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Case Report: A 52-Year Healthy Woman Developed Severe Microwave Syndrome Shortly After Installation of a 5G Base Station Close to Her Apartment

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Base station; 5G; Radiofrequency radiation; Electromagnetic hypersensitivity; Microwave syndrome; Health

1. Abstract

In this case report we present a woman aged 52 years who developed health problems consistent with the microwave syndrome after installation of a 5G base station facing her apartment at 60 meters' distance. These symptoms consisted of e.g., headache, dizziness, concentration difficulties, fatigue, arrhythmia, skin burning and nose bleeding corresponding to the microwave syndrome. High radiofrequency (RF) radiation levels were measured in her apartment especially in the part closest to the base station. In her living room at the window 17 500 to 758 000 μW/m^2 peak levels were obtained during 10 measurements, each over 1 minute. At the place of her sofa in her living room peak levels from 36 800 to 222 000 μW/m^2 were measured. It is noteworthy that very high radiation was found at the balcony facing the base station. All ten measurements at that place yielded within 10-15 seconds peak levels >2 500 000 μW/m^2, which is the highest measurable level with the meter used in this study. At the playground about 40 meters from the base station peak levels of 1 120 000 μW/m^2 and 479 000 μW/m^2 were measured, respectively. After temporally leaving the apartment for another dwelling with much lower RF radiation, 96 to 2 810 μW/m^2 peak levels, almost all symptoms disappeared within a short time. After moving back to her own apartment the symptoms reappeared. This study is in line with the results of our two previous case studies showing that installation of 5G caused an extreme increase in exposure and rapid development of the microwave syndrome. These case studies indicate that implementation of 5G cannot be done without the risk of harmful effects on human health.

2. Introduction

The fifth generation, 5G, for wireless communication is rolled out worldwide despite no previous research on possible negative effects on human health and the environment. Exposure to pulse-modulated microwave (radiofrequency; RF) radiation has increased dramatically on a world-wide basis [1,2]. Microwave radiation are frequencies in the range of 300 MHz to 300 GHz within the RF spectrum. 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/). Studies on possible health effects from exposure to the 5G frequencies around 3.5 GHz were until recently non-existent [3]. In a study published in October 2022, animals were exposed to the 5G frequency 3.5 GHz (GSM modulated) for 2 hours a day to 1 600 000 μW/m^2, 5 days a week during one month. The exposure caused oxidative stress and an increase of degenerated neurons in the hippocampus region of the brain in addition to decreased Irisin levels. The observed effects may trigger neurodegenerative diseases [4]. The level of exposure was non-thermal and well below the guidelines recommended by the International Commission on Non-Ionizing Radiation (ICNIRP)

[5]. We recently published two case studies on health effects from 5G base stations [6,7]. These studies showed that the study persons developed the microwave syndrome after the installation of 5G base stations that yielded high pulsed RF radiation to their dwellings.

The safety limits for exposure to RF radiation applied by most countries around the world are still based on heating (thermal) acute effects that appear within short time of exposure, thereby excluding protection against long-term exposure and any other harmful effects that are not based on heating (non-thermal) [5,8,9]. The guidelines for reference values based on heating are set by ICNIRP, a self-appointed private organization based in Germany [5,9]. ICNIRP has managed to get world-wide influence and dominance on the evaluation of scientific evidence of negative health effects from RF radiation. Their guidelines are based on evaluations that have rejected all scientific evidence on non-thermal effects, despite growing evidence of a range of harmful effects well below the ICNIRP levels. That unscientific evaluation is in the interest of industry thereby facilitating the deployment of 5G and the wireless society [10,11].

2.1. The Microwave Syndrome

Microwave sickness or illness as an effect of microwave exposure, was reported already in the 1960's and 1970's in the East European countries [12]. Most affected were the neural, cardiovascular, and endocrine functions. Investigations of exposed workers showed that microwave exposure at non–thermal levels caused symptoms such as fatigue, dizziness, headache, sleep disorders, anxiety, problems with attention and memory [13]. 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 [14].

Other terms for the illness were radiofrequency sickness syndrome or microwave syndrome [15,16]. 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 [17,18]. In general, the symptoms declined after the exposure had ceased. According to Marha et al "at a certain time after exposure had ended (sometimes as long as several weeks or more) (see page 31), the organism usually returns to its original physiological state and all subjective and objective complaints vanish" [13].

2.2. Previous Studies on 5G

Recently we published a case report of two previously healthy persons, a man aged 63 years and a woman aged 62 years, who quickly developed symptoms compatible with the microwave syndrome after installation of a 5G base station on the roof above their apartment [6]. Very high radiofrequency (RF) radiation with maximum (highest measured peak value) level >2 500 000 $\mu W/m^2$ was measured in the bedroom located only 5 meters below the new 5G base station on the roof. That is the upper detection limit for the used exposimeter, Safe and Sound Pro II. Before the deployment of the 5G base station peak level of 9 000 $\mu W/m^2$ was measured from the 3G/4G base station that had been located at the same place since several years. Due to the severity of the experienced symptoms, the couple left the apartment within a couple of days for another dwelling with much lower maximum RF radiation of 3 500 $\mu W/m^2$. Their symptoms abated within few days. This is an example of a provocation test. In our second study we presented two men that also developed the microwave syndrome after installation of 5G base station on the roof of the building where their office was located at the top floor [7]. High RF radiation levels were measured in the office with highest radiation level of 1 180 000 $\mu W/m^2$ after the deployment of the 5G base station. Within short time after leaving the offices the symptoms disappeared. As in the first study, a base station for 3G/4G was already at the spot since several years prior to the replacement by 5G. This was another clear example of a provocation test with the persons being their own control subjects. These two studies are to our knowledge among the first studies ever to be made of health effects in persons exposed to real life 5G microwave radiation.

2.3. This Case Study

In this article we present a new case, a woman aged 52 years, suffering of the microwave syndrome after installation of a 5G base station on 25 November 2022. The base station is located 60 meters from her apartment, see Figure 1. The 5G antenna is placed on the roof of a three-floor building and projected towards her apartment on the second floor, see Figure 2. There was previously a 4G base station antenna at the same spot, see Figure 3, but it was only after it was replaced by the 5G antenna that the woman quickly developed severe symptoms of the microwave syndrome. The 4G antenna was removed shortly after the 5G deployment.

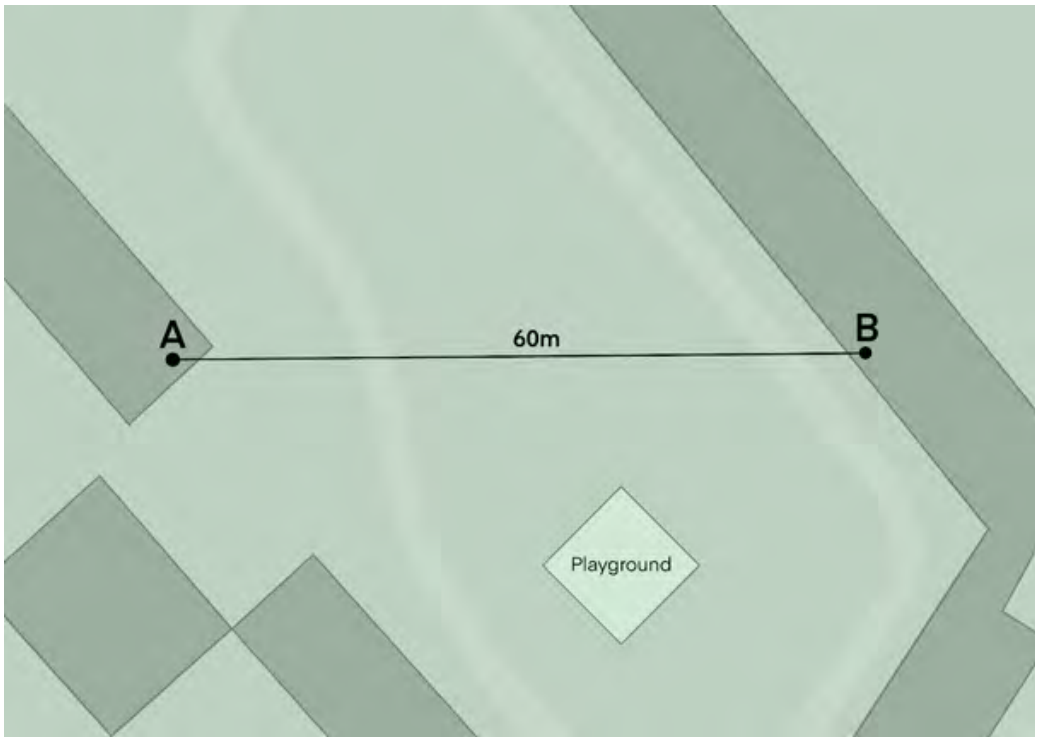

Figure 1: Distance between the 5G base station, A, and the apartment B, Note the location of the playground

Figure 2: 5G base station on the roof of a three floor building located 60 meters from the study apartment

Figure 3: 5G base station on the roof of a three floor building located 60 meters from the study apartment. Initial figure after the 5G installation showing the previous base station attached to the chimney

3. Methods

On 13 January 2023, the authors visited the study person at her home. Thereby her symptoms were investigated and discussed in person. She had previously answered a questionnaire on health with a list of symptoms adapted after Belpomme el al [19]. Four time periods were investigated. The first time period was in her home without 5G, the second at home with 5G, the third time staying in another apartment without 5G, and finally returning to her home with 5G exposure. Thereby the wash-out period of no 5G exposure between the third and fourth time period gave the possibility to investigate health during on and off exposure to RF radiation from 5G. The measurements were made during daytime with the device Safe and Sound Pro II. 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). The frequencies used for 5G in city environments in Sweden are mostly around 3.5 GHz. The upper detection limit for peak values of the exposimeter is 2 500 000 $\mu W/m^2$. At every investigated place in the apartment 10 or 20 measurements were made for 1 minute each.

4. Results

4.1. Health Symptoms

Table 1 gives the results for self-assessed health at four time periods. In July 2022 she was healthy. The base station for 5G that was installed in October 2022, was located opposite to her apartment with a small playground between the buildings, see Figure 1-3. After installation of 5G she rather quickly developed severe health problems with unbearable pain and/or discomfort due to a large number of symptoms such as headache, dizziness and balance problems, concentration problems, loss of immediate memory, confusion, fatigue, anxiety, emotive, cough, nose bleeding, symptoms from lungs, stomach, urinary system, and the skin. Interestingly one month later, staying in another apartment with no 5G, all symptoms disappeared except for minor problems with dizziness and tiredness both with grade 2, see Table 1. Within short after returning to her apartment in January 2023 the symptoms reappeared. This time her health declined and was even worse adding insomnia, suicidal ideation, heart problems, and irritation to the list of severe health issues.

Table 1: Clinical symptoms grades 0-10. Grade 0 = no symptoms, 10 = unbearable pain and/or discomfort in a 52 years old woman.

Symptom	Before 5G July 2022	With 5G October-November 2022	No 5G other place end of December 2022, beginning of January 2023	With 5G mid- January 2023
Headache	0	10	0	10
Dysesthesia	0	8	0	8
Myalgia	0	10	0	10
Arthralgia	0	10	0	10
Ear heat/otalgia	0	0	0	0
Tinnitus	0	2	0	8
Hyperacousis	0	0	0	0
Dizziness	0	10	2	10
Balace disorder	0	10	0	5
Concentration/Attention deficiency	0	10	0	10
Loss of immediate memory	0	10	0	10
Confusion	0	10	0	10
Fatique	0	10	2	10
Sleeping difficulty	0	7	0	9
- insomnia	0	7	0	10
- waking night time	0	0	0	0
- early wake-up	0	7	0	0
Depression tendency	0	6	0	10
Suicidal ideation	0	0	0	10
Cardiovascular abnormalities	0	7	0	10
- transitory high pulse	0	9	0	7
- irregular pulse	0	9	0	10
- slow pulse	0	0	0	10
Occular deficiency	0	8	0	8
Anxiety/Panic	0	10	0	10
Emotive	0	10	0	10
Irritability	0	6	0	10
Global body dysthermia	0	5	0	0
Dyspnoea	0	9	0	10
Chest squeeze	0	10	0	10
Cough	0	10	0	10
Nausea	0	10	0	10
Diarrehea (involuntary)	0	10	0	10
Urinary system -urgency	0	10	0	10
Skin (face, arms, legs))	0	10	0	10
-burning, lancinating skin on hands and arms	0	10	0	10
Nose bleeding	0	10	0	0
Hair loss	0	0	0	0

4.2. Measurement of RF Radiation

Table 2 displays the results for measurements of RF radiation. The highest levels were found in the part of the apartment facing the base station. In the living room close to the window at 30 cm distance, the peak radiation varied between 17 500 to 758 000 µW/m^2. Figure 4 illustrates the considerable variation of RF radiation within the measured time periods of 1 minute each and that 5G emits high repetitive pulses of microwave radiation. Also very high RF radiation was measured at the sofa in her living room 220 cm from the window facing the 5G antenna; 36 800 to 222 000 µW/m^2, see Figure 5 (note different scale for RF radiation compared with Figure 4). High radiation was also found in the bathroom, highest in the bathtub closest to the window. Considerably lower RF radiation was measured in the bedroom yielding peak level variation from 120 to 616 µW/m^2. Also, in the kitchen lower peak levels were measured from 156 to 1 420 µW/m^2. Both the bedroom and the kitchen are facing the other side of the apartment, thus with larger distance to the base station and additional walls in-between. The balcony of the apartment is facing the base station at 60 meters distance. RF radiation was measured 10 times 1 minute each time. Within 10-15 sec the highest measurement peak level for the meter, >2 500 000 µW/m^2, was obtained each time. Thus, the highest peak level was not possible to measure with the used exposimeter. The courtyard with a playground is located between the study subject's house and the building with the base station on the roof, see Figure 1. The distance is approximately 40 meters. Two measurements were made, 3 minutes each with circular walk around the playground. This yielded peak levels of 1 120 000 µW/m^2 and 479 000 µW/m^2, respectively.

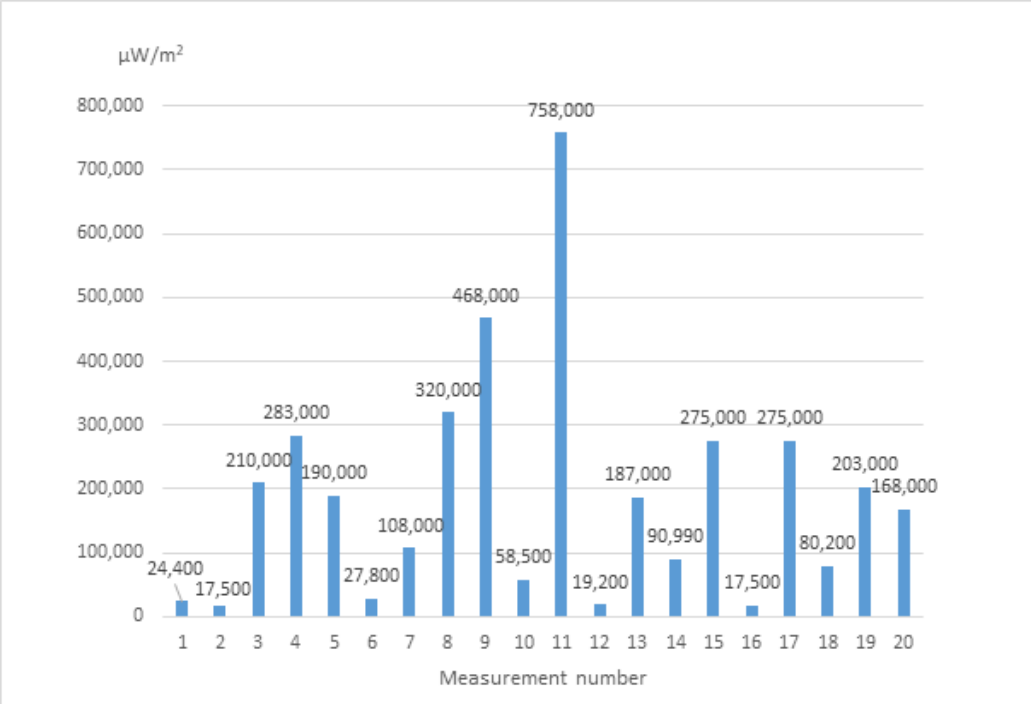

Figure 4: Results of 20 measurements in µW/m^2, each during 1 minute, for peak radiation from 5G in the living room 30 cm from the window

Table 2: Measurement of RF radiation in an apartment on January 13, 2023.

	Distance wall, cm	Distance floor, cm	Max (peak)
Kitchen, table	100	90	156-1420
Bedroom, pillow	80	80	120-616
Hall	440	110	2860-9390
Living room, window	30	120	17500-758000
Living room, sofa	220	80	36800-222000
Bathroom, bath	30	90	65400-150000
Bathroom, sink	180	100	8610-28900
Balcony		100	>2 500 000

Max (peak) value is given for every measurement during 1 minute each. Ten measurements were made during midday at each place and the results show the range of levels (µW/m^2). Twenty measurements were made at the window in the living room.

Note: At the balcony the level exceeded maximum for the used device within 10-15 sec each time for measurement.

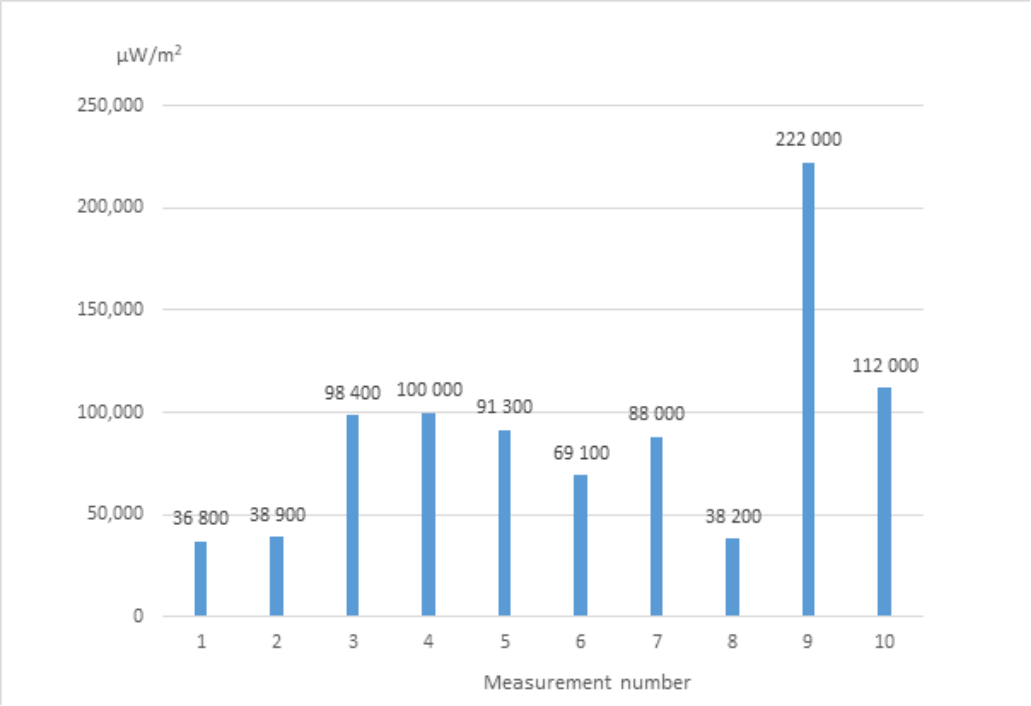

Figure 5: Results of 10 measurements in µW/m², each during 1 minute, for peak radiation from 5G at the place of the sofa in the living room 220 cm from the window

5. Discussion

In this article we present a 52-year-old woman who developed the microwave syndrome within short time after installation of a 5G base station 60 meters from her apartment. A 4G base station antenna was previously active at the same spot but it was not until the 5G deployment that her symptoms developed. Her home is located on the second floor and the base station is installed on the roof of a three floor building on the other side of the courtyard and directed towards her apartment, Figure 1,2.

This person answered a structured questionnaire on a series of symptoms associated with the microwave syndrome. This formula was similar as the one we had used in previous case studies, thus allowing the possibility to compare symptoms in different persons with similar exposure [6,7]. Of course the response is self-assessed and the evaluation of the health effects and their severity subjective. However, there were obvious signs of bruises on her arms as an objective marker of her complaint. It should also be noted that the study person has education in medicine, working as an assistant nurse. There is a truism in medicine that 'the patient is always right". Early research on effects of long term non-thermal microwave exposure concluded that the sensitivity to radiation may vary considerably among individuals and that women in general are more sensitive than men [13,18].

As presented in Table 1 the study person had a large number of severe symptoms inherent in the microwave syndrome. These included pain and a number of neurological symptoms such as dizziness, balance problems, concentration difficulties, loss of immediate memory and confusion. Nose bleeding and headache were severe problems as well as cardiac symptoms with irregular and transitory high pulse. In spite of fatigue she described insomnia as a problem. Body pain was another major symptom including skin burning on hands and arms. Nausea was also a major problem, grade 10, as well as diarrhea and urgency to urinate. Almost all symptoms disappeared after leaving her home to another accommodation with no 5G radiation. Using the same exposimeter RF radiation was measured at that place from 1 210 to 2 810 µW/m² in the living room 30 cm from the window, and 96 to 183 µW/m² in the kitchen 30 cm from the window. These measurements were done daytime and five times at each place during 1 minute each. Only slight dizziness and fatigue remained, both graded 2 on the 10 grades scale.

As presented in Table 1 her symptoms recurred after moving back to her dwelling. Some were worse such as tinnitus, grade 8, cardiovascular abnormalities, grade 10, and irritability grade 10. This time she did not note any nose bleeding.

This woman had since before slight hypertension. Living in her apartment she had no health complaints consistent with the microwave syndrome since before, although there was a 4G antenna at the same spot as the 5G base station. However, she had only lived in the apartment since October 1, 2022, thus less than 2 months of exposure to the 4G. No measurements are available of the radiation in the apartment before the 5G deployment. Our first case study indicated a sharp increase in radiation exposure from 5G compared to previous 4G antennas [6]. The windows of her apartment are energy efficient with thin metallic layers which are known to reduce incoming RF radiation. Our measurements also

showed clearly lower peak levels inside of the window compared to the balcony on the outside.

Since almost all symptoms disappeared after moving to another dwelling with no 5G exposure and low RF radiation levels and returned within short after moving back to her apartment, this must be regarded as a classic example of a provocation test.

The woman's dog also showed signs of ill health after the 5G deployment. According to her, the dog got diarrhea soon after the 5G deployment. This disappeared during the washout period in the other apartment with no 5G, but returned when they moved back to her own apartment. The dog also reluctantly returns to the 5G apartment after walks.

RF radiation levels were measured with Safe and Sound Pro II. Ten measures were made at every place during one minute each, except for 20 measures made at the window in the living room. There was a high variation of the peak level during that time, which is shown in Figure 4 and 5. As expected, highest levels were measured in the part of the apartment facing the building with the 5G base station on the roof. The levels measured in this study, and in our two previous case studies, were very high. These levels apparently provoked, within a short time period, ill health in the studied persons. They are far above levels that have been reported to provoke ill health from previous generations of wireless technology [20-27], and also far above levels recommended by experts. In 2012, the BioInitiative Report suggested a limit of 30-60 $\mu W/m^2$ for human exposure, lower for sensitive persons and children, 3- 6 $\mu W/m^2$ [28]. Even lower guidelines were proposed in 2016, maximum 10 – 1 000 $\mu W/m^2$, lower at night time 1-100 $\mu W/m^2$, and for sensitive persons 0.1-10 $\mu W/m^2$ [29]. On the other hand, the measured levels from 5G are still far below the levels recommended by ICNIRP [5] and the FCC [30]. According to ICNIRP 2020 exposure can be as high as 10 000 000 $\mu W/m^2$ for whole body exposure averaged over 30 minutes, thus allowing peak levels to be even very much higher [31].

5G apparently leads to very high microwave exposure with sharp peak pulses confirming warnings on high RF radiation from scientists several years before the 5G roll out. In the 5G Appeal, scientists and medical doctors called for a moratorium on the 5G deployment due to the "massive increase of mandatory exposure" to microwaves and the fact that the health hazards of this new technology had not been previously investigated [10] (www.5gappeal.eu).

The children's playground is located 40 meters from the base station, Figure 1. High RF levels were measured on the playground. For medical reasons it must be regarded to be a harmful place to be used, especially by children. Children are more vulnerable to RF radiation exposure than adults [32]. The microwave syndrome is similar to electromagnetic hypersensitivity; EHS [12]. However, unlike the microwave syndrome, individuals suffering from EHS can develop deliberating symptoms at extremely low exposure levels that are tolerated by most other people. That is in contrast to the very high RF radiation levels seen in our three case studies where healthy individuals, with no prior major reactions to wireless technology, quickly developed symptoms due to the sharp increase in exposure from 5G.

The sensitivity to RF radiation is known to vary considerably between different persons [33,34]. Most prevalent symptoms are related to the nervous system, the heart, the skin and the hormone system just as exemplified for this presented case and in our previous cases. For occupational exposure similar symptoms including also headache, sleeping problems, heart palpitations, mood swings and balance disorders were described some 50 years ago [17,18].

The microwave syndrome has previously been associated with living close to base stations in several studies since almost two decades [20-27]. A German study found effects on biological markers such as neurotransmitters and symptoms similar to the microwave syndrome among inhabitants living in a village after the activation of a GSM base station [35]. An increased frequency of micronuclei and lipid peroxidation was seen in cultured human lymphocytes in persons living within 80 meters from the base station, compared with a distance of 300 meters [36]. In 2011 the International Agency for Research on Cancer (IARC) classified RF radiation as a possible human carcinogen, Group 2B [37]. Additional research both on humans and laboratory animals since 2011 has confirmed the risk for cancer associated with RF radiation [8] appearing below the ICNIRP thermal limits. In spite of that, current guidelines for exposure propagated by ICNIRP [5] and the Federal Communications Commission in USA [30] have not been lowered although the scientific evidence of various health effects below these guidelines has increased over the years. They are based only on acute thermal effects, observed within very short exposure from extremely intense RF radiation [5]. These guidelines do not take account of e.g., long-term exposure, people's sensitivity, particularly vulnerable persons such as children, sick and old ones, and important physical properties of the RF radiation for instance pulse modulation [8,9]. They are clearly not adapted to prolonged 24 hours a day during lifetime.

It is obvious that during the recent two decades there has been increasing evidence on detrimental effects on both human health and the environment from RF radiation. Unfortunately, the recommendations of much lower limits than those by ICNIRP and FCC have not resulted in any practical steps to reduce the obvious risks for the public. On the contrary ambient RF radiation has increased [1,2]. In a recent article a former long-time member of ICNIRP concluded that "There are substantial abnormalities in these putative health safety protection guidelines and standards. Some of the safety limits are irrelevant, debatable, and absent of scientific justification from the standpoint of safety and public health protection" [9].

In a recent review on health risks from the wireless technology it was concluded that "A wide range of evidence indicates that there are numerous non-thermal effects from wireless radiation on reproduction, development, and chronic illness" [38]. Further, in an Essay it was stated that "Based on the precautionary principle, the author echoes the calls of others for a moratorium on the further roll-out of 5G systems globally, pending more conclusive research on their safety…In short, one should 'err on the side of caution'. In the case of 5G transmission systems, there is no compelling public health or safety rationale for their rapid deployment" [39].

6. Conclusion

This study confirms our previous publications on microwave syndrome caused by RF radiation emissions from 5G [6,7]. Our three studies are to our knowledge among the first to have investigated health effects from 5G base stations. 5G substantially increases exposure to microwave radiation and in the present case, as well as in the previous case studies, the 5G deployment was followed by a rapid development of symptoms known as the microwave syndrome. Urgent attention is needed to the 5G health hazards by the responsible governmental agencies.

7. Acknowledgements

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8. Funding

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9. Availability of Data and Materials

The information generated and analyzed during the current study is available from the corresponding author on reasonable request.

10. Authors' Contributions

Both authors participated in the conception, design and writing of the manuscript, and have read and approved the final version.

11. Ethics Approval and Consent to Participate

Not applicable.

12. Patient Consent for Publication

Not applicable.

13. Competing Interests

The authors declare that they have no competing interests.

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