite poor with some researchers definitely lacking a full understanding of the “syndrome”. Nearly all of these “syndromes” have been associated by some scientists with psychologically induced conditions. It is perplexing as to why someone would be making sensitivity claims unless they were real especially when the suffers often know that there is a stigma attached to it and that their lives will be turned upside down.

1. - **Hillert L** *et al*, (February 2002) *Prevalence of self-reported hypersensitivity to electric or magnetic fields in a population-based questionnaire survey*, Scand J Work Environ Health. 2002 Feb;28(1):33-41 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/11871850)]

Comment: A survey based study in which a questionnaire was shared among 15,000 men and women between 19 and 80 years of age in Stockholm County in 1997. 1.5% of the respondents reported hypersensitivity to electric or magnetic fields. The hypersensitive group reported all symptoms, allergies, and other types of hypersensitivities included in the survey to a significantly greater extent than the rest of the respondents. Of course the statement “*there is widespread concern among the general population about risks to health posed by electric and magnetic fields*” could be interpreted by some to suggest that the condition may be considered a psychologically based issue even though the author does say interpret the result with caution. The study unfortunately does not provide any useful information with respect to EHS and whether it relates to exposure to EMR.

1. - **Hillert L** *et al*, (November 1999) *Hypersensitivity to electricity: working definition and additional characterization of the syndrome*, J Psychosom Res. 1999 Nov;47(5):429-38 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/10624841)]

Comment: A study that provides some biological parameters as well as providing some characterisation such as triggering factors, behaviour, and duration of symptoms.

It is important note that “*No association was found between specific psychosocial work characteristics nor personal traits and hypersensitivity to electricity*.” This means that is not limited to a subpopulation of people who have a consistent psychological profile for example hypochondriacs. However the statement “*Results indicate that skin, and not neurovegetative symptoms, characterize the syndrome, at least during the first years of illness*” could be questionable because skin effects do not explain cognitive function issues, dizziness, light headedness etc. Of course many studies during this period were focused on skin irritation from VDU’s. The study does not prove or disprove EHS is linked to EMR

1. - **Bergdahl J** *et al*, (October 1998) *Odontologic survey of referred patients with symptoms allegedly caused by electricity or visual display units*, Acta Odontol Scand. 1998 Oct;56(5):303-7 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/9860100)]

Comment: Biological tests performed on 28 patients who claimed electro hypersensitivity. The study showed that various odontologic factors might be involved in some of these patients' suffering. The study does not prove or disprove EHS is linked to EMR.

**Negative (no finding) Studies**

**Overall summary 11 of the 25 Negative tests were reviews of other studies and not actual tests**

1. N **Augner C** *et al*, (March 2012) *Acute effects of electromagnetic fields emitted by GSM mobile phones on subjective well-being and physiological reactions: A meta-analysis*, Sci Total Environ. 2012 Mar 13. [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/22421088)]

Comment: A meta-analysis, no actual provocation or biological tests performed. Results show no significant impact of short term exposures – This is difficult to interpret. One could say a short term exposure is unlikely to have a long term effect even for people who are EHS which is what I experience – I do recover after a exposure. An exposure to WiFi for half a day could leave me fatigued and with a headache for 2 days but my health will be restored after 3 days of no further exposure. Also subjective symptoms are hard to determine whether these effects are significant and can be classified as health damaging (short term). However ICNIRP’s 2002 statement says “*Annoyance or discomfort may not be pathological per se but, if substantiated, can affect the physical and mental well being of a person and the resultant effect should be considered as a potential health hazard*.” The study mentions that future studies should look at long term exposures.

1. N **Frei P** *et al*, (January 2012) *Cohort study on the effects of everyday life radio frequency electromagnetic field exposure on non-specific symptoms and tinnitus*, Environ Int. 2012 Jan;38(1):29-36. doi: 10.1016/j.envint.2011.08.002. Epub 2011 Sep 10 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/21982030)]

Comment: No biological tests or provocation tests performed. Simply used survey data to make finding of no association. Exposures were predicted using an apparently validated prediction model. Indicates it has objective data but this only relates to possible emission levels based on a prediction model. Subjective data used and does not consider unconnected RF sources that maybe present in the environment such as WiFi or other forms of EMF’s.

1. N **Wallace D** *et al*, (January 2012) *Cognitive and physiological responses in humans exposed to a TETRA basae station signal in relation to perceived electromagnetic hypersensitivity*, Bioelectromagnetics. 2012 Jan;33(1):23-39. doi: 10.1002/bem.20681. Epub 2011 Jun 6 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/21647932)]

Comment: This study examined whether acute exposure to a TETRA base station signal has an impact on cognitive functioning and physiological responses. Definition of *acute exposure*: Single exposure to a potentially harmful substance (not lasting more than a day). This was a double blind provocation test, included some physiological measurements such as skin conductivity and heart rate variation. 3 people sensitive did not complete the study. Signal duration and whether data was propagated with the signal is unknown. Need to full study detail to understand protocol and limitations. Were the skin conductivity tests and HRV tests performed during, immediately after and sometime post exposure? Some studies such as **A.** **Tuengler et al 2013** suggest the measurements should be taken simultaneously during and after provocation.

1. N **Rubin GJ** *et al*, (December 2011) *Do people with idiopathic environmental intolerance attributed to electromagnetic fields display physiological effects when exposed to electromagnetic fields? A systematic review of provocation studies*, Bioelectromagnetics. 2011 Dec;32(8):593-609. doi: 10.1002/bem.20690. Epub 2011 Jul 18 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/21769898)]

Comment: This was a review of studies rather than actually conducting biological and or provocation tests. Need to see the full study to understand which studies were reviewed to come to the suggested conclusion that EHS is not likely to be linked to EMR.

1. N **Roosli M, Hug K**, (May 2011) *Wireless communication fields and non-specific symptoms of ill health: a literature review*, Wien Med Wochenschr. 2011 May;161(9-10):240-50 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/21638215)]

Comment: A study that reviewed existing studies. No actual provocation or biological tests were conducted. Study indicated that “*In most of the randomized trials, no exposure-response association was observed*.” “in most…” suggesting that some tests did show an association but of course like RF studies and health and safety in general suggest “all swans are white” and “black swans” are ignored or down played. We also need to understand what exposure response association means. “The dose–response relationship, or exposure–response relationship, describes the change in effect on an organism caused by differing levels of exposure” - were different levels of exposures performed? How long after exposure were symptoms tested? How were they tested. Need to see full study and studies referenced to understand protocols used*.*

1. N **Nieto-Hernandez R** *et al*, (September 2010) *Can exposure to a terrestrial trunked radio (TETRA)-like signal cause symptoms? A randomised double-blind provocation study*, Occup Environ Med. 2010 Sep 23. [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/20864469)]

Comment: This study produced tetra like signals (provocation test). It is uncertain without looking at the device specifications as whether it simulated data being sent. The study did show that the frequency when sent as a continuous wave caused headaches in all participants, fatigue in non-sensitive participants and difficulty concentrating in sensitive participants. But when sent as a pulse most symptoms disappeared except itching. This suggests there could be an immune component involved to account for itching. No biological tests or skin biopsies taken to look at immune system action. As a an example the WiFi beacon signal (10hz) which occurs when there no data transmission activity, does not seem to affect me in the short term unlike scenarios where high volumes of data is being sent. It is therefore important to understand what is being simulated (modulation pattern) when doing these tests. One also needs to look at the test protocol to see whether participants were asked about their feelings at set times or only once during exposure. Did they try to account for delayed effects and recovery time?

1. **N** **Mohler E** *et al*, (September 2010) *Effects of everyday radiofrequency electromagnetic-field exposure on sleep quality: a cross-sectional study*, Radiat Res. 2010 Sep;174(3):347-56 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/20726726)]

Comment: Another study similar to Frei P above where survey data was used and tested against a model to verify whether sleep was affected by RF/EMF. No provocation or biological tests performed. Subjective data used. Study apparently accounted for confounders. Would need to see full study to understand what these were (night shift workers? Use of electronic devices before going to bed? Coffee intake? Alcohol intake etc.) . Given the number of possible confounders the value of this analysis is questionable without doing actual provocation tests while people are sleeping and analysing brain activity.

1. **N** **Danker-Hopfe H** *et al*, (September 2010) *Do mobile phone base stations affect sleep of residents? Results from an experimental double-blind sham-controlled field study*, Am J Hum Biol. 2010 Sep-Oct;22(5):613-8 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/20737608)]

Comment: This provocation study looked at the effects Mobile Phone base stations have on sleep. The study did not provide any evidence for short-term physiological effects of EMF emitted by mobile phone base stations on objective and subjective sleep quality. This is very subjective because there were no biological tests performed and instead relied on survey responses. If the test subjects are normal healthy people then this is not unexpected. The results indicate that mobile phone base stations as such (not the electromagnetic fields) may have a significant negative impact on sleep quality. Study appears to suggest that psychological factors could impact sleep. The signals for the base station were from an experimental base station. Exactly how this compares to a real life station in terms of the electromagnetic fields generated and the volume of data that is transmitted is unknown. The other potential limiting factor is the duration of the exposure. Base stations are transmitting 24x7 and the effects can develop over time.

1. N **Wallace D** *et al*, (January 2010) *Do TETRA (Airwave) Base Station Signals Have a Short-Term Impact on Health and Well-Being? A Randomized Double-Blind Provocation Study*, Environ Health Perspect. 2010 Jan 14. [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/20075020)]

Comment: Short-term exposure to a TETRA base station signal did not have an impact on the health. What about long term exposure? Were test subjects healthy or sensitive individuals? If the signals interfere with cellular processes with effects only being seen over time then a short term test is not useful. Some biological tests were conducted with provocation test. Tests were conducted to see if people can detect the signal, this is a useless test especially if the symptoms are delayed. Electrosensitve does not always mean instant feelings. In many instances researchers need to understand that it is not like switching on/off a light. Study finding suggested a psychosomatic cause “belief of harm” but it is unclear what psychological assessments were performed to develop this conclusion. No mention of results of biological tests in abstract.

1. N **Rubin GJ** *et al*, (January 2010) *Idiopathic environmental intolerance attributed to electromagnetic fields (formerly 'electromagnetic hypersensitivity'): An updated systematic review of provocation studies*, Bioelectromagnetics. 2010 Jan;31(1):1-11 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/19681059)]

Comment: Same comment as other negative systematic reviews performed by Rubin before and after this study (refer to comments on 4., 21. and 24. in the negative list]

1. N **Eltiti S** *et al*, (May 2009) *Short-term exposure to mobile phone base station signals does not affect cognitive functioning or physiological measures in individuals who report sensitivity to electromagnetic fields and controls*, Bioelectromagnetics. 2009 May 27. [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/19475647)]

Comment: Another short term study. Provocation and some biological tests. Showed nothing conclusive. Of course we have no idea whether the sensitive subjects were effected already by other sources prior to the test. Would need to look at the full study to understand the test protocol and how they determined whether a sensitive was feeling okay prior to the test. From my own personal experience my cognisant functions are not consistently impaired every time I am exposed. Impairment could develop sometime after exposure and can be influenced by sleep patterns. EMF can cause insomnia in some people and having poor sleep will definitely effect cognitive performance. Looking for direct impacts with a short term exposure does not consider the long term impacts and probably requires cognitive tests to be performed a number of timed after multiple exposures. How many times were the provocation tests conducted and the cognitive tests performed per subject? Were the sensitive subjects claiming to be sensitive to the frequency that they were using? Were they using real mobile base station signals carrying data or just simulation carrier signals?

1. N **Berg-Beckhoff G** *et al*, (February 2009) *Mobile phone base stations and adverse health effects: phase 2 of a cross-sectional study with measured radio frequency electromagnetic fields*, Occup Environ Med. 2009 Feb;66(2):124-30 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/19151228)]

Comment: What is the definition of an adverse health effect? *“An adverse health effect is defined as the causation, promotion, facilitation and/or exacerbation of a structural and/or functional abnormality, with the implication that the abnormality produced has the potential of lowering the quality of life, contributing to a disabling illness, or leading to a premature death.“*

Is sleeping problems an adverse health effect? Sleeping problems can cause downstream adverse health effects but are not necessarily themselves an adverse health effect. So one needs to question what the real purpose of this study is? Did the researchers consider other transmitting devices in the homes of those who are surveyed such as DECT phones and WiFi, neighbour’s wireless equipment? What about the exposure that a person will experience as part of their daily lives? Work places may be situated near mobile phone towers and so the study protocol is questionable and so is the outcome. I foresee a problem in the value of future health surveys and epidemiologic studies because the industry (supported by Governments) have been allowed to saturate our environments with cell towers, free public WiFi and other wireless transmitters. To make a study like this valuable one needs to have a group of the population (controls) who do not use mobile phones,are not living or working near a cell tower or using electrical appliances. The Amish might be a good example or an African country that sees the city dwellers having access to these services but remote villages do not.

1. N **Furubayashi T** *et al*, (September 2008) *Effects of short-term W-CDMA mobile phone base station exposure on women with or without mobile phone related symptoms*, Bioelectromagnetics. 2008 Sep 8. [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18780296)]

Comment: A provocation test with a small sample. Included some physiological and cognitive tests. It identified potentially 2472 candidates from 5000 women. It then finally resolved this down to 11 sensitive women. How did they do this? What made these 11 more viable than the other potential 2461 candidates? “*The MPRS group did not differ from the controls in their ability to detect exposure to EMF*.” The question remains whether the controls could also detect the exposure. When were the subjects questioned about their experience? During the exposure? Immediately after? Was any follow up done to check for claims of delayed symptoms? Would need to look at the full study to understand the protocol. Unfortunately scientists are trying to validate EHS by seeing if we can perceive a signal which is a questionable test and should not form the basis for validating EHS. Instead scientists need to test physiological reactions and whether there are both immediate and delayed reactions.

1. N **Kim DW** *et al*, (2008) *Physiological effects of RF exposure on hypersensitive people by a cell phone*, Conf Proc IEEE Eng Med Biol Soc. 2008;2008:2322-5 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/19163166)]

Comment: Heart Rate, Respiration and HRV test only. No changes in heart rate were detected for 30 minutes of CDMA phone RF exposure. From my own personal experience the only signals that effected my heart were when using a WiFi (2.4Ghz) from a powerful router (108mbs) for several hours and smart meter. Such events have not always been consistent (not every exposure gives me heart palpitations but it has only every occurred when using WiFi.) Less powerful WiFi or sitting many meters away from the transmitter will not give me palpitations but I will often experience pressure on my chest. How long was the HRV test performed? The duration of the exposure or longer?

1. N **Cinel C** *et al*, (March 2008) *Exposure to Mobile Phone Electromagnetic Fields and Subjective Symptoms: A Double-Blind Study*, Psychosom Med. 2008 Mar 31 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18378872)]

Comment: A provocation study. It is unclear whether there were any EHS people as part of the study (not mentioned in the abstract) and could have all been “normal”. Dizziness was the only reported symptom and only by one of the groups to be tested. Lack of consistency was indicated to discount this finding. The test looked for changes in severity of symptoms – so how did the study classify people who developed a symptom during an exposure but its severity was not altered during the exposure event? The study abstract does not mention when the questions were asked such as during exposure, immediately after exposure or hours later. This is important to understand whether delayed reactions are being picked up. Often I can experience situations where I am exposed to RF but don’t immediately feel anything. It is only after I leave the field that a headache develops. I am able to associate it with the RF field because the delayed action only happens in these scenarios where I purposely subject myself to a weak RF field through my own provocation tests and a headache develops sometime after the field is turned off. No other environmental changes occurred that could be confounding this result and it occurs consistently. Some scientists will then attribute my headache to stress of “being concerned” about RF but concern had not been part of the picture when I experienced this the very first few times I was exposed as I was completely unaware of any risks. Further tests have been conducted with an open mind. Certain devices will cause me a strong headache while I am experiencing exposure. An example is a 3G or 4G USB wireless broadband modem that is being used to connect and download data from the internet. I often experience these effects in a meeting room without me knowing someone is actually using these devices. It is only after the symptoms develop to I find that someone has a wireless devices on.

1. N **Roosli M**, (March 2008) *Radiofrequency electromagnetic field exposure and non-specific symptoms of ill health: A systematic review*, Environ Res. 2008 Mar 20 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18359015)]

Comment: A systematic review of EHS articles. Not an actual test. Studies investigated all look at short term exposures. Many test to see whether people can perceive the signal. This is a not a useful test and proves only that most people cannot consciously perceive RF signals. It is also not clear how they define EHS people whether the studies they reviewed tried to weed out true electrosensitivity people from those who believe they are but might not be. If studies do not discriminate between genuine EHS and those who claim to be EHS, but are in reality not, and then clump them all into the same “EHS” pool this could lead to a dilution of the results leading to an inconclusive or no effect position. We would need to look at individual studies and look at each tested individual’s test result to look for consistency. Test protocols of each study review would need to be analysed to see the time frame between subsequent tests and whether sham signal test is being performed while EHS people are still experience a delayed recovery from previous real signal. Potential confounding factors would all need to be identified and details of how they were mitigated documented.

1. N **Kwon MS** *et al*, (November 2007) *Perception of the electromagnetic field emitted by a mobile phone*, Bioelectromagnetics. 2007 Nov 20;29(2):154-159 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18027840)]

Comment: This study is a provocation test with no biological tests. Its intention was to see whether people could detect a signal and not necessarily look for health effects. Of course no one was able to detect the signal above chance. Nearly all devices that affect me do so over time. In most cases I am not able to reliably detect the signal of a transmitter as it is turned on or off like turning on/off a light switch. The only device that I could sense from past experience almost immediately is 3G broadband USB modem and also a cordless microphone although with the microphone the intensity of the signal (relating to the distance of separation) is also important i.e. within 50cm I felt it but not within a couple of meters. Even a Nintendo Wii controller will only begin to affect me after many minutes of exposure. I also know from my own experience that my sensitivity to different fields also depends on how much exposure I have had and for how long. There was one point in my recent past where I could feel mobile phone towers before I saw them. At that time I had been exposed to pulsed RF from a mobile phone tower, smart meters, cosmic radiation (flying), WiFi for more than 6 months. I was sensitive to EMF from an electric hotplate, dimmer switch etc. I recovered by shielding my house and my sensitivity was reduced. Testing for perception of signal is not a useful test for validating EHS and demonstrates that researchers on this project didn’t have a good understanding of EHS.

1. N **Eltiti S** *et al*, (November 2007) *Does short-term exposure to mobile phone base station signals increase symptoms in individuals who report sensitivity to electromagnetic fields? A double-blind randomized provocation study.*, Environ Health Perspect. 2007 Nov;115(11):1603-8 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18007992)]

Comment: A provocation based study with some biological tests performed. Short-term exposure to a typical GSM base station-like signal did not affect well-being or physiological functions in sensitive or control individuals. How long was the exposure, was data sent with the signal and how long after exposure were people asked about their symptoms? If feelings were asked during exposure was there any follow up an hour or more later to account for delayed onset and delayed recovery? The abstract did not have any specific details. Need to see full paper. Sensitive individuals did report elevated levels of arousal when exposed to a UMTS (3G) signal. Wireless can increase my alertness in the short term but then lead to fatigue some hours later.

1. N **Mortazavi SM** *et al*, (May 2007) *Prevalence of subjective poor health symptoms associated with exposure to electromagnetic fields among university students*, Bioelectromagnetics. 2007 May;28(4):326-30 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17330851)]

Comment: This study was based on survey questions only. No biological or Provocation tests were conducted. This is a very subjective study where the researchers appear to believe a psychological role has to play “*This finding can confirm the results obtained in provocative studies which indicated the role of psychological factors in electromagnetic hypersensitivity*.” The researchers suggested “*No significantly higher prevalence of self-reported symptoms was found in individuals who had used mobile phones, video display terminals or cordless phones more frequently than others*.” does not mean that there is no correlation between EMR and symptoms in sensitive people. I am assuming that they are trying to show that dose response differences to EMR has no correlation with an increase in severity or types of symptoms. Did the researchers consider other sources of EMR in the environment such as Wi-Fi? Mobile phones are used intermittently and not likely to be the main source of EMR exposure. AM/FM transmitters, Cell towers and WiFi are transmitting all the time and so for an individual would make up the majority of the accumulated exposure when comparing with a mobile and cordless phone. How were all these aforementioned confounders treated? Were they surveying only normals or were there any self-diagnosed sensitive people involved in the survey? Were any symptoms found? Average age of those surveyed (University students) are young adults and so the study unlikely to find many unhealthy individuals. Students are also unlikely to have accumulated as much EMR exposure as more senior members of society. I was 32 years old when I found I was sensitive and had used computers extensively for at least 14 years and a cordless phone/mobile phone for at least 6 years.

1. N **Oftedal G** *et al*, (May 2007) *Mobile phone headache: a double blind, sham-controlled provocation study*, Cephalalgia. 2007 May;27(5):447-55 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17359515)]

Comment: A study based on provocation tests. Researchers suggests that experiences are a nocebo effect. Not much described in the abstract so it is unclear whether any survey questions were asked with respect to technology usage, nature of the health impairments in terms of when they commence and for how long after the exposure they persist. Whether there was an attempt to understand the history of the sensitivity. The test was conducted assuming that other forms of EMR were not causing sensitivity issues. No biological tests were done. My personal EHS case study describes the limitations of these forms of primitive subjective tests and this study is one of those.

1. N **Rubin GJ** *et al*, (April 2006) *Are some people sensitive to mobile phone signals? Within participants double blind randomised provocation study*, BMJ. 2006 Apr 15;332(7546):886-91 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/16520326)]

Comment: A provocation test. Subjective testing with the principal outcome that tried to measure for headache severity assessed with a 0-100 visual analogue scale. See my personal EHS case study with respects to these types of studies that try to objectively measure pain. This test is a furphy because it assumes that humans can measure pain with accuracy like a an analogue meter. It shows that the testers does not have a good understanding of EHS and human behaviour (despite being a psychologist). The findings are also equally contentious. “*Headache severity increased during exposure and decreased immediately afterwards. However, no strong evidence was found of any difference between the conditions in terms of symptom severity.”*  So there is evidence that provocation testing does create headaches. Was there an expectation for difference in severity? “*Nor did evidence of any differential effect of condition between the two groups exist*.” Differential effects are not immune to differential biases.

1. N **Wilen J** *et al*, (April 2006) *Psychophysiological tests and provocation of subjects with mobile phone related symptoms*, Bioelectromagnetics 2006 Apr;27(3):204-14 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/16304699)]

Comment: A study that involved both provocation and biological tests. Hard to say this is a “no effect study” as the study did note an increase in reaction time for those who were EHS vs controls. The following physiological and cognitive parameters were measured during the experiment: heart rate and heart rate variability (HRV), respiration, local blood flow, electrodermal activity, critical flicker fusion threshold (CFFT), short-term memory, and reaction time. The following finding was made by researchers “*No significant differences related to RF exposure conditions were detected*.” is only meaningful if there is an understanding of the time difference between the sham exposure and the active exposure. If insufficient time is given to recover or tests were not conducted to account for delayed reactions then the test results are not that useful. “*Wilen et al. could not find significant differences in their power spectral analysis of HRV recordings between self-declared electromagnetic hypersensitive individuals and matched controls. But they did not investigate and compare the dynamics of changes in HRV during and after exposure. In our experience, the dynamics of changes in HRV are of vital importance. After recording and analysing them and comparing them with simultaneously recorded measurements of capillary blood flow and electric potential difference of the skin*.” **A.Tuengler et al.2013**

1. N **Seitz H** *et al*, (October 2005) *Electromagnetic hypersensitivity (EHS) and subjective health complaints associated with electromagnetic fields of mobile phone communication--a literature review published between 2000 and 2004*, Sci Total Environ. 2005 Oct 15;349(1-3):45-55 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/15975631)]

Comment: A review of other EHS studies. In only one provocation study, individuals with self-reported electromagnetic hypersensitivity were exposed to EMF. So one could possible assume that the other remaining studies were subjective only. This study recognised that the studies reviewed were limited due to short exposure period and the small study size.

1. N **Rubin GJ** *et al*, (March 2005) *Electromagnetic hypersensitivity: a systematic review of provocation studies*, Psychosom Med. 2005 Mar-Apr;67(2):224-32 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/15784787)]

Comment: A statistical analysis of EHS studies. Looking to see if EHS people can perceive signals shows that scientists are looking at EHS from the wrong perspective. It should not be about whether we can detect a signal but rather do we experience biological effects immediately, hours or a day later. What are those effects being claimed and how consistent are they being claimed? How are confounders being handled such as exposure to external environment EMF/RF triggers? Are they kept in rooms with shielding throughout the whole test period? How long is the testing period and is adequate recovery time being provided before the next test irrespective of whether it is the sham signal or not? What signals are being used and do people claim to be sensitive to them? Do the signals simulate data transmission?

1. N **Hillert L** *et al*, (March 2001) *Environmental illness: fatigue and cholinesterase activity in patients reporting hypersensitivity to electricity*, Environ Res. 2001 Mar;85(3):200-6 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/11237508)]

Comment: Biological test only to confirm whether cholinesterase changes in ES people. Without knowing whether there was provocation tests or not it does not present a meaningful test to verify EHS. It only shows that hypothesis of changes in cholinesterase activity is not useful mechanism (biomarker) to verify whether someone is EHS. This study neither proves or disproves EHS.

**Positive Findings that potentially suggest EMR has a role to play in EHS**

1. **P Griesz-Brisson M**  *Electrosensitivity from a neurological point of view* Neuroepidemiology 2013 41:3-4 (275) [<http://www.karger.com/Article/Pdf/356326>]

Comment: Biological tests were conducted on 22 sensitive subjects. the study showed most EHS subjects were deficient in essential elements. The questionnaire showed that the subjective symptoms started during exposure and continued after exposure stop. From my own personal experience I have found that I meet some the above criteria. A hair analysis test showed that I had a deficiency in some essential minerals. Blood tests showed that I had a vitamin D deficiency and a higher than normal t.bili count (used to indicate a liver enzyme function problem or haemolysis – excessive breakdown of red blood cells). A urine test showed I was suffering pyroluria which can indicate oxidative stress (something that RF has been linked to and recognised by many scientific studies).

1. **P Schmid MR** *et al. (February 2012) Sleep EEG alterations: effects of different pulse-modulated radio frequency electromagnetic fields.* [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/21489004)]

Comment: Provocation and cognitive tests. Although the cognitive tests showed no clear exposure-related effects, results did provide evidence that pulse-modulated RF EMF alter brain physiology and demonstrated that modulation frequency components within a physiological range may be sufficient to induce these effects. Regarding the cognitive effects the tests were performed weekly for 30 minutes. This of course is not representative of a real person’s exposure especially if their living quarters are located near a mobile phone base station which is transmitting 24x7 or have WiFi and DECT phones installed.

1. P **McCarty DE** *et al*, (December 2011) *Electromagnetic hypersensitivity: evidence for a novel neurological syndrome*, Int J Neurosci. 2011 Dec;121(12):670-6. Epub 2011 Sep 5 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/21793784)]

Comment: Provocation test. Sample size of only one test subject is probably not going to be convincing to those scientists who are EHS sceptics. The test subject was shown to have reacted to 60Hz field transitions (on/off) but not when the field was left on or off. The test subject developed temporal pain, headache, muscle twitching, and skipped heartbeats within 100 s after initiation of EMF exposure. Subject could not consciously recognise whether the field was on or not. The same occurs for HF as well and that is why testing for perception of RF field is a useless test and proves nothing when it comes to validation of EHS. The body reacts to changes in E/M fields even those that are considered to be very weak (i.e. RF). I have found myself in situations where I have been working in an environment with RF (WiFi, blue tooth devices etc.) and not felt a thing initially. Continual exposure will often lead to fatigue but not always result in a headache until I leave the field. There are exceptions however and include 3G broadband modems transferring lots of data. I will develop a serious headache within minutes of the download starting. Data transfer rate and short pulses affect me fare worse than a WiFi network that is not being used much (beacon signal). This is one reason perhaps why smart meters affect me so seriously because of its short bursts of RF which it is not a constant field or continuous wave. Some scientists indicate that symptoms are not a noxious effect of EM fields. I classify my symptoms on a whole as mild in most cases. I suspect my cells are reacting to these fields leading to cellular stress and perhaps triggering an immune response. I am able to function to a large degree of normality if I am able to keep my exposure to a minimum. However sustained exposures although not causing me to collapse writhing in agony, do lead to chronic fatigue, head pressure and insomnia. Poor sleep can have a cascade of effects that can have long lasting effects on health and wellbeing. It is interesting to note the researchers had the following to say about provocation test limitations by other researchers “*In previous provocation studies, the assumption was made that true hypersensitive subjects would exhibit more or less the same symptoms in response to repeated provocations. The assumption led to experimental designs that involved averaging across exposed and control groups, which is an inherently insensitive statistical procedure for detecting real but variable responses. The assumption is particularly inapplicable to EMF hypersensitivity because intrasubject and intersubject variabilities are its salient features*.”

1. P **Nishimura T** *et al*, (March 2011) *A 1-uT extremely low-frequency electromagnetic field vs. sham control for mild-to-moderate hypertension: a double-blind, randomized study*, Hypertens Res. 2011 Mar;34(3):372-7. Epub 2011 Jan [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/21248759)]

Comment: Not a test to validate high frequency and EHS but rather an ELF test. Measurements were taken of Blood Pressure. No change to Diastolic Blood Pressure between control and exposed group but a change was found in Systolic Blood Pressure reading. Repeated exposure to an ELF-EMF has a BP-lowering effect on humans with mild-to-moderate hypertension.

1. P **Lowden A** *et al*, (January 2011) *Sleep after mobile phone exposure in subjects with mobile phone-related symptoms*, Bioelectromagnetics. 2011 Jan;32(1):4-14 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/20857453)]

Comment: A provocation test using a Mobile Phone frequency and testing effect on sleep performance. It would appear exposure occurred prior to sleep but was not maintained during sleep. The test did however find changes in the various sleep stages for those who were exposed prior to going to sleep as compared to the controls. It would be interesting to conduct a sleep study that had test subjects sleeping with a provocation device simulating a smart meter transmitting (simulated data that one would expect from a smart meter) every minute or so over the entire sleeping period and look at what impact it has compared to a sham scenario.

1. **P El-Helaly M** *et al.* (September 2010) *Oxidative stress, melatonin level, and sleep insufficiency among electronic equipment repairers.* Indian J Occup. Environ. Med v.14(3); Sep-Dec 2010 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/21461157)]

Comment: Biological tests. Researchers found that the mean level of serum melatonin in the electronic equipment repairers was lower than that of the controls (P < 0.01). Also serum MDA mean level of the electronic equipment repairers was higher than that of the controls (P < 0.01). Sleep insufficiency was more frequent among electronic equipment repairers (18.00%) in comparison with the controls (8.70%) (P > 0.05). It is good to see the researchers selected controls who were people who did not use computers much, were not living near high voltage lines or mobile phone towers. I am not sure whether there are any considerations for TV usage? I did not see any information relating to whether participants tried to maintain regular sleeping patterns. Do those who work on electronic equipment go to bed later than those that don’t? Melatonin is impacted by light levels and plays an important role in the co-ordination of circadian rhythms.

1. **P** **Blettner M** *et al*, (November 2008) *Mobile phone base stations and adverse health effects: Phase 1: A population-based cross-sectional study in Germany*, Occup Environ Med. 2008 Nov 18. [Epub ahead of print [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/19017702)]

Comment: A cross sectional study using a survey on a large population base for those living near mobile phone towers. Participants who were concerned about or attributed adverse health effects to mobile phone base stations and those living in the vicinity of a mobile phone base station (500 m) reported slightly more health complaints than others. The slightly higher prevalence of health complaints near base stations could not be fully explained by attributions or concerns. Of course it does not give a lot of insight about the validity of EHS but does possibly suggest that increased health complaints could be linked to proximity to base stations.

1. P **Wiholm C** *et al*, (September 2008) *Mobile phone exposure and spatial memory*, Bioelectromagnetics. 2008 Sep 15. [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18792947)]

Comment: Provocation test to test effects on memory. 2 x 30 minute exposures designed to mimic real life mobile exposures. Mixed group of people with and without EHS symptoms who used the mobile phone daily. Study suggests the symptomatic group saw an increase performance during exposure but there was no effect on those who were not symptomatic.

1. **P** **Landgrebe M** *et al*, (March 2008) *Cognitive and neurobiological alterations in electromagnetic hypersensitive patients: results of a case-control study*, Psychol Med. 2008 Mar 26;:1-11 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/18366821)]

Comment: Provocation test supplement with a survey. The study found significant cognitive and neurobiological alterations pointing to a higher genuine individual vulnerability of electromagnetic hypersensitive patients. I can certainly relate to this. Sensitivity to light and sound has increased. Getting tired and headaches every time I am exposed to free public WiFi, mobile phone base stations and people with smart phones/tablets. There is also a psychological component as a result of associating these fields to my conditions leading me to actively try and avoid exposure where possible by spending as much time as I can in an environment that I do have some limited control, my home.

1. **P** **Abdel-Rassoul G** *et al*, (March 2007) *Neurobehavioral effects among inhabitants around mobile phone base stations*, Neurotoxicology. 2007 Mar;28(2):434-40 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/16962663)]

Comment: A survey based study that investigated health effects of residents living under or near a mobile phone tower vs controls. The prevalence of neuropsychiatric complaints as headache (23.5%), memory changes (28.2%), dizziness (18.8%), tremors (9.4%), depressive symptoms (21.7%), and sleep disturbance (23.5%) were significantly higher among exposed inhabitants than controls. It is not surprising as similar complaints are made by those who work with radar or exposed to other RF sources such as smart meters, AM/FM radio transmitters. A similar breakdown of symptoms and ranking can be found with a lot of the aforementioned technologies.

1. **P** **Landgrebe M** *et al*, (March 2007) *Altered cortical excitability in subjectively electrosensitive patients: results of a pilot study*, J Psychosom Res. 2007 Mar;62(3):283-8 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17324677)]

Comment: Biological tests to verify if there are differences between electrosensitives and controls. Electrosensitive patients showed reduced intracortical facilitation as compared to both control groups, while motor thresholds and intracortical inhibition were unaffected. It was interesting to note that the authors postulated that an “*altered central nervous system function may account for symptom manifestation in subjectively electrosensitive patients as has been postulated for several chronic multisymptom illnesses sharing a similar clustering of symptoms*.”

1. P **Johansson O**, (2006) *Electrohypersensitivity: state-of-the-art of a functional impairment*, Electromagn Biol Med. 2006;25(4):245-58 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/17178584)]

Comment: Biological tests were performed. “*Immunohistochemistry using antisera to the previously characterized marker substances of interest has been utilized*.” Evidence from the preliminary data suggests that various alterations are present in the electrohypersensitive person's skin. I can correlate my own experience with this finding because when I take a Zyrtec “allergy relief” tablet some of my symptoms fall away.

1. **P** **Hutter HP** *et al*, (May 2006) *Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations*, Occup Environ Med. 2006 May;63(5):307-13 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/16621850)]

Comment: A cross sectional study that had some cognitive tests and s sleep study. Measurements were taken of RF power density in homes of test subjects. There was no mention of a control group. Instead tests were performed to see if differences in measured power density resulted in altered performance and sleep quality. Researchers found there was a significant relation of some symptoms to measured power density; this was highest for headaches. Perceptual speed increased, while accuracy decreased insignificantly with increasing exposure levels. Effects on wellbeing and performance cannot be ruled out, however, mechanisms of action at these low levels were considered unknown. Many of these symptoms may “*not be pathological per se but, if substantiated, can affect the physical and mental well being of a person and the resultant effect should be considered as a potential health hazard”* **ICNIRP Statement 2002**

1. P **Papageorgiou CC** *et al*, (April 2006) *Acute mobile phone effects on pre-attentive operation*, Neurosci Lett. 2006 Apr 10-17;397(1-2):99-103 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/16406308)]

Comment: Provocation study that measured effect on cognitive functions. Test subjects were normal. Results showed that the presence of MP-EMFs induced statistically significant increase in the amplitude of P50 evoked by the low frequency stimuli, In contrast the exposure to MP-EMFs revealed statistically significant decrease of the amplitude of P50 evoked by the high frequency stimuli. This study does not try to distinguish between normal people and EHS people. It demonstrates that RF can affect brain responses in everyone.

1. **P** **Meo SA, Al-Drees AM**, (2005) *Mobile phone related-hazards and subjective hearing and vision symptoms in the Saudi population*, Int J Occup Med Environ Health. 2005;18(1):53-7 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/16052891)]

Comment: A survey of people in Saudi Arabia usage of mobile phones and vision/hearing complaints. The study showed an association between the use of mobile phones and hearing and vision complaints. About 34.59% of problems were related with impaired hearing, ear ache and/or warmth on the ear, and 5.04% of complaints with the decreased and/or blurred vision. This study does not try to verify EHS as a condition.

1. **P** **Leitgeb N** *et al*, (May 2005) *Does "electromagnetic pollution" cause illness? An inquiry among Austrian general practitioners*, Wien Med Wochenschr. 2005 May;155(9-10):237-41 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/15999632)]

 Comment: A survey of doctors in Austria on their opinion regarding the potential health-relevance of environmental electromagnetic fields. An overwhelming percentage of general practitioners (up to 96%) to some degree, or totally, believe in a health-relevant role of environmental electromagnetic fields. Researchers found “*It is rather remarkable that there is such a widespread contradiction between physicians' opinions and established national and international health risk assessment*.” Personal comment: Those who are educated and EHS have the same problem when dealing with scientists from organisations responsible for maintaining standards and health risk assessments. There is a serious disconnect, with many sufferers suspecting commercial interests are taking a higher priority than acknowledging that EMF is affecting a proportion of the population in a severe way and so recommendations for adopting precaution are muted.

1. **P** **Bortkiewicz A** *et al*, (2004) *Subjective symptoms reported by people living in the vicinity of cellular phone base stations: review*, Med Pr. 2004;55(4):345-51 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/15620045)]

Comment: A survey type study performed on populations living near mobile phone base stations. The survey revealed that people living in the vicinity of base stations report various complaints mostly of the circulatory system, but also of sleep disturbances, irritability, depression, blurred vision, concentration difficulties, nausea, lack of appetite, headache and vertigo. The performed studies showed the relationship between the incidence of individual symptoms, the level of exposure, and the distance between a residential area and a base station. This association was observed in both groups of persons, those who linked their complaints with the presence of the base station and those who did not notice such a relation

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1. **P Oberfeld G** *et al*, (October 2004) *The Microwave Syndrome - Further Aspects of a Spanish Study*, Conference Proceedings [[View Author's abstract conclusions](http://www.apdr.info/electrocontaminacion/Documentos/Investigacion/ESTUDOS%20EPIDEMIOLOXIDOS%20E%20ANTENAS/The%20Microwave%20Syndrome%20-%20Further%20Aspects%20of%20a%20Spanish%20Study.pdf)]

Comment: Spanish Survey Study which measured the power density on subjects homes and gave a questionnaire to be completed. The five strongest associations found were depressive tendency, fatigue, sleeping disorder, difficulty in concentration and cardio vascular problems. All the symptoms are in line with symptoms reported in literature as Microwave Syndrome.

1. **P** **Al-Khlaiwi T, Meo SA**, (June 2004) *Association of mobile phone radiation with fatigue, headache, dizziness, tension and sleep disturbance in Saudi population*, Saudi Med J. 2004 Jun;25(6):732-6 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/15195201)]

Comment: A survey of mobile users and health in Saudi Arabia. The overall mean percentage for the clinical findings in all groups were headache (21.6%), sleep disturbance (4.%), tension (3.9%), fatigue (3%) and dizziness (2.4%).

1. P **Westerman R, Hocking B**, (May 2004) *Diseases of modern living: neurological changes associated with mobile phones and radiofrequency radiation in humans*, Neurosci Lett. 2004 May 6;361(1-3):13-6 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/15135881)]

Comment: The abstract does not indicate what tests were performed or how the conclusion “*It is concluded that RFR from mobile phones can cause peripheral neurophysiological changes in some persons. The effects occur at exposure levels below the present safety levels for RFR*” was made. Would need to see the full study to understand the protocol used and the extent of the study.

1. **P** **Navarro EA** *et al*, (December 2003) *The Microwave Syndrome: A Preliminary Study in Spain*, Electromagn Biol Med 22(2-3): 161-169 [[View Author's abstract conclusions](http://www.emf-portal.de/viewer.php?aid=13498&l=e)]

Comment: A health survey that showed a *significant association between reported severity of the symptoms and the measured power density*. Subjective tests with no biological tests to support conclusion. We should not undervalue subjective symptoms analysis nor should we ignore them simply because science cannot adequately explain why they are happening.

1. **P** **Santini R** *et al*, (September 2003) *Symptoms experienced by people in vicinity of base stations: II/ Incidences of age, duration of exposure, location of subjects in relation to the antennas and other electromagnetic factors*, Pathol Biol (Paris). 2003 Sep;51(7):412-5 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/12948762)]

Comment: Part 2 of a Survey study found a significant increase (p < 0.05) in relation with age of subjects (elder subjects are more sensitive) and also, that the facing location is the worst position for some symptoms studied, especially for distances till 100 m from base stations. Other electromagnetic factors (electrical transformers, radio-television transmitters,...) have effects on the frequency of some symptoms reported by the subjects. From a personal perspective there was a point of time in my life when I was sensitive to a variety of devices that normally did not impact me. This occurred when my exposure to a large number of RF sources was extreme. I have lost my sensitivity to some of these items (e.g. dimmer switches, hot plates, mobile phone chargers) after I significantly reduced my exposure to RF transmitters.

1. **P** **Hocking B, Westerman R**, (October 2002) *Neurological changes induced by a mobile phone*, Occup Med (Lond). 2002 Oct;52(7):413-5 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/12422029)]

Comment: This study was based on a provocation test on a single individual who claimed she was sensitive. Dysaesthesiae (a disagreeable, atypical sensation; maybe spontaneous or induced ) of the scalp after mobile phone use have been previously reported, but the basis for this has not been clear. We report a case of a 34-year-old journalist who complained of symptoms associated with use of a mobile phone. She agreed to a provocation study with her phone. Current perception threshold testing before and after exposure showed marked changes in the C-fibre nerves of the affected area compared with the opposite side. The case is supportive of a neurological basis for some cases of dysaesthesiae associated with mobile phone use. I experience dysaethesiae on my face and scalp in the presence of different radio frequencies. Sometimes the sensation is almost immediate (during exposure) while other times I experience this after exposure (hours or a day later). It depends on the device (frequency and modulation pattern), duration and power density. I have made this association based on experience over the last 12 years to many different devices, distances and exposure times.

1. **P** **Stenberg B** *et al*, (October 2002) *Medical and social prognosis for patients with perceived hypersensitivity to electricity and skin symptoms related to the use of visual display terminals*, Scand J Work Environ Health. 2002 Oct;28(5):349-57 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/12432989)]

Comment: A survey based study. A larger proportion of patients with hypersensitivity to electricity (38%) than those with skin symptoms related to VDT use (17%) was no longer gainfully employed. Both groups reported a higher symptom frequency than that reported by the general population. It appears that treatment helped those with skin symptoms but not those who were sensitive to electricity. No biological tests performed to verify whether immunological factors had a role to play and whether they relate directly to these sources of EHS.

1. **P** **Levallois P** *et al*, (August 2002) *Study of self-reported hypersensitivity to electromagnetic fields in California*, Environ Health Perspect. 2002 Aug;110 Suppl 4:619-23 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/12194896)]

Comment: A survey based study on those who were self-diagnosed as EHS. Researchers stated that EHS has been reported for more than 20 years. 68 subjects from a total of 2072 people (or 3.2% surveyed) were EHS. 27 Subjects indicated they were EHS but not sensitive to chemicals. Characteristics of the people reporting hypersensitivity to EMFs were generally different from those of people reporting being allergic to everyday chemicals. The perception of risk of exposure to EMFs through the use of hair dryers (vs. exposure to power and distribution lines) was the factor the most associated with self-reporting about hypersensitivity to EMFs. However, risk perception was not sufficient to explain the characteristics of people reporting this disorder.

1. **P** **Santini R** *et al*, (July 2002) *Investigation on the health of people living near mobile telephone relay stations: I/Incidence according to distance and sex*, Pathol Biol (Paris) 2002 Jul;50(6):369-73 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/12168254)]

Comment: Part 1 of a survey study on symptoms for people living or not living near a mobile phone base station. The study showed significant (p < 0.05) increase as compared to people living > 300 m or not exposed to base station, till 300 m for tiredness, 200 m for headache, sleep disturbance, discomfort, etc. 100 m for irritability, depression, loss of memory, dizziness, libido decrease, etc. Women significantly more often than men (p < 0.05) complained of headache, nausea, loss of appetite, sleep disturbance, depression, discomfort and visual perturbations. The symptoms described above match the nonspecific symptoms associated with microwave sickness, radiowave sickness and EHS.

1. **P** **Edelstyn N, Oldershaw A**, (January 2002) *The acute effects of exposure to the electromagnetic field emitted by mobile phones on human attention*, Neuroreport. 2002 Jan 21;13(1):119-21 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/11924872)]

Comment: A provocation study performed on healthy individuals (not people claiming to be sensitive). Sample size was not large and was looking at acute mobile phone exposures on cognitive tasks. The study showed improved performance for some of the tests for the exposed subjects. Significant differences between the two groups were evident after 5 min on two tests of attentional capacity (digit span forwards and spatial span backwards) and one of processing speed (serial subtraction). In all three instances, performance was facilitated following mobile phone exposure. No deficits were evident. From my own personal experiences I certainly have not experienced positive benefits from RF exposure. Quite the opposite, memory lapses, increased volatility (argumentative) and speech impairments to name a few.

1. **P** **Johansson O** *et al*, (November 2001) *Cutaneous mast cells are altered in normal healthy volunteers sitting in front of ordinary TVs/PCs--results from open-field provocation experiments*, J Cutan Pathol. 2001 Nov;28(10):513-9. [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/11737520)]

Comment: Provocation study with biological tests which looked for the presence of histamine-containing mast cells in the dermis of healthy volunteers. In vivo study indicated that normal cutaneous mast cells could be altered by exposure from ordinary TV/PC screens. This was demonstrated in 5 of 13 test subjects. It would be interesting to see what happens to people when they are exposed to RF to see if a similar reaction occurs. I know that if I take Zyrtec (antihistamine) it greatly reduces my reactions to WiFi – particularly with respect to dysaesthesia I experience. However 24 hours later I am totally wiped out (fatigued).

1. P **Lyskov E** *et al*, (October 2001) *Provocation study of persons with perceived electrical hypersensitivity and controls using magnetic field exposure and recording of electrophysiological characteristics*, Bioelectromagnetics. 2001 Oct;22(7):457-62 [View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/11568930)]

Comment: Provocation study with biological tests. persons reporting EHS differed from the control subjects in baseline values of investigated physiological characteristics. Perhaps EHS patients have a rather distinctive physiological predisposition to sensitivity to physical and psychosocial environmental stressors. The conclusions are touching onto something that we need to recognise and that is people have different sensitivity to environmental and emotional stress. Of course state of health and EMR exposure levels experienced all have a role to play.

1. **P** **Lyskov E** *et al*, (November 2001) *Int J Psychophysiol. 2001 Nov;42(3):233-41*, Int J Psychophysiol. 2001 Nov;42(3):233-41 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/11812390)]

Comment: Provocation test performed on a small sample of EHS and controls. The study data indicated that the observed group of patients had a trend to hyper sympathotone, hyper-responsiveness to sensor stimulation and heightened arousal. Also Heart rate variability and response to standing test were decreased in the patient group compared to the controls. I can associate some of my reactions to EMR with the studies finding particularly with respect to heightened sensitivity to sound and light.

1. **P** **Oftedal G** *et al*, (May 2000) *Symptoms experienced in connection with mobile phone use*, Occup Med (Lond). 2000 May;50(4):237-45 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/10912374)]

Comment: No testing performed as it was a cross sectional epidemiological study looking at the effects claimed to be experienced by mobile phone users. Most symptoms usually began during or within half an hour after the call and lasted for up to 2 h.

1. **P** **Gangi S, Johansson O**, (April 2000) *A theoretical model based upon mast cells and histamine to explain the recently proclaimed sensitivity to electric and/or magnetic fields in humans*, Med Hypotheses. 2000 Apr;54(4):663-71 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/10859662)]

Comment: A review of data and not an actual biological or provocation study. However the researchers found that data from studies made on interactions of EMFs with the cardiac function have demonstrated that changes are present in the heart after exposure to EMFs. This is often overlooked by researchers as they generally perform their heart monitoring during exposure.

1. **P** **Haugsdal B** *et al*, (1998) *Comparison of symptoms experienced by users of analogue and digital mobile phones: a Swedish-Norwegian epidemiological study*, Arbetslivsrapport 23: 1998 [[View Full Study](file:///C%3A%5CUsers%5CEd%5CAppData%5CLocal%5CMicrosoft%5CWindows%5CTemporary%20Internet%20Files%5CContent.Outlook%5C33X5BZQN%5Cnile.lub.lu.se%5Carbarch%5Carb%5C1998%5Carb1998_23.pdf)]

Comment: This study contacted people 3 consecutive times over a period of time. It shows symptoms such as concentration and fatigue occurred after they had been using the phone for several years. This correlates with my own personal experience where fatigue was not a symptom that I experience when I first used wireless devices but developed many years later after exposure to different forms of RF and EMR over time. Now fatigue is very common and occurs within a day of prolonged RF exposure and can last for days.

1. **P** **Eriksson N** *et al*, (December 1997) *The psychosocial work environment and skin symptoms among visual display terminal workers: a case referent study*, Int J Epidemiol. 1997 Dec;26(6):1250-7 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/9447405)]

Comment: Study suggests psychosocial conditions as well as VDT use could be attributed to dermatitis found in an Office illness study. Study was based on a survey and did not include any biological testing. Does not look at RF and EHS. Another possibility that may not have been considered is the fumes that might be coming out of the VDT (outgassing) as plastics and circuitry get hot with usage. I know of a number of cases where people who are exposed to pulsed radiofrequencies develop unexplained rashes on their body that disappear when the emissions are turned off. This suggests there is a possible immune component to their reaction. Not everyone has asthma or is allergic to peanuts.

1. P **Gangi S, Johansson O**, (December 1997) *Skin changes in "screen dermatitis" versus classical UV- and ionizing irradiation-related damage--similarities and differences*, Exp Dermatol. 1997 Dec;6(6):283-91 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/9412815)]

Comment: This study looked at patients with dermatitis that was associated to VDU usage. Biological tests were performed and showed similarities between VDU dermatitis and dermatitis caused by UV or ionising radiation exposure. This study however does not look at EHS and RF’s.

1. P **Sandstrom M** *et al*, (January 1997) *Neurophysiological effects of flickering light in patients with perceived electrical hypersensitivity*, J Occup Environ Med. 1997 Jan;39(1):15-22 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/9029427)]

Comment: Provocation test showed negative result with the exception of one case. Researchers indicated that sensitivity of the brain to visual stimulation was tested by means of objective electrophysiological methods such as electroretinography and visual evoked potential. A higher amplitude of brain cortical responses at all frequencies of stimulation was found when comparing patients with the control subjects, whereas no differences in retinal responses were revealed. A personal observation of my own and other EHS people I have been in contact with has shown that some EHS people tend to be sensitive to other stimuli such as light and sound. This test did not really prove EHS is linked to RF but did show sensitive people did react to visible light pulses consistently more than the controls. The retina contains visible light sensors which will stimulated resulting in signals being sent to the brain. Radiofrequencies are invisible, are absorbed by the body and it is believed that they cannot be felt directly (consciously). However some people’s bodies can react to specific RF frequencies and modulation patterns (whether it be neurological or immunological) resulting in effects that a sensitive individual can pick up consciously.

1. **P Forman SA** *et al*, (October 1995) *Psychological symptoms and intermittent hypertension following acute microwave exposure*, J Occup Med. 1982 Nov;24(11):932-4 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/7175588)]

Comment: Sample size is small (2 people) who had acute exposures to X-band microwaves. Researchers indicated “*comparable subjective symptoms and hypertension following a common exposure, provide further strong, circumstantial evidence of cause and effect*”. X-band is typically used for Radar but also in communications. What is not clear without looking at the full study is whether or not the exposure level was above the thermal protection guidelines.

1. **P** **Johansson O** *et al*, (October 1994) *Skin changes in patients claiming to suffer from "screen dermatitis": a two-case open-field provocation study*, Exp Dermatol. 1994 Oct;3(5):234-8 [[View on Pubmed](http://www.ncbi.nlm.nih.gov/pubmed/7881769)]

Comment: Biological test. Researchers were able to show a high-to-very high number of somatostatin-immunoreactive dendritic cells as well as histamine-positive mast cells in skin biopsies from the anterior neck taken before the start of the provocation. At the end of the provocation the number of mast cells was unchanged; however, the somatostatin-positive cells had seemingly disappeared.

**Appendix B EHS Non Specific Symptoms**

**Neurological:** headaches, dizziness, nausea, difficulty concentrating, memory loss, irritability, depression, anxiety, insomnia, fatigue, weakness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint paint, leg/foot pain, "Flu-like" symptoms, fever. More severe reactions can include seizures, paralysis, psychosis and stroke.
**Cardiac:** palpitations, arrhythmias, pain or pressure in the chest, low or high blood pressure, slow or fast heart rate, shortness of breath.
**Respiratory:** sinusitis, bronchitis, pneumonia, asthma.
**Dermatological:** skin rash, itching, burning, facial flushing.
**Ophthalmological:** pain or burning in the eyes, pressure in/behind the eyes, deteriorating vision, floaters, cataracts.
**Others:** digestive problems; abdominal pain; enlarged thyroid, testicular/ovarian pain; dryness of lips, tongue, mouth, eyes; great thirst; dehydration; nosebleeds; internal bleeding; altered sugar metabolism; immune abnormalities; redistribution of metals within the body; hair loss; pain in the teeth; deteriorating fillings; impaired sense of smell; ringing in the ears."

**"*Symptoms of Radio Wave Sickness" excerpt from ‘No Place To Hide’ April 2001***

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4. Gérard Ledoigt, Dominique Belpomme 2013 Cancer induction molecular pathways and HF-EMF irradiation Advances in Biological Chemistry, 2013,3,177-186
5. Irina Milisav 2011 Cellular stress response