

The 5G communication system - Expect skin and general health problems

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Abstract

In the Netherlands, the first transmitters of the 5th generation mobile telephony have been taken into use by three telecom companies. In the Netherlands, the transmitters mainly work on 700 MHz. It is a kind of "entry-level 5G" transmitter, without the features of the later 3.5 GHz in 2022 and the 26 GHz transmitters in 2027 or later. Some people may experience additional electrical stress complaints (EHS). Not only for the chronic 50 Hz synchronization pulses in the signal, but also because of the numerous 3.5 GHz "small cells" that are to be installed and increase exposure. The proposed 26 GHz transmitters increase the risk of skin damage and disruption of physiological functions due to non-thermal effects. The skin is a large, delicate, thin and fragile organ. The recently updated ICNIRP exposure limits do not take into account the special position and functions of the skin. There are effects of 5G radiation on biological matter, but a link between physiological effects and health problems is not being sought. It is time to set up a 'task force' to specifically elucidate the effects of 5G radiation on the skin and on well-being - and adjust the exposure limits accordingly.

Transmitters and biological effects - in order of appearance

Three internet providers: KPN, Vodafone / Ziggo and T-Mobile put their 5G channels into use after the acquisition of broadcasting licenses during the auction on July 21, 2020. It concerns frequencies in the 700 MHz band (*plus* 1400 and 2100 MHz) bands. Its electromagnetic fields reach far and penetrate the walls of houses even better than existing transmitters. The transmitters will provisionally be installed in the existing high transmission masts, whether or not integrated with the 4G systems.

In a few years' time, we will get the 3.5 GHz systems with limited MIMO, which will mainly be installed in streets and public spaces. They can handle considerably more conversations and data.

Only after years will the 26 GHz band become operational in this country. Those advanced transmitters are then equipped with all 5G options ¹. Such as super-fast connections for many callers simultaneously (massive MIMO and beamforming). This gives everyone who registers with a 5G smartphone their own bundle connection with the transmitter, wherever they walk. Given the high frequency and therefore small wavelength, the fields of these transmitters consist of "millimeter waves" (MMW). The 5G systems radiate all pulsating fields, day and night, pulse frequency 50 Hz. The Internet service providers have never investigated potential health effects and do not intend to do ². Hundreds of scientists have expressed concerns in the 5G Appeal, issued to the UN, WHO and UNEP ³. The reasons for these concerns are listed below.

Health effects

Pulsed fields are generally harmful

People can develop a hypersensitivity (cf. allergy) to the low-frequency radiation from household appliances, or to the high-frequency (RF) radiation from transmitters in the home or outdoors, or to both. Digital electronics is in many cases the culprit, especially the switching power supply of electronics in it that produces pulsed "dirty" power. Approx. 3% of the citizens developed a hypersensitivity to this, called 'electrical hypersensitivity' (EHS) ^{4, 5}.

In addition, several household channels were also installed that pollute the ether with pulsed transmission signals, such as Dect phones, WiFi, mobile phones, Bluetooth, Zigbee and other communication modes. All of these sources of EMF are pathogenic. The remedy is to switch off or remove that piece of equipment, or to increase the distance to the source ⁶.

Transmitters of the second (2G), third (3G) and fourth-generation (4G) transmitters also give comparable EHS complaints to local residents: chronic fatigue, sleeping problems, ringing in the ears, headache and many derived complaints ⁷. These transmission signals are also pulsed. A physical characteristic of 'pulses' in electronics is that the rising and falling edges of the signal, such as those that can be visualized on an oscilloscope, run very steeply and that the duration of the pulse is very short: from a few to several hundred microseconds. In some unknown way some physiological process in the body is disturbed by the pulses. Presumably one or more functions of the nervous system are affected, although those precise effects have never been further analyzed.

The 5G transmitter fields are also pulsed, frequency 50 per second ⁸. The arrival of more 5G transmitters means cause an increase in the field pressure on humans. With the predicted installation of unprecedented large numbers of 3.5 GHz transmitters as small cells in streets, and as picocells in offices, and as Internet-of-things (IoT) applications in the household, this is a foreseeable extension of the total transmitter fleet ⁹. We fear for the health of many.

ICNIRP: "The skin should protect the body against millimeter waves" - Nonsense!

The skin is an integral part of the body. The skin collects all MMW and is likely to suffer damage – and – as a consequence - also the interior of the body. Millimeter waves (MMW) are absorbed by water molecules, which gives an increase in temperature in the tissue, just like in a microwave oven. MMW enter the body only 1 mm or less and thus get stuck in the water-containing structures in the skin. The skin thus becomes the major addressee.

ICNIRP ¹⁰ simply sees the skin as a kind of "shell" that absorbs MMW waves and "thus" protects the body against MMW effects. The skin is not considered separately in terms of exposure limits, but it is considered a "limb" ¹¹. The advantage of this reasoning for telecom is that one can increase the radiation intensity by a factor of 2.5. The body temperature may increase of 2°C, for a limb that is 5°C. This is unfavorable for the skin because it concentrates all the radiant energy that was actually "intended" for the entire body part of which it is part. The skin has a thickness of about 1 mm ¹², an area of up to 2 m² and a mass of 7 kg, which is about 10% of the body mass ¹³. While capturing all incident energy, the skin is loaded with ten times the foreseen field energy. That is, if the skin had a homogeneous structure. But the skin contains layers / structures with hydrophilic or lipophilic properties. Only the water-containing structures can absorb the MMW energy and it are precisely these layers that are now heavily being overloaded. The result have yet to be worked out.

The skin - a large and delicate organ

The skin is a metabolically active organ with a very complex structure and contains many organ functions, endocrine and immunological ¹⁴. It contains a series of senses and receptors, contains numerous - sometimes 'naked' nerve endings with neuroactive substances, cytokines and other regulating compounds. The exact functions of this have only been partially clarified. Given the vulnerability of all those components to EMF and MMW, there are fears of health effects on skin and body ¹⁶.

Morphology of the skin

Figure 1 shows the layered structure of the skin, with on the outside (top of the figure) the stratum corneum with dead cells. MMW can partly reflect that layer, depending on the moisture content. Below this is the horn-forming epithelial cell layer of the epidermis, the keratinocytes. The dermis underneath is the most voluminous part of the skin with numerous structures such as blood vessels, sweat glands with drainage, muscle fibers, nervous system branches, often filled with many types of

neuroactive transmitter substances sensors, sensory cells and hair, and various free-moving cell types such as leukocytes, macrophages and cells of the immune system. At the base the hypodermis, associated with a basement membrane and muscle layers.

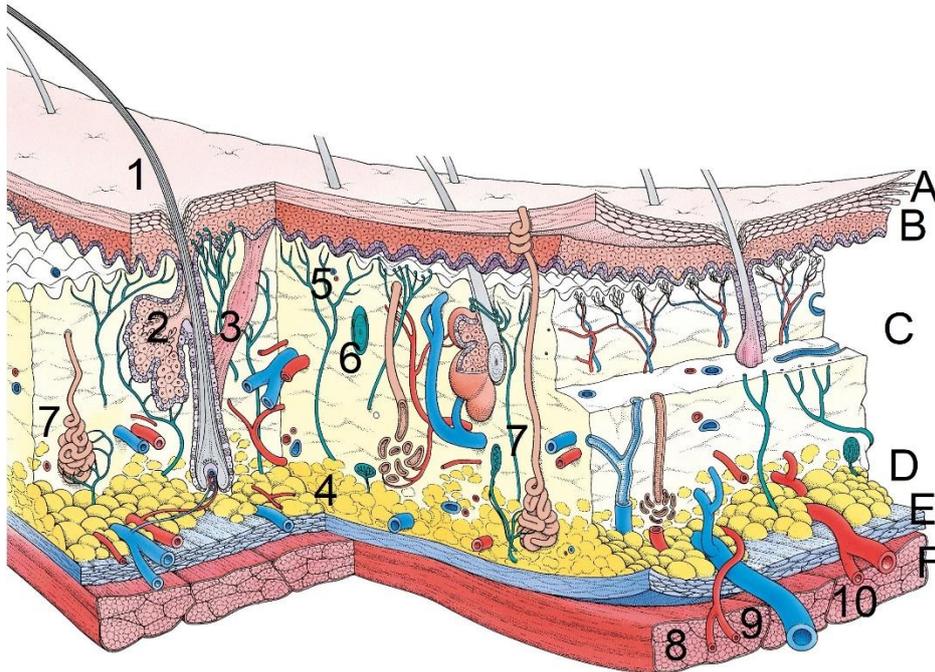


Figure 1. Schematic representation of a cross-section of the skin. Layers: A, stratum corneum; B, epidermis; C, dermis; D, hypodermis; E, basement membrane; F, muscle layer. Components complete with innervation and blood supply: 1, hair; 2, hair follicle; 3, muscle; 4, adipose tissue; 5, branched bare nerve endings; 6, macrophage; 7, sweat gland with drain tube outward, spiraling; 8, muscle layer; 9, vein; 10, artery. *Source: Alamy Stock Photo*

Functions of the skin

The skin is not only the target organ of the nervous system and the neurohormonal system, the skin is above all a rich source of many types of hormones and immune-active substances ¹⁷. The skin can be understood as a semi-autonomous peripheral "organ", which serves to protect the rest of the body against damage by mechanical forces, dehydration, heat and cold. In addition, the skin is equipped with many types of senses and sensors to monitor the environment for relevant environmental factors.

The skin has a dense peripheral nerve network for communication with the central nervous system - upstream and downstream. There is also communication via the bloodstream and signaling substances of the immune system. Any "experience" is "noticed" and will lead to compensatory responses to ensure homeostasis.

Heat development - thermal effects of 5G / 26 GHz waves)

Stretched structures in the skin act as receive antennas for millimeter radiation ¹⁸. These can be blood vessels, intercellular fluid-filled spaces, and especially sweat gland drainage ducts. The helicoidally shaped end of such a duct, filled with conductive sweat moisture, is perfectly suitable as an antenna for MMW ¹⁹. They may be expected to become overheated, resulting in damage to the cell itself and surrounding tissues.

It is even worse because biological structures are not a homogeneous conductive mass. In a model approach with dead bovine brains, the outer millimeter of the brain mass was warmed up to 35°C, after a 30-minute irradiation with a 39 GHz field ²⁰. That is approx. 175 times stronger warming than radiation with a 1.9 GHz field. This is due to the micro-architecture of brain tissue. Admittedly, the

meninges aren't skin, and there are more uncertainties in assumptions used. Nevertheless, this shows the oversimplification of the ICNIRP principles. Warming is seen as a simple diffusion process of heat; heat diffusion differs in complex composite fabric layers.

Non-thermal tissue effects of millimeter waves (MMW)

The non-thermal effects are of biological importance. They concern, among other things, physical effects on the structure of biomolecules and on the change in function of biological processes in which temperature does not play a role ²¹. The characteristic of non-thermal effects of EMF is that they occur at field densities far below the exposure limits of the ICNIRP ²².

Neurological effects. There are several examples of the influence of nerve and brain tissue nervous stimuli activity on MMW. It is not the cell bodies of the neurons in the spinal cord that are susceptible to MMW disturbance. It is the "naked" pieces of nerve spurs - dendrites and neurites / axons - that are not partly surrounded by the insulating glia sheaths. "Naked" nerves in the paw of the mouse respond to stimulation by MMW with a decrease in spontaneous spike activity. This is due to a further decrease in the negative cell wall potential, which makes it less sensitive to stimulus transmission ²³. In an in vitro culture of neurons in a thin slice of rat cerebral cortex, the neuronal activity could also be suppressed by MMW irradiation. It did require a precisely adjusted dose: too low or too high stimulus strength had a sub-optimal effect. This is due to the complexity of the neuron network in this tissue piece. The most effective stimulus field strength was orders of magnitude below the limit for this frequency range ²⁴.

The stimulation frequency is also important because it should induce resonances in a frequency-dependent manner in the naked axon membrane. There, elastic membrane displacements occur, as a result of which the ion ports in the membrane can no longer optimally spread over the lipid membrane and function as an ion channel ²⁵.

Molecular effects. Numerous molecular and cellular effects have been found with MMW exposure in the higher GHz range. In the former Soviet Union, much research has already been done on this in the last century. Several health complaints were successfully treated ^{30, 31}. MMW has also proven its worth for cancer therapy ³², but in the Western world the (most Russian) publications have never attracted much attention.

Searching for MMW effects on humans, Dariusz Leszczynski ³³ found only 99 articles on MMW in biological databases, of which only 11 related to humans. There is still no clear picture of the primary physico-chemical or molecular effects on any biological material. Effects on mucous cells, fibroblasts, keratinocytes, lymphocytes and melanocytes were found in human cells in vitro. There was considerable variability in effects on different skin types and between persons. The state of health also influences the strength of effects.

MMW effects were found on gene expression, chromosome breaks, oxidative stress, immunological processes, genotoxicity and inflammation, among others. The energy of MMW is said to be too small to influence biochemical interactions. However, resonances with cell structures or charged groups of biomolecules can explain the effects of MMW, including the breaking of hydrogen bonds or influences of the van der Waals forces ³⁴.

Structural change of biomolecules. The general view is that EMF can generate molecular resonances in charged chemical groups on the surface of macromolecules, such as proteins. Due to the configuration changes, connections between protein and substrate may not or will not take place as well. This applies to all kinds of receptors and to the ion gates of the 'voltage-gated calcium channels (VGCC)' ³⁵. Charged groups on the proteins of the ion gates can undergo a change in shape due to the alternating electric fields, such that also the permeability of the gate for Ca⁺⁺ ions

changes. This also applies to the ion ports for other ion types³⁶. Uncontrolled intake of ions can disrupt the cell or organ function - and thereby the entire organism.

Effects on the genome. Experiments with MMW mainly date from the last few years and are summarized by²⁶. Research concerned the effects on biomolecules, cell membrane potentials, ion gates and cell divisions²⁷, in animals. There are also effects on gene expression, transcription, protein form, oxidative stress, immune reactions and other functions²⁹. Long-term exposure to 35 GHz fields gives both thermal stress and inflammation of the skin³². Irradiation of rats with radio frequency fields from a Dect phone or smartphone produces major shifts in the protein pattern in the brains of mice³⁹. Also, the irradiation of human skin for 1 hour with 900 MHz fields from a GSM telephone at a SAR of 1.3 W / kg showed a shift in the synthesis of 8 proteins⁴⁰. These observations indicate that radio frequency fields alter the DNA and RNA expression²⁸.

We need more research – But what type of research....?

Earlier experiments were carried out with MMW of very different frequency and intensity, but none of them contained the precise frequency and data modulation of the 5G waves currently used with 5G. Furthermore, the tests were often carried out with field strengths that are (far) above the ICNIRP limits that we consider too high after all. We must repeat experiments with current field parameters in daily life. And the implementation of 5G systems is now going fast³⁷.

What type of research is to be done, then? We search for "targets" of EMF impact on the body^{1, 28}. It is obvious that there is cell and DNA damage, but the significance of this for the development of health complaints is still unknown. There are claims that the rise in melanoma incidence in Sweden is the result of increased radiofrequency tissue damage⁴¹. In the Netherlands, there has been a dramatic increase in the number of the skin cancers, type 'basalcarcinoom', over the last few years, especially in the head/neck region of the body⁴². It is fully speculative, but can there be a connection with excessive exposure of patients to the fields around 4G smartphones? And what then to expect from high densities of 5G waves?

Fundamental biological studies as to disturbance of physiological processes are indispensable, but well-designed epidemiological studies are necessary as well. A European Parliament report supports this allegation¹⁵. In spite of the fact that the 'Precautionary Principle' has been accepted by the EU³⁸, there is no evidence that initiatives for new research are being announced.

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