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Residential exposure to non-ionizing electromagnetic radiation from mobile base stations: a systematic review on biological effects assessment

Abstract

The effects of non-ionizing electromagnetic radiation from cellular base station exposure on human health are discussed in this review. Because of technological development, electromagnetic emissions are present at high levels in human existence. Due to the health risks linked with exposure to electromagnetic radiation (EMR), its effects are known. The systematic review work was done to identify measured values of non-ionizing radiation (such as power density and electric and magnetic fields) emitted by phones and GSM base stations, along with any potential biological consequences connected with the measured values. In the literature, all measurements of power density, electric fields, and magnetic fields were made using various instruments over a variety of base station distances and times. The findings from the literature showed that the non-ionizing electromagnetic radiation's power density, electric field, and magnetic field varied with distance from the tower and were highest at the closest distances. The findings also demonstrate that, in some situations, home exposure levels to base station-emitted non-ionizing electromagnetic radiation are within the limit. In some instances, however, the situation varies, and persons living close to base stations experience health effects from high levels of non-ionizing electromagnetic field exposure. The biological effects of non-ionizing electromagnetic radiation exposure in homes are summarized in this article. Numerous studies to date have established the dangers of mobile phone base station radiation to people and wildlife. The negative biological effects of exposure to non-ionizing electromagnetic radiation were compiled from numerous articles. Residents who are exposed to higher levels of non-ionizing electromagnetic radiation at home are more likely to experience symptoms like fatigue, nausea, disturbed sleep, discomfort, headache, memory loss, skin problems, visual disturbances, hearing problems, dizziness, muscle pain, DNA damage, and infertility. Some mobile base stations are situated quite close to homes and commercial buildings, putting individuals at risk from the base stations' electromagnetic radiation. Depending on the infrastructure impediment, such as interior obstructions or buildings, the emf changed from location to location. As a result, cellular mobile towers shouldn't be placed closer than 200 meters from residential structures.

Keywords: non-ionizing radiation, mobile base station, biological effects and electromagnetic fields

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Introduction

The emergence of digital technologies like GSM 900 and DCS 1800 in the 1990s significantly enhanced the use of mobile telecommunications on a global scale. In metropolitan areas, mobile phones are used by 80% of the world's population at this time. A significant deployment of base stations has resulted from the rise in mobile phone usage. Based on a variety of variables, including the number of network providers, users, simultaneous calls, and base stations, a nation's base station count may increase. These base stations frequently are located close to residences or other buildings, which has raised worries about human exposure in recent years. The level of exposure to radio frequency electromagnetic fields (EMFs) caused by base stations is something that this group is interested in learning about. How dangerous are these radiation exposure levels? Whether they adhere to similar laws and regulations or standards that are based on both national and international laws Local and national authorities or agencies, network providers, and private citizens should consult reputable organizations to look into the non-ionizing electromagnetic field exposure levels in prohibited regions in order to get the answers to these issues. Concern among the general public is particularly high in nations like France, Romania, Italy, Australia, New Zealand, Lisbon, and Korea.[1] Studies in the domain of exposure field measurement and the potential effects of human exposure to such fields have been conducted in order to assess the potential effects of exposure to electromagnetic radiation via mobile communications. Despite the efforts of the scientific community, little is known about how the general population is exposed to mobile communication systems and the contributions of various services.

The cellular communication system is a recognized method of obtaining connectivity solutions for point-to-point and point-to-multipoint applications. Wireless communications examples include AM and FM radio, television transmission, mobile phones, radar and microwave systems, etc. Ionizing radiation and non-ionizing radiation make up the two main subgroups of the electromagnetic (EM) frequency spectrum. Ionizing and non-ionizing electromagnetic radiation are the two different forms of EM radiation. The frequencies utilized by cellular base stations—900, 1800, 1900, and 2100 MHz—are classified as non-ionizing radiation. Ionizing radiation has a stronger impact on human organs. The non-ionizing radiation emitted by cellular base stations does not change the atomic structure of living things, but it nonetheless affects human cells in ways that are not fully understood and could be harmful to human health. Cellular base stations emit non-ionizing electromagnetic radiation (EM radiation). found that school-aged adolescents who had high exposure to non-

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ionizing EMF from mobile phone base station towers (MPBSTs) had delayed fine and gross motor abilities, spatial working memory, and attention compared to students who had minimal exposure to non-ionizing EMF. Their research aims to determine how exposure to the non-ionizing electromagnetic fields (non-ionizing EMFs) produced by MPBSTs affects cognitive abilities. 217 male volunteers between the ages of 13 and 16 were recruited from two different intermediate schools: 124 students attended School 1 and 93 students attended School 2. The MPBSTs were 200 meters or less from the school structures. They discovered that the non-ionizing EMF in School 1 was 2.010 W/cm2 (20.1 mW/m2) and that it was 10.021 W/cm2 (100.2 mW/m^2) at a frequency of 925 MHz in School 2. For a total of two years, the pupils were exposed to EMFR for six hours per day, five days per week.

In Nigeria, thousands of mobile base stations have been set up to aid in the growth of mobile telephony. In addition, there is a public concern regarding the electromagnetic fields created by these MBS, especially among people who live close to these GSM masts and worry about being exposed to the radiation's negative consequences. The International Committee for Non-Ionization Radio Protection (ICNIRP) Standards must be used to define the level and assess whether it is dangerous or not as a result of this fear. The existing research that has been done on measuring and estimating the non-ionizing electromagnetic (EM) field intensity in relation to human exposure from cellular base stations and potential health implications of non-ionizing EM exposure is reviewed in this study.

Potential risks from cell tower

The tissues that are closest to where a cell phone is held can absorb radiofrequency energy, a type of non-ionizing electromagnetic radiation, from the device. The technology of the phone, the distance between the phone's antenna and the user, the volume and kind of use, and the user's proximity to mobile phone towers all affect how much radiofrequency energy a cell phone user is exposed to. The user's head will receive 60% of the radiation that a standard cell phone emits (enough to cause warmth).[2] Popularly researched health risks include: potential connection to cancer, Distraction when driving sources, Males with poor fertility or DNA damage and Pregnancy-related morbidity and miscarriage. Hearing aids, defibrillators, and pacemakers all exhibit non-ionizing radiation. Public worry about the negative effects of radiation released by these devices has increased as a result of the rapid use of mobile phones (and, consequently, transmitting masts). In order to evaluate the effects of radiofrequency electromagnetic fields (non-ionizing -emf) on other cell lines,[3] employed stem cells. Studying the effects of GSM 900 MHz at a certain distance (20 cm) and intensity (354.6 W/cm^2) for five exposures on the development and proliferation of mesenchymal stem cells generated from adipose tissue. They came to the conclusion that the duration of exposure to 900 MHz non-ionizing signal radiation from antenna can decrease cell viability and proliferation rates of human adipose-derived stem cells (ADSCs).The International Agency for Research on Cancer of the World Health Organization classified non-ionizing radiation exposure in 2011 as a potential human carcinogen, Group 2B[4] despite the fact that EMR is a non-ionizing radiation that very modestly warms tissues. 74,531 measurements were made in all, which equates to about 83 hours of recording,[5] After measuring the entire flat, including the balconies, the mean total non-ionizing radiation level was determined to be 3,811 W/m^2 (with a range of 15.2 to 112,318 W/m^2). From the balcony outside the tower, the closest base stations were only 6 m away. Surprisingly, they came to the conclusion that the apartment's level of radiation makes it unsuitable for long-term habitation, especially for kids who may be more susceptible than adults.

EMFs produced by mobile phone base station antennas in public spaces were presented in Figure 1 and examined[6] The near- and far-fields of the mobile phone base station antenna's non-ionizing electric field strength and non-ionizing EMF power density were measured. They conducted penonionizing tests on the roof in the near-field in front of the antennas for mobile phone base stations, and the results showed that there is a dynamic energy interaction within the antenna electric field that varies quickly with distance. At 50, 100, 200, 300, 400, and 500 m from the base station, the non-ionizing EMF power density values on the ground are very low and are dispersed between 0.02 and 0.50 mW/m^2 intervals. The outcomes were contrasted with global exposure recommendations (ICNIRP).

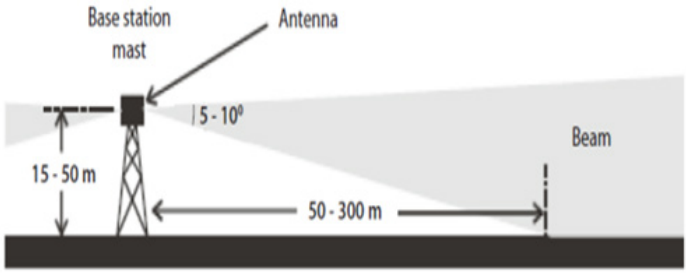

Figure 1 Direction of coverage due to base station antenna.

Many researchers did a survey on "residential exposure to radiofrequency fields from mobile phone base stations, and broadcast transmitters." 200 randomly chosen participants in total were registered. Each participant maintained a time location-activity record and received a personal exposure meter for 24-hour measurements. C Goiceance and R Dannlescu conducted research on household EM radiation exposure near mobile phone base stations in Romania in 2010. Here, several exposure situations were considered in respect to where measurement sites should be placed in relation to antenna and propagation conditions. They tested EMF levels in numerous areas of the homes, such as the room, balcony, loggia, and roof-terrace, to determine the worst case residential exposure. EMF values were measured between 0.25 and 9.7 v/m[7] Mobile phone base stations are the main source of EMF in homes, accounting for the majority of the exposure. According to epidemiological research, there is a strong correlation between living close to MBS and certain health impacts, including brain cancer, greater psychological strain ratings, significantly higher salivary alpha-amylase concentrations, obsessive-compulsive traits, anxiety, and performance. In Nigeria, network providers indiscriminately mount MBS near residences, workplaces, hospitals, and educational institutions, raising the exposure level in such settings and posing a serious health risk. Environmental impact evaluations and precautionary measures must be implemented prior to installation, and legislation prohibiting the installation of MBS in protected natural areas and places with endangered species must be passed.

Material and method

Literature Search Strategy

According to the Preferred Reporting Items for Systematic Reviews and Mata-analysis, a literature search of the research findings that had been published was carried out utilizing the databases of Google Scholar, Research Gate, Academia, and PubMed. It was also not limited to a specific time period. The search phrases were created by combining different ways of characterizing the exposure features, such as "Health consequences of Non-ionizing Electromagnetic Radiation," "Health implications of Magnetic and Electric Fields," and

"Effects of Electromagnetic Fields." the additional synonyms for each main sentence. Before data extraction, two researchers enhanced the data extraction table. These two researchers independently searched citation databases, such as Google Scholar, Research Gate, and other databases, before gathering data using prepared tables (Table 1). Any contradictions were resolved by discussion with a third investigator.[7]

Inclusion criteria

The search was limited to studies in which people and animals were exposed to EMFs. The databases' "related article" features and the citations of relevant papers were both used to search for further articles. Only peer-reviewed works that were published in English were taken into account. According to the various exposure frequency ranges, the studies required to provide the exposure levels for magnetic field, electric field, specific absorption rate, and kilo voltage in indoor environments.

Data extraction

B. Samaila extracted the data, and others validated the findings. Information on the biological consequences of emfs, exposure time, frequency, power density, kilovoltage of power lines, and other factors was gathered. It was discovered that the health implications had negative short- and long-term effects. We analyzed studies on the adverse effects of EMFs that concentrated on either short-term or long-term residential exposure impacts.

Result and discussion

Tables 1 & 2 provide an overview of the international exposure limits that various nations and organizations have adopted for power densities and their consequences. Table 3 lists the observed distances and heights to GSM towers, power densities, electric and magnetic fields, and their results. Actions to reduce public exposure to electromagnetic fields should be weighed against the additional advantages to health, safety, and security that products that emit electromagnetic fields provide to daily life. Table 1 displays several criteria for electromagnetic field exposure following research on the ICNIRP recommendations and European Community recommendations on human exposure to electromagnetic fields in 1998.The regulations on non-ionizing electromagnetic radiation exposure limits are mostly based on recommendations made by various nations and by international organizations like ICNIRP and the E.C. with reference limits for potential exposure to EMF (Table 1). As a result, there is a wide range of reference limits for both general public and occupational exposure to electromagnetic fields. As a result, there is very little information on the radiation exposure from cellular base stations in residential areas at various angles and distances from GSM towers It should be noted at this time that penon-ionizing radiation assessed in broadband rather than frequency-selective measures makes up the majority of the official public exposure levels. According to the 2007 Bio-Initiative Report on Power Density (Table 2), the strength and quantity of non-ionizing electromagnetic radiation have a role in the biological effects brought on by the power densities detected from electronic devices, particularly mobile base stations. A base station's transmitting power and design should allow a mobile phone to send and receive a strong enough signal for reliable connectivity up to a few kilometers. The frequency bands that the cell tower uses to broadcast include 869-894 MHz for CDMA, 935-960 MHz for GSM 900 and 1805-1880 MHz for GSM 1800.[8–11]

Table 1 International exposure limits adopted by various countries

	International exposure limits adopted by various countries	Power density W/m²
1	USA public exposure guidelines at 18000 MHz	10
2	E.U and ICNIRP recommendation adopted in 1998 by India	9.2
3	Canada	3
4	Australia	2
5	Belgium	1.2
6	Newzealand	0.5
7	Switzerland	0.09
8	Poland, China, Italy, and Paris	0.1

Table 2 Bio-Initiative report 2007on power density

S/N	Power density	Effects	Reference
1	<0.1 μW/m² (0.00001 μW/cm2)	No health effects	Opara, 2014 &Girish, 2010
2	0.1 - 10 μW/m² (0.00001 - 0.001 μW/cm2)	Small health effects	
3	10 - 1000 μW/m² (0.001 to 0.1 μW/cm2)	Severe health effects	
4	>1000 μW/m² (>0.1 μW/cm2)	Extreme health concern	

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Table 3 Overview of power density, distances/tower height and effects

Source and Frequency of EMFs	Distance/ Tower height	PD, E & H	Effects	Ref
Mobile Base Station	200m	1.54μW/m^2	The distance between cellular base station transmitters and residential buildings should not be closer than 200 meters.	Udo et al.[27]
	500m	0.32		
	800m	0.17		
	1200m	0.14		
	1700m	0.03		
	2500m	0.001		
Mobile Base Station 900/1800Mz	210m	348.94nW/cm^2	.Within 300 meters of BS transmitters, the power density is higher and poses a risk to one's health.	Opara, 2014
Mobile Base Station	0-80m	MTN E: 21.03 μA/m	The acceptable thresholds of 61 V/m for electric field intensity and 0.16 A/m for magnetic field strength are not exceeded by any of the mobile base stations that are being considered.	Abdulsalam et al.[18]
		MTN H: 55.78 mV/m		
		GLO E: 9.41		
		GLO H: 24.96		
		Etisalat E: 2.33		
		Etisalat H: 6.18		
		Airtel E: 18.32		
		Airtel H: 48.62		
Mobile Base Station:Yanbu	74-149m	0.0050-0.0123	The findings demonstrate that EMF levels at every site evaluated are much below the National Standards for Public Exposure to non-ionizing emfsand that MPPs are located within the distance range recommended by the CITC guidelines.	Mouaaz&Mohammed[6]
Madinah	119-196.59m	0.0032-0.0046		
Taif	70.81-144m	0.0011-0.0145		
Jedda	79-285m	0.0026-0.0148		
Makkah	70.81-165m	0.0007-0.0981		
MBS: GSM	10-100	0.211 mW/m^2	These base stations' exposure levels were discovered to be well below the ICNIRP-recommended upper limits for exposure to the general population. There was no impact.	Asiegbu and Ogunlaj[3]

Table Continued....

Source and Frequency of EMFs	Distance/ Tower height	PD, E & H	Effects	Ref
MBS	12-30m tower height	0.0054 - 0.7784	The investigation, which lasted a full year, discovered that mobile towers are emitting electromagnetic radiation in several parts of the city that is above the permitted limits. Effects on health are likely.	Shashank & Mahendra[21]
GSM 900, GSM 1800 and 3G Mobile Base Station	Few cm	0.11 -6.73 μW/cm^2	Surveys conducted in 21 nations across five continents are contrasted with the findings of the experimental survey conducted in Kosovo. Despite being greater, the power density values obtained in Kosovo are frequently below the safety standard limits.	Enver et al.[5]
MBS	Within	10.45 mW/m^2	Mobile towers shouldn't be placed in densely populated areas because doing so increases the risk of residents experiencing health problems such fatigue, nausea, disrupted sleep, discomfort, headache, memory loss, skin problems, visual disturbances, hearing problems, dizziness, and muscle pain.	Lalrinthara&Zaithanzauva[9]
GSM 900, 945MHz and 950MHz	100m			
GSM 900 (935-960 MHz)	40-90m	0.003-0.066	For Mandalay residents, the safest location from the impacts of electromagnetic radiation might be suggested. The analyses support the observation that safe mobile device use might be advised by the experimental works.	Than and Yi Mon[26]
GSM 1800 (1805- 1880 MHz)		0.170-2.396		
mobile jammer device (MB06-Mobile Blocker) operate in GSM, 850 MHz, 900 MHz, 1800 MHz, 1900 MHz	1-5m 5-500m	-	Sperm motility was significantly reduced in semen samples subjected to radiofrequency radiation, and DNA fragmentation was significantly increased. It can be established that cell phone jamming may have detrimental impacts on reproductive health.	Parsanezhad et al.[19]

Table Continued....

Source and Frequency of EMFs	Distance/ Tower height	PD, E & H	Effects	Ref
900 MHz	-	--	Rats exposed to mobile phone radiation may have alterations in body weight and detectable histological changes in their brain tissue. These modifications might not, however, be accompanied by concurrent DNA damage.	Usikalu et al.[28]
GSM				
900 MHz	11-55m	0.20-46 μW/Kg	According to ICNIRP recommendations, the field strength and power density levels from GSM 900 MHz base station antenna never exceed the reference values when results of practical experiments using non-ionizing radiation are analyzed in a small number of places.	Mimoza et al.[11]
Mobile Base station				
GST 9000 and GSM100	50-300m	0.19-0.188mW/m^2	However, it has been asserted that in order to see an effect, power densities between 0.5 and 1 mW/m2 must be exceeded. This is because cause and consequence do not always manifest right away.	
MBS				
MTN GSM	20-100m	11.59-45.60	The rate of radiation absorption by the body increases together with the proximity of the human body to the BTs, increasing the danger of disease.	Maduka et al.[16]
AIRTEL		18.62-22.08		
9MOBILE		34.20-34.56		
GSM Mast	160 m, 230 m, 300 m	46.5 μW/m^2 86.8 μW/ m2 395.8μW/m^2	The 90-minute clip from yesterday reveals a lot of variance in the long-term power density during this global event. There will be both minor and significant health impacts.	Alnajjar et al.[1]

Below are some details on the potential effects of residing near mobile base stations and being exposed to non-ionizing electromagnetic radiation

In a three-day event of the Formula 1 race on April 4–6, 2008 at the Bahrain International Circuit, Kingdom of Bahrain, Alnajjar et al.,[12] measured the power density of the electromagnetic radiation emitted from the mobile base station (transmitting mast), and the results showed that the exposure to EMR was much lower than the allowable limit set by several professional organizations (seven organizations); it represented less than 0.1%. Average power densities at distances of 160 m, 230 m, and 300 m from the transmitting tower were 46.5 W/m2, 86.8 W/m2, and 395.8 W/m2, respectively. On Sunday, April 6, 2008, the day of the winner announcement, there was a power density of 901 W/m2, the highest ever recorded during the whole competition. On the last day of the competition (Sunday), which is also the winner announcement event, the long-term measured power density during this international competition exhibits a great deal of variance. The variance on this day was from 0.607 W/m2 to 16.832 W/m2, while on Saturday it was from 0.313 W/m2 to 5.455 W/m2 and on Friday it was from 0.139 W/m2 to 2.356 W/m2. This shows that there are a lot of phone calls made by F1 spectators while they watch the races. Maduka et al.,[13] measured radiation exposure levels below the recommended limit of 4.5W/m2 in a study that is comparable to this one. This demonstrates that the exposure levels in these locations are modest and, as a result, won't significantly endanger the health of those residing in the research area.

To evaluate the impact and contrast the findings with the safety criteria provided by ICNIRP, Mimoza et al.,[14] conducted a study using a field measurement approach. Information on the radiation level in Nigeria's university environment was revealed by the examination of the results. The findings revealed that PG recorded the lowest power density, 0.0158 mW/m2, whereas Odim recorded the highest power density, 0.1879 mW/m^2. At a distance of 200 m from the base station antenna's foot, the highest power density value could be measured.

Low radiation, or around 0.004 percent of the safety limit, was found when this power density level was compared to the global safety level standard of roughly 4.5 W/m2. Similar research was conducted by Usikalu et al.,[15]on the impact of 900 MHz radio frequency radiation (non-ionizing radiation) from digital mobile phones on the brains of Albino Wistar rats. Three groups of four male rats each were created out of a total of twelve (12) male rats for the study. For two months, Groups A and B were subjected to 8 hours per day of mobile phone radiation exposure and 4 hours per day of exposure, respectively, while Group C served as the control.A gel filtration electrophoresis was used to access genomic DNA (Deoxyribonucleic Acid) fragmentation, and a histological examination was carried out to examine the structural alterations in the brain tissue following the period of radiation exposure. The outcome demonstrated that there was no detectable DNA damage in the rat brains. The exposed rats' brain tissues displayed changes like congested cerebral blood arteries and a high number of spongiform vacuoles in the neuropil. The use of mobile phone jammers may have harmful consequences on reproductive health, it can be said. Than and Yi Mon (2020) discovered through measurement data that distance from the base station results in a 60% reduction in the electromagnetic field's magnitude (from 40 m to 70 m). Since the measurement position is straight with the antenna at 90 meters, the measured values are slightly higher at that distance. The measured values are slightly lowered due to the non-ionizing signals being significantly absorbed, reflected, or scattered by structures, trees, and other solid objects. The electric field is a direct function of power density. As a result, when the location is farther from the base station, the power density values that are obtained likewise drop. People who live close to this place must be protected from the effects of electromagnetic radiation. These analysts' experimental work has demonstrated that there are legitimate uses for a safe environment in the actual world.

According to Lalrinthara & Zaithanzauva[9] those who live close to mobile towers experience greater health issues than people who live elsewhere. The Kruskal-Wallis t-test was used to statistically evaluate and compare responses from respondents in both localities who took the surveys. Four (4) of the thirteen (13) different symptoms under study showed statistically significant comparisons with a p value of 0.05. In terms of headache and muscle pain, women were statistically more affected than men (p 0.05). Enver et al.,[16–20] employed theoretical, Software application, and experimental evaluations to determine the minimum safe distances for population and occupational exposure to electromagnetic fields produced by GSM 900, GSM 1800, and 3G base stations in metropolitan settings. The electromagnetic field levels were evaluated with the aid of the software program SPECTR Aemc, the P.1546 propagation wave model, and a topographic digital map, with the receiving antenna's height assumed to be that of an average person. In-situ measurements of the electric field strength were penon-ionizing at a few spots in the direction of the strongest radiation. At a few exposure areas, base station power densities ranged from 0.11 (W/cm2) to 6.73 (W/cm2).Surveys conducted in 21 nations across five continents are contrasted with the findings of the experimental survey conducted in Kosovo. Although higher than the safety standard limits, the power density values obtained in Kosovo are frequently below them. According to Shashank & Mahendra (2017), the worldwide communication business has experienced extraordinary expansion in recent years, which has led to a notable rise in the number of wireless devices. One of the global industries with the quickest growth is the mobile sector. Cell phone and tower electromagnetic radiation is a type of environmental pollution that can be harmful to people. People who live around mobile phone masts are constantly bothered by the noise and radiation they emit, which may have long-term repercussions including weakening their natural defenses, deteriorating their health, having difficulties reproducing, etc. The amount of electromagnetic radiation emitted by mobile towers in Kota City has been investigated, as well as its potential impacts on human health. The electromagnetic radiation emitted from mobile towers is determined to be beyond the allowable limits at some sites in the city, according to the year-long study.

An initial examination of non-ionizing radiation exposure levels from mobile phone towers in Aba, southeast Nigeria, was conducted by Asiegbu and Ogunlaja (2010).Within a 100-meter radius of the masts, 0.211 mW/m2 is the average exposure density for the general public. When compared to the ICNIRP reference norm for the GSM and CDMA frequency ranges, which is 4.5 W/m-2, this value is quite low. Therefore, studies show that the exposure situation in the city is currently quite safe. However, as telecommunications networks are dynamic systems that change and expand every day, efforts should be made to govern and limit the indiscriminate placement of masts in order to prevent the city, and possibly the entire country, from experiencing a crisis stage in the future. One of the Millennium Goals is to ensure everyone's health. The state of the environment shouldn't be compromised in our efforts to create one that makes communication easier. This essay aims to shed some light on how radio frequency exposure may affect people's health in general. As a result, it provides information on the electromagnetic energy coming from mobile phone base station antennas in Aba, a city in southeast Nigeria, at the radio frequency exposure level. At a distance of more than 10 to 100 m from 8 base stations, densitometric measurements of primarily CDMA 800 and GSM 900 signals were made at penon-ionizing wavelengths. The exposure levels recorded from these base stations were found to be well below the ICNIRP-recommended upper limits for exposure to the general population. The highest amount ever detected from a single base station was 2.20 x 10 times the exposure limit for the general public. A project was carried out by Mouaaz and Mohammed (2011) in the western region of Saudi-Arabia.The project's goal is to identify the Maximum Peak Point by measuring the intensity of EMFs around base stations (MPP). The purpose of the measurements is to confirm that the site complies with the CITC recommendations for radiofrequency exposure to humans. The potential effects of non-ionizing radiation exposure on human health are covered in this essay. Additionally, it highlights the findings from 20 chosen base stations that were situated in Makkah, Madinah, Jeddah, Taif, and Yanbu. The findings demonstrate that EMF levels are consistently far below the National Guidelines for exposing the general population to non-ionizing radiation at all investigated sites, and that MPPs are located within the distance range recommended by the CITC guidelines. For non-ionizing radiation site surveyors, the report finishes with some insightful remarks and suggestions.In Katsina, Nigeria,[21] conducted this study to evaluate the health risks related to exposure to radiofrequency electromagnetic fields from mobile base stations (MBS). Through a reconnaissance study, 77 MBS were found. Using a portable B and K precision spectrum analyzer, the received radiated power was measured at a distance of 0, 20, 40, 60, and 80 m from the MBS. The intensities of the electric and magnetic fields (E and H) were computed. The average values for E (mV/m) and H (A/m) for MTN, GLO, Etisalat, and Airtel, respectively, were 21.03 and 55.78, 9.41 and 24.96, 2.33 and 6.18, and 18.32 and 48.62.According to our findings, all of the mobile base stations under consideration expose the general population to radiofrequency electromagnetic radiation at levels below the permitted limits of 61 V/m for electric field intensity and 0.16 A/m for magnetic field intensity.

The electromagnetic radiation from cellular base stations and its effects on the human body are presented by Udo et al. in 2022. Human life is subjected to high amounts of electromagnetic emission as a result of technological innovation. Due to the health dangers connected with electromagnetic radiation (EMR) exposure, its effects are understood. The study was carried out at two communication firms, COMPA and COMPB, in the neighborhoods of Onitsha-Owerri Road and Owerri Municipal in Owerri, Imo State. The purpose of the study was to assess power densities in 72 homes between 200 and 2500 meters from the base stations using a Sure Call signal meter. The results showed that the average cumulative power density was 1.54005627200 W/m2, 0.319382647200 W/m2, 0.171062647200 W/m2, 0.139667752800 W/m2, 0.028675447200 W/m2, and 0.001429063200 W/m2, respectively, at different distances of 200 m, 500 m, 800 m, 1200 m, 1700 m, and 2500 m. The World Health Organization's (WHO) permissible limits and these results were compared. In conclusion, it was discovered that the power density varied with distance from the tower and was greatest at the closest distance. Due to infrastructural constraints like internal barriers or buildings, power density also differed from location to location. The effects of EMR from the mobile cellular base station (BS) transmitter on the body were examined by Opara K. F. (2014).[22–25] In two scenarios—along the express road and in a residential or business area—the received power density from the BS transmitter was measured using a cellular mobile network analyzer, which can gauge the strength of a cellular mobile signal. The calculated radiated power absorption was 348.94 nW/cm2 at 210 m from the emitter and increased as one got closer to the transmitter. Based on the findings, it was determined that the power density found within 300 meters of BS transmitters is a greater and more serious health issue. In order to ensure that the power density emitted is generally reduced, we advise the government to establish tight regulations that require BS transmitters to be placed between 300 and 500 meters from residential areas. In their study, Santini et al.,[23–29] found that in France, those who lived closest to cellular antennas had higher rates of the following ailments: fatigue, disturbed sleep, headaches, a feeling of discomfort, difficulty concentrating, depression, memory loss, visual disturbances, irritability, hearing disturbances, skin issues, cardiovascular disorders, and dizziness. Based on the medical data of individuals who resided 350 meters or less from a seasoned phone mast, Wolf and Wolf (2004) conducted study and presented it in Israel. They discovered a non-ionizing radiation-induced higher incidence of cancer compared to the Israeli general population and a tenfold increase among women specifically compared to the neighborhood farthest from the mast. Obenon-ionizing radiation (2004) in Spain discovered in a study significant adverse health effects among those residing near two GSM mobile phone base stations: He discovered that depressive tendencies, fatigue, sleeping disorders, trouble concentrating, and cardiovascular issues were the strongest five associations. People who live within a 50- to 300-meter radius are more vulnerable to the negative effects of electromagnetic radiation, as seen in the high radiation zone.

Conclusion

The exposure level data can be used to see all of the harmful side effects of radiation from cell phones and communication towers. The base transceiver station of any communication tower is still emitting radiation at such time, it is not considered dangerous because humans are exposed to it for a small period of time compared to other exposures. This naturally leads to the conclusion that residents are subject to radiation depending on how close they are to the communication tower, which has an effect on their health. The same effects also occur in nearby tower positions at other towers. According to this literature review, it was discovered that those who lived closest to cellular antennas had the highest rates of the following ailments: fatigue, disturbed sleep, headaches, discomfort, inability to concentrate, depression, memory loss, visual disturbances, irritability, hearing disturbances, skin problems, cardiovascular disorders, and dizziness. Therefore, it is necessary to take precautions and conduct environmental impact studies before installing mobile base stations in protected natural areas and regions where endangered species (including people and animals) are present.

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Conflicts of interest

There are no conflicts of interest.

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