

Knowledge of the Causes, Effects and Mitigation of Climate Change among Medical Students in Anambra State

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DOI: <https://doi.org/10.62154/ajhcer.2025.019.01034>

Abstract

Climate change, driven by human activities, is fundamentally altering the Earth's ecosystems, posing an unprecedented threat to human societies, economies, and the planet's biodiversity. The study assessed the knowledge level of medical students and the factors that will influence their knowledge of climate change. A descriptive cross-sectional study was conducted on 160 medical students of Nnamdi Azikiwe University, Anambra State. Data was analyzed using SPSS version 27.0. In the study, 54.4% of the respondents were male and 45.6% female. Awareness of climate change was 100%, and the major source of information was from the internet (73%). The majority (63%) of the respondents have good knowledge of the causes of climate change, and 86.3% agreed that the burning of fossil fuels was the most prominent cause. The majority (44.4%) of the respondents demonstrated good knowledge of the effects of climate change, with increased temperature and wildfire as the most prominent effects of climate change (89%). Planting trees was the most recognized mitigation strategy, with 90.63% of respondents identifying it as a key method to combat climate change, and 71% of the respondents have good knowledge of climate change mitigation strategies. The most recurring themes on factors that will improve the knowledge of climate change among medical students are education and awareness, followed by the internet and media. Medical students need to be properly equipped with the knowledge and skills to combat climate change because they are the future of the healthcare system. They can influence the policies of the government and create changes that can mitigate the impact of climate change and its impact on health.

Keywords: Climate Change, Knowledge, Students, Mitigation Strategies.

Introduction

Climate change, driven by human activities is fundamentally altering the Earth's ecosystems, posing an unprecedented threat to human societies, economies, and the planet's biodiversity. Climate change encompasses prolonged alterations in temperatures and weather patterns, which can stem from both natural phenomena such as variations in solar activity or significant volcanic eruptions, as well as anthropogenic activities primarily

driven by the combustion of fossil fuels like coal, oil, and gas since the 1800s (United Nations, 2024). The repercussions of climate change encompass a spectrum of challenges, including heightened droughts, water scarcity, severe wildfires, rising sea levels, flooding, polar ice melt, catastrophic storms, and dwindling biodiversity (Mahato, 2014). These consequences are predominantly fueled by the surge in greenhouse gases like carbon dioxide, methane, and nitrous oxide in the Earth's atmosphere, which act as thermal insulators, trapping heat from the sun and instigating the warming phenomenon known as the greenhouse effect (United Nations, 2024).

The effects of climate change encompass a broad spectrum of phenomena, including the rising temperatures worldwide, resulting in more frequent and intense heatwaves and alterations in weather patterns; the ongoing melting of ice caps and glaciers, contributing to the steady rise in sea levels and consequent risks of coastal erosion and flooding; the escalation of extreme weather events such as hurricanes, floods, droughts, and wildfires, driven by shifts in temperature and precipitation patterns (Agbebaku, 2015); the profound impact on ecosystems characterized by habitat loss, alterations in migration patterns, and heightened risks of species extinction; and the significant health implications, including exacerbated air pollution, the spread of diseases, and increased incidence of heat-related illnesses, collectively underscoring the multifaceted and far-reaching consequences of climate change on both natural and human systems (Lindwall, 2022). Mitigation strategies for addressing climate change encompass a range of approaches, including transitioning to renewable energy sources such as solar, wind, and hydroelectric power, as well as enhancing energy efficiency in buildings, transportation systems, and industries to diminish greenhouse gas emissions. Additionally, afforestation and reforestation efforts aimed at planting trees and restoring forested areas play a vital role in sequestering carbon dioxide from the atmosphere. The implementation of carbon capture and storage technologies, which involve capturing carbon dioxide emissions from power plants and industrial facilities and storing them underground, further mitigates atmospheric carbon levels. Moreover, policy interventions such as carbon pricing, emissions trading schemes, and regulatory measures can incentivize businesses to mitigate their carbon footprint, thereby facilitating collective efforts to combat climate change. Through a comprehensive understanding of the causes, effects, and mitigation strategies associated with climate change, both individuals and governments can take proactive steps to address this pressing global challenge (Weiskopf et.al., 2020). Climate change is estimated to cause an additional 250,000 fatalities per year between 2030 and 2050, primarily due to undernutrition, malaria, diarrhea and heat stress (Fawzy et.al., 2020).

In Africa, according to the State of the Climate in Africa 2022 report, the rate of temperature rise in Africa has accelerated in recent decades, making weather and climate related threats increasingly severe (WHO 2023). In 2022 more than 100million people on the continent were directly affected by weather and water-related risks, resulting in economic losses of more than \$8.5billion.⁵ According to the Emergency Event Database, there were 5,000

fatalities, with 48% caused by drought and 43% by flooding; however due to under reporting, the true toll is likely to be significantly greater (WHO 2023).

In Nigeria, climate change has resulted in increasing and frequent flooding, rising sea levels and droughts. For example, floods in Nigeria in late 2022 impacted more than 2.5million people and destroyed much of the country's crops (Mbah et. al., 2025). Nigeria is one of ten nations designated by the International Rescue Committee (IRC) as especially vulnerable to climate change impacts (International Rescue Committee,2023; Mbah et. al., 2025). This has been aggravated by a variety of circumstances, including poverty, activity of multinational corporations (MNCs) and widespread environmental injustice issues throughout the country especially the Niger Delta, where in oil and gas industry is located. Multinational corporation's activity in the Nigeria oil and gas business also has negative consequences on the climate (International Rescue Committee,2023).

Climate change has far-reaching consequences spanning environmental, social, economic, and political realms (Ebele et.al. 2016). Environmentally, it manifests through an escalation in extreme weather events such as hurricanes, droughts, floods, and heatwaves, alongside rising sea levels that engender coastal erosion and habitat loss for coastal ecosystems, exacerbating biodiversity decline. Socially, it poses significant threats to human health, food security, and livelihoods, precipitating climate-induced migration and potential conflicts over dwindling resources, while economically, it entails mounting costs for disaster response, agricultural losses, decreased productivity, and disruptions across various sectors. Politically, it amplifies risks of social unrest and instability in regions grappling with severe climate impacts, challenging international cooperation and diplomacy in formulating effective strategies to mitigate emissions, adapt to climate change, and foster resilience in vulnerable communities and ecosystems (Fawzy et.al., 2020; Weiskopf et.al., 2020). Addressing these consequences requires concerted efforts to mitigate greenhouse gas emissions, adapt to the changing climate, and build resilience in communities and ecosystems.³ Some of the efforts involve scientific investigations on the causes and effects of climate change and mitigation strategies (Mahato,2014; Weiskopf et.al., 2020).

This study aimed to add to the scientific body of knowledge by informing relevant authorities on the need of training future healthcare professionals with the knowledge and skills necessary to prevent and adapt to the health risks and other consequences as a result of the changing climate.

Methodology

Study Area

The study was done in Nnewi, in Anambra state, Nigeria. Nnewi is the second largest city in Anambra State in South Eastern Nigeria. Nnewi's 2024 population is now estimated at 1,301,000 and the city spans over 2,789km² in Anambra State (Nnewi, 2023). Nnewi comprises of two local government areas, Nnewi north and Nnewi south local government areas (Nnewi, Nigeria Metro Area Population, 2024).

Study Design

The study design was a descriptive cross-sectional study.

Study Population

The study population included all medical students of Nnamdi Azikiwe University.

Inclusion Criteria

Medical students in 3rd, 4th, 5th and 6th year.

Exclusion Criteria

Medical students who were absent from school during the study period and students who were indisposed during the study.

Sample Size Determination

The sample size used for the study was 160. It was determined using the Cochran formula,

$$n = (Z^2 \times p \times q) / d^2$$

Where n = the minimum desired sample size

Z = Represents standard normal deviate which was set at 1.96 and corresponds to a 95% confidence interval

p = Represents prevalence of awareness of climate change of a previous study done among students of Tertiary institutions in Benue state, Nigeria in 2022 = 86% or 0.86.¹⁶

$$q = 1 - p$$

$$q = 0.14$$

d = represents the degree of precision, which was set at 5% for this study

Sampling Technique

A two staged sampling technique was used. For the first stage, since there are 5 classes to be studied, they were grouped according to the strata and equal allocation of 32 students was given for each class then the second stage was simple random sampling by balloting to avoid bias.

Study Instrument

Study instrument comprised of interviewer administered questionnaires that consist of two sections (A, B). Section A comprised of questions on socio-demographic data and Section B assessed their awareness of climate change, knowledge of the causes, effects and mitigation strategies of climate change respectively and what will improve their knowledge of climate change.

Validity and Reliability of Study Instrument

The study instrument was reviewed by experts and research specialist in climate change for face and content validity. This was to improve validity and reliability of the study tool. The

instrument was pretested among medical students in another institution to ascertain the clarity, comprehensiveness of the questionnaire and time spent to answer the questionnaire.

Data Collection Methods and Data Management

Data was collected in the classrooms via distribution of the questionnaires. All participants that met the eligibility criteria were given self-administered questionnaires. Continuous variables were summarized using percentages and mean. Categorical variables were summarized using frequency and percentages. The knowledge levels of causes, effects and mitigation of climate change were graded as follows: <50%: Poor Knowledge, 50-69%: Moderate Knowledge, 70 and above: Good Knowledge.²⁵ Chi-square test and P-value were used to find association between sociodemographic variables and knowledge of climate change. Data collection for the study lasted for one week.

Data Analysis

The data was cleaned, coded, analyzed and interpreted through appropriate statistical techniques and a Statistical Package for Social Sciences (SPSS) version 27.0 was used for data analysis. Descriptive statistics was used to summarize and present the characteristics of the research respondents. The categorical variables were analyzed using percentages and the association between categorical variables was analyzed using chi-square. The statistical significance of $p\text{-value} \leq 0.05$ was considered statistically significant. The variables were presented using appropriate tables and charts.

Ethical Consideration

The research work was done with approval from the Nnamdi Azikiwe University Teaching Hospital Health Research Ethics Committee (NAUTHREC) through the head of the department of community medicine Nnamdi Azikiwe University. The NAUTHREC reference number was NAUTH/CS/66/VOL.16/VER.3/163/2024/136. Informed consent was obtained before administering the questionnaires.

Results

A total of 160 respondents were studied with a response rate was 100%. The mean age of the participants was 23.34 ± 4.30 years, with age range of 18 to 64 years. Majority (54.4%) of the respondents were males, the major age group was 20-25 (58.75%). Most of the respondents were of the Igbo tribe, comprising 95% of the total participants (tables 1 and 2). Regarding the awareness and sources of knowledge of climate change, 160 (100%) of participants indicated they were aware of climate change and a majority of the respondents 117 (73.125%) claimed to have gotten the information from the Internet.

The majority of respondents attributed climate change to traditional causes like burning of fossil fuels (95%), deforestation (93%), and industrial pollution (92%)(figure 1). This

suggests a strong awareness of the major contributors to climate change among the respondents.

In the study, only 36.25% of respondents connected climate change with health-related issues, indicating a potential gap in understanding the broader impacts of climate change on public health. Majority (89%) of the respondents recognize Increased temperature and wildfire as the most prominent effect of climate change. The most recognized mitigation strategy is planting of trees by 90.63% of the respondents. This indicates widespread awareness and support for afforestation as a critical measure. 81.88% of respondents acknowledge the importance of shifting to renewable energy sources like solar power. 65.63% of respondents see the adoption of electric vehicles as a significant mitigation strategy. None of the sociodemographic variables exhibited significant associations with knowledge levels of awareness and knowledge of mitigation of climate change in this study. Only Gender (χ^2 : 7.172, p-value: 0.028) had statistically significant association with the knowledge level of climate change effects. The male gender had more knowledge on climate change effects.

Table 1a: Sociodemographic Characteristics of Respondents

Variable	Category	Frequency (n=160)	Percentage (%)
Age			
	<20	14	8.75
	20-25	94	58.75
	25-30	47	29.38
	30-35	4	2.5
	35-40	0	0
	>40	1	0.62
Gender:			
	Male	87	54.375
	Female	73	45.625
Marital status			
	Never married	156	97.5
	Currently married	4	2.5
Tribe			
	Igbo	152	95
	Hausa	2	1.25
	Tiv	1	0.625
	Ogba	1	0.625
	Berom	1	0.625
	Ekpeye	1	0.625
	Yoruba	1	0.625
	Ijaw	1	0.625

Table 2: Sociodemographic Characteristics of Respondents

Variable	Category	Frequency (n=160)	Percentage (%)
Religion	Catholic	77	48.125
	Pentecostal	44	27.5
	Anglican	31	19.375
	Christian	2	1.25
	Sabbath	1	0.625
	Non-denominational	1	0.625
	Jehovah witness	1	0.625
	Methodist	1	0.625
	Witness	1	0.625
	Traditional	1	0.625
Current level			
	500LB	32	20
	300L	32	20
	500LA	32	20
	400L	32	20
	600L	32	20

In the thematic analysis, the most recurring themes were education and awareness (19.0%), and internet and media (14.7%).

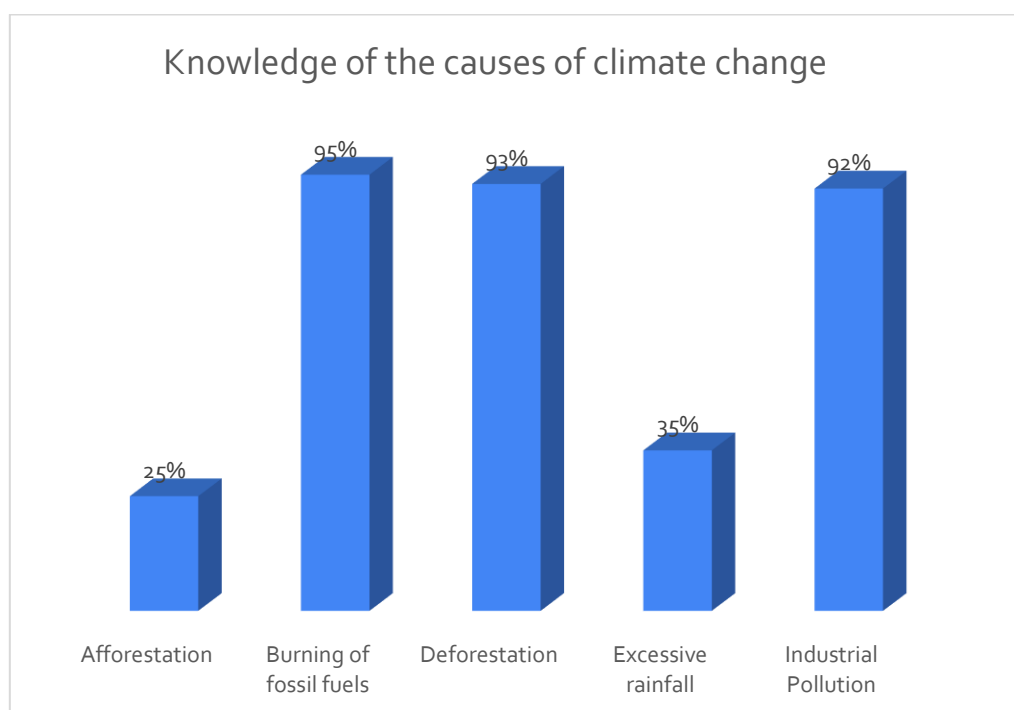


Figure 1: The Knowledge of the causes of climate change

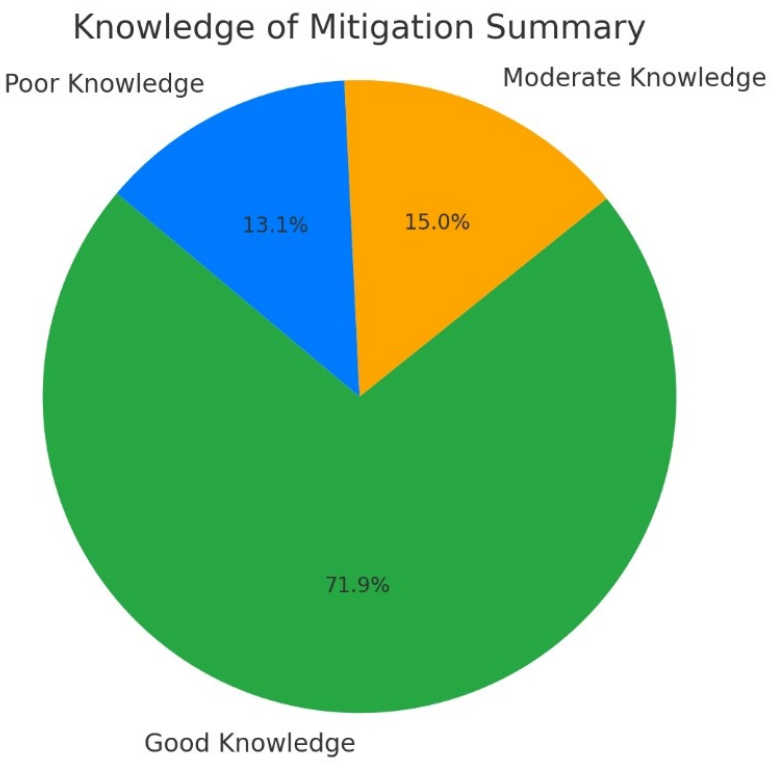
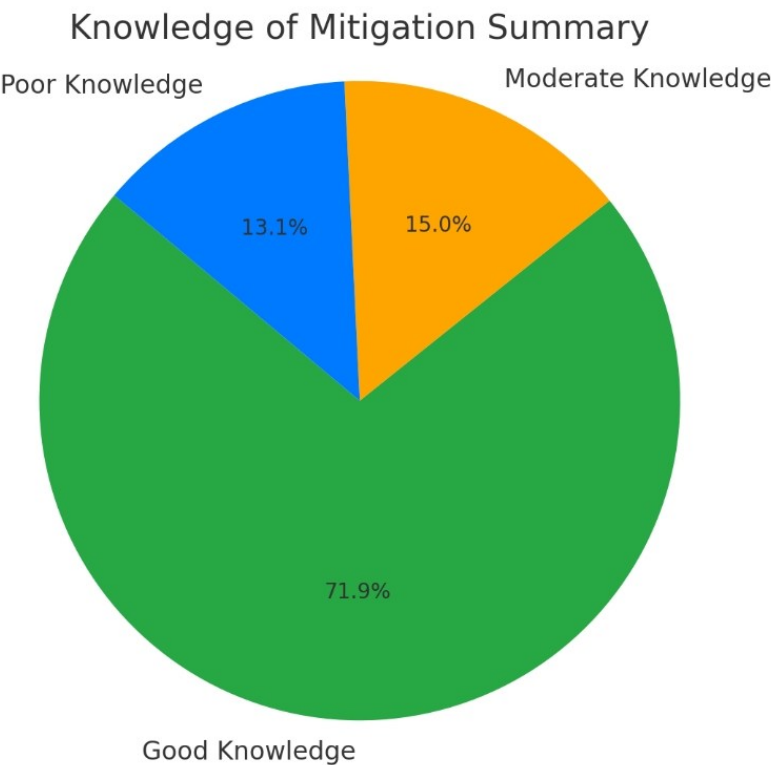




Figure 2: A Word Cloud visualization of students' response on improving knowledge of climate change with the most recurring themes in bold.

Discussion

Our study showed that 100% of the respondents have heard about climate change with the internet as the major source of information (73.1%) followed by school (63%) then television and radio with peers, social network and parents as the least source of information. This is in contrast to a study done in Benue state (Adamgbe et.al.,2022); where 14% of students were not aware of climate change and the difference may be due to their educational curricula and the level of study of the students involved.

Concerning the knowledge level of the causes of climate change most of the respondents of this study indicated burning of fossil fuels as the major cause followed by deforestation as this is in contrast to a study done in Pune city, India (Pandve & Raut, 2011); which showed that the major cause of climate change is deforestation (77%) followed by Industrial pollution; this difference could be due to the practices observed by the respondents and the difference in location of the study.

The knowledge level of the effects of climate change in our study is in contrast to a similar study done among medical students of college of Health science Nnewi 2020, that revealed that 91.7% of medical students knew about the health related impact of climate change and this finding maybe due to the different time period that the study was carried out and the medical curriculum of the students (Pandve & Raut, 2011). In this study, the knowledge level of mitigation of climate change shows that majority of the medical students have good knowledge (71.9%) while the remainder of the respondents had moderate knowledge (15%) and poor knowledge (13.1%). This study also indicated planting of trees (90.63%) as the most prominent mitigation strategy followed by transitioning to renewable energy such as solar (81.88%). This is in contrast to a study done among medical students in Karimnagar city, India (Japhet et.al., 2020); which revealed energy saving measures such as turning off

devices and light bulb when not in use (94%) as the major mitigation strategy and in a study done in Benue state (Adamgbe et.al.,2022); which revealed planting of trees as the less eminent mitigation strategy (18%) and increasing public awareness of climate change as the most prominent mitigation strategy (57%). The differences between the contrasting findings of the above studies could be due to difference in study area and the knowledge level of the respondents based on their medical curricula and sources of information.

Regarding factors influencing knowledge level of causes, effects and mitigation of climate change, Brown et al 2018 study (Reddy et. al., 2022)³⁵ showed that demographic factors such as age, gender and prior exposure to environmental issues may affect the knowledge of climate change as it revealed females and younger students were more knowledgeable about climate change. Similar to our study is that gender is significantly associated with knowledge of effects of climate change.

This study assessed qualitative variables that could improve the knowledge of climate change, education and awareness is the single most recurring theme (19%) followed by internet (14%) and research and scientific information (11%) (Brown et.al., 2018).

Conclusion

Medical students demonstrated heightened awareness of climate change however there is need to sustain the interest of medical students in climate change topics by inviting environmental health professionals to engage with medical students in training workshops early in their medical trainings. Medical students have good knowledge of the causes of climate change however there is need for further sensitization and updating to the latest information and this is done to ensure continued interest in the topic through introducing climate change related topics in the medical curriculum. There is need to improve the knowledge level of effects of climate change among medical students and this can be done through excursions and postings to areas vulnerable to climate change and this experiential knowledge will further close the gap in knowledge. Medical students are the future of the healthcare system and need to be properly equipped with the knowledge and skills to combat the issues that may arise as a result of the changing climate especially as it pertains to the impact of climate change on health. They can influence policies of the government and venturing into politics can provide a platform to create changes that will mitigate the impact of climate change.

Regarding the recurring themes that will improve the knowledge of climate change among medical students, environmental health and public health organizations and institutions have roles to play in providing more public awareness campaign on climate change information on the internet and other media.

Limitations

This study is limited because it was conducted only among medical students in one institution. There would be need to assess the knowledge of other faculties and in different

institutions which will give a broader and comprehensive information on the subject of study.

Future directions

It is recommended that more comprehensive research should be carried out among tertiary students in all geopolitical zones in Nigeria. It should not be limited to medical students but involve students in all field of study because climate change is public

Conflict of interest: There is no conflict of interest among the authors

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