STUDY AND DETERMINE THE RADIATION LEVELS FROM TELECOMMUNICATIONS TOWERS FOR SELECTED AREAS IN NAJAF GOVERNORATE IRAQ

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Abstract

In this research,(the EMF strength meter) was used to measure the energy intensity of electromagnetic radiation emitted from communication towers whose locations were determined using the GPS. The research examines the measurement intensity levels of energy issued by telecommunications towers of Zain and Korek Telecom in Najaf city, thus determining the amount of radiation emitted from the towers and comparing it with international standards for radiation protection.Electromagnetic radiation energy density was measured for 80 points spread over the study area. The highest value of the average energy density issued by the towers was (157000 µ W / m²). At the same time,the third point intensity populated the E6 block that contains many shopping centres and the general hospital.The total electromagnetic energy density for this region as a whole was (45477.99 µ W / m²), and the lowest value of the average energy density inblock F7 was (1.6 µ W / m²), which is very little because it is an uninhabited and remote area located at the outskirts of the city.Peak time was set for a point installed in the Al-Jamaiya neighbourhood over the day.From this, we conclude that the amount of radiation measured in the city centre and some neighbourhoods with a high population density, in which there are many markets and hospitals, is very high compared to the city's outskirts, which may reach at some points to zero.The measured results showed that the levels of radiofrequency radiation for the antenna of various companies do not exceed the national limits allowed by the Iraqi Ministry of Health and Environment, as well as within the global limits of both the International Committee for the Protection of Non-Ionizing Radiation (ICNIRP) and the US Federal Agency FCC. However, it exceeds the permissible Russian limits by a large percentage.
Keywords: electromagnetic radiation (EMR), Non-ionizing electromagnetic radiation (GSM), cell phone towers, energy density meter (EMF)

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1.Introduction

With the evolution of communications systems and information exchange techniques are world is witnessing a massive revolution in the use of modern technology in communication.Wireless communication has become the most common due tothe revolution, and many users of this service[1].These work using electromagnetic waves systems include radio, television broadcasting stations, radar, satellite and satellite broadcasting, industrial, medical and home applications such as microwave ovens[2][3]. The mobile phone has become a daily necessity in all countries of the world, including Iraq, thus, leading to a significant increase number of mobile towers belonging to various telecommunications companies spread within cities and in all residential. Many varied and different studies have emerged on the environmental effects of radiation that warn against continuous exposure to this radiation and despite concerns raised about the overuse of mobile phones[4][5].Previous studies show that no single scientific study has proven that radiofrequency causes cancer, but it may sometimes result in headaches and pain in the eyes[6].The working principle of the mobile phone is to transmit information to the nearest Warsaw reception station dotted on the rooftops of buildings in residential areas or towers that connect by antennas. These antennas are power transformers that convert electrical signals into radioactive waves and vice versa. Antennas are used in wireless communication systems for transmission and reception[7]**.** The transmitting, the RF front interface provides electric signals to the antenna, turning them into electromagnetic signals and making the antenna radioactive waves effective. Alternating current signals must be applied to the antenna output, and the antenna works with the resonance state[8]**.**According to Maxwell's equations, electromagnetic radio waves travel through free space and air to represent the displacement current[9]**.**Electromagnetic waves are characterized by a constant frequency of each type, a specific spread direction, different speeds depending on their type, the widespread nature of the medium and the greater the spread distance, the lower the energy density, and despite that difference, they have the same shape and characteristics[10]**.**The world is currently reliant on transmitting information on wireless links in communications, so it is concerned with developing the wireless local area network (WLAN) and developing low-weight, low-cost, high-efficiency antennas[11]. Devices that transmit information over long distances, such as mobile phones, need to exchange their signals in electromagnetic waves. These devices need to use the antenna for its unique effect in the successful design of any wireless tool, which significantly impactsthese systems[12][13].Radiation from mobile phone towers affects the human body, especially the brain and muscles, in places near the towers.[14]

There are different regions of Iraq and the world where studies have shown that the energy density is higher than the permissible value**.**. [15][17]

This paper aims tomeasure the energy density issued by telecom towers to mobile phones of various companies and compare it with the internationally permissible limits.Eighty points were measured throughout Najaf Governorate using an**EMF strength Meter**.

2.Experimental Methods

A.RF EMF Strength Meter

The RF EMF Strength Meter is shown in Figure 1; this hand-held Meter is used to measure the intensity level of energy of electromagnetic rays. The RF EMF Strength Meter model is 480836, a large-scale device for monitoring high-frequency radiation. It can measure electromagnetic radiation from 50MHz to 3.5 GHz.The Meter measures range from 900 MHz to 1800 MHz, the ranges mobile phones operate. This Meter can take different units according to the device's settings. The measurement process was done by holding the Meter vertically on the straightness of the arm and making a fixed angle (90º) with the arm. The distance between the meter and the earth's surface is about (1.3-1.5)meters, which is the average length fora human being to takea reading while five seconds wait to prove the reading rate of three readings per point.

Figure (1)show EMF strength Meter.

b.Location

Najafgovernorate:

The calculation of intensity levels of energy issued by mobile phone towers in the Najafgovernorate, with the total area of the governorate being 28,824 square kilometres, is located to the southwest of the capital Baghdad.Figure 2 shows a map of the Najaf governorateobtained from the Najaf Municipal Department of Planning and Drawing and represents 6.6% of the area of Iraq.Najaf City, with an 11,471,592 population according to the 2018 census, is considered the fifth city in terms of population.

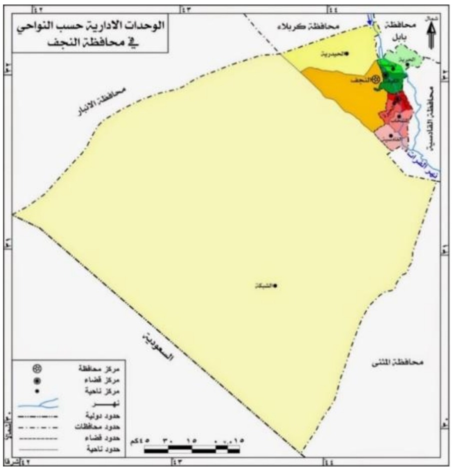

Figure (2) Represents the map of the Najaf Governorate.

The telecommunications towers of mobile phones are therefore heavily spread throughout the province to meet the population's needs. Among the most important communication companies in the governorate are Zain, Asiacell, Korek, Umniah and Kalimat Company, and Itisaluna. Zain, Asiacell and Korek are the leadingCompany for our study andNajaf city centre is the Location for the study,as shown in Figure (3)

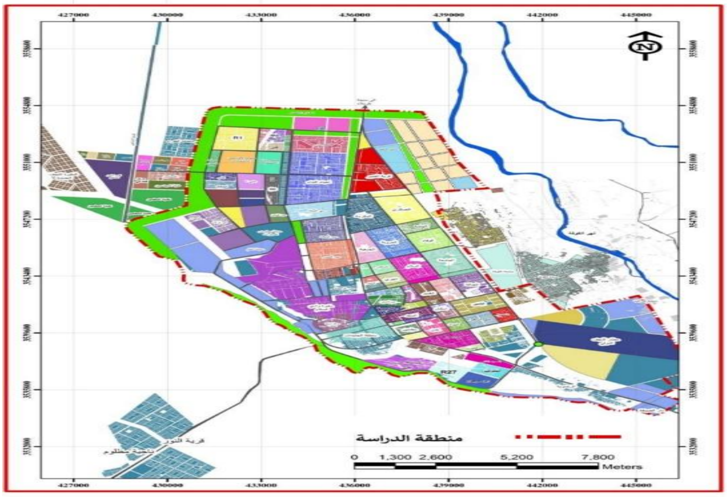

Figure (3)showsa map of Najaf city centre

As the working mechanism begins by dividing the city map into equal squares, the area of one square is equal to (1300) m^{2} and we appoint five points within each square in a uniform arrangement in the form of the letterZ, as shown in the Figure(4).

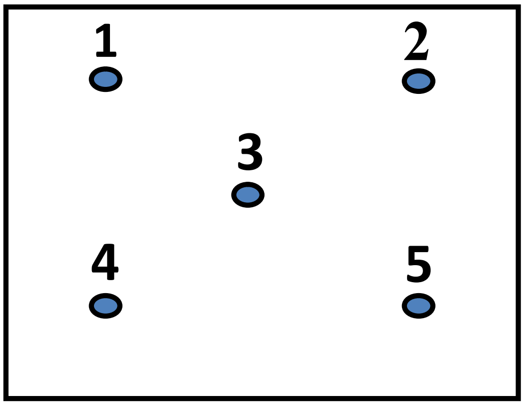

Figure 4: Shows points distributed in one square

It gives each square on the map a specific symbol by linking the rows and columns, i.e. the numbers and letters, from which we divide the city of Najaf into 25 squares, and the number of points required to measure the energy density and radiation levels in the squares is 80 points, as shown in figure 5.

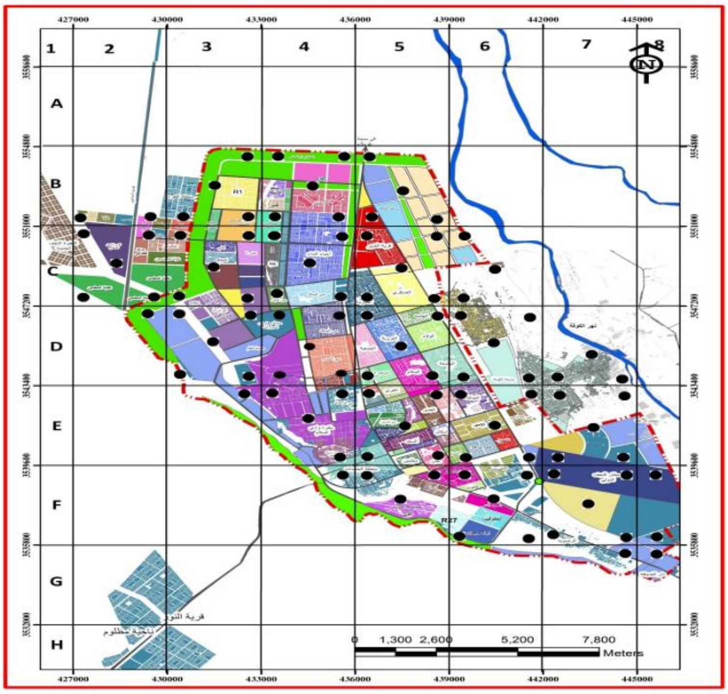

Figure (5) shows a divided map of the city of Najaf with measurement points installed on it.

Telecommunications companies' towers are distributed to the governorate areas depending on the population and distribution systems of communication towers, as in figure 6

Figure (7) shows a
map of the distribution of Zain towers throughout the city of Najaf.

Figure (6) shows some of the antennas in the study area.

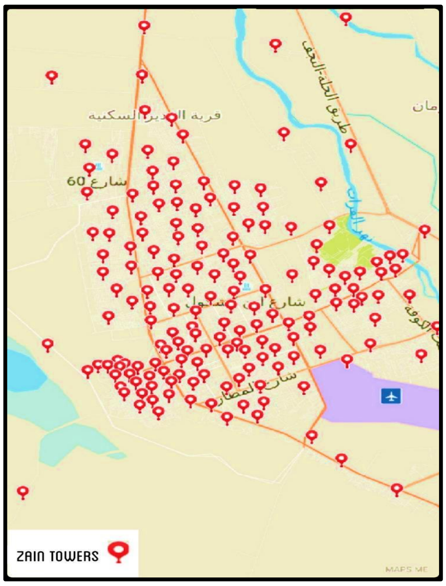

Figure (7) Zain Towers[19]

Figure (8) shows a map of the distribution of Korek's towers throughout the city of Najaf.

Figure (8) Korek Towers[19]

When merging the locations of the Zain and Korek companies' towers,we get Figure (9), which shows a map of the distribution of the towers of the Zain and Korek companies together, where we note the concentration of towers sites in the city centre.

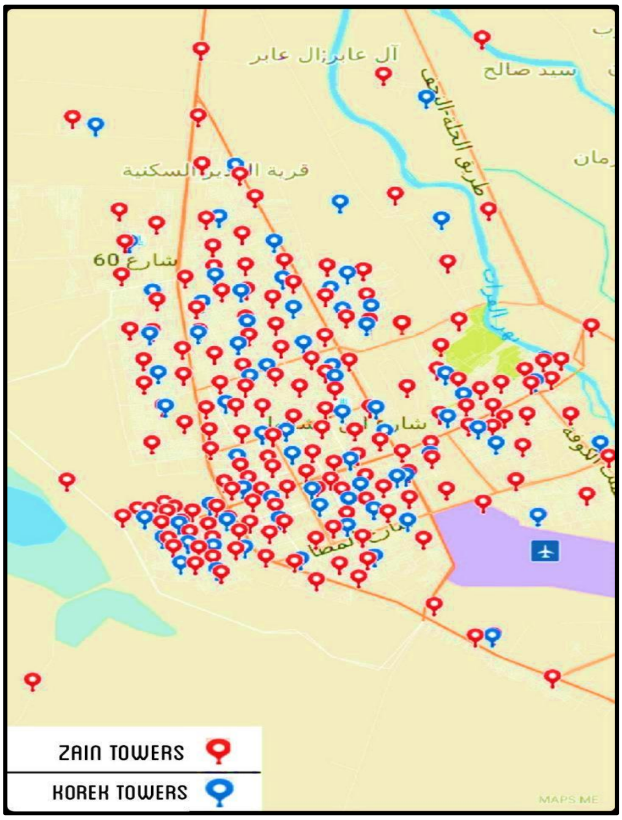

Figure (9) is the location of the towers of Zain and Korek companies together[19]

3.Results and discussion

The field measurement process was conducted for five months,which took about four to five hours per day at a rate of three days per week to measure in the morning from 8:30 am to 1:30 pm,while afternoon from 3:30 to 7:30 pm. The energy intensity of electromagnetic radiation at the critical points has been measured using the radiation intensity measurement units of the area unit (μ W/m2). Measurements have been collected from the setpoints and fixed on the map of 80 points as in table (2).

Table No. 1 shows the locations and coordinates of some towers for Zain and Korek.[19]

Location	GPS coordinates	Zain Sites\ Korek sites	The Company's name
Salam\ Ghari St	N: 32.02437 E: 44.33892	6280	Zain
Al-Salam district	N: 32.02961 E: 44.34763	5306	Zain
Al-Ghari district	N: 32.0245 E: 44.3328	5903	Zain

Al-Dhubaat district	**N: 32.01804 E: 44.32668**	**5232**	**Zain**
Al-Ansar district	**N: 32.03832 E: 44.32785**	**246**	**Zain**
Al-Jamaiya district	**N: 32.04454 E: 44.32425**	**5245**	**Zain**
Al-Hussain district	**N: 32.011061 E: 44.333069**	**NJ 5123**	**Korek**
Al-Ghari district	**N: 32.025281 E: 44.330489**	**NJ 5083**	**Korek**
Al-Salam district	**N: 32.032297 E: 44.3361**	**NJ 5057**	**Korek**
Al-Salam district	**N: 32.0351 E: 44.340131**	**NJ 5127**	**Korek**
AL-Adalah district	**N: 32.017611 : 44.3676**	**NJ 5069**	**Korek**
AL-Adalah Edistrict	**N: 32.02275 E: 44.357739**	**NJ 5124**	**Korek**

Peak time

After the completion of the fieldwork, the results of this study showed that the highest reading we had was at the third point in the E6 area and its reading rate was 157,000 µ W/m2). This point is located in the Amir neighbourhood and is abundant in shopping centres, malls and leisure centres andhas the fourth-highest reading point of 12661.7 µ W/m2). This point is located in the Zahra neighbourhood, which is characterized by the presence of the general hospital in the governorate and doctors' clinics. The total electromagnetic energy intensity of this area as a whole is 45,477.99 µ W/m2).compared to the average of the highest readings we got and in large units (0.1570 W/m2) With Iraqi Telecommunications Authority allowance limit of 4 W/m2) and with the International Committee for the Prevention of Non-Ionizing Radiation (ICNIRP) and their allowance is W/m2 (9) as well as our comparison with the FCC and their proper amount is (10 W/m2) The Russian permitted border is 0.1 W/m2) Table 3 is a comparison of current study results with permitted limits and a comparison with some previous studies. We found that the readings are less than the Iraqi determinant by 96.075%, less than the ICNIRP limits by 98.25%, and less than the FCC limits by 98.43%. These percentages are within the internationally permissible limits and exceed the Russian limits by 157%. As shown in the following table (3)

Table (2) compares the study results with international determinants and previous studies.[16][19][18]

Percentage of determinant				Average Energy Density	Symbol	**Region** (Reference)
Russia 0.1	FCC 10	ICNIRP 9	IRAQ 4			
3.6%	**0.036%**	**0.04%**	**0.09%**	**0.0036**	**Iav**	**Nepal** [16]
161.83%	**1.62%**	**1.80%**	**4.05%**	**0.18114139**	**A2**	**Mosul** [19]
157%	**1.57%**	**1.75%**	**3.925%**	**0.15700**	**E6**	**Najaf** The study

Table(3) shows the practical readings of the levels of energy intensity in the areas of the city of Najaf.

E 6	1	N: 32.021484 E: 44.355246	6250	8168	6941	7119.667	45477.99
	3	N: 32.005425 E: 44371334	147710	152160	171130	157000	
	4	N: 32.000825 E: 44.361667	12180	14120	11685.3	12661.76	
	5	N: 31.992265 E: 44.3477	4970.5	2889.8	7531.5	5130.6	
E 7	3	N: 32.006179 E: 44.384636	3.6	15.2	60.1	26.3	76.63
	4	N" 32.000320 E: 44.378949	35.3	77.4	98.2	70.3	
	5	N: 32.004578 E: 44.392038	64.1	125.3	210.5	133.3	
F 7	1	N: 31.999089 E: 44.382491	120.1	98.3	80.9	99.76667	276.396
	2	N: 32.004985 E: 44.400733	335.2	701.6	682.1	572.9667	
	3	N: 31.990427 E: 44.402106	780.9	881.2	353.2	671.7667	
	4	N: 31.968877 E: 44.387429	1.3	2.1	1.5	1.6	
	5	N: 31.987442 E: 44.413435	30.1	20.4	57.2	35.9	

A point was installed in the Al-Jamaiya neighbourhood. The energy density of the radiation was measured at that point around the clock and the rate of three readers per hour, as shown in table (4). The peak time at 6 pm, as in figure 10, showed how to increase the energy density over hours during one day, and the peak time was determined.

Table (4) Energy density reading for a specific area for multiple hours

I average $\mu W/m^2$	I_3 $\mu W/m^2$	I_2 $\mu W/m^2$	I_1 $\mu W/m^2$	time	GPS
0.13	0.1	0.2	0.1	07:00 AM	N: 32.032251
8.60	5.2	13.1	7.5	08:00 AM	E: 44.355972
25.33	20.3	25.4	30.3	09:00 AM	
101.97	85.4	111.3	109.2	10:00 AM	
113.58	125.00	95.21	120.53	11:00 AM	
239.23	313.7	195.2	208.8	12:00 AM	

341.63	341.63	307.1	239.2	01:00 PM	
330.10	330.1	277.7	266.2	02:00 PM	
388.97	388.97	399.3	361.5	03:00 PM	
387.40	387.4	370.5	290.6	04:00 PM	
527.83	527.83	454.6	367.2	05:00 PM	
887.80	887.8	835.3	935.3	06:00 PM	
777.20	777.2	790.5	720.8	07:00 PM	
593.57	831.2	506.7	442.8	08:00 PM	
474.23	405.3	406.9	610.5	09:00 PM	
422.37	324.5	521.9	420.7	10:00 PM	
153.07	128.7	160.4	170.1	11:00 PM	
89.30	101.5	102.1	64.3	12:00 AM	

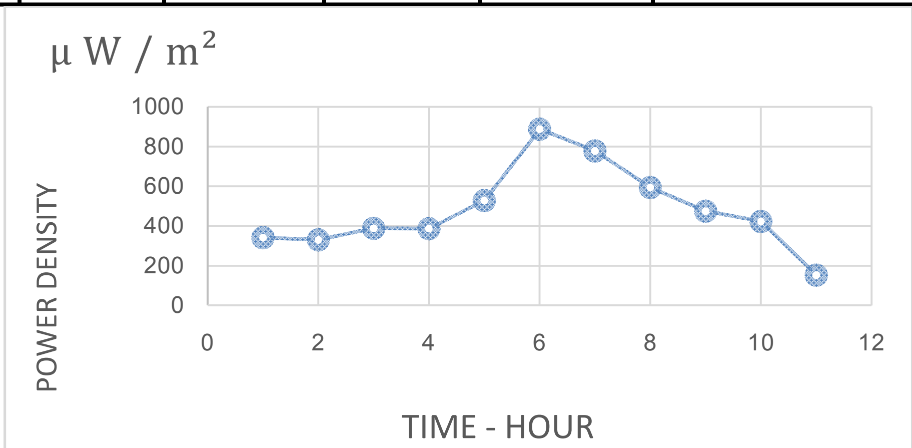

Figure (10) Chart shows the relationship between energy density and day hours.

Conclusion

This study provided measurements of the electromagnetic energy density issued by the telecommunications towers of Najaf Governorate.These results after the completion of the fieldwork showed that radiation levels of the radio waves of the tower antennas do not exceed the permitted limits, and the highest readings we obtained(157000 μ W/m2) is within the Iraqi limit of 3.925% and within the limits of ICNIRP (1.75%) and the FCC limit of 1.57%. These ratios are within the permissible limits established by international organizations ICNIRP and FCC and within limits permitted under the instructions of the Iraqi Ministry of Health and Environment but exceed the Russian border by 157%.We had less reading of the fourth point of the F7 area and its amount (1.6 μ W/m2) because this point is situated on the city's outskirts and is virtually devoid of residents, so there are fewer base stations and towers.

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