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Very High Radiofrequency (RF) Radiation at Skeppsbron in the Old Town in Stockholm, Sweden

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1. Abstract

We published recently three case reports on persons that developed the microwave syndrome within short after the installation of 5G base station close to their dwellings. The health symptoms were attributed to high levels of RF radiation measured in their apartments. Since before we have reported levels of RF radiation at certain places in Stockholm, Sweden. In 2019 one location with especially high levels was at Skeppsbron in the Old Town. This was before the deployment of 5G base stations that started in Stockholm in 2020. New measurements in the same area were made during April 2023 using the broadband meter Safe and Sound Pro II. At every place 20 measurements were done during one minute each, 200 in total. We recorded the maximum (peak) level for each measurement. More than 10 base stations are located on a low building on the seaside of the street. Most of the base stations are directed towards the Old Town, fewer towards the sea. Especially high RF radiation levels were measured on the Old Town side, all but 12 peak levels of 100 in total exceeded the upper detection level for the used meter, 3 180 000 $\mu\text{W}/\text{m}^2$. These high levels were observed within 5 to 10 seconds of the measurement. In fact, at one place the exposimeter exceeded the upper detection level immediately during all of the 20 measurements. The lowest measured level on the town side was 1 180 000 $\mu\text{W}/\text{m}^2$. Lower emissions were found on the seaside varying from 91 300 to $>3\ 180\ 000\ \mu\text{W}/\text{m}^2$. Nine of the 100 results on the seaside exceeded the upper detection level. In conclusion RF radiation levels are extremely high at the Skeppsbron area in the Old Town. Based on current knowledge

these levels are detrimental to human health. The persons residing in buildings on the Old Town side of the base stations are at increased risk of health problems. In contrast no buildings exist on the seaside. People should be informed about the potential health risks when visiting, living or working in this area.

2. Introduction

During recent years ambient levels of pulsed radiofrequency (RF) radiation or microwaves have increased substantially, mainly due to deployment of the fifth generation, 5G, for wireless communication. Microwaves are frequencies within the RF spectrum between 300 MHz and 300 GHz. It is within these frequencies that 5G and previous generations of telecommunications operate. People, such as concerned scientists and Non-Governmental Organizations (NGOs), have asked for the halt of the 5G roll-out until studies have been made regarding risks to human health and the environment [1-3]. However, these calls have been unheard, and currently, as presented in this article, ambient levels of RF radiation are increasing.

The microwave syndrome (microwave illness) was first described already in the 1960's and 1970's in the Eastern Europe countries as an effect of prolonged exposure to microwaves or radiofrequency radiation [4]. Typical symptoms were related to effects on the cardiovascular, neurological, and the endocrine system. Among the most common reported symptoms were fatigue, dizziness, headache, sleep problems, anxiety, and reduced memory [5]. These symptoms were not caused by tissue heating, (thermal effects), from RF radiation, but described to be non-thermal.

We have in three case series published indoor levels of RF radiation in Swedish apartments and one office after the deployment of 5G [6-8]. The places were selected based on reported health symptoms among people residing in these apartments or offices. All study persons answered a structured questionnaire with symptoms adapted after Belpomme et al [9] ascribed to the microwave syndrome.

Interestingly, in all three apartments, very high RF radiation was measured, even exceeding the upper limit, 2 500 000 $\mu\text{W}/\text{m}^2$, for the used meter, that was an earlier version of Safe and Sound Pro II. In all cases, 5G base station antennas had been installed on the roof directly above the studied apartment or office [6, 7] or at the distance of 60 meters on a roof facing the investigated apartment [8]. The study persons developed within short after the deployment ill health with symptoms typical for the microwave syndrome. After leaving the apartment or office almost all symptoms disappeared within a short time, but reappeared after returning to the apartment. Finally, all studied persons had to leave their homes or offices for other places with no 5G radiation and much lower RF radiation exposure.

These three case reports show a substantial increase in ambient levels of RF radiation after installation of 5G base stations. One of the authors (LH) has with another research team previously made a series of studies on RF radiation levels in Stockholm, Sweden. Exceptionally high levels were found at Skeppsbron located in the Old Town [10]. Using the meter EME Spy 200, that measures 20 predefined frequency bands, the highest level was 373 381 $\mu\text{W}/\text{m}^2$. Note, the actual level was higher for certain frequencies since the highest detection limit, 95 522.5 $\mu\text{W}/\text{m}^2$, was exceeded several times, see Table 2 in [10]. We used also a broadband analyzer, Narda NBM-520. This yielded maximum recorded reading for the entire area of 2 648 000 $\mu\text{W}/\text{m}^2$. The measurements were made in January 2019, which is before the official start of 5G, in Stockholm in May 2020. 5G is combined with upgraded 4G technology and therefore real exposure of 5G gives simultaneous exposure to both 4G and 5G. (<https://www.ericsson.com/en/press-releases/2020/5/telia-company-launches-ericsson-powered-commercial-5g-in-sweden>; <https://www.teliacompany.com/en/news/press-releases/2020/5/telia-swedens-first-major-5g-network-up-and-running-in-stockholm/>).

Table 1: Measurements of RF radiation levels at Skeppsbron, Old Town in Stockholm, Sweden. At each place 20 measurements were performed on April 26, 2023 using Safe and Sound Pro II. Results for lowest and highest level are shown and expressed in $\mu\text{W}/\text{m}^2$. Number for places that were measured are shown in Figure 1. Seaside is located at Skeppsbrokajen.

no.	Place	Range
1	Tullgränd-Skeppsbron	All > 3 180 000 in 5-10 sec
2	Packhusgränd-Skeppsbron	All > 3 180 000 in 5-10 sec
3	Johannesgränd-Skeppsbron	All > 3 180 000 in 5-10 sec
4	Gaffelgränd-Skeppsbron	1 180 000 to > 3 180 000*
5	Drakens Gränd-Skeppsbron	All > 3 180 000 immediately
6	Drakens Gränd on seaside	632 000 to > 3 180 000**
7	Gaffelgränd on seaside	758 000 to > 3 180 000**
8	Johannesgränd on seaside	358 000 to > 3 180 000***
9	Packhusgränd on seaside	91 300 to 938 000
10	Tullhusgränd on seaside	218 000 to 1 030 000

*Eight measurements > 3 180 000

**Four measurements > 3 180 000

***One measurement > 3 180 000

Table 2: Public exposure to radiofrequency radiation in Stockholm. Measurements were made with three different meters (selective frequency meter and broadband meters) and are therefore not quite comparable.

Study	Maximum (peak)
Stockholm, Central Station, measured 2015 [11]	9 206 ¹
Stockholm, Old Town, measured 2016 [12]	173 302 ¹
Stockholm, Järntorget, Old Town, measured 2018 [13]	178 928 ¹
Stockholm, City, measured 2017 [14]	205 155 ¹
Stockholm, Skeppsbron, measured 2019 [10]	373 381 ¹
Stockholm, Skeppsbron, measured 2019 [10]	2 648 000 ²
Stockholm, Skeppsbron, measured 2023 (present study)	
-alleys on townside (Skeppsbron)	1 180 000 to > 3 180 000 ³
-alleys corresponding to waterfront (Skeppsbrokajen)	91 300 to > 3 180 000 ³

¹) EME Spy selective frequency meter, upper detection limit 95 522.5 $\mu\text{W}/\text{m}^2$ for each measured frequency, maximum level (RMS mode). Results are given as the sum of all measured frequencies. ²) Narda broadband meter, upper detection limit 241 000 000 $\mu\text{W}/\text{m}^2$, maximum level (RMS mode).

³) Peak levels for Safe and Sound Pro II broadband meter, upper detection limit 3 180 000 $\mu\text{W}/\text{m}^2$.

3. Aim of the Present Study

The Skeppsbron area is, due to the exceptional number of base stations in a limited area, obviously of interest to study regarding expansion of 5G in Stockholm and its contribution to RF radiation in the environment. In our previous study [10] 15 base stations were located at the top of a one floor building (Tullhus 2) located at the seaside of the Skeppsbron street. Thus it was of interest to study any change of environmental levels of RF radiation in the surrounding area after the change to 5G. These base stations emit today 5G and 4G (The Swedish Post and Telecom Authority, personal communication).

4. Study Design and Methods

Measurements were performed after lunchtime on April 26, 2023. Thereby 10 predefined places were used, see Figure 1. At each place 20 measurements were made, each during 1 minute. Maximum RF radiation level was recorded each time. Thus in total 200 measurements were performed. As in our previous studies [6-8] the broadband device Safe and Sound Pro II was used. The true response detection range is between 400 MHz and 7.2 GHz. The frequencies used for 5G in city environments in Sweden are mostly around 3.5 GHz while frequencies used for 4G are primarily around 2.6 GHz (<https://www.induo.com/b/lte-band-mobilt-bred-band/>). The readings are from $0.005 \mu\text{W}/\text{m}^2$ to the upper detection

limit for peak values of $3\,180\,000 \mu\text{W}/\text{m}^2$ for this latest version of the exposimeter. It was calibrated by the manufacturer and has an accuracy of $\pm 6 \text{ dB}$ (<https://safelivingtechnologies.com/products/safe-and-sound-pro-ii-rf-meter.html>).

5. Results

As shown in Table 1 at the three first alleys ending at Skeppsbron (Figure 1) all 20 measurements at each place exceeded the upper detection limit of $3\,180\,000 \mu\text{W}/\text{m}^2$ for the used meter within 5 to 10 seconds. For one of the alleys, Gaffelgränd, (measurement number 4 in Figure 1) the levels varied between $1\,180\,000$ to $>3\,180\,000 \mu\text{W}/\text{m}^2$, see Table 1. In fact eight of the readings were above the detection limit, Figure 2. All readings were above the detection limit immediately and no lower levels were measured for the final alley measured on that side of the research area.

Measurements were also performed on the waterfront of the building, Tullhus 2, corresponding to the alleys on the Old Town side, see Figure 1, measured points 6-10. As shown in Table 1 only nine of the 100 readings were above the detection limit. The lowest measured level was $91\,300 \mu\text{W}/\text{m}^2$. There was considerable variation of the peak pulses as exemplified by the place corresponding to Drakens gränd at the waterfront, see Figure 3 and point 6 in Figure 1.



Figure 1: Map of study area in Old Town (Gamla Stan) in Stockholm, Sweden. Numbers indicate measured points.

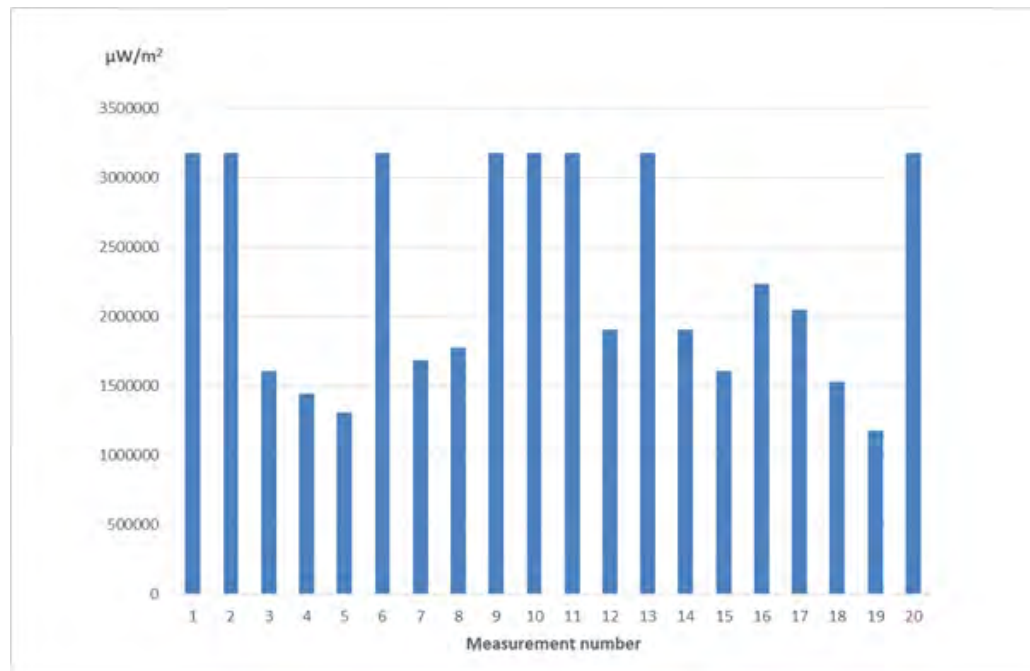


Figure 2: Peak levels of 20 measurements at point 4 in Table 1, Gaffelgränd ending at Skeppsbron. Eight measurements exceeded the highest detection limit of 3 180 000 $\mu\text{W}/\text{m}^2$ for the used broadband meter Safe and Sound Pro II. Each point was measured during 1 minute.

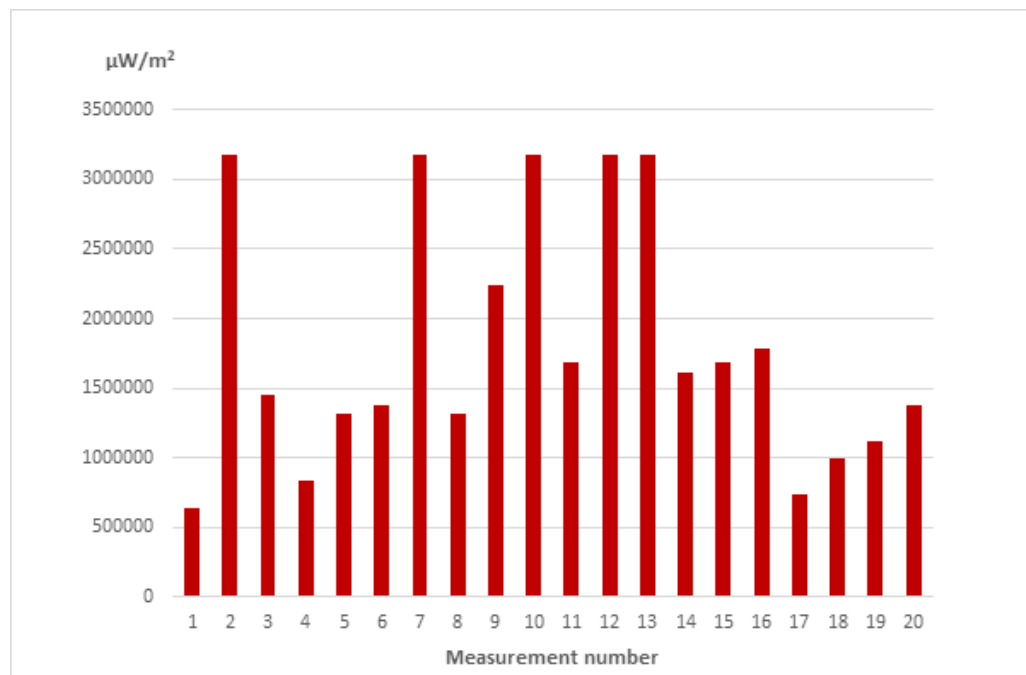


Figure 3: Peak levels of 20 measurements at point 6 in Table 1, seaside at Skeppsbrogajen corresponding to Drakens Gränd. Five measurements exceeded the highest detection limit of 3 180 000 $\mu\text{W}/\text{m}^2$ for the used broadband meter Safe and Sound Pro II. Each point was measured during 1 minute.

6. Discussion

In our recently published case reports we have clearly documented that 5G emits high levels of pulsed RF-radiation that is detrimental to human health. All studied persons developed within short a large range of symptoms consistent with the microwave syndrome. The symptoms decreased and disappeared soon after moving to another place with no 5G radiation. Interestingly these persons had tolerated 3G/4G since before which indicates that the high levels of 5G pulsed microwaves combined with 4G are especially dangerous.

<http://www.acmcasereport.com/>

5G leads to increasing ambient levels of RF radiation. We have published results on measurements in Stockholm since 2016, see Table 2. It should be noted that in the previous studies, the EMF Spy 200 exposimeter was used, whereas this time the broadband meter Safe and Sound Pro II was used. Therefore direct comparisons with the previous measurements are problematic. However 5G was expected to increase exposure to RF radiation significantly as proposed for instance in the 5G Appeal [1]. The transmitted power from a 5G base station can be almost the double of that of a previous 4G. (<https://health.ec.europa.eu/system/files/2022-08/>

scheer_o_044_0.pdf).

In our previous studies the lowest RF radiation levels were found at the Central Station (indoor) in Stockholm published in 2016 [11]. Higher environmental levels were found in the Old Town [12], especially at the square Järntorget [13], and at Skeppsbron [10]. High levels were also reported in Stockholm city [14]. More details can be found in the different publications.

The previous measurements at Skeppsbron, Stockholm were made in January 2019, which is before the implementation of 5G. The now presented results are based on measurements in April 2023, i.e. after deployment of 5G base stations. There seems to be more than 10 base stations on the roof of a one floor building, Tullhus 2. Most are directed towards the buildings in the Old Town, but some also towards the sea, Strömmen. Skeppsbron is a street linking Stockholm northern city areas with the southern city areas. It is a busy street for busses, cars, cyclists and pedestrians. Passing this street area results in very high levels of exposure to RF radiation, see Figures 4 and 5. Although the exposure for most of the people passing this area is for a short time period, these very high levels may induce ill health symptoms, particularly if the passing is made frequently or during a longer time as for pedestrians.

Of special concern is exposure to the buildings in the Old Town

facing Skeppsbron. These buildings contain offices, hotels, shops but also dwellings for inhabitants. The persons living or staying in these buildings are at an increased risk of ill health due to the very high levels of RF radiation. Since RF radiation emissions are not an issue of public health debate or information in Sweden, most people are unaware of the risks. No studies have investigated the health among people living or working in that area to our knowledge. As we have discussed in our previous articles, the microwave syndrome has since almost two decades been associated with living close to base stations and at very much lower levels of exposure from previous generations of telecommunication technologies [15-17]. Our results show that it is pertinent with further studies on 5G RF radiation levels, both at public spaces and areas like in this case, but also in buildings, in people's homes, in their offices and in children's schools where people spend most of their time. In addition further studies on effects from 5G real emissions should be made to investigate both impact on human health and animal life. It is important that studies are made by scientists with no ties to the telecommunications industry, since research has shown that industry funding can influence the results [18]. Information to the people about the risks is urgently needed, as proposed by many scientists for many years (www.5GAppeal.eu; <https://emfscientist.org/>).



Figure 4: The figure shows base stations on a one floor building, Tullhus 2, close to Skeppsbron. Note the low position causing high RF radiation levels to the surrounding area close to the base stations.



Figure 5: The figure shows base stations on a one floor building, Tullhus 2. Note the low position causing high RF radiation levels to people passing by such as pedestrians and cyclists on Skeppsbron.

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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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