

Case Report: Both Parents and their Three Children Developed Symptoms of the Microwave Syndrome while on Holiday near a 5G Tower

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1. Abstract

Antennas emitting radiofrequency (RF) radiation for 5G wireless communication are being deployed since 2019/2020 in Sweden, although no studies are available on health impacts from the new 5G radiation. In five case reports published during 2023 we have described that persons living or working close to 5G base stations developed the microwave syndrome soon after installation of the base stations. In this new case report we describe a previously healthy family of a man, a woman and their three children that rapidly developed symptoms of the microwave syndrome after arriving at a summer cottage located at 125 meters distance from a mobile phone tower with 5G antennas. The most severe symptoms for the adults were sleeping problems, headache, tiredness, and irregular heartbeat. The children got sleeping problems, diarrhea, pain in the stomach, skin rashes, headache, and emotional symptoms. All the symptoms disappeared and health was restored when the family returned to their own house at another place with no 5G base stations. No measurements were available inside or outside the cottage during the time the family stayed near the mast. Later measurement showed that the radiation level varied from 9 000 to 43 400 $\mu\text{W}/\text{m}^2$ outside the cottage on the 5G base station side, compared with 2 500 $\mu\text{W}/\text{m}^2$ at most within their regular home without a 5G base station nearby. However, during their stay it is likely that the radiation was higher due to more mobile phone users staying at this summer cottage area. This case report is in line with results from our previous case reports showing that 5G rather rapidly may cause ill health and that elimination or reduction of

5G exposure restores health back to normal.

2. Introduction

Microwaves are frequencies between 300 MHz and 300 GHz within the radiofrequency (RF) spectrum and it is within these frequency bands that 2G, 3G, 4G and 5G technologies operate. Exposure to pulse-modulated microwave (RF) radiation was documented to have increased a lot after the 4G and 4G+ deployment [1]. 5G for wireless communication has been rolled out since 2019/2020 in many countries. While previous studies on health effects from RF radiation emitted from mobile communication technology have investigated effects from previous generations, mostly 2G and frequencies used for WiFi and 3G, no research on possible negative health or biological effects from the radiation emitted from 5G were available before the rollout. The lack of studies on health effects caused scientists and medical doctors to sign the 5G appeal (www.5gappeal.eu) asking for a moratorium on the 5G deployment until health risks with the 5G RF radiation have been properly investigated. The appeal also stated that the 5G technology would lead to a massive increase in exposure to RF radiation [1,2]. In city environments in Sweden, frequencies used for 5G are currently in the 3.5 GHz band. (<https://pts.se/sv/5g/inforande-av-5g/>). Normally today, 5G base stations use both 5G and 4G+ antennas, which further complicates real life exposure situations. Over the coming years, the telecommunications industry plans to roll out 5G millimeter wave technology using frequencies from 24 GHz and above. This technology is also untested as to its safety for human health and the environment [3].

Concerns about the effects of 5G were also formulated in a paper for the European Parliament in 2019 that raised the issue of more complex exposure from 5G than from previous systems: “Although fields are highly focused by beams, they vary rapidly with time and movement and so are unpredictable, as the signal levels and patterns interact as a closed loop system. This has yet to be mapped reliably for real situations, outside the laboratory” (https://5gfree.org/wp-content/uploads/2020/07/IPOL_IDA2019631060_EN.pdf).

The safety limits for exposure to RF radiation applied by most countries around the world are still based on heating (thermal) effects that appear within short time of exposure (less than an hour). Protection against long-term exposure effects and any other harmful effects that are not caused by heating are excluded [4-6].

The limits were first established in 1998 by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) a private organization based in Germany [7], and later recommended by the WHO and the EU Commission. In 2020 ICNIRP modified the recommendations and relaxed them somewhat in spite of increasing critique of their ability to protect against harm (www.emfscientist.org). The ICNIRP limits are important to the telecommunications industry thereby facilitating the deployment of 5G and the other wireless technologies emitting RF radiation [8,9]. 5G roll-out would be difficult or impossible if the limits were lowered 100 times according to a leading 5G infrastructure provider (https://www.itu.int/en/ITU-T/Workshops-and-Seminars/20171205/Documents/S3_Christer_Tornevik.pdf).

3. Animal Studies on 3.5 GHz

There were at the start of the roll-out of 5G practically no studies available on biological effects from exposure to the 5G frequencies around 3.5 GHz [10].

A few animal studies have by the time of the publication of this case study investigated effects on animals after exposure to levels below the ICNIRP limits, but no study has this far investigated exposure similar to that encountered by millions of people now exposed to radiation from 5G antennas in combination with 4G technology.

The studies exposing animals to the 3.5 GHz frequency have found negative effects such as oxidative stress in the liver, kidneys, the plasma, degenerated neurons in the brain as well as oxidative stress in muscles and negative effects on bone strength. Further, modified behavior after fetal exposure has been reported [11-14].

4. Human Laboratory Study

A study published in September 2023, investigating effects on human brain waves, exposed 34 healthy young volunteers to GSM pulse-modulated 3.5 GHz at a mean level of between 1.5 and 2 V/m or up to 10 610 $\mu\text{W}/\text{m}^2$ during 26 minutes. The estimated peak power density (PD) was calculated to 680 000 $\mu\text{W}/\text{m}^2$. The authors reported “an overall non-significant difference in beta, alpha, theta, United Prime Publications LLC., <https://acmcaseport.org/>

and delta brain oscillations relative to 5G exposure. However, a few electrodes in the baseline-corrected exposure and post-exposure periods exhibited significant modulation corresponding to the eye condition only in the alpha, theta, and delta rhythms, which did not survive the posterior statistical correction.” [15].

This study consequently exposed 34 persons, that were non-representative of the general population (all are not healthy and sensitivity to microwave exposure varies), to levels far below the allowed limits from ICNIRP (10 000 000 $\mu\text{W}/\text{m}^2$) during a very short time (26 minutes). In spite of this, some changes in human brain waves were observed. However, a 5G signal generator was not used. Instead the exposure was GSM modulated (personal communication with first author) and is consequently not representative of real 5G exposure. In addition, real life exposure includes simultaneous exposure to several other signals, for instance to 4G.

5. The Microwave Syndrome

Microwave syndrome, sickness or illness as an effect of microwave exposure, was reported already in the 1960’s and 1970’s in the East European countries [16,17]. Investigations of exposed workers showed that microwave (RF) exposure at non-thermal levels caused symptoms such as fatigue, dizziness, headache, sleep disorders, anxiety, problems with attention and memory [18]. A review of these studies, as well as studies on animals, concluded that “a surprisingly wide variety of neurological and physiological reactions are to be expected” because of exposure to non-thermal levels of RF/microwave radiation [19].

Other term for the illness was radiofrequency sickness syndrome [20]. The non-thermal effects depend primarily on the modulation and/or pulsation of the signal and also on the peak and average intensity. Pulsed signals and simultaneous exposure to several frequencies caused more effects and were thus considered more hazardous. The observed effects increased with time of exposure [21,22].

In general, the symptoms declined and disappeared after the exposure had ceased, but it could take some time, in some cases several weeks or more [18].

6. Previous Studies on Health Effects near Base Stations

Studies investigating health effects among inhabitants near mobile phone masts or base stations have been published during the last two decades. Some studies have investigated prevalence of symptoms identified within the microwave syndrome, others have investigated risk of cancer or effects on biomarkers or indications of genetic damage [23,24]. One study from France has studied risk of ALS [25]. According to a review of most of these studies published in 2022, 17 of 23 studies showed evidence for radiofrequency sickness or the microwave syndrome, 10 of 13 reported increased cancer risks and 6 of 8 studies found changes in biochemical markers among people living in the vicinity of masts or

base stations [24].

6. Previous Studies on Health Effects from 5G Base Stations

We published recently five case studies on health effects from 5G base stations [26-30]. These studies showed that the study persons developed the microwave syndrome after the installation of 5G base stations that caused high pulsed RF radiation in their apartments or office. The levels measured in the case studies were much higher than levels that previously had been reported to increase the risk of these symptoms in studies of people living close to base stations [31-33].

All studied persons developed symptoms of the microwave syndrome to a varying degree, in some cases so severe that the persons left the apartment already after a couple of days for another dwelling.

These five studies are to our knowledge among the first ever to have been made on health effects in persons exposed to real life 5G RF radiation. Thus we were motivated to investigate further the potential health effects of being exposed to RF radiation from base stations for 5G.

7. This Case Study

In this article we present a new case study of a family with five persons, a man and a woman both 39 years old and their three children 4, 6 and 8 years old. The parents rented a summer cottage from July 29th to August 1st 2023. A mobile phone tower, 24 meters high, with 5G and 4G antennas was situated 125 m from the house (Figures 1 and 2).

The family had previously rented the same house during the past two summers (2021 and 2022) without experiencing any health issues. The mobile phone tower was also at these occasions at the same spot, 125 meters away from the house. However after their last stay in the summer 2022, two of three telecom operators using the tower, installed 5G antennas at the site during November/December 2022. Also a third operator had antennas on the tower and had installed 5G equipment during their stay in 2022 but not in 2021. Consequently, in 2023, there were in total three operators with 5G antennas on the tower.



Figure 1: Tower with 5G antennas (A) situated 125 m from the cottage where the family stayed (B).



Figure 2: Picture of the 5G tower at 125 m distance from the cottage where the family stayed.

8. Methods

The parents were asked to fill in a questionnaire about symptoms and the severity of the symptoms (on a scale of 0 to 10) that the family experienced during the stay in the summer house close to the 5G tower as well as before the stay and after coming back to their permanent home. The questionnaire is a list of symptoms identified within the microwave syndrome. The questionnaire was also used in our previous case studies [26-30].

Measurement of RF radiation outside the summer cottage was performed on October 9, 2023 with the device Safe and Sound Pro II broadband RF meter. The true response detection range is between 400 MHz and 7.2 GHz. It was calibrated by the manufacturer and has an accuracy of ± 6 dB (<https://safelivingtechnologies.com/products/safe-and-sound-pro-ii-rf-meter.html>). Ten measurements of RF radiation was performed at each side of the summer house, at 1 m distance from the outer wall.

Measurements were also performed on September 19 and 20, 2023 in the regular home of the family with the same meter.

9. Results

9.1. Measurements of RF Radiation

The measurements showed that the levels of RF radiation was high on the side of the summer house which faced the 5G tower with free sight and no obstacles between the house and the tower. The levels varied between 9 000 and 43 400 $\mu\text{W}/\text{m}^2$ (results not in table).

At the other sides of the house measured levels were much lower and maximum peak levels varied between 200 and 400 $\mu\text{W}/\text{m}^2$ due to the attenuation of the buildings in between these sides and the tower.

The measurements in the family's home showed much lower levels of radiation. At the pillow in the beds of the five family members the maximum peak levels varied between 257 and 1 403 $\mu\text{W}/\text{m}^2$, between 758 and 2 500 $\mu\text{W}/\text{m}^2$ at the table in the living room, and between 553 and 593 $\mu\text{W}/\text{m}^2$ at the kitchen table (results not in table).

9.2. Health Symptoms

The results for self-assessed symptoms by the parents and their children at home before the vacation, while staying in the area near the 5G tower including in the cottage, and after returning home, are presented in Table 1. Only symptoms graded >0 are displayed.

The answers were given on August 10, 2023, one week after the family had returned to their home.

The most severe symptoms, graded to be 10 on the 10-grade severity scale while staying in the rented cottage were sleeping problems, headache, tiredness (fatigue), and irregular heartbeat for the adults. The woman experienced soon after the arrival high pulse, graded 10. In addition she experienced dysesthesia (abnormal sense of touch), graded 7 on the severity scale. She also reported numbness grade 8 in arms and legs (not in table). The man soon experienced breathlessness, grade 5, after arriving at the house near the 5G tower.

Also all children aged 4, 6 and 8 years had sleeping problems and were emotional, both symptoms graded 10 on the 10-grade severity scale. Two of the children got diarrhea, pain in the stomach and headache graded between 8 and 3 on the severity scale. The child aged 6 years who did not get pain in the stomach and diarrhea, got skin rashes graded 8 on the severity scale.

All symptoms disappeared soon after returning to the family's home apart from emotional symptoms (emotive, irritability) among the children that were reduced to the same grade as before the stay near the 5G tower (5 on the severity scale) and early waking up for the 4 year old boy that was reduced to same level as before the stay in the summer house.

Table 1: Clinical symptoms grades 0-10. Grade 0 = no symptoms, 10 = unbearable pain and/or discomfort for man 39 years, woman 39 years and boys 8, 6 and 4 years old adapted after [37].

Symptom	One week before 5G	July 29 – August 1, 2023 with 5G	One week after 5G
Headache			
Man 39 y / Woman 39 y	0 / 0	5 / 10	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	8 / 0 / 3	0 / 0 / 0
Dysesthesia			
Man 39 y / Woman 39 y	0 / 0	0 / 7	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
Fatigue			
Man 39 y / Woman 39 y	0 / 0	10 / 10	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
Sleeping difficulty			
- insomnia			
Man 39 y / Woman 39 y	0 / 0	10 / 10	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	10 / 10 / 10	0 / 0 / 0
- waking night time			
Man 39 y / Woman 39 y	0 / 0	10 / 10	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	10 / 10 / 5	0 / 0 / 0
- early wake-up			
Man 39 y / Woman 39 y	0 / 0	10 / 10	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 5	10 / 10 / 10	0 / 0 / 5
Cardiovascular abnormalities			
- irregular pulse			

Man 39 y / Woman 39 y	0 / 0	0 / 10	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
- transitory high pulse			
Man 39 y / Woman 39 y	0 / 0	0 / 10	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
Dyspnoea			
Man 39 y / Woman 39 y	0 / 0	5 / 0	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	0 / 0 / 0	0 / 0 / 0
Emotive			
Man 39 y / Woman 39 y	0 / 0	0 / 0	0 / 0
Child 8 y / 6 y / 4 y	5 / 5 / 5	10 / 10 / 10	5 / 5 / 5
Irritability			
Man 39 y / Woman 39 y	0 / 0	0 / 0	0 / 0
Child 8 y / 6 y / 4 y	5 / 5 / 5	10 / 10 / 10	5 / 5 / 5
Diarrehea (involuntary)			
Man 39 y / Woman 39 y	0 / 0	0 / 0	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	8 / 0 / 8	0 / 0 / 0
Abdominal pain			
Man 39 y / Woman 39 y	0 / 0	0 / 0	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	8 / 0 / 8	0 / 0 / 0
Skin, rashes (face, arms, legs)			
Man 39 y / Woman 39 y	0 / 0	0 / 0	0 / 0
Child 8 y / 6 y / 4 y	0 / 0 / 0	0 / 8 / 0	0 / 0 / 0

10. Discussion

The symptoms experienced by the family members including three minor boys when exposed to the RF radiation from the 5G tower during the short stay at the summer house are typical for the microwave syndrome. These symptoms are among the most commonly reported as an effect of radiation exposure from mobile phone technology and were already described as an effect of similar radiation over 50 years ago. All family members got sleeping difficulties and all except one boy got headache. Other symptoms experienced by individual family members have also been reported repeatedly as an effect from increased exposure to RF radiation. The symptoms appeared soon after the arrival to the house and disappeared after they came home, where radiation levels were considerably lower.

The measured levels outside the summer house were not as high as in our previous case studies on health effects from 5G base stations [26-30]. The measurements in this study were performed two months after the time when the family stayed at the house during high summer season when the nearby camping area was full of campers and the other nearby summer houses and apartments were fully occupied. The area has a capacity of over 400 camping spots and also more than 70 apartments and 10 cottages. When the measurements were made two months later, there were very few people staying at the camping area and in the nearby houses which likely would lead to lower radiation from the tower compared to the pe-

riod when the family was actually there. It is unfortunate that no measurements could be made during the actual stay when the area was fully occupied and the mobile phone traffic from the tower most likely was much higher. Furthermore, we were not able to make measurements within the cottage. The RF radiations would probably be somewhat lower inside the building, c.f. [28]. In addition there are no available measurements of the radiation levels in the summer house or outside the house before their stay in 2023.

It is known that radiation from base stations for telecommunication increases with increasing data traffic, i.e. the number of people using mobile phones in the area around the base stations. For instance measurements in an apartment in Stockholm showed that levels of RF radiation from 3G/4G were considerably lower during nighttime when few people use their phones compared to late afternoon and evening [34]. According to the French governmental agency for RF radiation, L'Agence Nationale des Fréquences (ANFR), 5G base station exposure levels depend on the number of users. With more users in the area surrounding a 5G mast, RF radiation levels rise considerably: "The level of exposure will indeed highly depend on the use, and in particular on the data calls made by the terminal" [35]. ANFR states that RF radiation levels depend on:

- "The distance between the antenna and the terminal, which is classic;

- The beam focus and the number of beams controlled by the antenna;
- The duration of presence of the beam in each direction and therefore of the data requests by the terminals in the beam”.

In consequence, it is highly likely that the radiation was significantly higher when the family stayed in the house and the camping area was fully occupied by visitors compared to when the measurements were made when the camping was nearly empty.

Although the tower during their stay in the summer 2022 was equipped with 5G antennas from one telecom operator, the two other operators installed 5G antennas on the tower in late 2022, after the family’s previous stay when they experienced no health problems. It is likely that these 5G antennas from the two larger operators led to increased RF radiation from the tower in 2023 compared to the summer 2022. These two larger operators had together 47.1% of the Swedish mobile phone subscriptions market in 2022 compared to 16.4% held by the third operator with 5G on the tower in 2022. In addition, by the end of 2022, 5G data traffic was still rather limited, representing only 1% of all mobile data traffic in Sweden. This might also indicate that radiation from the tower had increased in the summer 2023 compared to the summer 2022 [36].

This study confirmed results from previous case studies that healthy people who tolerated radiation from 3G or 4G antennas, rather rapidly developed symptoms of the microwave syndrome after base stations in their vicinity were equipped with 5G antennas. The tower in this case was previously emitting mostly 3G and 4G radiation with base stations at the same spot since several years. The family did not have any health problems when staying at the same house for a couple of days during the summer of 2021 and of 2022. The symptoms disappeared when the family returned to their permanent house where RF radiation levels were much lower.

11. Conclusion

This study showed that an entire family with two adults and three minor children developed symptoms of the microwave syndrome rapidly after arriving at a summer house located 125 meters from a 5G tower where three telecom operators had 5G antennas installed. The symptoms disappeared when the family returned to their own home with much lower RF radiation. The study confirmed results from our previous case studies showing that 5G base stations can cause the microwave syndrome in healthy people within a short period of time.

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