Geospatial Assessment of Telecommunication Mast Proximity and Its Perceived Health Effects in Abeokuta South LGA

ATTAH, T .O[1], ABUBAKAR, S.A[2]

Department of Surveying and Geoinformatics, Federal Polytechnic Ilaro, Ogun State, Nigeria.

Department of Urban and Regional Planning, Federal Polytechnic Ilaro, Ogun State Nigeria.

Corresponding author email: Theophilus.attah@federalpolyilaro.edu.ng
Whatsapp Phone Number: 07060749120

Abstract

This study explores how residents in Abeokuta South, Nigeria, perceive the effects of telecommunication masts on their health. It employs a mixed-methods approach that blends geospatial techniques with a social survey. Data were gathered from 294 residents living at varying distances (5m, 10m, and 15m) from the masts. The survey focused on self-reported health symptoms, such as headaches, dizziness, sleep disruptions, and noise/vibrations, commonly linked to electromagnetic field (EMF) exposure. Findings indicated that the masts were unevenly spread across areas like Sapon, Isabo, Kuta, and Panseke. The study finds that headaches and noise/vibrations were most frequently effect and were reported at 5 meter distance. However, further Statistical analysis using one-sample t-test*and ANOVA show no significant variation in perceived health effect across the three proximity distances: 5metres, 10metres and 15metres. This reveal that despite scientific findings indicating no significant health risks at 10meter distance (based on Specific Absorption Rate (SAR)), residents within this range still expressed concerns about safety. This highlights a gap between scientific findings and public perception, stressing the need for both to be considered when setting safe distances for telecommunication masts.*

Keywords: Telecommunication Masts, Effect, Proximity, perception.

Introduction

The rapid growth of telecommunications infrastructure, particularly the installation of telecommunication masts, has improved mobile network coverage and connectivity, however, their locations of these telecommunication masts within the neighborhood and communities have raised many concerns regarding health hazards and public safety (Charles & Julian, 2021)

Public have continue to express concern about potential risks associated with living proximate to to telecommunication infrastructures. Many studies have suggested the possible health risk associated with living proximate to telecommunication mast to include: cancer, neurological disorders, headaches, dizziness, and fatigue (Isah, Abdulrahaman, and Ibinaiye, 2024; Maffei, 2022; Odunola, Omoakin, and Afolabi, 2015). However, the findings are not consistent. Exposure to radiofrequency electromagnetic fields (RF-EMFs) is associated with some health effects, these include: nerve stimulation, changes in cell membrane permeability, and temperature-related effects, However, exposure beyond 100 kHz and 300 GHz is safe (ICNIRP,2004 ;ICNIRP, 2020). The goal of these limits is to prevent tissue heating from energy absorption, thereby protecting individuals from harmful health effects. The guidelines for RF-EMF exposure include key restrictions such as specific absorption rate (SAR) and reference levels like external field strength to ensure compliance with safety standards. In Nigeria, numerous studies have investigated the effects of RF-EMF exposure from GSM masts, assessing compliance with safety standards and evaluating potential health risks (Danladi et al., 2016; Shalangwa, 2010; Odoh & Ezekiel, 2023). Some findings indicate that SAR values from GSM masts remain within safe limits at distances of 10-50 meters (Danladi et al., 2016). However, other studies have detected radiation from telecom masts at distances of 100-200 meters and even up to 500 meters, with lifetime cancer risks exceeding the 10-meter safety distance set by NCC and NESREA (Shalangwa, 2010; Odoh & Ezekiel, 2023). The uncertainty surrounding RF-EMF exposure's potential health effects has sparked concerns among both the scientific community and the general public.

Telecom mast installations have extensive socioeconomic and environmental implications that extend beyond health concerns. Specifically, proximity to masts can detrimentally impact residential property values and rental demand, driven by public apprehensions regarding potential health risks and environmental disruptions. Empirical evidence from Nigerian cities, including Enugu Metropolis, Osogbo, and Ibadan, indicates that properties situated near telecom

masts are less desirable, resulting in diminished property values (Nzekwe, Oladejo, & Nnamani, 2023). Conversely, studies conducted in New Zealand and Germany produced mixed findings, wherein clustered masts were associated with decreased property values, whereas individual masts exerted no significant effect (Brandt &Maennig, 2010)

Telecom providers prioritize expanding coverage, but residents often feel excluded from decision-making processes regarding mast placement. This lack of community engagement can fuel public concern about safety, even when scientific evidence suggests minimal health risks (Hermans, 2015). To address this, involving local communities in decision-making, informed by both scientific evidence and public perception, is crucial.

This study aims to investigate the perceived health effects of telecommunication masts on residents living at varying distances (5m, 10m, and 15m) in Abeokuta South, Nigeria. Specifically, the research will:

1. Assess the perceived health effects of telecom masts on residents

2. Evaluate the relationship between distance and perceived health risks

3. Examine residents' perceptions of safety regarding the 10-meter regulatory distance set by NCC and NESREA.

MATERIAS AND METHODS

Study area

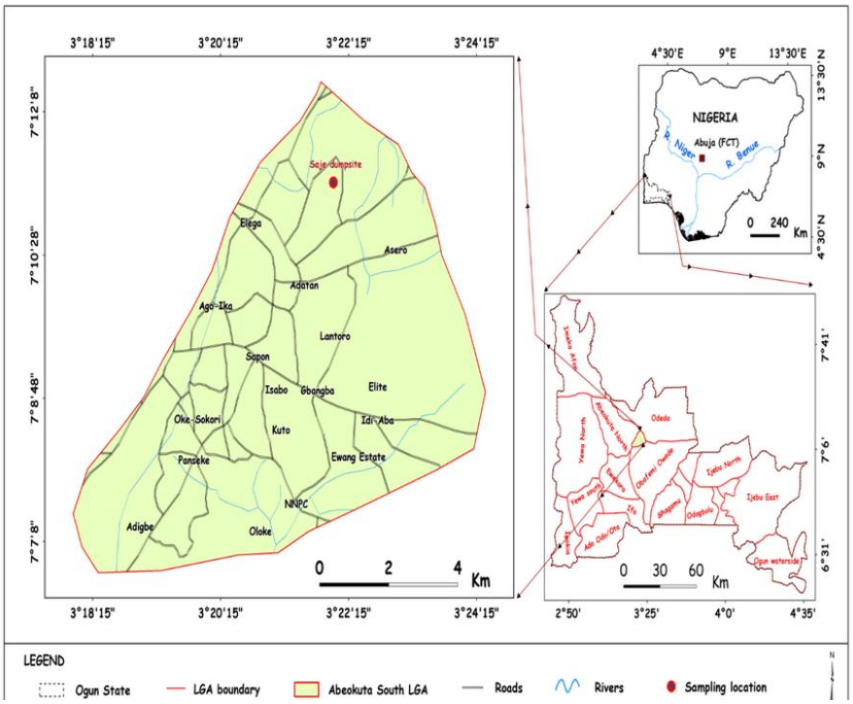

Fig 1: Study area map

This study was conducted in Abeokuta South Local Government Area (LGA), situated in Ogun State, Nigeria (Safra, 2010). As part of Abeokuta, the state capital and administrative center, Abeokuta South spans approximately 879 square kilometers (Safra, 2010). Characterized by a dense population, the LGA features numerous telecommunication masts in close proximity to residential areas, raising concerns about potential health effects.

Study Design

The study utilized a mixed-methods approach, leveraging geospatial analysis and social surveys to assess the perceived impacts of telecommunication masts on residents. This methodological integration allowed for the spatial mapping of mast locations and the analysis of trends and variations in perceived health effects at varying distances, yielding a nuanced understanding of the relationship between mast proximity and resident perceptions.

Geospatial Data Acquisition

Geospatial datasets for this study were sourced from GRID3 Nigeria, comprising the administrative map of Abeokuta South LGA and the built-up area shapefile, which delineated the study area boundary and residential locations. Furthermore, handheld GPS devices (Garmin eTrex 30 xs) were used to collect coordinates of telecommunication masts, which were recorded in CSV format and subsequently imported into ArcMap 10.8 for spatial analysis and visualization.

Survey on Perceived Health Effects

Data collection involved an interviewer-administered questionnaire targeting residents living at varying distances (5 meters, 10 meters, and 15 meters) from telecommunication masts. Conducted in three purposefully selected locations Kuta, Panseke, and Sapon - the survey focused on areas with a high density of masts within residential zones. With a total of 294 participants, the survey comprised 91 respondents from Kuta, 92 from Panseke, and 111 from Sapon. The questionnaire gathered information on self-reported health symptoms attributed to mast proximity, including headaches, dizziness, sleep disturbances, and other general symptoms commonly linked to electromagnetic field (EMF) exposure, thereby providing insight into residents' perceived health impacts.

Data Analysis

I. Geospatial Analysis

The spatial distribution of telecommunication masts was visualized by overlaying the collected GPS coordinates onto a base map of the study area using ArcGIS 10.8. The coordinate layer was exported as shapefiles to enable further spatial analysis and geospatial queries. To examine the proximity of telecommunication masts to residential areas, buffer zones of 10 meters and 15 meters were created around each mast. This analysis provided valuable insights into the proximity of masts to residential areas and assessed compliance with the 10 meter regulation set by the Nigerian Communications Commission (NCC) and the National Environmental Standards and Regulations Enforcement Agency (NESREA).

II. Statistical Analysis

Descriptive and inferential statistical methods were employed to analyze the frequencyand difference of perceived effects across 5m-15m from the masts.

A one-sample t-test was performed to compare the reported perceived effects against a null hypothesis mean of zero, testing for significance at each distance. This allowed the identification of whether residents reported significant health effects relative to the expected baseline of no effect.. Following this, an ANOVA was conducted to assess whether there were statistically significant differences among the reported effects across three proximity categories: 0-5 meters, 5-10 meters, and 10-15 meters. The primary objective was to evaluate if the perceived health effects varied significantly among residents living at different proximities to the telecommunication masts. The analysis was carried out using SPSS (Version 26.0; IBM Corp),

RESULTS AND DISCUISION

The results of the analysis include maps showing the geospatial distribution of telecommunication masts, proximity to residential areas and the results of the one-sample t-test.

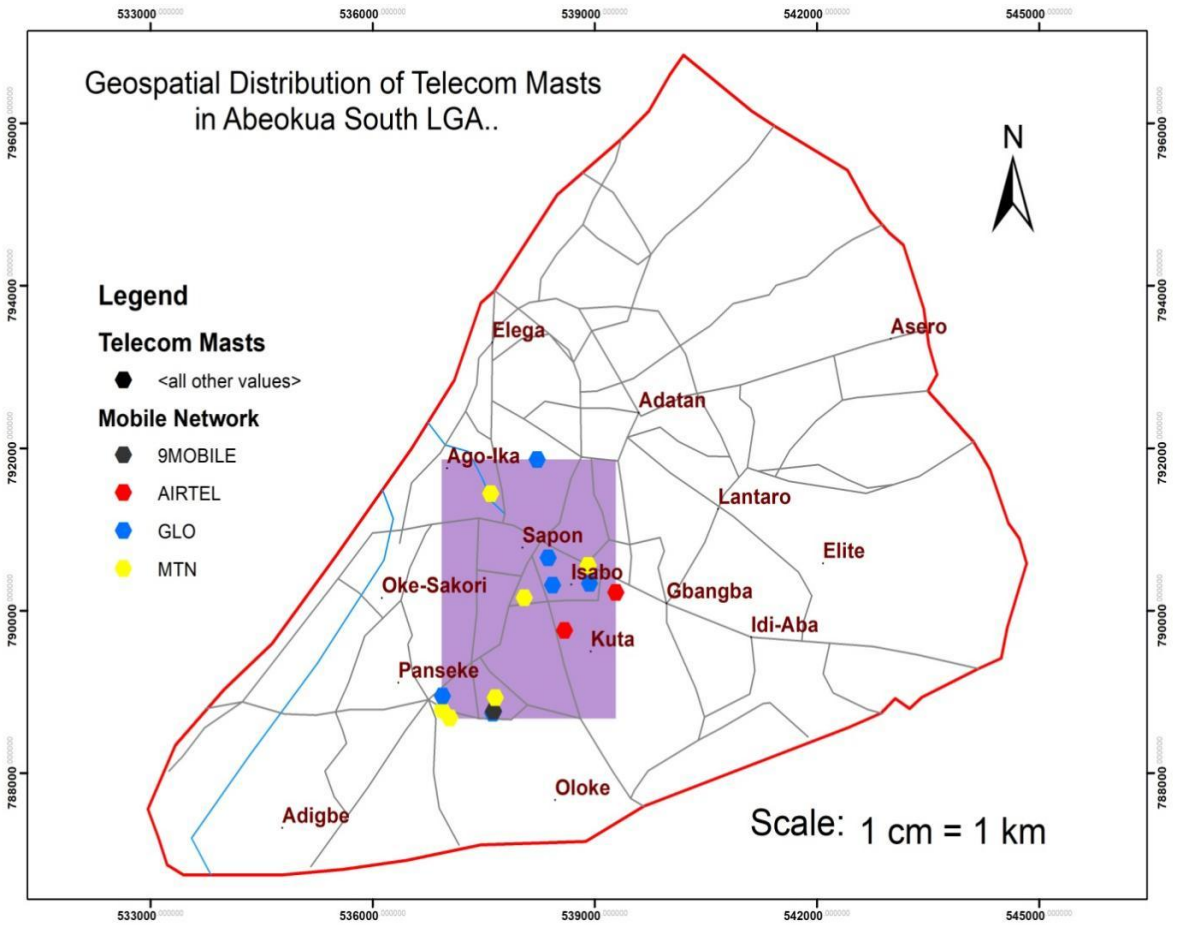

Figure 2: Geospatial Distribution of Telecommunications Masts in Abeokuta South.

Figure 2 illustrates the distribution of telecommunication masts within Abeokuta South Local Government Area (LGA). The results show that telecommunication masts in Abeokuta South LGA are not evenly distributed . The Telecommunication mast are concentrated in specific areas, particularly Sapon, Isabo, Kuta, and Panseke.

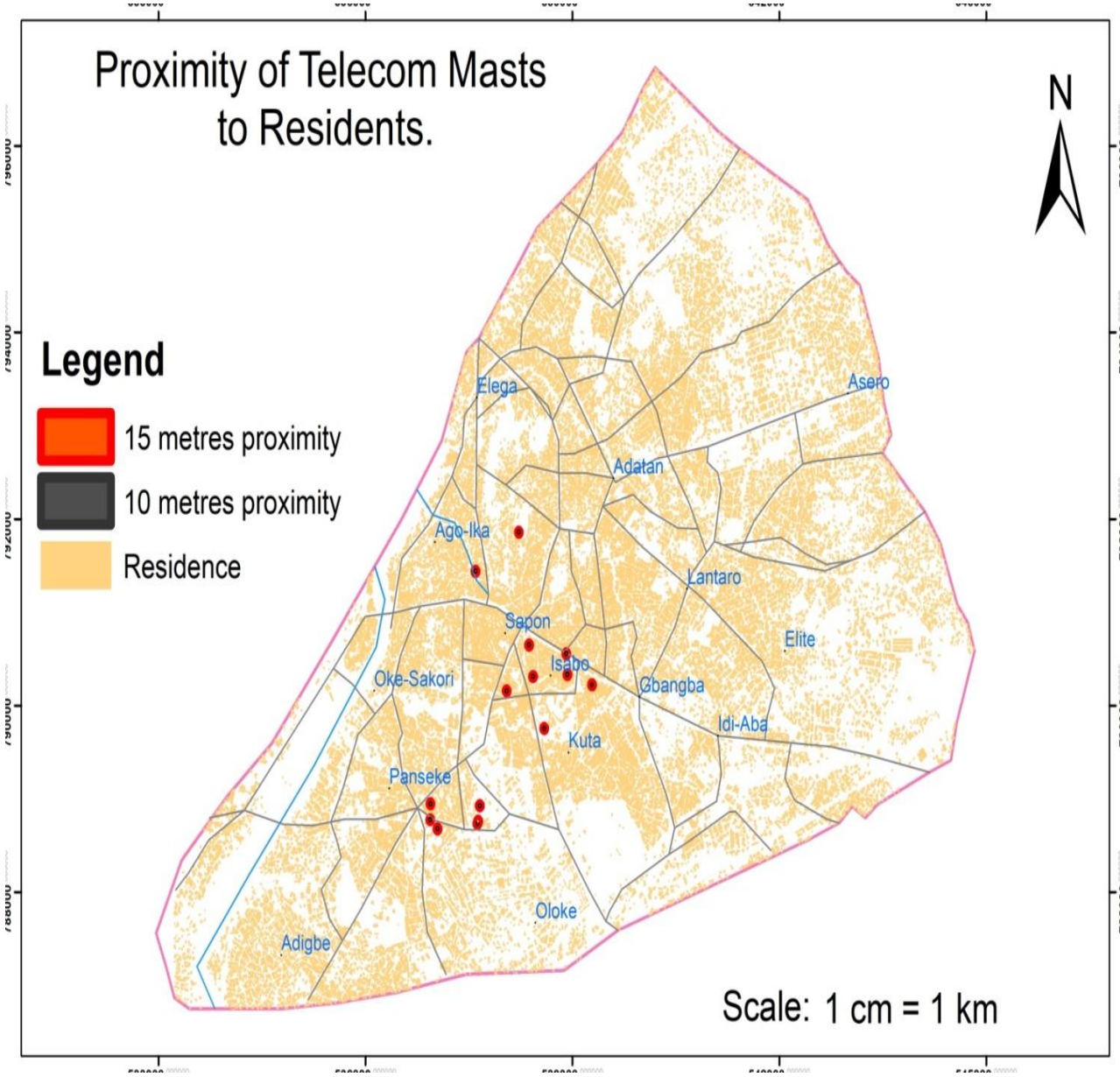

Figure 3: Proximity of Telecommunication Masts to Residences.

Figure 3 shows the proximity of telecommunication masts to residences in Abeokuta South. The map reveals the proximity of masts to residents at 0-10 meter and 10-15 meter radii. The result shows that most telecommunication mastsare located close to residences.

Frequency of perceived effects of Telecommunication Masts.

EFFECTS	5 METRES	10 METRES	15 METRES	TOTAL
Headache	16	12	7	35
Dizziness	10	9	9	28
Fatigue	8	10	3	21
Memory Loss	3	3	2	8
Nose bleeding	9	8	7	24
Mental uneasiness	10	10	8	28
Cancer	0	0	0	0
Sleeping disorder	6	8	5	19
Noise / vibration	17	15	10	42
Pollution	12	10	5	27
Accident	0	0	0	0
Inability to concentrate	14	10	7	31
Fear/shock	15	9	7	31
TOTAL	120	104	70	294

Table 1: Total Perceived effect from the three locations : Kuta, Panseke and Sapon.

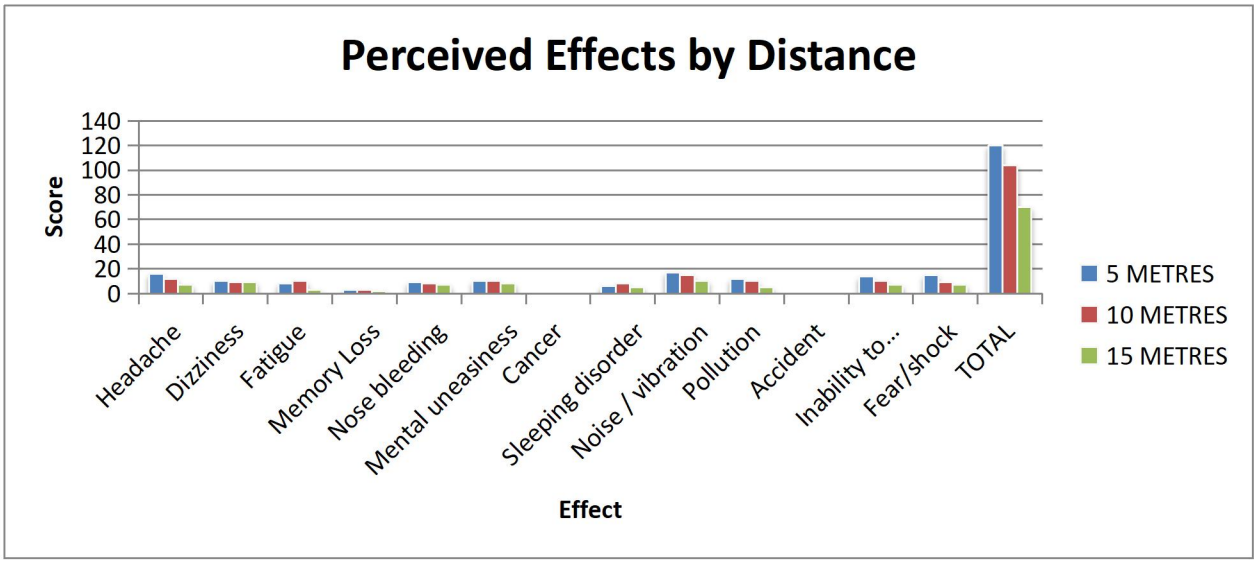

Figure 4:Perceived effect by distance

Table 1and figure 4 presentthe aggregated results of perceived health and psychological effects reported by residents in Kuta, Panseke, and Sapon. A total of 294 responses were recorded across three distance categories: 5 meters, 10 meters, and 15 meters. The results show that:

- Headache (35 reports) was the most commonly perceived health effect, with the highest frequency at 5 meters (45.7%, 16 out of 35).
- Noise/vibration (42 reports) was the most commonly perceived psychological effect, with the highest frequency at 5 meters (40.5%, 17 out of 42).

The results indicate that health and psychological effects were more frequently reported at shorter distances, particularly headaches and noise/vibration, which were perceived more acutely by residents living closer to the masts.

Effect	Total Frequency
Noise / vibration	42
Headache	35
Inability to concentrate	31
Fear/shock	31
Dizziness	28
Mental uneasiness	28
Pollution	27
Nose bleeding	24
Fatigue	21
Sleeping disorder	19
Memory Loss	8
Cancer	0
Accident	0

Table2: Frequency of perceived effect

Table 2 displays the total occurrences of each perceived health effect across all three distances. The most frequently reported health effects are ranked to highlight the most common symptoms in the population. The most frequently observed effects include: Noise/vibration (42 occurrences), Headache (35 occurrences), Inability to concentrate (31 occurrences), and Fear/Shock (31 occurrences). Other effects, such as Dizziness, Mental uneasiness, and Pollution, were also reported, though at lower frequencies compared to the top four.

Effect	Mean Score	p-value
Headache	11.67	0.046
Dizziness	9.00	0.004
Fatigue	7.00	0.078
Memory Loss	2.67	0.015
Nose Bleeding	8.00	0.005
Mental Uneasiness	9.33	0.005
Cancer	0.00	N/A
Sleeping Disorder	6.33	0.019
Noise/Vibration	14.00	0.021
Pollution	9.00	0.050
Accident	0.00	N/A
Inability to Concentrate	10.33	0.036
Fear/Shock	10.33	0.050

Table 3:one-sample t-test

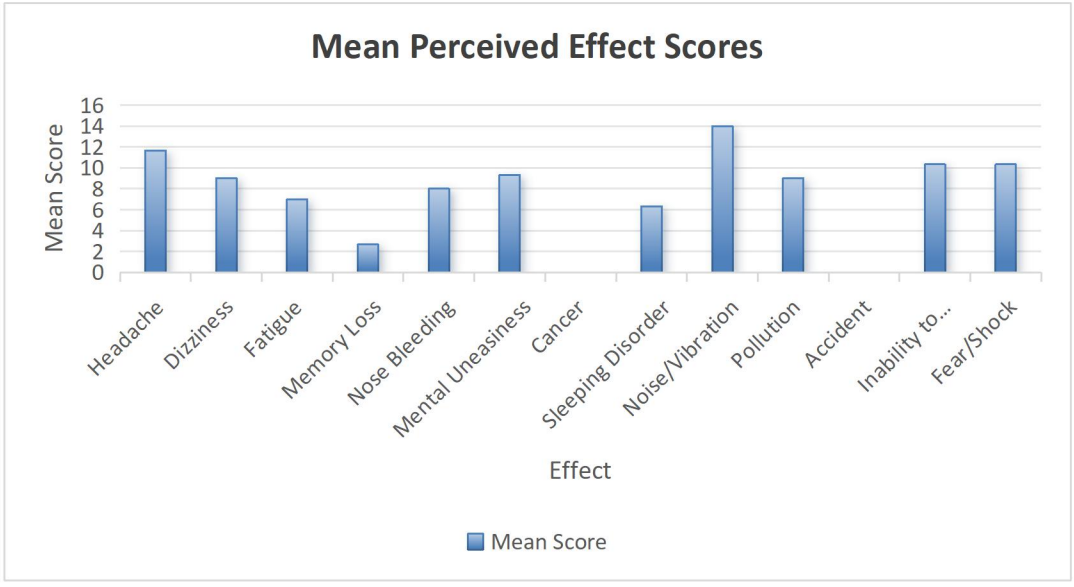

Figure 5: Mean perceive effect scores.

Table 3 and figure 5 present the result of one sample t-test and chart visualizing the trend of mean perceived effect across 5-15m from telecommunication masts.

A one-sample t-test was conducted to determine whether perceived health effects from telecommunication masts differed significantly from a baseline value. The results showed that several health and psychological effects were statistically significant, with p-values less than 0.05. These effects include headaches, dizziness, memory loss, and others, suggesting that residents perceive these effects as associated with their proximity to telecommunication masts. In contrast, fatigue, cancer, and accidents did not show statistically significant perceptions, with p-values above 0.05, indicating that residents may not directly link these effects to living near telecommunication infrastructure.

One-Way ANOVA by Proximity

To further investigate whether the perceived effects vary significantly between different distances (5m, 10m, and 15m) from the telecommunication masts, a **one-way ANOVA** was conducted for each perceived effect. The results indicated that none of the effects showed statistically significant differences across the three proximity categories (all p-values were greater than 0.05).

This suggests that while there are numerical differences in the perceived effect scores at the different distances, these differences are not statistically significantIn other words, the proximity to the masts (whether at 5m, 10m, or 15m) does not significantly influence the perception of these effects.

The findings indicate that the perception of health and psychological effects in residents living within 5 meters is essentially the same as those living at 15 meters.

Recommendations

I. Public Engagement by Network Providers

Telecommunication providers should engage with local communities before siting masts to better understand residents' safety concerns. This proactive approach will help alleviate fears, encourage collaboration, and ensure that residents are well-informed about the safety of telecommunication masts based on scientific evidence.

II. Review of the 10-Meter Safety Distance by NCC and NESREA

The Nigerian Communications Commission (NCC) and the National Environmental Standards and Regulations Enforcement Agency (NESREA) should reconsider the 10-meter safety distance guideline. While SAR values suggest no significant health risks, residents still feel unsafe. Both scientific findings and public perceptions must be considered, and additional research on the long-term effects of RF radiation should be carried out to ensure safety standards align with residents' concerns.

REFERENCES

B, S., Ah, A., Mn, Y., & N, A. (2023). Residential exposure to non-ionizing electromagnetic radiation from mobile base stations: A systematic review on biological effects assessment. *Material Science & Engineering International Journal*, *7*(2), 44–52. https://doi.org/10.15406/mseij.2023.07.00203

Charles, E., & Julian, C. (2021.). *The Challenges and Effect of Telecommunication Mast Station To Human Health*.

Danladi, A., Gaya, G., Aliyu, B., Stephen, M., Michael, Y., &Na'imu, A. (2016). Determination of safety distance for installing GSM mast in residential areas in Nigeria. *Journal of Applied Sciences and Environmental Management*, *20*(4), 997. https://doi.org/10.4314/jasem.v20i4.12

Guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz). (2020). *Health Physics*, *118*(5), 483–524. https://doi.org/10.1097/HP.0000000000001210

Hermans, M. A. (2015). *Engaging with risks: Citizens, science and policy in mobile phone mast siting controversies* [maastricht university]. https://doi.org/10.26481/dis.20150206mh

Isah, A. T., Abdulrahaman, J., &Ibinaiye, I. D. (n.d.). *Improving Access to Information on Health Hazards of Telecommunications Masts by Residents in Zaria Local Government Area of Kaduna State*.

Maffei, M. E. (2022). Magnetic Fields and Cancer: Epidemiology, Cellular Biology, and Theranostics. *International Journal of Molecular Sciences*, *23*(3), 1339. https://doi.org/10.3390/ijms23031339

[No title found]. (n.d.). *International Journal of Science and Healthcare Research*.

Nzekwe, J. U. (n.d.). *INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN SCIENCE AND ENGINEERING, VOL.4, NO.04, APRIL 2023.*

Odoh, C. M., & Ezekiel, Y. A. (2023a). Assessment of Background Radiation Around Telecommunication Masts of the Major Network Service Providers in Kaduna South, Kaduna State, Nigeria. *European Journal of Theoretical and Applied Sciences*, *1*(5), 1454–1463. https://doi.org/10.59324/ejtas.2023.1(5).125

Odoh, C. M., & Ezekiel, Y. A. (2023b). Assessment of Background Radiation Around Telecommunication Masts of the Major Network Service Providers in Kaduna South, Kaduna State, Nigeria. *European Journal of Theoretical and Applied Sciences*, *1*(5), 1454–1463. https://doi.org/10.59324/ejtas.2023.1(5).125

Odunola, O. O., Omoakin, M., & Afolabi, M. (2015). *Telecommunication Mast Location and It's Health Implication for Residents in Ogbomoso, Nigeria*.

Safra, J. E. (with Encyclopaediabritannica inc.). (2010). *The new encyclopaedia Britannica* (15th ed). Encyclopaediabritannica.

Shalangwa, D. A. (n.d.). *Measurement of exposure of radio frequency field (RF) radiation from global system for mobile communication (GSM) masts*.