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Article

Article Review: Electromagnetic Pollution Resulting from Non-Ionizing Radiation in Kirkuk City

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Abstract: A new environmental threat on a global scale is electromagnetic pollution, which is caused by non-ionizing radiation (NIR). Using emissions from mobile cellular base stations and high-voltage transmission lines as a focal point, this paper examines the levels of non-ionizing electromagnetic radiation in Kirkuk City, Iraq. Research based on measurements shows that EMF levels in residential areas are still below the recommendations made by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). It is recommended that ongoing monitoring and public awareness be implemented to minimize the long-term impacts of exposure, even though the acute health hazards seem to be minimal.

Keywords: Electromagnetic pollution, Non-ionizing radiation (NIR), Electromagnetic fields (EMF), Kirkuk City.

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1. Introduction

An ever-increasing number of people using mobile phones has led to massive expansion in the wireless communications market [1]. Cellular base stations are proliferating in nearly every area to accommodate the ever-increasing user base. Controversy has arisen in scientific circles regarding the increasing radiation from GSM cellphones [2]. The purpose of this survey was to confirm that GSM technology poses long-term health risks to humans through radiation exposure. The operation covered the whole Kirkuk Governorate. Sites for radio frequency measurements were chosen in public spaces,

densely inhabited locations, and residential neighborhoods by the consulting team. The acronym for "Global System for Mobile Communications" is GSM. This digital mobile phone system is utilized globally, including in Kirkuk Governorate. The idea for this technology originated in 1982, when the Special Group (GSM Mobile) was established by the European Conference of Postal and Telecommunications Administrations to design standards for mobile phone systems that could be utilized all throughout Europe [3]. Factors that contribute to electromagnetic fields (EMFs) include television and radio transmission towers, radar, microwave ovens, and transmitters of microwave communications. Nevertheless, there has been rather less focus on radiation emanating from cellular mobile and personal communications system (PCS) base stations. Original cellular mobile radios were 450 or 900 MHz in frequency. However, the 900 MHz, 1800 MHz, or 1900 MHz band is where the digital second generation of mobile phones operate [4],[5],[6].

2. Materials and Methods

This study adopted a field-based environmental monitoring approach to assess non-ionizing electromagnetic radiation (NIR) levels in Kirkuk City, Iraq, with a particular focus on emissions from mobile cellular base stations and high-voltage transmission lines. Measurement locations were systematically selected to represent a range of exposure scenarios, including densely populated residential neighborhoods, public spaces, commercial zones, areas surrounding schools and markets, and locations in close proximity to cellular towers. This spatial distribution was intended to capture realistic variations in public exposure across the urban environment. Radiofrequency electromagnetic field (RF-EMF) measurements were conducted using calibrated portable electromagnetic field meters capable of covering the frequency bands used by local wireless communication systems, including GSM 900 MHz, GSM 1800 MHz, and third-generation mobile networks. Measurements were taken at standardized heights above ground level to approximate human exposure and were repeated at multiple points within each site to minimize random variability. The recorded power density values were averaged to obtain representative exposure levels for each location. Geographic Information System (GIS) tools were subsequently employed to spatially map the measured EMF intensities, enabling visualization of electromagnetic pollution distribution patterns across the city. The measured values were then compared with international exposure limits and reference levels recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) to evaluate compliance and potential health implications. Descriptive statistical analysis was used to summarize the data and identify hotspots of relatively elevated exposure. This integrated methodology combining field measurements, spatial analysis, and international guideline comparison provides a robust basis for assessing current electromagnetic pollution levels and supporting evidence-based recommendations for monitoring, urban planning, and public health protection

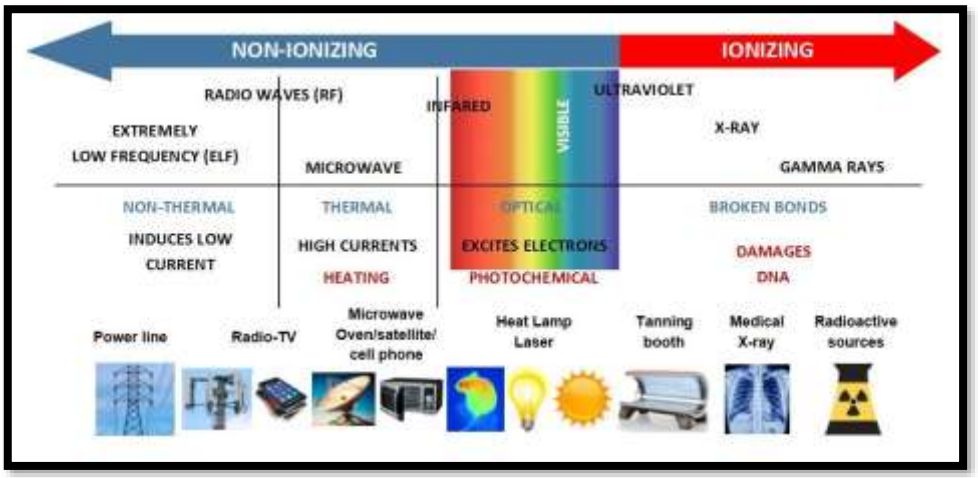
3. Results

Electric and magnetic fields that oscillate at the speed of light constitute non-ionizing radiation, which is defined as a sequence of energy waves [6]. The visible light, infrared, microwave, radio frequency, and very low frequency (ELF) spectra are all examples of non-ionizing radiation. Common frequency bands used by lasers include ultraviolet, visible, and infrared light. A large variety of work settings contain non-ionizing radiation, which, if not adequately regulated, can cause serious health problems for those who could be exposed to it [7].
Kirkuk Governorate and the Iraqi telecom system both use the GSM900, GSM 1800MHz, and the third-generation frequency G MobiTel. The environment and humans are both

heated by this range of frequencies, which is known as non-ionizing radiation [8]. Figure 1 shows the spectrum of non-ionizing radiation.

Figure 1 : Non –ionizing radiation spectrum

Consumer demand for wireless traffic is directly proportional to the number and placement of towers [9]. Each major city has hundreds, if not thousands, of towers. The height of these towers is determined by the surrounding tall structures. Most freestanding buildings are more than fifteen meters tall in order to block out prying eyes. Some modern



cell phone towers have been artistically constructed to resemble building ornaments and flagpoles in an effort to solve the aesthetic problem. Antennas and various electronic devices, such microwave transmitters, are mounted atop these towers. The radio antennae exchange low-frequency energy when a call is made. Real hotspots of tension can be seen at certain junctions in dense locations where multiple towers operated by various carriers are situated in close proximity to one another [10].

The Canadian Radio Communications Corporation, a division of Industry Canada, is in charge of cell phone towers and frequencies in the country [11]. There will be an increase in cell phone tower density due to the rising demand for smartphones and the changing usage patterns of consumers and businesses. There are a number of new regulations that aim to address public concerns. One of these is that service providers must communicate with their local governments if the combined height of two towers is more than fifteen meters, and another is that they must share towers (co-locate antennas). Some municipalities have set very strict requirements, reaching up to two meters in some cases in sensitive areas [11].

Typically, a cell phone tower will be a steel truss or pole that reaches heights of hundreds of feet. The transmitters and receivers that allow the mobile phone tower and the phones to communicate are housed in a box that is installed on the tower. The devices are connected to the antennas mounted on the tower by a set of thick cables. For safety reasons, the tower and all cables and equipment at the base of the tower are connected to the ground. The number and location of cell phone towers are determined based on the number and demands of wireless data users. Each major city has hundreds, if not thousands, of towers. In Kirkuk, there are said to be thousands of cell phone towers, some of which are merely skeleton structures with antennas. The height of these towers is determined by the heights of the surrounding buildings. The structures themselves are usually more than 15 meters tall and, in most cases, have an unsightly appearance. The equipment installed on these towers includes antennas and electronic equipment such as microwave transmitters. When calls are made, the antennas transmit low-power radio frequencies back and forth. In high-density areas, many towers are located closely together, belonging to different service providers, creating hotspots of high radiation intensity. Cell phone towers are everywhere in Kirkuk Governorate, especially in Kirkuk

city. Many towers are located on top of the roofs of houses. This has not only changed the appearance of the city but also affects public health.

2.3- Data and Discussion

Kirkuk Governorate has a greater amount of electromagnetic radiation compared to many developed countries, while it is lower than the Iraqi standard rate of 0.4 mw/cm². Table 1 displays the worldwide limits of radio frequency exposure from cell phones.

Table 1. International Limits of Cell Phone Radio Frequency Exposure

Location	Reference	Exposure Time	Limit Based On	Lower by	µW/m²	V/m
Most of Western Europe	IEEE C95.1-1999 and ICNIRP	30 minutes	Thermal / Heating	-	10,000,000	61.4
USA	(FCC) IEEE C95.1-1999 and ICNIRP	30 minutes	Thermal / Heating	-	10,000,000	61.4
Canada	Safety Code 6, Table 5 (2015)	6 minutes	Thermal / Heating	66×	4,393,278.4	40.7
Russia	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100×	100,000	6.14
China	UDC 614.898.5 GB 9175 -88	3 hours +	Biological Effects	100×	100,000	6.14
Italy	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100×	100,000	6.14
Most of Eastern Europe	Sanitary Norms and Regulations 2.2.4/2.1.8.055-96	3 hours +	Biological Effects	100×	100,000	6.14
Switzerland	Ordinance on Protection from Non-ionizing Radiation (NISV)	Long Term	Precautionary	100×	100,000	6.14
Toronto Board of Health, Canada	Proposed 1999	Long Term	Precautionary	100×	100,000	6.14
Bio Initiative recommendation	Bio-Initiative Report 2007	Long Term	Biological / Precautionary	10,000×	1,000	0.614
Salzburg Resolution on Mobile Telecommunication	Preventive public health protection, Salzburg, June 7-8, 2000	Long Term	Precautionary	10,000×	1,000	0.614
European Parliament	Resolution 1815, Strasburg, May 27, 2011	Long Term	Precautionary	10,000×	106	0.2
Building Biology Guidelines Germany (Sleeping Area)	SBM2008 - Level of No Biological Concern	Long Term	Precautionary	100,000,000×	0.1	0.00014
Cell Phone Operational Requirements	-	-	-	10,000,000,000×	0.001	0.0000014
Natural Cosmic Radiation	MAES 2000	Long Term	Natural Exposure	10,000,000,000,000×	0.000001	0.0000000614
Average Indoor Urban Exposure Toronto, Canada	Safe Living Technologies Inc. 2011	Long Term	-	-	200 - 5000	0.3 - 1.4

It is the responsibility of Health Canada to establish national standards for radiofrequency exposure in Canada. The federal government has set limitations for radio frequency exposure in Safety Code 6, which was adopted in 1999 [11]. The short-term thermal effects of heating bodily tissues are the only basis for these limits, which range from 2,000,000 to 10,000,000 µW/m² or 200 to 1,000 µW/cm². Evidence of harmful biological consequences exists at concentrations far lower than those recommended by Safety Code 6 [12]. Recommendations for the safe and effective long-term exposure of living organisms to low-level radiofrequency radiation do not exist in Canada. The United States is not an exception.

Cell towers can be seen in many places in heavily populated locations, including residences, schools, and markets, thanks to the surge in mobile phone use. The public's health is a major worry for those who live in close proximity to radio frequency (RF) emitting towers, as there is mounting evidence that these waves may cause harm [13].

Many are worried about the well-being of individuals who may be exposed to radiation from these devices because of this. According to Health Canada, humans can safely be exposed to radio frequencies within the range of 23 to 300 GHz, with an average exposure time of six minutes to the highest limit. This leads us to cite the Safety Code of Canada (8) and the amount of radio frequencies released by cell towers [11]. This has been the subject of a great deal of study and investigation. "Yes, mobile phones are definitely dangerous to health" and "No, they are not dangerous at all" are just two examples of the extremes of opinion expressed in the ensuing reports [14]. But most people didn't have a strong view either way, and they didn't even mention the possible dangers to people's health. Consequently, two schools of thought developed on the subject of GSM radiation's potential dangers.

The First Group

According to one school of thought among health professionals and scientists, mobile phones and their base stations only cause a thermal effect, which has already been covered in the ICNRP safety recommendations [8].

The Second Group

The second school of thought holds that microwaves aren't just powerful, and that GSM radiation does more than just heat people. Based on their research, this organization has determined that cell phones and the networks that support them pose a danger of:

1. Impact on the nervous system, which can lead to issues with sleep, learning, depression, and even suicide [15].
2. The second is the risk of reproductive problems, arrhythmia, heart attacks, and cardiovascular disease [15].
3. cancer, which encompasses a wide range of malignancies, such as brain tumors, leukemia, breast cancer, liver cancer, to name a few [2], [16].
4. Infectious illnesses and viruses [17].

The World Health Organization has recommended taking precautions and preventative measures because there is a lack of definitive data from the medical and scientific community [1].

4. Conclusion

As it is, the electromagnetic field (EMF) exposure in the city of Kirkuk is below the global safety threshold. To keep up with compliance and handle new infrastructure improvements, mobile stations and transmission cables must be monitored continuously. If we want to keep the long-term health effects to a minimum, we need to raise public awareness and take precautions. Policy frameworks ought to incorporate EMF considerations into city design in accordance with ICNIRP standards.

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