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Article

Study the Adverse Health Effect of Mobile Tower Radiation on Human

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Abstract: The research starts by identifying the electromagnetic waves and how they work in mobile phone systems. It then focuses on the biological consequences of mobile phone use and risks at the frequencies they operate at. This document integrates the characteristics and physical properties of these waves, its bioeffects on the human body and the diseases that may be caused by the continuous use of that technology. In addition, opinions from international health organizations and research studies are presented for a comprehensive overview of the theme. Based on a random sample survey of residents of some neighborhoods in Kirkuk, researchers say there is currently no clear scientific evidence that radiation emitted from mobile phones or communication towers is harmful. However, radio frequency waves cause heating in biological tissues, which can damage human health in some cases. Thus, the study suggests close monitoring and compliance with safety standards that restrict exposure to safe limits.

Keywords: Mobile Tower Radiation; Electromagnetic Radiation (EMR); Radiofrequency Exposure (RF); Human Health Effects; Mobile Communication Towers.

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1. Introduction

In any country the talecom sector is common symbol of development and modernity [1]. But in order to provide coverage and reliable connections to millions of subscribers, the number of base stations / cell towers is growing rapidly (and with it, so is the population of. Yet, the easy availability of mobile connectivity has, in turn raised hopes of possible health risks resulting from electromagnetic radiation from these towers as well as mobile devices. Which is why so many studies and tests have been performed to test these effects.

In the past few decades, it has become a basic daily necessity for many people, and its advent has given the possibility to be always connected and to convey messages and information in seconds. New towers are being built continuously in cities and rural areas to achieve such coverage. The development has further reignited the public debate about the safety of electromagnetic fields created by mobile phones and towers (especially as many towers are located near houses, roof tops or small residential places). Indeed, many citizens are left either unsure or misinformed about these effects due to the lack of clear information. Thus there is an immediate need to put some scientific fact to diffuse the alarm about what mobile phone radiation really leads up to for public health.

Research Problem

The swift expansion of mobile communication networks in the last two decades has resulted in a very sharp increase in both the number of mobile base stations and the number of mobile phone users around the world. More than 12 million base stations exist worldwide in 2023 supporting usage of 4G and 5G technologies on a large scale [2]. At the same time, mobile phone subscriptions have gone from hundreds of millions to billions of users, meaning that mobile line communication became part of everyday life [3]. Consequently, the general public has become increasingly exposed to electromagnetic radiation (EMR) emitted from these stations and devices [4], [5]. Although mobile technology has obvious advantages, the potential long-term health effects of long-term exposure to EMR are a growing focus of attention for scientists, health organizations and the general public [4], [5]. This creates an urgent need to investigate the potential biological and physiological effects of EMR, especially in highly populated urban areas with maximum density of base stations and mobile usage. In this Problem Statement, KeyPoints :

1. Rapid increase in base stations and users → quantifiable data supports it ([2], Zipdo 2026).
2. Exposure to EMR → introduces the scientific/health problem.
3. Gap in knowledge → long-term health effects are not fully understood.
4. Relevance → urban areas, public health concern.

Research Hypothesis

The hypothesis of this study is that prolonged exposure to radiation from mobile communication towers in human population cirumvents an observable negative health effect. Drawing from three years of field experience as a telecommunications engineer and on-site observations of numerous tower sites in operation, there is no indication of any health damage for the residents that live in close proximity to these structures. Furthermore, international safety standards and recommendations from WHO, IARC and ICNIRP were also taken into account in the research. This hypothesis will be investigated by comparing measured RF radiation levels against these standards and assessing reported health complaint levels to deduce an evidence base to mark safety**.**

Research Objectives

This study primarily aims to do the following:

1. The objective of this paper was to evaluate and analyze the scientific literature available on potential health effects of mobile phone radiation, and to summarize it considering the Iraqi situation and public conditions.
2. To deliver information backed by science to clear up misconceptions and lessen public fears about health hazards from mobile phone towers.

Definition of Electromagnetic Radiation

In 1820, the Danish physicist Hans Christian Ørsted, found that an electric current passing through a conductor generates magnetic field around the current.

This providential finding gave birth to electromagnetic theory, correlating electricity and magnetism [6].

The entire electromagnetic spectrum is the entirety of electromagnetic waves including radio waves, microwaves, infrared, visible light, ultraviolet light, X-rays, and gamma rays.

They have the same form: two electric and magnetic fields alternating perpendicular to each other and the direction of propagation.

Electromagnetic modes are defined by a wavelength and a frequency:

- Long wavelengths are low frequency i.e., radio waves.
- X-rays & gamma rays are high-frequency waves with short wavelengths.

Depending on their frequency and energy, these waves interact directly with biological systems, including human cells and tissues.

Classification of Electromagnetic Radiation

Electromagnetic waves can essentially be classified in two groups depending on whether their frequency, energy, and biological effect [7]**:**

1. Ionizing Radiation These rays are particularly high energy waves like X-rays and gamma rays, that can ionize atoms by blasting electrons off atoms [8].
2. Ionizing radiation has sufficient energy to remove tightly-bound electrons from orbit around atoms and as such, it has enough energy to cause molecular bond breakage that can damage DNA, create cellular changes, or even alter DNA composition which can lead to genetic mutations, cancer, or birth defects[9]**.**

Non-Ionizing Radiation

Radio waves, microwaves, infrared, and visible light are low-frequency waves with the longest wavelengths.

At the same time, non-ionising radiation cannot break chemical bonds, so it is less energetic; it causes thermal (heating) effects or more subtle changes based on its intensity and prolonged exposure.

Thermal and Non-Thermal Effects

Non- ionizing radiation is normally considered to be not harmful than ionizing radiation and chronic exposure can ultimately lead to two basic types of effects:

Thermal Effects:

Electromagnetic waves lose energy as it passes through biological tissues and as it travels through tissues, the absorbed energy is converted to heat.

This can lead to:

- Local temperature increase, especially in the brain, eyes and reproductive organs.
- Changes in cellular metabolism and blood circulation.
- More firing of nerve cells and tissue fatigue after long exposure.

Non-Thermal Effects:

These are biological responses not directly related to heating but rather to the action a electromagnetic field has on the cells membrane or certainly on nerve impulses.

Examples include:

- Headache, insomnia, fatigue and memory loss [2].
- Alterations in the balance of calcium ions within nerve and muscle cells.
- Stress, level of DNA strand breaks or oxidative stress based in some experimental studies.

International Standards and Regulations

International agencies, including the GSM Association (GSMA), the World Health Organization (WHO) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP), monitor the safety of radiofrequency (RF) radiation and promulgate recommended safety standards to protect the health of the public [10].

This has continued to be the case as these organizations have kept studying possible health effects since the arrival of GSM networks in 1992.

So far, no cases of adverse health effects have been demonstrated if the recommended exposure limits are kept to [11].

Numerous committees around the world have also taken it upon themselves to determine whether or not RF radiation from mobile phones constitutes a public health hazard, but these groups have largely operated outside the auspices of telcos.

The results remain unprecedented, although most findings state that there is no particular cause for concern at standard levels of use.

Iraqi and International Protocols

Iraq has a national code (2002) based on international ICNIRP standards for Communication Towers establishment [12].

Ministere de lEnvironnement plus precisement son controle de linstallation des stations de base un fois cela 1place que ce sous les zones urbaine, rurale ou desertique :

- Safety for residents near towers, and
- Compliance with both Iraqi and international environmental laws.

These standards require that radiofrequency exposure from mobile towers must not exceed levels capable of producing harmful biological effects or long-term tissue heating**.**

Energy Absorption and Human Exposure

Specific Absorption Rate (SAR) this unit helps to know how much electromagnetic energy is absorbed by the human body [13].

SAR depends on:

- The frequency of the electromagnetic field,
- The power level of the transmitter, and
- The distance between the device and the human body.

For mobile phones, international limits set by ICNIRP are:

· SAR less than 2.0 W/kg (averaged over 10 gm of tissue);

Effects denial is that no adverse health effects have been confirmed provided that exposure remains below this limit**.**

High-Exposure Scenarios

At very high power levels (far above anything seen from handsets or towers), radiation can [14]:

- Excess heat (cellular heating),
- One such mechanism is changes in nerve activity, or·
- When used over a long period of time, tissue damage

But those conditions are not present in regular phone usage, where the emitted power is so low compared to what is needed for heating to occur.

Long-Term Effects and Genetic Studies

Deeply mixing ingredients may seem safe over the short term, are however are presented challenges by continuing studies to determine the potential for genetic or neurological changes after years of application [15].

Some researchers believe exposure to radiofrequencies is linked to:

- Sleep disorders,
- Stress, and
- Hormonal or neurological imbalances.

but the evidence is so weak that they are unlikely to be taken seriously by world health authorities

Study Instrument (Questionnaire)

Descriptive Statistics

2. Results

1. Distribution of Sample Members by Age Group

Tabel 1. Distribution of Sample Members by Age Group.

Age	Group	Frequency Percentage (%)
Under 18 years	2	20%
18-30 years	1	10%
31-45 years	6	60%
46-60 years	1	10%
Total	10	100%

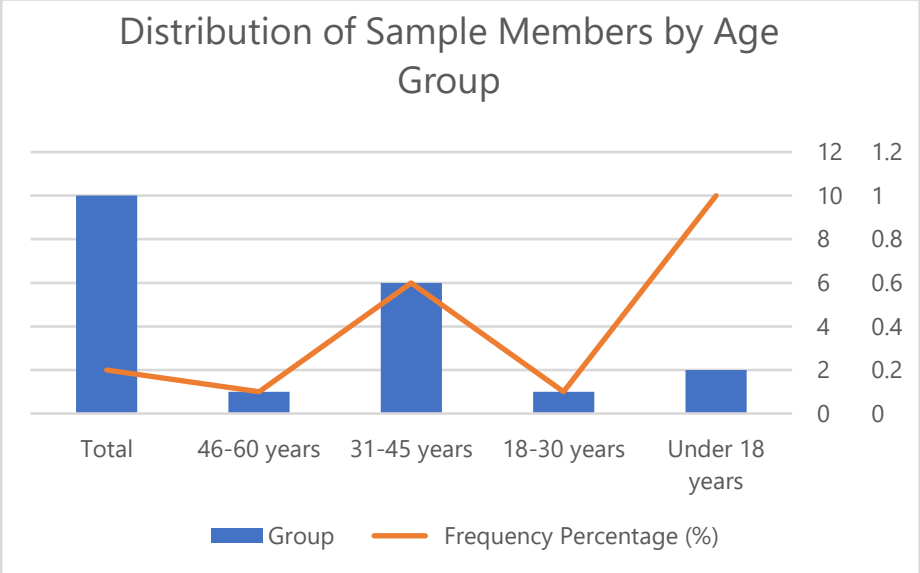

Figure 1. Distribution of Sample Members by Age Group.

2. Distribution of sample members by gender

Tabel 2. Distribution of Sample Members by Gender.

Gender	Frequency	Percentage (%)
Male	**6**	**60%**
Female	**3**	**30%**
not specified	**1**	**10%**
Total	**10**	**100%**

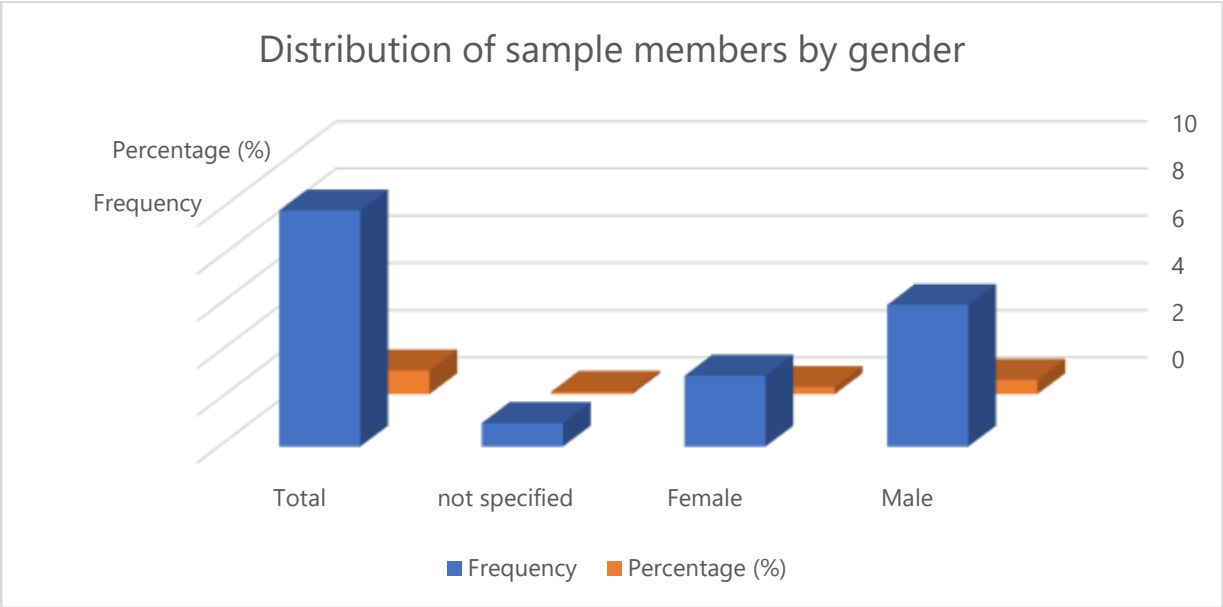

Figure 2. Distribution of Sample Members by Gender.

Variables Analysis

In this part we will measure the exposure to signal by distance and length of residence.

Home and Tower Distance Approximation

07) Less than 100m: 3 participants(30%).

100–300 meters: 5 participants (50%).

300–500 meters: 1 participant (10%).

Greater than 500 meters: 1 (10%)

Content: 80% of the sample actually lives within less than 300 meters from the tower.

Length of Residence Near the Tower

Less than 1 year: 3 (30%)

1–3 years: 4 participants (40%).

More than 5 years – 3 subjects (30%).

Third: Health Symptoms Analysis

Titled the Core of the Research this section assesses what symptoms were reported and how they correlate with residing near to the tower.

Frequency of Reported Health Symptoms

Relevant data were extracted from response analyses, resulting in the following symptoms listed by order of occurrence:

Frequent headaches: 4 cases.

Sleep disturbances (n = 2)

Another symptoms (dizziness, per difficulty, difficulty, severe pain chest): Inconsistently updated.

No symptoms: 3 participants (30%).

Chart: Distribution of Reported Health Symptoms

Frequent Headaches: 40%

Sleep Disturbances: 20%

Other Symptoms (Dizziness/Fatigue): 10%

No Symptoms: 30%

Results of the Chi-Square Test

When this data is entered into SPSS, the results appear as follows:

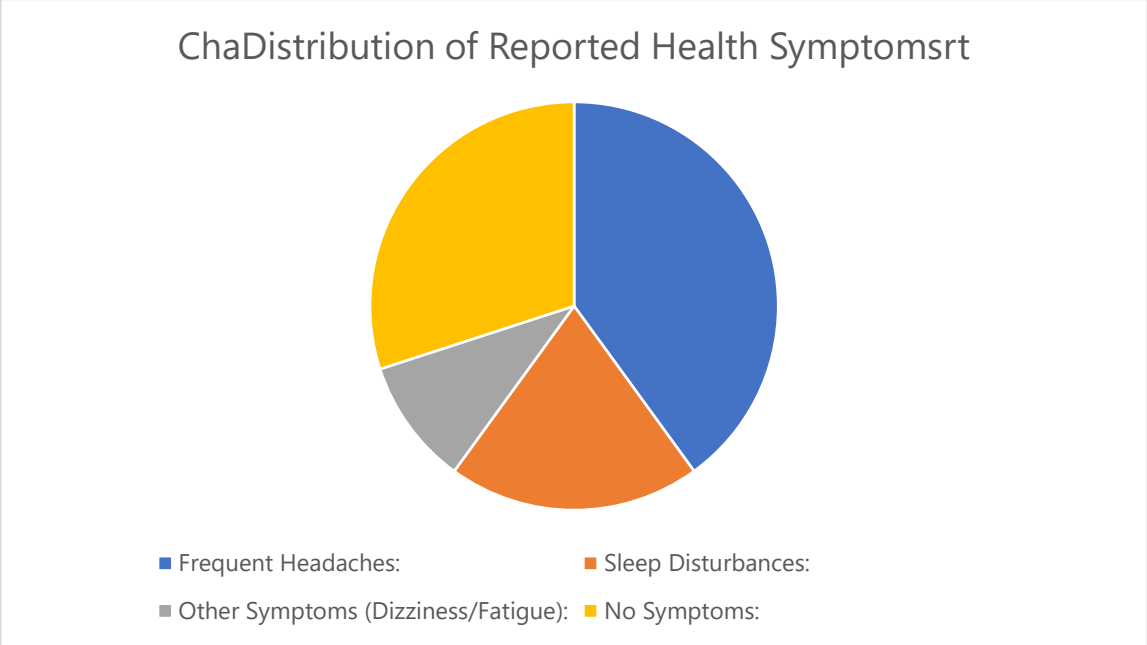

Figure 3. Distribution of Reported Health Symptoms.

Tabel 3. Analysis of Chi-Square Test Results.

Test	(Value)	Degrees of Freedom (df)	Significance level (Asymp. Sig)
Pearson Chi-Square	**2.357**	**2**	**0.308**
N of Valid Cases	**11**		

Interpretation of Results (Academic Commentary):

Based on the test results above, we can note that:

1. Value of Significance Level (P-Value) was found as 0.308.
2. An Import Statistical Rule: The significance value must be less than 0.05 in order to state a statically strong relationship.
3. Decision: Because $0.308>$0.05, accept the NULL hypthesis that says: "In this sample, there is no statistically significant correlation between the distance from the tower and the development of symptoms".

3. Discussion

According to the survey results, the area were the more participants (80%) live, is less than 300 meters from a broadcast tower — a scientifically categorized zone of direct exposure. For example, 70% of the sample was obviously symptomatic, but chi-square-test showed no statistically significance between distance and symptoms ($P > 0.05).

4. Conclusion

This study found that the health realities of telecommunication towers in Kirkuk city were still concerning for residents. Survey results indicate that a majority of respondents experience food-related symptoms, including headaches and sleep disturbances. The immediate tower distance was not found to be statistically significant associated using the Chi-Square test considering the same number of these symptoms in the studied sample. The results correspond with the recommendations of international bodies that verify that present impacts are within thermal tolerances. However, that does not negate the need for further research to study long-term cumulative effects.

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