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# Effects of 5G Network radiation and its Preventions

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## Abstract

**To understand the impact of 5G networks on the environment, we're learning deep about how electromagnetic radiation might throw a curveball at our ecosystems and effects the living beings in them. We're not just throwing big words around; we're mixing a good dose of care with some solid science. We want to know if 5G's network could mess with the delicate balance of nature and maybe even our own well-being.**

**In this research we are also looking at how this advanced technology could shake up human& Environmental health and the happiness of our communities. We're walking the tightrope between tech wonders and making sure our planet stays in good shape. Because 5G's perks shouldn't be a one-way ticket to messing up the environment or our collective happiness.**

**To deal with these worries, we've got some good and easy suggestions. let's be smart about where we put those antennas, Increase up the security, and rules can be made that keep both excellent connectivity and our love for the environment in check.**

**Keywords:- 5G, 5G network, electromagnetic fields, Effects of 5G technology, Advantages and disadvantages of 5G network**

## 1. Introduction

Telecommunication technologies employ various forms of Radiofrequency (RF) electromagnetic fields, and new ones emerge continuously. Radio and TV broadcasting and other sources of telecommunication that run below 6 GHz include wireless sources like local area networks and mobile telephony. To meet the growing need for high-speed data transmission with improved reliability and low latency to users, telecommunication sources in future are planned to be developed operating at frequencies above 6 GHz, reaching the 'millimeter wave' range (30–30) For many years, frequencies higher than 6 GHz were used in different applications including radars, microwave links, airport security screening and in medicine for therapy purposes. Nonetheless, concerns related to potential health hazards associated with 60 GHz millimeter wave technology that will be used in the next-generation (5th generation or 5G) mobile networks.RF fields above 100 kHz lead to tissue heating as the main effect (for example, HPA; SCENHIR). For frequencies above 6 GHz, the depth of penetration becomes relatively small such that the resulting effects are mostly limited to superficial burning.

## What is Network? How it works?

Mobile networks enable wireless communication between mobile devices such as smartphones, tablets. There are generations of Network types commonly known as 2G,3G,4G and most recent 5G

Being the fastest network yet. These networks use a system of interconnected base stations or commonly known as cell towers to provide coverage across different geographic areas in order to provide connectivity to wireless devices used by people.

In a mobile network, ***Radio Frequency (RF)*** plays a crucial role in enabling wireless communication.

The mobile phones act as radio transmitters, they emit RF signals which go to the base station located in the proximity. The communication process is managed through the network's RAN, which routes the signals to the core network and

connects them to other external networks. This leads to smooth transitions that are known as seamless handovers as mobile devices switch from one base station to another one. On the other hand, information is extracted to demodulate RF signals at the destination, and this is reversed for response. This makes for sure and fast voice transmission in mobile networks.

| Characteristic | 3G | 4G | 5G |
|---|---|---|---|
| Bandwidth (maximum amount of data that can be handled at any moment) | 2 mbps | 200 mbps | >1 gbps |
| Average Speed (rate of data transmission) | 144 kbps | 25 mbps | 200-400 mbps |
| Latency | 100-500 ms | 20-30 ms | <10 ms |

k - kilo; m - mega; g - giga; b - bits; p - per; s - seconds

Figure.1 Comparison of Network generations [1]

# Advantages and disadvantages of 5G network

**Advantages :-**

1. **Higher Data transfer Rates:** But 5G is capable of data speeds that are several times faster than those enjoyed by previous generations, so downloads and uploads can proceed more rapidly.
2. **Low Latency**: The goal of 5G is to decrease the latency between devices, so that communication will be almost instantaneous. This is especially important for applications like augmented reality (AR), virtual reality (VR) and self-driven vehicles. As a result, the time it takes data to travel.
3. **Increased Capacity:** There are more 5G connected devices, which means there can be a larger number of things in IoT (Internet of Things).
4. **Improved Connectivity in Dense Areas:** 5G will be able to handle high-density environments such as crowded urban areas or sporting stadiums, where many devices are connected at the same time.
5. **Enhanced Mobile Broadband (eMBB):** 5G delivers a superior, more robust and reliable mobile broadband experience, supporting higher res video streaming or gaming as well data-intensive applications.
6. **Innovation in Industries:** Better connectivity via 5G and faster processing of real-time data make possible breakthroughs in many industries, such as healthcare, manufacturing transportation or agriculture.

**Disadvantages:-**

1. **Infrastructure Cost:** 5G network deployment requires heavy investment in infrastructure. New base stations have to be installed and existing ones upgraded. Such a price tag may be the obstacle to rapid adoption.
2. **Limited Range:** But 5G uses higher frequencies with shorter ranges than lower-frequency technologies. It also means that to attain wide coverage, more base stations are needed, particularly in the countryside.
3. **Potential Health Concerns:** High-frequency electromagnetic waves used in 5G have been suspected of hindering human health. The scientific community, meanwhile generally considers 5G safe within established guidelines.
4. **Compatibility Issues:** This means that 5G devices won't be compatible with the older networks. Users will have to leave their old equipment behind if they want all the good things in full measure.
5. **Security Challenges:** The more interconnected and the higher number of devices connected to the internet, however, means increased risk for potential cybersecurity threats.

# Potential effects of 5G network radiation

The introduction of the fifth generation (5G) of wireless communication will increase the number of high-frequency-powered base stations and other devices[2]. On 5G networks Data is transmitted through **radiofrequency radiation (RF radiation)**. But this type of radiation is non-ionizing. Its energy doesn't have enough punch to rip electrons off atoms, and even if it did would be too weak to damage DNA directly There have been concerns about the effect of RF radiation on birds and other wildlife. Some studies indicate that the RF radiation might affect bird navigation, because birds use Magnetic field of earth for guidance in their migration. But the evidence is not unambiguous, and there remains much that needs to be researched.

There is some evidence that the new devices and technologies associated with 5G will be harmful to delicate ecosystems. The main component of the 5G network that will affect the earth's ecosystems is the millimeter waves. The millimeter waves that are being used in developing the 5G network have never been used at such scale before. This makes it especially difficult to know how they will impact the environment and certain ecosystems. However, studies have found that there are some harms caused by these new technologies.

The millimeter waves, specifically, have been linked to many disturbances in the ecosystems of birds. In a study by the Centre for Environment and Vocational Studies of Punjab University, researchers observed that after exposure to radiation from a cell tower for just 5-30 minutes, the eggs of sparrows were disfigured. [3]He disfiguration of birds exposed for such a short amount of time to these frequencies is significant considering that the new 5G network will have a much higher density of base stations (small cells) throughout areas needing connection. The potential dangers of having so many small cells all over areas where birds live could cause whole populations of birds to have mutations that threaten their population's survival. Additionally, a study done in Spain showed breeding, nesting, and roosting was negatively affected by microwave radiation emitted by a cell tower. Again, the issue of the increase in the amount of connection conductors in the form of small cells to provide connection with the 5G network is seen to be harmful to species that live around humans.

Additionally, Warnke found that cellular devices had a detrimental impact on bees.[4] In this study, beehives exposed for just ten minutes to 900MHz waves fell victim to colony collapse disorder. Colony collapse disorder is when many of the bees living in the hive abandon the hive leaving the queen, the eggs, and a few worker bees. The worker bees exposed to this radiation also had worsened navigational skills, causing them to stop returning to their original hive after about ten days. Bees are an incredibly important part of the earth's ecosystem. Around one-third of the food produced today is dependent on bees for pollination, making bees are a vital part of the agricultural system. Bees not only provide pollination for the plant-based food we eat, but they are also important to maintaining the food livestock eats. Without bees, a vast majority of the food eaten today would be lost or at the very least highly limited. Climate change has already caused a large decline in the world's bee population.

## Methodology

This research paper combines qualitative and quantitative analysis to learn that if people are aware of 5G network and its potential effects on environment and infrastructure. We can analyze and draw a conclusion from people's responses on a public survey.

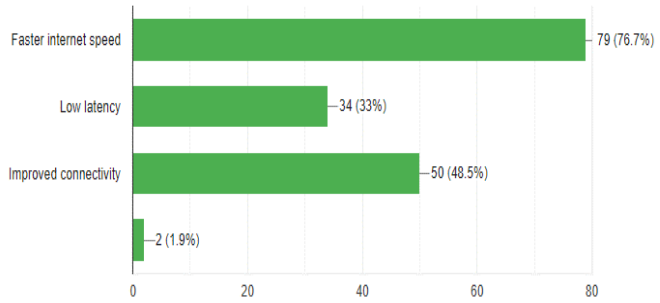
## Public Survey

The survey is used to gather the data. Both the outcome and the process by which it was arrived at will be examined. In this instance, 100 people were asked their opinions about their awareness and effects of 5G networks and how much they are aware of it. Conducting a survey is essential to obtaining reliable data that can be analyzed and used to determine the survey's outcome.

## Questionnaire

- How familiar are you with 5G technology?*
- Are you currently using a 5G-enabled device ?
- What motivated you to switch to or adopt 5G technology?
- In your opinion, how has 5G technology impacted internet speed and data transfer rates?
- Do you believe that the implementation of 5G has positively or negatively affected your overall digital experience?
- Are you concerned about potential health effects related to 5G technology?
- Do you believe the implementation of 5G technology has any positive or negative environmental impacts?

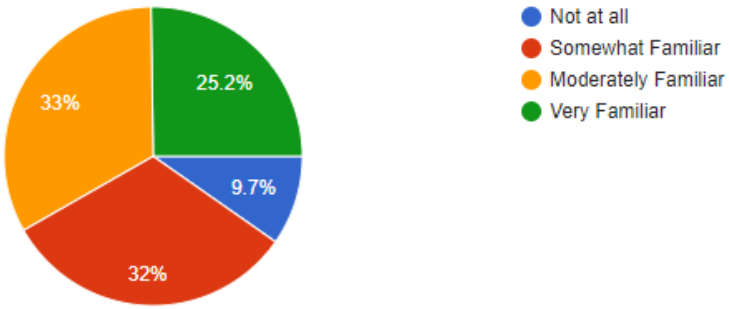
- Do you find the costs associated with upgrading to 5G technology justified based on the perceived benefits?
- Do you think the widespread deployment




of 5G infrastructure has any environmental implications?

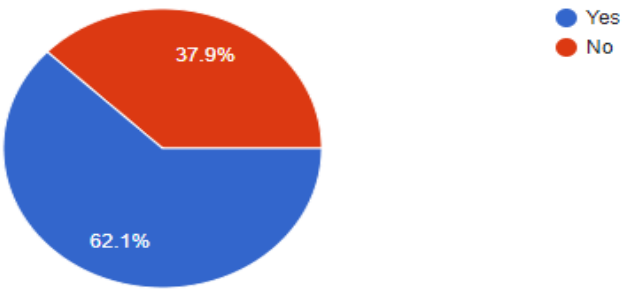
## Results

1) How familiar are you with 5G technology?*




When people were asked how familiar they were with concept of 5G network 25.2% were very familiar,
33% were moderately familiar, 32% were somewhat familiar & 9.7% were not familiar at all.

2) Are you currently using a 5G-enabled device ?

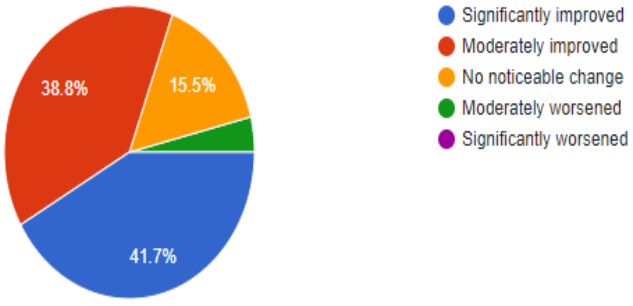



When people were asked if they use 5G enabled device 62.1% were using 5G enabled device and 37.9% were not using a 5G enabled device

3) What motivated you to switch to or adopt 5G technology?

When people were asked about what motivated them to switch to 5G network 76.7% people switched for faster internet speed, 33% people switched for Low latency, 48.5% people switched for improved connectivity, 1.9% people switched for "other reasons"

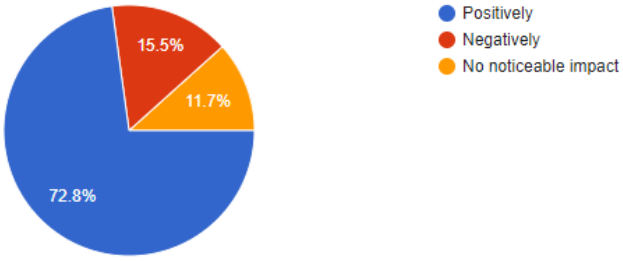
4) In your opinion, how has 5G technology impacted internet speed and data transfer rates?




When people were asked how arrival of 5G has impacted internet speed 41.7% people said significantly improved,

38.8% people said moderately improved, 15.5% people said no noticeable change, 3.4% said moderately worsened.

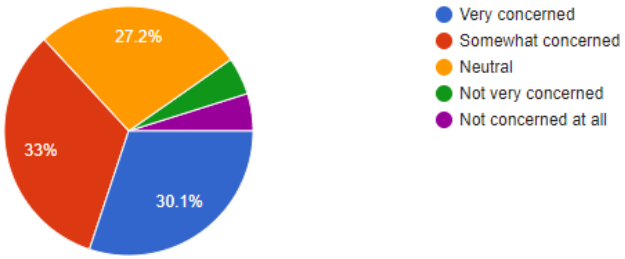
5) Do you believe that the implementation of 5G has positively or negatively affected your overall digital experience?




When people were asked about how 5G affected their digital experience 72.8% people said positively,

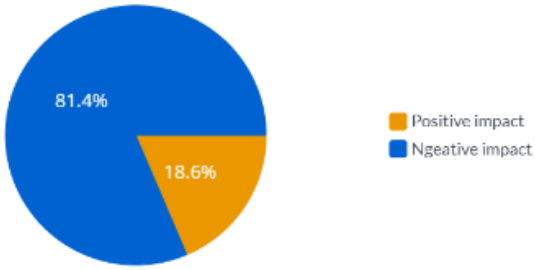
15.5% people said negatively & 11.7% people said no noticeable change.

6) Are you concerned about potential health effects related to 5G technology?



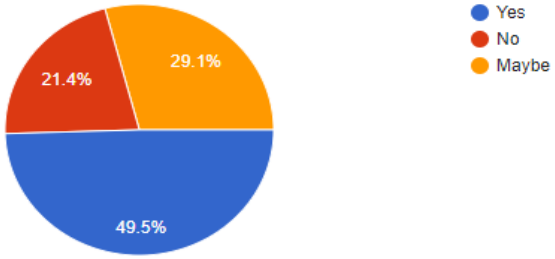

When people were asked about how concern they are about health effects that 5G network can cause 30.3% people were very concerned, 33% people were somewhat concerned, 27.2% were Neutral, 4.9% people aid not very concerned and 4.9%people said not concerned at all.

7) Do you believe the implementation of 5G technology has any positive or negative environmental impacts?



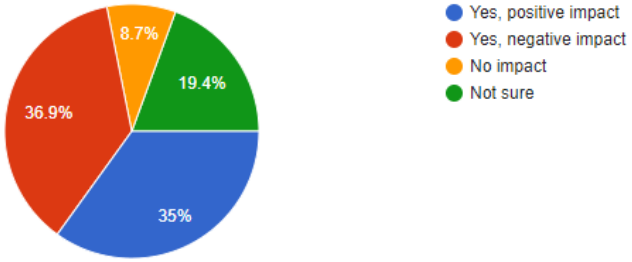

When people were asked if 5G has negative or positive or negative environmental impact 81.4% people said Negative impact and 18.6% people said positive impact

8) Do you find the costs associated with upgrading to 5G technology justified based on the perceived benefits?




When people were asked about the cost associated with upgrading to 5G is justified based on received benefits 49.5% people said yes, 21.4% people said No, 29.1% people said maybe menaing they are unsure about their upgread

9) Do you think the widespread deployment of 5G infrastructure has any environmental implications?




When people were asked about what they think of effects of widespread deployment of 5G infrastructure has any environmental implications 35% people said yes, positive impact ,36.9% people said negative impact, 8.7% people said no impact, 19.4% people said not sure.

## Hypothesis testing

Hypothesis testing is a sort of statistical reasoning that includes analyzing data from a sample to derive inferences about a population parameter or probability distribution. First, a hypothesis is created regarding the parameter or distribution. This is known as the null hypothesis, abbreviated as H0. After that, an alternative hypothesis (denoted Ha) is defined, which is the polar opposite of the null hypothesis. Using sample data, the hypothesistesting technique determines whether or not H0 may be rejected. The statistical conclusion is that the alternative hypothesis Ha is true if H0 is rejected. For this paper, Null hypothesis (H0): Peoples are concerned about effects of 5G network radiation. Alternative hypothesis (Ha): Peoples are not concerned about effects of 5G network radiation.

TEST (STATISTICS) There are many tests available to determine if the null hypothesis is to be rejected or not. Some are: 1. Chi-squared test 2. T-student test (T-test) 3. Fisher's Z test. For this paper, we will be using Chi-Squared Test Pearson's chi-square test is a statistical test for categorical data. It is used to determine whether your data are significantly different from what you expected.

Level of significance - (Also known as alpha or α). A significance level of 0.05, for example, means there's a 5% probability of discovering a difference when there isn't one. Lower significance levels indicate that more evidence is required to reject the null hypothesis. Level of confidence The confidence level indicates the probability that the location of a statistical parameter (such as the arithmetic mean) measured in a sample survey is also true for the entire population.

| Sr.no | Mail_id | Gender | Grade |
|---|---|---|---|
| 1 | Anish | M | Concerned |
| 2 | Mayank | M | Not Concerned |
| 3 | Surya | F | Concerned |
| 4 | Rohit | M | Concerned |
| 5 | Vinish | M | Not Concerned |
| 6 | Dinesh | M | Concerned |
| 7 | Apurva | F | Concerned |
| 8 | Vedang | M | Not Concerned |
| 9 | Prachi | F | Concerned |
| 10 | Riya | F | Concerned |
| 11 | Ganesh | M | Concerned |
| 12 | Manasi | F | Not Concerned |
| 13 | Suyash | M | Concerned |
| 14 | Chetan | M | Concerned |
| 15 | Vighnesh | M | Concerned |
| 16 | Janhavi | F | Concerned |
| 17 | Nishant | M | Concerned |
| 18 | Kshipra | F | Concerned |
| 19 | Ruchika | F | Not Concerned |
| 20 | Mugdha | F | Concerned |

| | Concerned | Not Concerned | Total |
|---|---|---|---|
| Male | 8.00 | 3.00 | 11 |
| Female | 7.00 | 2.00 | 9 |
| Total | 15.00 | 5.00 | 20 |
| Ei | 8.25 | 6.75 | 15 |

Level of significance = 0.09 i.e., confidence = 96%

The chance of accepting the null hypothesis in a chi- squared test depends on the chosen significance level and whether the calculated Chi-value is more than or equal to that significance level. Then we can reject the alternative hypothesis and conclude that 5G network radiation have bad impact on environment

**Step 1: Determine what the null and alternative hypothesis are-**

Null hypothesis (H0): 5G network radiation have bad impact on environment Alternative hypothesis (Ha): 5G network radiation don't have bad impact on environment

**Step 2: Find the test statistic - Calculating Ei value-**

To Calculating Ei= Row total*Column Total/Grand Total

9*15/20=6.75, 9*5/20=2.25

11*15/20=8.25, 11*5/20=2.25

**Step 3- Calculating Σ(Oi-Ei2)/Ei-**

$\Sigma (7-6.75)^2/6.75= 0.009259$

$\Sigma (2-2.25)^2/2.25= 0.027778$

$\Sigma (8-8.25)^2/8.25= 0.007576$

$\Sigma (3-2.75)^2/2.25= 0.027778$

**Step 4-To Calculate Chi Squared value**

The formula Is =CHIINV (0.06,2)

Where 0.05 is the level of significance and 2 is the degree of freedom (3-1) *(2-1) =2 CHIINV (0.06,2) = 0.968112086

Since this Chi Squared-value is greater than our chosen alpha level of 0.05, we can accept the null hypothesis. Thus, we have sufficient evidence to say that 5G network radiation harmful to environment

evidence to say that 5G network radiation is harmful to environment

# Findings

1.Majority of the audience we surveyed had 5G enabled device and they were using 5G network in day to day life.

2.Audience was interested in higher data transfer speeds and improved connectivity, But also there were some areas where 5G network was not available.

3. As per survey Audience was quite fond of using 5G Network.

4.Majority of the Audience was aware of effects of 5G network on the environment and were concerned about it.

# Conclusion

In conclusion, people are concerned about health effects of 5G network radiation and they are trying to mitigate those risk in order to get better health in modern day and age. Audience is well aware of the harmful effects of 5G network radiation on their surrounding environment and they are trying their best to live a healthy life with causing less and less damage to their surrounding environment