5G Awareness and its Link to COVID-19: Case of Zambians with Access to Internet

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Abstract - **Fifth Generation (5G) mobile cellular networks are envisaged to provide for high data rates and very low delay to support a lot of applications. However, its deployment has been met with a lot of resistance from some members of the public in various countries around the globe. This resistance has been exacerbated by the onset of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which has since been named COVID-19. Since the beginning of December 2019, COVID-19 has spread rapidly around the world with increased discussions on the topic across various online platforms. Due to the nature of these online platforms, misinformation is greatly shared and it becomes difficult for policy makers to implement measures that could save lives. For example, there have been conspiracy theories that were circulating on social media platforms perpetuating that radiation from 5G towers are linked to symptoms associated with COVID-19. This information led to some people burning 5G towers in certain countries. Basic awareness of 5G technology and its related health concerns should be made available to the general public. Therefore, this research highlights general health**

concerns about 5G technology based on various research conducted. Furthermore, the paper present results from an online survey with a total of 258 respondents. Results show that 67% of respondents are aware of 5G technology and most users get their information from online social media platforms (about 78%). About 62% of respondents have heard the conspiracy theories linking 5G to COVID-19 symptoms, however, only 14.3% believe the conspiracy. Interestingly, 57.8% *think coronavirus originated from the laboratory and 47.3%* think the COVID-19 pandemic was planned by certain pharmaceutical corporations and government agencies to depopulate the world. Additionally, 43% of respondents think there is no good reason for the current lock-down by various governments. Results also shows that there is no link between 5G and COVID-19 as far as health issues are concerned. This paper recommends sensitization on the dangers of COVID-19 and discourage members of the public from believing any information from the Internet without further investigations.

Keywords: Fifth Generation, 5G Awareness, COVID-19, 5G Radiation, Coronavirus..

I. Introduction

Mobile cellular networks have shaped the modern communication paradigm. The cellular technology has been evolving steadily from First Generation (1G) to current Fourth Generation (4G) in most part of the world [1]. 1G is mainly used for voice services operating in the frequency range of 800 to 900 MHz where as 2G, operating in 1.8GHz frequency band, added text message capability to the voice call. 3G operates in the frequency range between 1.6 to 2.0GHz and it supports services that provide an information transfer rate of at least 2Mbps. 4G operates in the frequency range between 2GHz to 8GHz with more services added because of increased data rates. Services include video conferencing, mobile web access, gaming services, IP telephone, high-definition mobile TV and many more [2].

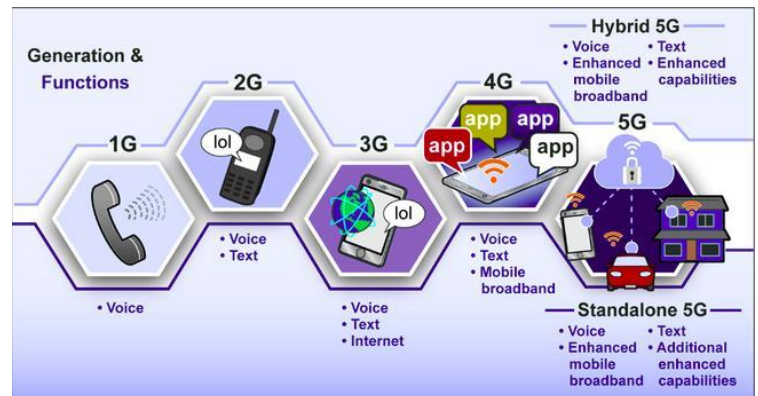Figure 1 depicts the evolution of mobile cellular networks.

Figure 1: Evolution of Mobile Cellular Networks [3]

Compared to 4G with enhanced services, Fifth Generation (5G) is said to be a game changer in mobile cellular industry. It is estimated that a 5G network could deliver connection speeds of up to 20 Gigabits per second and enable Smartphone owners to download high definition movies in less than a

second [4]. In addition, 5G is envisioned to provide low latency to various applications making it a network of choice for many applications envisaged for Internet of Things and Smart Cities [5]. One of the enabling factor for 5G is by using high frequency spectrum bands in the millimeter wave (mmWave) ranging from 24.25 GHz to 52.6 GHz [6]. Due to limited research on the health implications of these frequencies, there have been backlash from the public on deploying 5G technologies in many parts of the World [7]. The call not to deploy 5G technologies was exacerbated by the coming of Coronavirus/COVID-19 which was declared a pandemic by the World Health Organization (WHO) earlier this year [8].

The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) later named COVID-19 was first reported at the end of 2019 in China and later declared a pandemic because it had spread across the globe [8, 9]. The current literature suggest that SARS-CoV-2 is closely related to severe acute respiratory syndrome-like coronaviruses found in bats [9]. Therefore, there is a general consensus among researchers that the virus which cause COVID-19 has a natural origin [9, 10,11]. Despite the scientific research and consensus, there have been a lot of conspiracy theories about the origin of the virus that cause COVID-19 which has made the works of front line health and emergency workers a bit difficult. For example, there is no current cure or vaccine for COVID-19, nevertheless, WHO recommends preventative measures such as social distancing and wearing masks. However, due to the prevalence of conspiracy theories, some people do not follow the guidelines hence putting themselves and others at risk of getting infected. In addition, the conspiracy theories linked the symptoms associated with COVID-19 to radio frequency emanating from 5G towers. In some Countries such as the United Kingdom (UK), some members of the public started vandalizing the infrastructure for 5G technology [12].

This research aimed to determine awareness of 5G technologies among members of the public in Zambia who have access to the Internet. The study wanted to determine the extent to which the 5G/COVID-19 conspiracy theories impact peoples' attitudes towards the COVID-19 fight. Furthermore, the research wanted to establish link between source of information and (COVID-19) and conspiracy theories in the public. The paper present results from an online survey covering the following objectives: (i) to establish 5G awareness; (ii) to determine the main source of information and how it affects respondents' perception of 5G technology; (iii) to determine respondents' opinions on 5G and its link to COVID-19 as well as how it affects decision making such as following health guidelines.

II. FIFTH GENERATION (5G) MOBILE CELLULAR NETWORKS

Fifth Generation (5G) is a standard for mobile cellular networks and a successor to 4G [13]. The official name for 5G is International Mobile Telecommunications 2020 (IMT-2020) according to the International Telecommunications Union, Radio communication Sector (ITU-R) [13]. There are three main applications of 5G according to ITU-R [13] and these are; enhanced mobile broadband, massive machine type connections and ultra-reliable and low latency communications. With enhanced mobile broadband, a theoretical maximum transmission rate of 20 Gbit/s is envisaged. Massive machine type connection envisages 1 million (10^6) connections per square kilometer whereas ultra-reliable and low latency communication refers to delay of 1 ms. Furthermore, ITU-R has identified eight capability specifications, which include throughput, latency, connection density, spectral efficiency, mobility, traffic volume density among others. Therefore, 5G is posed to provide for high speed data rate transfer with low latency (delay) and improved quality of service which is expected to meet high-end user requirements [14].

It is expected that many devices will connect to 5G ubiquitously with provision of uninterrupted user experience. This feature of 5G is envisioned to support the growing field of Internet of Things [5]. In addition, 5G networks are expected to support applications with stringent delay tolerance measures such as those in health, emergency response teams, etc. Thus, 5G is posed to provide extremely low latency to support such applications. In order to support low latency, 5G technology is envisioned to support high-speed connections in orders of Gigabits per second (of up to 20Gbps data rate) between end users [4]. Consequently, it is expected that 5G technology will utilize high frequency spectrum bands in the millimeter wave (mmWave) ranging from 24.25 GHz to 52.6 GHz. Nevertheless, 5G is also expected to utilize lower frequency spectrum in the range of 450 MHz to 6 GHz, which includes the Long Term Evolution (LTE) frequency range [6]. Despite the promises and benefits envisaged by 5G, a lot of technical, environmental and social challenges should be overcome before its implementation.

A. Challenges Associated with 5G

New technology comes with its implications. 5G is expected to use spectrum band in millimeter wave range, this implies that new hardware and software should be developed to accommodate this new technology. Chin et al in reference [15] identified various technologies which are crucial in standardizing 5G wireless technologies including: heterogeneity of 5G networks; support for Software Defined Cellular Networks; support for massive Multiple-Input, Multiple-Output (MIMO) and 3D MIMO; and support for Machine to Machine (M2M) or Device to Device (D2D) Communications. A detailed discussion of technical challenges associated with interference management in D2D

communication in 5G has been given in [16]. Other technical challenges are implicit due to the errant demand for massive data traffic capacity, increased indoor and small cell traffic, higher numbers of connected devices stemming from IoT and many more [17]. Reference [18] identifies privacy and law enforcement as social issues related to the introduction of 5G technology. Technologies operating in high frequency bands demand for high power consumption. Therefore, 5G technology poses a challenge of power consumption that would lead to CO_2 emission which would increase the current global warming that the world is experiencing [19]. It is estimated that current radio access networks consume approximately 70% to 80% of total power in communication [20, 21]. Therefore, for 5G to be attractive to Governments fighting the effects of global warming around the world, the technology has to be energy-efficient from production of hardware to deployment.

B. Health Concerns Associated with Radio Frequency Electromagnetic Fields

Several researches have been conducted on the effect of Radio Frequency Electromagnetic Fields (RF-EMF) on the biological systems [22, 23, 24, 25, 26]. Cucurachi et al [27] provides a detailed review of scientific studies on the possible effects of RF-EMF in the range of 10 MHz to 3.6 GHz on the ecological systems. From the 113 studies original peer-reviewed publications reviewed, it was concluded that RF-EMF had a significant effect on birds, insects, other vertebrates, other organisms and plants in 70% of the studies. Among the most affected within the ecosystem was the development and reproduction of birds and insects [27]. However, the paper could not discern on the clear dose-effect relationship, also most of the studies reviewed focused more on the GSM frequency ranges. In [25], an investigation was conducted as to whether exposure to Ultra ne Particles (UFP) (12{14 nm, 100g/ml) and RF-EMF (EMF; 2 W/kg specific absorption rate (SAR); continuous wave (CW) or modulated (217 Hz or GSM-nonDTX)), alone or in combination in influenced levels of the super-oxide radical anion or the stress protein heatshock protein (Hsp70) in the human monocyte cell line Mono Mac 6. They used heat treatment (42-43 oC, 1 h) as positive control for both stress reaction and for heat development in the RF exposure setup. The study concluded that for Mono Mac 6 cells, RF exposure alone or in combination with UFP cannot in influence stress-related responses. Lerchl et al [26] replicated the study by Tillmann et al., 2010 [28] which suggested tumor-promoting effects of RF-EMF. The replication concluded that tumors of the lungs and livers in exposed animals were significantly higher than in sham-exposed controls. Nevertheless, they noted that further studies are needed to investigate the underlying mechanisms emanating from their hypothesis that the tumor-promoting effects could be caused by metabolic changes due to RF-EMF exposure. Another study in [29] performed experiments to determine the effects of RF-EMF in the range of 1966 MHz (UMTS) on reproduction and development of Mice. The

results of this study did not indicate harmful effects of long-term exposure of mice to UMTS over several generations.

Despite all these studies reported on the effect of RF-EMF on the ecosystem, there is scanty research which has been conducted on the effect of 5G technology. The main concern lies in the use of the mmWave in the range of 24.25 GHz to 52.6 GHz and not the lower frequency range less than 3 GHz which is similar to other spectrum bands used in current wireless systems [30]. The study in [31] reviewed and analyzed 94 relevant publications performing in vivo or in vitro investigations considering frequency range 6-100 GHz in which 5G technology falls. The review of the published articles determined no consistent relationship between power density, exposure duration, or frequency, and exposure effects. Therefore, the study by Simko and Mattsson [31] concluded that available studies do not provide adequate and sufficient information for a meaningful safety assessment, or for the question about non-thermal effects. On the contrary, Kostoff et al [32] reported that 5G mobile networking technology will have some effect on the skin and eyes. However, no experiment or investigations were conducted to confirm the assertion that 5G technology affects skin and eyes.

Other perspectives on health concerns associated with 5G have been reported in [33, 34, 35, 36, 37, 36]. Most of the research on 5G technology and its effect on human health is either inconclusive or not adequate. Therefore, more research should be conducted to determine the effect of mmWave on the human body. Nevertheless, since the break of the COVID-19 pandemic many people around the world have tried to associate symptoms caused by the coronavirus as emanating from (or exacerbated by) the radiation associated with 5G towers.

C. Perception of 5G Technology and its link to COVID-19

From the onset of COVID-19, before being declared as a pandemic, a lot of "infodemic" has been circulating on social media and the Internet on various issues related to the virus. For example, there was a rumor in France that cocaine could cure COVID-19 virus, however, this was later refuted by the French Ministry of Public Health [12]. On the other hand, there was an online conspiracy theory in the UK that the 5G mobile technology was causing symptoms associated with COVID-19, this lead to some members of the public in that country destroying 5G mobile communication infrastructure [12]. The initiator of the conspiracy theory argued that COVID-19 started in Wuhan, China just after rolling out 5G [38]. Ahmed et al [39] investigated the prevalence of conspiracy theories, which included the link between 5G and COVID-19. From 6556 Twitter users, they examined tweets containing hash-tag #5GCoronavirus, it was determined that 35% of those users believed there was a link between 5G and COVID-19 [39]. A similar survey was conducted in the UK between 3-7 April 2020 by Allington and Dhavan [40],with a sample size of 949. It was determined that 37% of respondents

who believed there was a connection between 5G and COVID-19 also expressed the notion that there was no good reason for the current lock-down in that country at the time of the survey. Other studies found that people believed the notion that COVID-19 symptoms were exacerbated by the radio frequency emanated from 5G technology [41, 42, 43].

Similar to the study in [40], this work aimed to determine the penetration of conspiracy theories about 5G technology and its link to COVID-19 among Zambians with access to the Internet. Our approach is different in that we first establish the awareness of 5G among the respondents and present the results from the survey.

III. METHODOLOGY

A. Design

The study followed an exploratory research (sometimes associated with Grounded Theory) approach because the topic of COVID-19 is relatively new and not well understood. In addition, 5G technology is also not well understood as more research has to be conducted. Despite the lack of clarity in the initial problem, the exploratory approach provides guidelines leading to a better understanding of the initial problem. The approach comprises a number of activities such as surveys/polls, focus groups, undertaking online research, literature reviews among others. Therefore, grounded theory can be used as a starting point to understand the linkage of 5G to COVID-19 and facilitate further research. A similar study used exploratory approach to study the correlation between collective narcissism and dissemination of conspiracy theories during the COVID-19 pandemic [44].

In this study, a baseline survey was undertaken to ascertain the extent to which the public perceived 5G and whether there was a link with the current pandemic. In order to achieve this task, a total of 21 questions were prepared on 5G awareness with its link to COVID-19. We used online self-administered questionnaire between June and July 2020 taking into account suggestions on how to create online survey reported by Norman et al [45]. The online survey approach was adopted because of the partial lock-down in order to limit physical interactions and prevent the spread of COVID-19. In addition, the target group was online users with presence on social media networks where misinformation is perpetrated.

B. Population and Sample Size

The population of respondents came from members of the public with access to Internet. According to Zambia Information Communication and Technology Authority (ZICTA), about 9.1 million users had access to Internet through mobile broadband network in the first quarter of 2020 [46]. Only 2.3 million of these are social media users. This give a proportion of 0.2523 of the target population. Random sampling was used to administer online questionnaire using Google Forms. The survey link was shared on Facebook and various WhatsApp groups to get wide range of respondents. Only groups with participants from Zambia were used. Groups that had international members were not used. In order to avoid bias and instill confidence in the data captured, the sample size was calculated using Cochran formula as suggested by Barlett et al [47]. In this study we used a 95% confidence level and 5.4% margin of error. Based on the number of mobile broadband users with access to the Internet and the Cochran formula, a minimum sample size was 249. A total of 258 respondents answered the online questionnaires.

C. Data Analysis

Data collection was performed using Google forms while analysis was done using R Statistics Package. Quantitative data analysis based on inferential and descriptive statistics was used in this study. The inference statistics used to test the hypothesis was Pearson's Chi-squared and Fisher's Exact tests. Pearson's Chi-squared test was used to compare the frequencies observed in the categories with the frequencies expected under some hypothesis, while Fisher's Exact Test was used as an alternative to the Chi-Square test.

1. Null hypothesis: Peoples' 5G opinions and awareness are not linked/associated to COVID-19.
2. Alternative hypothesis: Peoples' 5G opinions and awareness are linked/associated to COVID-19.

IV. RESULTS AND DISCUSSION

A. Descriptive Data Analysis

In this section, descriptive analysis of the survey results are presented. As indicated earlier, a total of 258 respondents was recorded, for which 71.1% were male while 28.9% were female. The age distribution is shown in Figure 2.
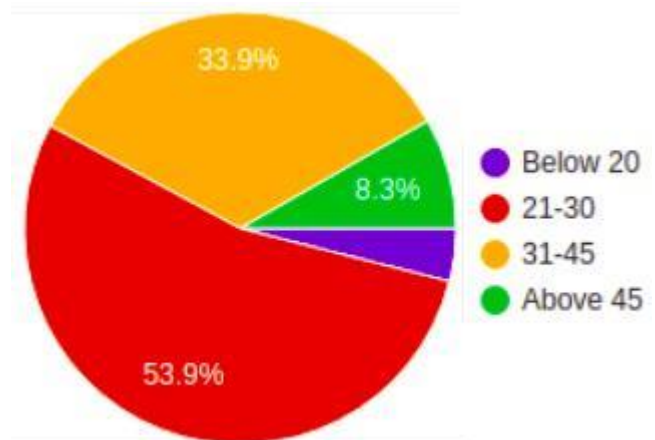

Figure 2: Age of Respondents

More than 53% of respondents were in the age group of between 21 and 30 years old followed by those in the age group of 31 to 45 years old accounting for 33.9% while 8.3% represented the age group above 45 years. Those less than 20

years old accounted for less than 4%. Figure 3 presents the main source of information for respondents. Checkbox was provided to select all choices that applied. The options were Television (TV) including online versions, Newspapers including online versions, Social Media Platforms such as Facebook, Twitter, YouTube as well as Internet (Newsfeeds). More than 78% of 258 respondents indicated they get their latest information from Social Media platform followed by Internet as the source of information accounting for 61% of 258 respondents. TV and Newspapers accounted for 52% and 29% of 258 respondents respectively.
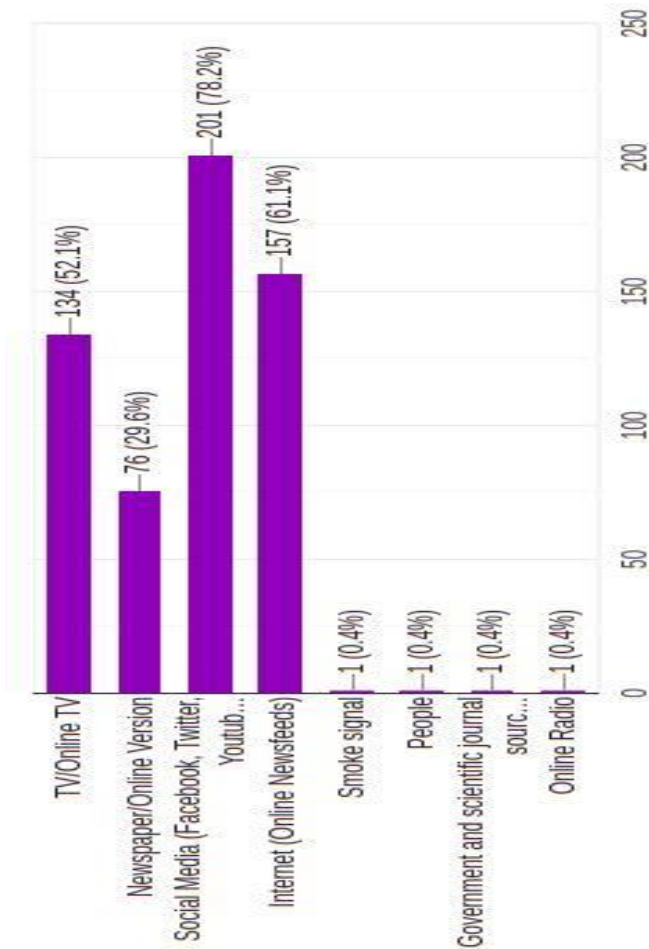

Figure 4: Mobile Network technology currently used

One of the objective of this paper was to determine whether respondents were aware of 5G technology. Therefore, a question was asked as a follow up on Figure 4 to establish 5G awareness among respondents. It was discovered that more than 67% of respondents are aware of 5G technology. This could be attributed to the fact that most of the respondents access their information online, hence the possibility of getting information related to 5G technology is high. Figure 5 presents response about 5G awareness by respondents. A follow up question was asked to determine whether respondents were aware of the frequency bands reserved for 5G technology. Only 30% responded with a resounding "Yes". 53% responded with a "No" and 16% were not sure.

Figure 3: Source of Information

For respondents to appreciate 5G technology, a question was asked to determine the current mobile network being used and associated services offered. Results show that more than 74% of respondents use 4G Mobile Cellular networks where as 24% of respondents use 3G networks. Results are presented in Figure 4.
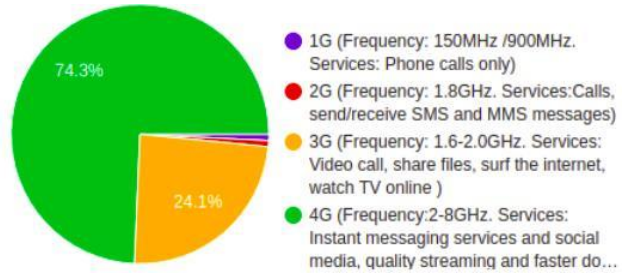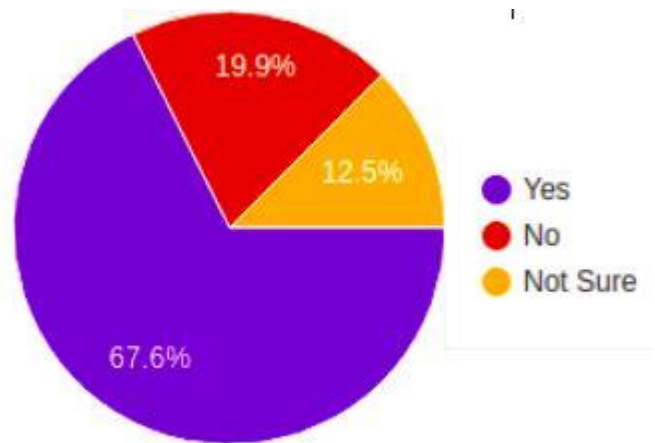

Figure 5: Respondents Awareness of 5G

A follow up question was asked to probe whether those who were aware of the frequency bands reserved for 5G technology thought the radiation from these bands could have any effects to humans. Here the knowledge was scanty, majority were not sure representing 46% of respondents while those who responded with "Yes" and "No" represented 26% and 27% respectively.

The next set of questions were to determine information related to coronavirus. To that effect, a question was asked to find out the respondents' opinions on the origin of the virus that has caused the COVID-19 pandemic. Interestingly, more than 57% of respondents think the virus that cause COVID-19

was created in the laboratories, 26% said animal e.g Bat and 15% were not sure see Figure 6.
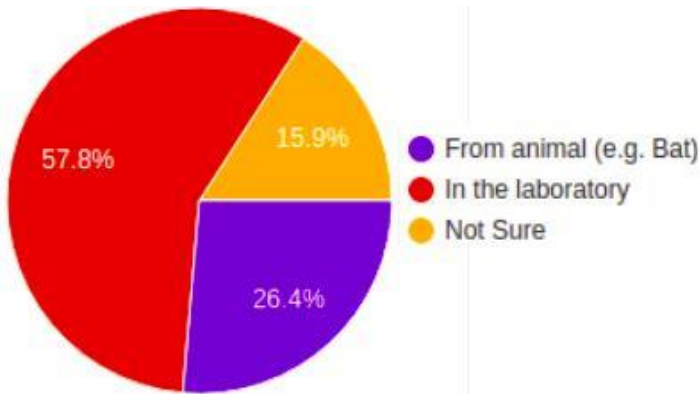

Figure 6: Respondent Knowledge on the origin of Coronavirus

These results have implications especially on the perception of the pandemic. If the members of public think the virus is created in the laboratories, they could lose "faith" in scientists which could later have an impact on following health guidelines put forward by these scientists. Therefore, fighting these "infodemics" from all angles to change and educate the general public about scientific consensus on certain issues is important. For example, the current general consensus among researchers is that the virus which has caused COVID-19 has it origin in nature [9, 10, 11].

Figure 7 sought to determine to which extent respondents believed in conspiracy theories about the origin of the COVID-19 virus and major corporations. Thus, a question was asked to establish opinion from respondents whether they thought the COVID-19 pandemic was planned by certain pharmaceutical corporations and government agencies to depopulate the world. Surprisingly, 47% of respondents said "Yes" and only 20% said "No" while 33% were not sure.
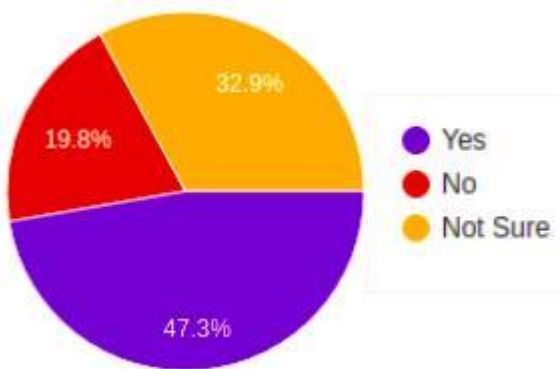

Figure 7: Response on "Do you think the COVID-19 pandemic was planned by certain pharmaceutical corporations and government agencies to depopulate the world?"

Another question in that line was asked to seek opinion as to whether respondents felt dangers of coronavirus are being covered up by powerful forces in the global telecommunications industry to spearhead 5G Technology. Figure 8 presents the results.
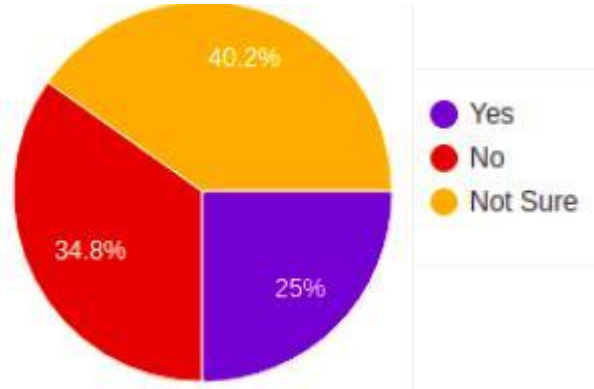

Figure 8: Response on "Do you think the dangers of coronavirus are being covered up by powerful forces in the global telecommunications industry to spearhead 5G Technology?"

About 25% of respondents said "Yes" while 35% said "No" and 40% were not sure. The response for this question (25% saying yes) was in contrast with results shown in Figure 7 which indicated 47% of respondents saying pharmaceutical corporations and government agencies are working to depopulate the world. This could be attributed to the fact that there are so many conspiracy theories about major pharmaceutical corporations and some government agencies assumed to do bad things to the general populace compared to telecommunications industry.

Other questions necessary to this research are presented in Table 1. A question was asked if respondents felt COVID-19 is a hoax (that is just made up and not real), about 21% of respondents said "Yes" while approximately 47% said "No" and 32% were not sure. On the question that asked if respondents have heard information linking symptoms of COVID-19 to 5G mobile technology radiation, 63% agreed they have heard such information. 28% had not heard the information and 9% were not sure. A follow up question was asked if respondents believed the information. Only 14% believed in the conspiracy theory, 47% said "No" and 38% of respondents were not sure of what to say. Another interesting question was asked if respondents thought the virus that cause COVID-19 could be transmitted through wireless technology such as 5G, 11% said "Yes". The other question was to determine opinions from respondents related to the current lock down. 43% of respondents said there is no good reason for the current lock down.

Table 1: Response on various questions on 5G and COVID-19

Question	Total	YES		NO		Not Sure	
		Freq.	%	Freq.	%	Freq.	%
Do you think COVID-19 is hoax? (Just made up and not real)	258	53	20.5	121	46.9	84	32.6
Have you ever heard that symptoms of COVID-19 seem to be connected to 5G mobile network radiation?	258	162	62.9	72	27.8	24	9.3
Do you believe 5G technology contribute to symptoms of COVID-19 as reported in various social media posts?	258	37	14.3	122	47.3	99	38.4
If the answer to the question above was Yes. Do you think the virus can be spread through wireless technologies such as 5G?	196	22	11.2	101	51.5	73	37.2
Do you think there is no good reason for the current lock-down by various governments?	257	111	43.2	109	42.4	37	14.4

B. Pearson's Chi Square and Fisher's Exact Tests

This section presents the results to test the null hypothesis "Peoples' 5G opinions and awareness are not linked/associated to COVID-19" and alternative "Peoples' 5G opinions and awareness are linked/associated to COVID-19". To test the null hypothesis, we examined the association between different pairs of variables. The first test was to examine association between 5G awareness and knowledge on the source of COVID-19 virus. The Pearson's Chi-squared test (Chi^2 = 4.218069) was p = 0.3772971 and the Fisher's Exact Test was p = 0.3337436. Both tests revealed that there is no link between awareness of 5G Mobile Technology and the knowledge for the source of COVID-19 virus. The second test was to examine association between 5G awareness and variable examining COVID-19 as a hoax. Pearson's Chi-squared test was p = 0.9048397 and Fisher's Exact Test was p = 0.8985261. Both tests revealed that there is no link between awareness of 5G Mobile Technology and considering COVID-19 a hoax.

The third test was to examine association between awareness of 5G Mobile Technology and the knowledge of the symptoms of COVID-19. Both tests revealed that there is a strong link between awareness of 5G Mobile Technology and the knowledge of the symptoms of COVID-19. Further, we examined the association between awareness of 5G and conspiracy that dangers of COVID-19 are being covered by global telecommunications industry to spearhead 5G Technology. The Pearson's Chi-squared test was 0.001930432 while Fisher's Exact test was p = 0.001818116. Both tests revealed that people who are aware of 5G Mobile Technology also strongly believe that the dangers of coronavirus are being covered up by powerful forces in the global telecommunications industry to spearhead 5G Technology.

In addition, we examined the link between respondents who believed COVID-19 is a hoax and planned by pharmaceutical corporations and government agencies to depopulate the world. The Chi-square test (p = 4.205389e-07) revealed that there is a strong association between believing that COVID-19 is a hoax and believing that pandemic was planned by certain pharmaceutical corporations and government agencies to depopulate the world. This accounted for 71.7% of such respondents. Additionally, The Chi-Square test (p = 4.009662e-20) revealed that there is a strong association between the source of COVID-19 virus and believing that pandemic was planned by certain pharmaceutical corporations and government agencies to depopulate the world. Unsurprisingly, 68.8% of those who believe COVID-19 was manufactured in the laboratory also believe that pandemic was planned by certain pharmaceutical corporations and government agencies to depopulate the world.

Not surprising, both test also revealed that there is a strong association between believing that COVID-19 is a hoax and believing that there is no reason for the lock-down. Unsurprisingly, 56.6% of those who believe COVID-19 is a hoax feel there is no need for lock-down.

After careful examination of the paired variables, we conclude that the majority of Zambians do not believe that there is an

association between 5G and COVID-19 conspiracy theories. In particular, the analysis revealed that there is no link between awareness of 5G Mobile Technology and the probable cause of COVID-19. Besides the analysis showed no relationship between 5G Mobile Technology and believing that COVID-19 is a hoax.

However, the tests showed that the majority of the respondents who are aware of 5G Mobile Technology also have the knowledge of the symptoms of COVID-19. Similarly, it was found that the awareness of 5G Mobile Technology is strongly linked to believing that the dangers of coronavirus are being covered up by powerful forces in the global telecommunications industry to spearhead 5G Technology. Also respondents who believed the virus that cause COVID-19 was created in the lab think some pharmaceutical corporations and government agencies have an agenda to depopulate the world through a pandemic.

V. 5G TECHNOLOGY IN THE FIGHT AGAINST COVID-19

Despite the conspiracy theories and misinformation about 5G, countries which have embraced the technology has benefited from its implementation. For example, China has embraced tele-medicine consultations enabled by 5G network, doctors and hospital management are able to interact seamlessly through the concept researchers are calling Internet of Medical Things (IoMT) [48]. In addition, 5G technology has facilitated mental health professionals and health authorities in the provision of online mental health services during the COVID-19 outbreak [49]. There are many more areas where 5G technology can be applied during the COVID-19 pandemic as it has been alluded to by many researchers. The application area includes:

1. **5G enabled Tele-medicine:** because of high data rates transmission and ultra-low latency, 5G technology can support immersive virtual and augmented reality (VR/AR) applications which lead to an interactive experience by doctors and health professionals [50].

2. **Smartphone technology with 5G:** mobile applications using Artificial Intelligence features could be used to fight COVID-19 through tracking and prediction, diagnosis and early warnings of the virus [51], such applications could benefit from low latency and high data rates of 5G technology.

3. **IoT with 5G:** the seamless connectivity envisaged by 5G can enable various medical sensors, devices, smartphones, imaging devices and many more to communicate to each other in a more efficient manner to fight the pandemic [52].

In addition, the fight against COVID-19 can benefit from other technologies put forward by many researchers such as those reported in [53, 54, 55, 56].

VI. CONCLUSION AND RECOMMENDATIONS

Fifth Generation technology is in its infancy, therefore, a lot of research needs to be conducted before its deployment. There has been research conducted to determine effects of radio electromagnetic frequency radiation on the human body. However, extensive work on the effects of millimetre wave is yet to be established. General procedure and recommendations on deployment of 5G technology have been given by regulatory bodies such as the Federal Communications Commission (FCC) and ITU-R. However, independent research teams should determine the safety of such systems and technology.

Needless, there is no current correlation between COVID-19 and 5G technology in as far as health issues are concerned. There is no research which has linked the symptoms associated with COVID-19 to radiation emanating from 5G towers. These conspiracy theories have been debunked from various scientific research and presented in this study. In addition, there are a lot of benefits that 5G technology bring about in the fight against pandemics such as COVID-19. Some countries in Asia such as China are already benefiting from such technology in telemedicines.

In this paper, we have highlighted various health concerns associated with radiation emanating from wireless technology, presented a review on 5G technology and how some people in society have linked it to symptoms associated with COVID-19. In addition, we have presented results obtained from an online survey on the awareness of 5G technology in Zambia among people with online access. It was determined that 67% of respondents are aware of 5G. More than 60% have heard information that link 5G radiation to COVID-19 symptoms but majority do not believe such information.

The Pearson's Chi-squared Test and Fisher's Exact Test showed that the majority of the respondents who are aware of 5G Mobile Technology also have the knowledge of the symptoms of COVID-19. Similarly, it was found that the awareness of 5G Mobile Technology is strongly linked to believing that the dangers of coronavirus are being covered up by powerful forces in the global telecommunications industry to spearhead 5G Technology.

Therefore, this research recommends that members of the public should be sensitised on the dangers of COVID-19 and discourage them from believing any information from the Internet. Especially information shared on social media platforms. Before, any information is to be believed, a source has to be verified to determine its credibility.

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