

Research Article

## Cardiovascular Responses to Electromagnetic Radiation

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**ABSTRACT**

Electromagnetic signaling has recently greatly increased due to mobile telephony and computers some of which radiate much and have wide spectra. The radiations are also reflected and thus form standing waves with incoming ones. In cities both the direct and reflected radiations form complex networks of waves. People may get symptoms, if they are highly exposed. Radiations and standing waves can be best studied outside cities where there is much less man made electromagnetic activity. Also Faraday cages permit cleaning of the extra radiation. We have used both these methods and shown that people sense those maxima and minima. Their hands move involuntarily when they cross these. People can also become sensitive to irradiation, and their finger temperatures cool down when blood flow lessens when having mobile phones in their hands and when typing laptop computers, if these cause high radiation. They also may get hand pain and become clumsy. If a person has a pacemaker and the heart rate remains constant, the mobile phone opening and closing can be reflected in the measured blood pressure. If highly radiation sensitive people stop using mobile phone, their symptoms can lessen as seen in the control of circulation. In valleys of hilly rocky countryside the radiation level is low and sensitized humans get less problems. Unnecessary exposure to mobile telephony is recommended.

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### INTRODUCTION

Probably all organisms collect iron as they have it in their respiratory enzymes and magnetite crystals in their tissues (Angrove 2010). Microbes also collect iron, and ores in lake bottoms can be originally microbial. Many organism sense electromagnetic fields and use them e.g. in their navigation during migrations from microbes to birds and whales. The honey bees and ants use them when moving around their nests and find their ways back also from longer distances. Pigeons have magnetite in their bills. (Russel *et al* 2008)

Magnetite is found also in human tissues, brains included (Banaclocha and Banaclocha 2011). Although our knowledge how the electromagnetic signals are actually sensed and how the information transmission takes place to the brains is still poorly known, it is obvious that they are used in guiding the motion, obviously modified by other sensory signals. Magnetoreception is important for the maintenance the body balance (magnet reaction). Thus it is also essential also in circulation control. (e.g. Guyton 1956)

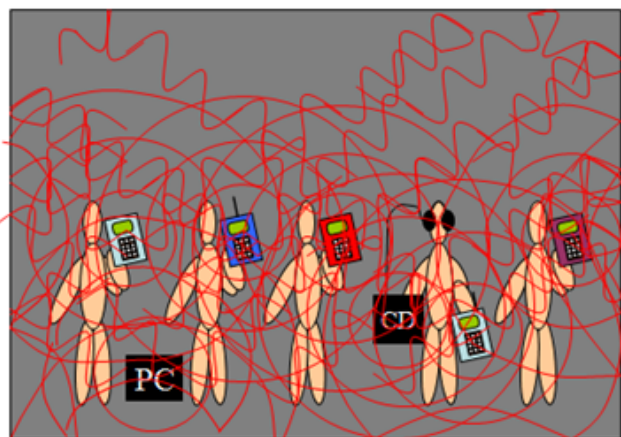
Electromagnetic load of people and whole biosphere has significantly rapidly increased in recent past two decades due to mobile telephony, its base stations and the use of portable music players etc close to their heads and lap top computers kept even on the thighs when sitting, thus near their gonads (Fig 1.). Man made electromagnetic activity exceeds several folds the former natural situation and also so near of our key organs like brains and heart - that existed earlier during the evolution. Electromagnetic radiation

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at frequencies used in radio and television broadcasting were previously considered harmless. Some humans and other organisms are much more sensitive than others due to variable loading near their skin, even brains and also their ability to correct the metabolic errors induced by the reactive intermediates even at low levels of irradiation. Several groups have reported that all the above mentioned agents break DNA molecules and that also interfere their metabolic correction. Both these actions can take place via oxygen free radicals. (Blank 2009, Davis 2010)



**Fig. 1**  
Schematic presentation of magnetic fields and electromagnetic irradiation emitted from most commonly used devices. Electromagnetic radiation and fields expose their active users but also others i.e. passive users.

## MATERIALS AND METHODS

The hand movements of 6 healthy volunteers were recorded in about 10 m test path between two buildings where both direct and the reflected electromagnetic waves formed standing maxima and minima in a forest covered countryside, where the powerful regional radio and television transmitting tower was in 5 km distance and not visible. The mobile phones were closed during the measurements, and there were no base stations in the area. The irradiation in the test path was recorded with a spectrum analyser (GW Instek GSP-827). The integrated radio frequency radiation (RFR) was measured with a broad band meter with a horizontal 150 cm long dipole antenna. The hand movement signals and the RFR signals were simultaneously stored in a computer. The instruments were carried in a rucksack when persons walked through the test path.

2nd chapter 2nd sentence: an infrared sensor.  
In laboratory eleven electromagnetic sensitive volunteers were first let to relax 15 min in a dentist chair in a simple Faraday cage. Their heart frequencies

were recorded in the same position with an infra-red sensor from a finger tip and brachial blood pressures were followed in a computer guided experiment. One of the volunteers had an installed pace maker. His hands became blue and cold when using mobile phone. Standardized mobile phone exposures were carried out with a silent standard mobile phone (Nokia, Finland) which was only opened and closed for 60 – 120 seconds to let mobile phone to make a contact to its base station and to close that again and the persons could not see this to happen. The mobile phone was placed 30 cm from the subjects' occiput center.

A computer program was used to calculate the data of heart rate, blood pressure and also the vegetative balance of circulation (based on the measured heart rates and blood pressures).

After the basic measurements we asked the most sensitive persons to avoid completely mobile phone use. One of them even moved for weeks to a cottage in forest covered rural area far from the base stations and radio and TV sending towers and again the recordings were repeated, but now without mobile phone exposure to record his circulation control.

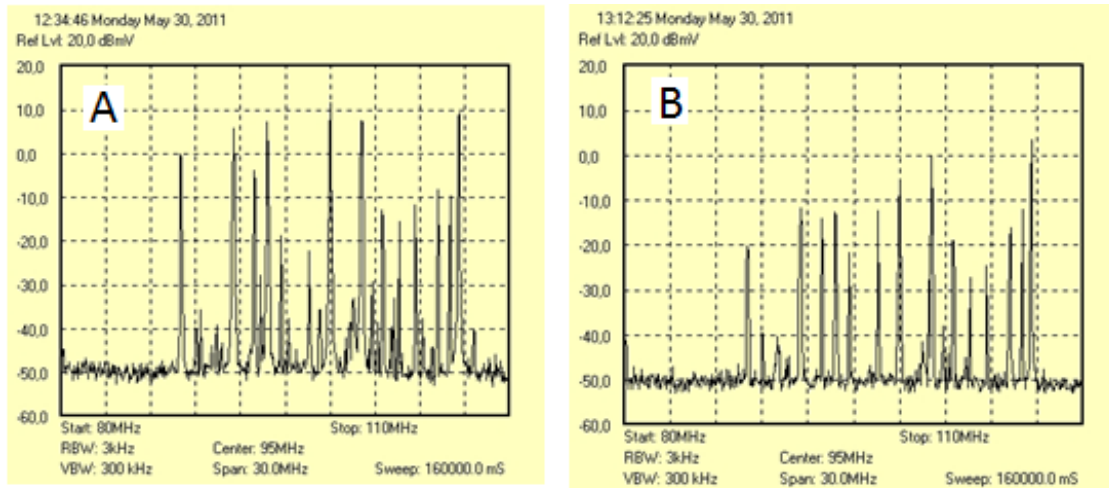
The hand temperature recordings were made with the aid of infrared video camera (IR Flex Cam, USA) in a distance of one meter when the subjects were typing different lab top computers (Fujitsu-Siemens and MacBook, Apple) in a Faraday room.

Also the radio waves of the computers emitted were recorded. One of the computers (the plastic covered Fujitsu Siemens laptop computer) radiated highly while the other one aluminium covered Apple MacBook was very much silent.

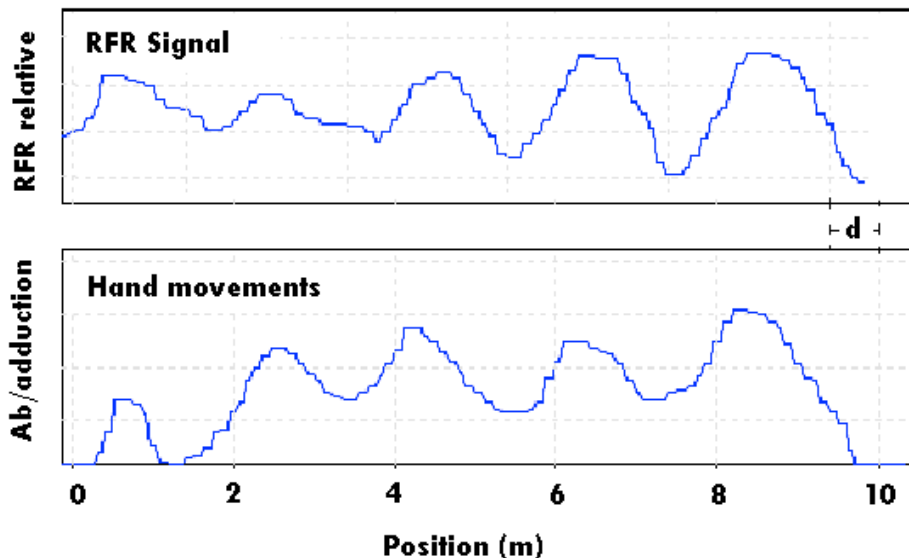
## RESULTS

Human body works as an antenna and picks the environmental irradiation (Fig 1). That can be directly recorded from the subjects' skin as also with physical antennas (Fig.2 A and B). The slight differences between 2 A and B were due to the fact that the direct measurement from the skin of the subject took place while he was sitting and the instrumental recording took place with a horizontal 150 cm physical antenna of the horizontally polarized signals.

Persons can also sense the standing radio waves. That is evidenced by their involuntary hand movements which were recorded when they walked across the maxima and minima of the standing waves generated by standard radio transmissions reflected back from a brick wall building 5 km from the sending tower and the persons carried the recording devices in the rucksack (Fig. 3.).



**Fig. 2.** Radiation spectra around the 100 MHz of common frequency modulated (FM) radio transmissions, recorded with a spectrum analyzer when the horizontally polarized signals were captured with the aid of a 150 cm long dipole antenna (A), and directly recorded from the same location the elbow skin of a sitting subject (one of us authors was serving as an receiving antenna) (B) and without any antenna as reference there was only small noise (not shown).



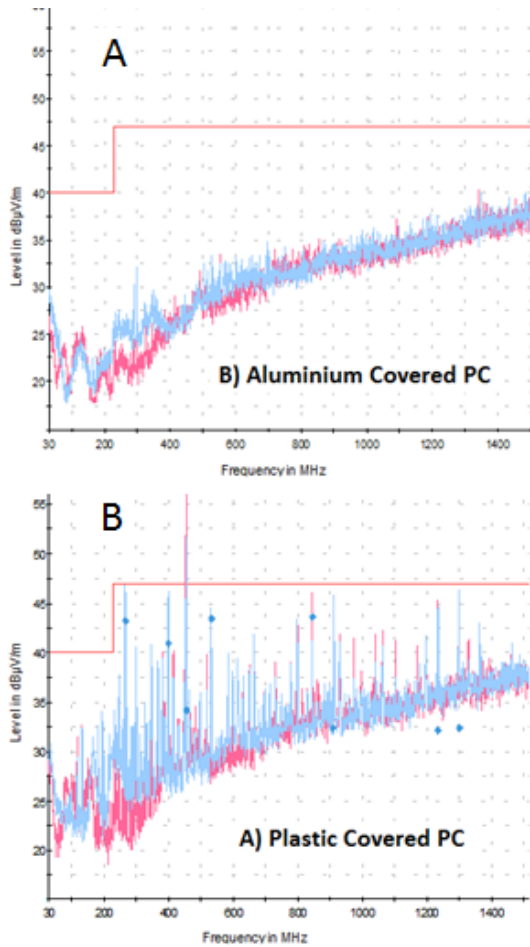
**Fig. 3.** Hand movements of a sensitive person correlated with the standing waves recorded by 150 cm long antenna linked to a computer carried in the rucksack. Reflection of FM-radio signals occurred from the brick wall about 5 km from the sending antenna in rural forest region. Distance between hands and the antenna were both nicely correlated. d is delay correction between the two signals

Fig. 4 shows the electromagnetic spectra emitted from two commonly used laptop computers. The emitted spectrum was much lower in a laptop computer having aluminium cover (Fig 4 BA) while the plastic covered laptop computer sent numerous high peaks (Fig 4B) When an electromagnetically highly sensitized person typed the above mentioned radiating laptop computer (Fig. 4B), her fingers cooled down fast, about up to one Celsius degree per minute as shown in Fig. 4C. She

experienced hand pain and could not use this computer in her work. She also reported clumsiness of her fingers. If the laptop computer had aluminum cover and was practically radiation silent as shown Fig 4A, she could work without pain for some hours.

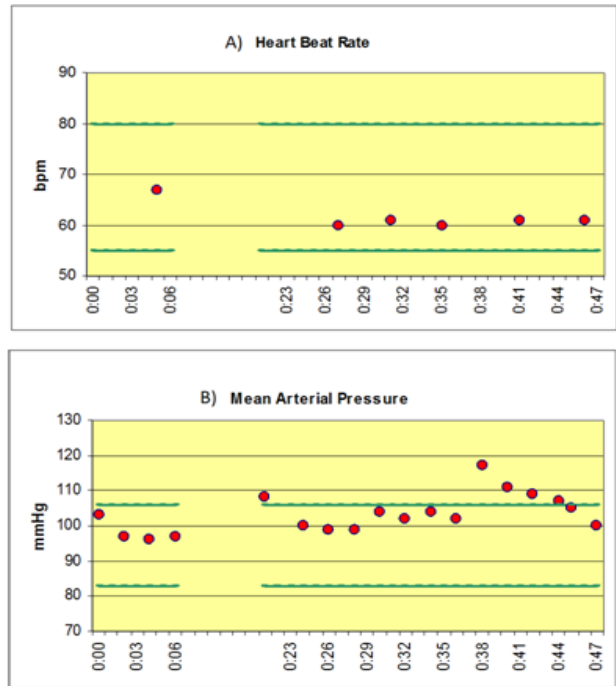
Sensitive volunteers seemed to respond, when they were blinded and a silent mobile phone was only shortly opened and closed behind their head. A highly electromagnetically sensitized pacemaker volunteer

reported rapid cooling of his hands, if he kept a mobile phone in his hand. When a standard silent mobile phone was opened and closed 30 cm from his occiput without his knowledge in a Faraday cage, due to the implanted pace maker his heart rate did not change as expected (Fig.5 A), but a short response was seen in his brachial blood pressure (Fig. 5 B).

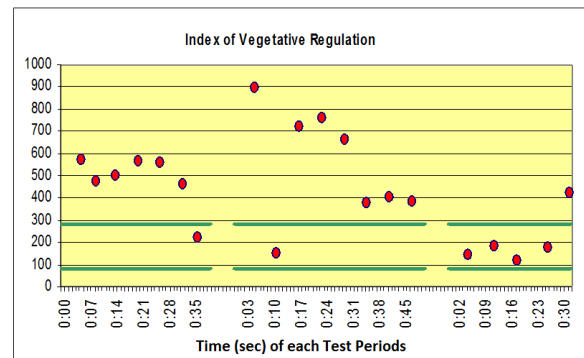


**Fig. 4.** Recoding of the radiowave spectra emitted by two laptop computers in common use. One with aluminum cover radiated much less (A) while a highly emitting laptop computer in plastic cover emitted much and over a in wide range (B). The finger temperatures of a highly electromagnetically sensitive typer cooled down fast the room temperature (C) when writing the highly radiating device. One can see that this laptop also radiated heat and still the fingers cooled when using it.

When electromagnetically sensitized persons avoided the exposure to electromagnetic radiation of mobile phones and were living in country side far away from the mobile phone base stations as also from the normal regional radio and TV antennas, they could at least partially recover as seen in the normalization of the autonomic index of circulation (Fig. 6).



**Fig. 5.** The heart rate (A) of highly electromagnetically sensitive volunteer having a heart pacemaker, when the silent mobile phone was opened and closed behind his back 30 cm from his occiput after relaxation and testing in a Faraday cage and his blood pressure increase due to unexpected short mobile phone on and off exposure (B).



**Fig. 6.** A partial recovery was seen in a very electromagnetically sensitive volunteer, when he spent 2 weeks in his rural cottage not using mobile phone and was far away from their base stations and also radio transmission towers. The normalization of the autonomic index of circulation is shown in a Faraday cage (without mobile phone opening and closing).

## DISCUSSION

Migratory animals are able to sense electromagnetic irradiation and use it in their seasonal travels even over long distances (Russel *et al* 2008). During the Second World War a lot of migratory birds were killed by the radars, which made the soldiers to ask why (personal communication to OH). The radars affected also the semen production i.e. the exposed soldiers became sterile (Davis 2010).

Humans are also able to sense much lower levels of electromagnetic irradiation than radars used and still use. The standing waves of normal FM radio transmissions make it easier to demonstrate as the maxima and minima are formed and make the difference of waves high and have thus have a greater contrast. Similar findings were made when moving back and forth of a metal reflector behind the test persons while they were standing in front of the reflector (Huttunen *et al* 2009). These recordings were made easier, if they were carried in forests and distant from housing where no mobile phones were used and no base stations either radio transmitting towers were close by (Huttunen *et al* 2009 and 2011).

If the irradiation source is near, as when keeping mobile phone in hand or when the fingers are typing of an highly radiating laptop computer i.e. the distance is only some 1-2 centimeters while the finger tips touch the keys for short contacts, the responses were easily recorded with infra red camera (Fig.4C). The laptop computers have different constructs, and their radiations are thus very different as seen in Fig 4 A and B. Plastic covered computer caused a rapid cooling of fingers and the cooling moved upwards in arms and caused pain. The pain was probably due to closing of peripheral circulation i.e. ischemia. The finger tips cannot cool more than to the temperature of the room. That itself cannot cause pain. As reflection to the high radiation level, the blood circulation was much closed in fingers and also wrists and up to forearms. This caused not only the pain but made the hands clumsy as the sensitive volunteer reported. That was due to electromagnetic radiation and not due the temperature decrease itself but due to neural response. That was initiated directly due to the action in sympathetic nerves (or possibly the magnetite crystals in fingers Banaclocha and Banaclocha 2011).

Some laptop computers have metal cover, and they may have also some other protective technical constructs to limit the radiation. This or both of them effectively lessened the radiation emitted as can be seen also in the spectrum Fig 4 A. The typing persons could keep writing for longer times when using an aluminium covered laptop computer without pain. If the highly radiating laptop computer itself was closed into a

Faraday box to prevent its radiation, even very sensitized persons could type long time with the keyboards outside the box (Hagström *et al* 2012).

The cooling of fingers and also hands suggest that that the peripheral sympathetic nerves respond to irradiation close by the mobile phones and laptop computers. Magnetite crystals are common in several tissues (Banaclocha and Banaclocha 2011). They can also be one of the targets of electromagnetic radiation. Magnetite is also found in finger tips and nearby tendons and muscles. One may wonder, if they are part of the sensory system there and contribute to the sensations the persons report. Iron is common element in all tissues and essential component of the respiratory chain enzymes in mitochondria. The mitochondrial metabolism can be directly affected by electromagnetic irradiation in addition to the anoxia due to suffering oxygen supply.

Our results of the highly radiation sensitive pacemaker volunteer's responses suggest that also central circulation regulation was affected when the silent mobile phone was only opened and closed near the subjects head. It is known that people who are sensitive to electromagnetic radiation suffer from headache, fatigue, depression and have several other problems (Hagström and Auranen 2013). This suggests that they may have brain circulation problems. As brains have magnetite crystals they may also be responsible for sensing the electromagnetic radiation and finally contribute to the effect. It has been reported that significant responses take place in brain glucose metabolism (Volkow *et al* 2011). Iron containing mitochondrial respiratory enzymes can also be directly involved in this response. Also blood-brain barrier problems exist at least in experimental animals (Nittby *et al* 2009). An increase of brain tumors in heavy mobile phone users support this conclusion in humans (Hardell *et al* 2013).

As the radio frequencies of emitted by mobile phones and computers can affect the local circulation in hands as we have here demonstrated as cooling of fingers, the clumsiness and involuntary hand movements thus caused can mean problems e.g. in traffic. This is one additional reason that mobile phones should not be used when driving cars (Huttunen *et al* 2011).

Mobile phone signals to and from the base stations generate responses in the user and some of them may also be universal in the body as the systemic blood circulation pressure is increased. This could be directly recorded in a subject whose heart rate did not change due the pacemaker. The distance from occiput to the persons' head was 30 cm. His blood pressure increase most probably was mediated from the brain signals to the sympathetic nervous system of circulation. The mobile phone signals weaken in the distance squared

and in this experiment only head was in the neighbourhood of the base station searching mobile phone.

The reports of sensitized subjects indicate that the start in their sensitivity was usually due the intensive use of computers and long hours in mobile phone use (Hagström and Auranen 2013). In mobile telephony more limited frequency area of electromagnetic radiation is used than is released from computers (Fig.3 A and B). Some of the very sensitive persons claim that even electromagnetic irradiation of sun light cause serious problems. Thus the sensitivity can probably broaden with time to other frequencies and in worst case to even to the frequencies emitted in sunlight. Sensitivity to mobile phone use seems also to broaden to other agents in allergic persons.

Luckily the symptoms of sensitive people seem at least partially weaken if the electromagnetic exposure is lessened as also shown in our study. Help can be found in countryside, especially valleys between hills (Hänninen et al 2011)

In conclusion, the electromagnetic radiation, which has so much increased, can cause several problems both in nature and also in human health. The unnecessary use of radiating computers and mobile phones, which also means high activity in their base stations should be avoided. It is recommendable to keep these devices closed when not in use. Luckily there are computers and other devices, which radiate much less than others i.e. there are better technologies than some others. To alleviate symptoms, one can seek shelter in places where the man made radio waves are minimal. Those places can be found by modest measurements, but also sensitive persons can directly give their advice, too.

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