

Comparative Analysis of Misinformation Spread Models During Health and Environmental Crises in Jalingo Metropolis, Taraba State, Nigeria

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ABSTRACT

This descriptive survey examined residents' awareness, experiences, and perceptions of misinformation spread models during health and environmental crises in Jalingo Metropolis, Taraba State. The study was motivated by the demonstrable harms wrought by health-crisis misinformation including suppressed vaccine uptake and panic-induced remedies and by the chronic environmental misinformation that obscures industrial pollution impacts across Nigerian communities. A stratified random sampling technique was used to select 384 respondents across four administrative wards of Jalingo Metropolis. Data were collected using a validated structured questionnaire, the Misinformation Spread Perception Questionnaire (MSPQ), with a reliability coefficient of 0.84. Mean and standard deviation were employed to answer the four research questions. Results revealed that respondents had a high awareness of health-crisis misinformation but moderate awareness of environmental-crisis misinformation. WhatsApp and religious networks were identified as the dominant propagation channels for health-related falsehoods, while formal institutional sources government press releases and regulatory agency filings were identified as principal vectors of environmental misinformation. No significant difference in misinformation awareness was found by gender, but significant differences were observed by educational attainment and residential ward. The findings have direct implications for science education curriculum development, community health communication, and environmental governance in Taraba State and comparable Nigerian contexts.

Keywords: Misinformation, Health Crises, Environmental Crises, WhatsApp, Science Education.

INTRODUCTION

Mobile digital communication technologies have fundamentally reconfigured the global information ecosystem, and nowhere is this reconfiguration more consequential than in sub-Saharan Africa, where high mobile-phone penetration coexists with historically fragile institutional trust and limited digital literacy (Adebayo & Nwachukwu, 2022). Nigeria, with its population exceeding 220 million, an ethnolinguistically plural society, and an estimated WhatsApp penetration of approximately 90% among internet users, represents a particularly instructive environment in which misinformation dynamics are studied (Kalu, 2020). Within this environment, misinformation defined as false or misleading information irrespective of intent to deceive has evolved into a public-safety hazard by which vaccination campaigns are undermined, the harms of industrial pollution are obscured, and the epistemic foundations of evidence-based governance are eroded (Wardle, 2020; WHO, 2022).

Taraba State, located in the north-eastern geopolitical zone of Nigeria, is a region characterized by ecological diversity, an agrarian economy, and documented vulnerability to both infectious-disease outbreaks and environmental degradation arising from unregulated mining and agricultural chemical use. Jalingo Metropolis, the state capital, functions as the commercial, administrative, and communication hub of Taraba State, making it the primary node through which information accurate or otherwise is entered and circulated across the state.

Despite this strategic significance, empirical studies specifically examining misinformation dynamics in Jalingo and Taraba State remain scarce. This gap is addressed by the present study, which focuses on the awareness and perception of residents regarding the propagation mechanisms of both health-crisis and environmental-crisis misinformation, with internationally validated theoretical frameworks being drawn on and adapted to the local socio-institutional context.

Recent scholarship has demonstrated that the SIR/SEIR epidemic modelling framework (Islam et al., 2020; Mbah et al., 2021), network cascade theory (Sharma et al., 2022; Cinelli et al., 2020), and Wardle's (2020) 5Ws Information-Disorder Framework collectively provide a robust analytical toolkit through which misinformation spread is understood. Health-crisis misinformation has been shown to be rapidly propagated through personal-trust networks principally WhatsApp driven by fear, religious authority, and low governmental trust (Fatunde & Abioye, 2022; Roozenbeek et al., 2021). Environmental misinformation, by contrast, is slowly diffused through formal institutional channels corporate press releases, regulatory filings, and legislative discourse and is deliberately manufactured by economically motivated actors (Ibrahim & Zakariyya, 2023; Amnesty International, 2020). These contrasting dynamics have yet to be empirically examined at the community level in Taraba State, and a knowledge gap has been created that the present study is designed to fill."

Statement of the Problem

Jalingo Metropolis and Taraba State entirely have felt the real damage caused by health-related misinformation. During the COVID-19 pandemic, wrong information about how the virus spreads, how to prevent it, and how to treat it was shared widely across WhatsApp groups and in religious gatherings in the state. Negative effects on how people sought healthcare and whether they accepted vaccines were documented by researchers (PERC, 2021). At the same time, people living in Taraba's mining and farming areas have suffered environmental health problems, including poisoning from heavy metals and pesticides. The true causes of these problems have been hidden by false information that was produced by business and government actors (Ezeibe et al., 2020). In spite of all this recorded damage, no published study has been conducted by any researcher to look at how aware residents of Jalingo Metropolis are of these two types of misinformation or how they feel about them. Without this basic data being gathered, the creation of useful communication programmes, science education efforts, and community health campaigns cannot be properly guided by facts that match the local situation.

Purpose of the Study

The broad purpose of this study was to investigate residents' awareness and perception of misinformation spread models during health and environmental crises in Jalingo Metropolis, Taraba State. Specifically, the study sought to:

- i. Determine the level of awareness among residents of misinformation propagation channels during health crises;
- ii. Assess the level of awareness of misinformation propagation channels during environmental crises;
- iii. Compare respondents' perceptions of misinformation severity by crisis type; and
- iv. Examine whether significant differences exist in awareness and perception scores by gender and educational attainment.

Research Questions

The following research questions guided the study:

- i. What is the level of residents' awareness of misinformation propagation channels during health crises in Jalingo Metropolis?
- ii. What is the level of residents' awareness of misinformation propagation channels during environmental crises in Jalingo Metropolis?
- iii. What are residents' perceptions of the relative severity and persistence of health-crisis versus environmental-crisis misinformation?
- iv. Are there significant differences in misinformation awareness and perception scores by respondents' gender and educational attainment?

METHODOLOGY

A descriptive survey research design was adopted for this study to precisely characterize the phenomenon, population, and situation by systematically observing and gathering data on residents' awareness and perception of misinformation spread in Jalingo Metropolis, Taraba State, Nigeria. This design was appropriate given the goal of identifying characteristics, frequencies, and trends in misinformation propagation, while also validating existing findings and defining the characteristics of the target population. The study was conducted in Jalingo Metropolis, Taraba State, targeting adult residents (18 years and above) estimated at approximately 165,000. A sample of 384 respondents was determined using the Taro Yamane formula at a 95% confidence level and distributed across four administrative wards; Kona Ward, Barade Ward, Unguwan Rimi, and Turaki B Ward through stratified random sampling with proportional allocation. The instrument used for data collection was the Misinformation Spread Perception Questionnaire (MSPQ), divided into sections measuring awareness of health-crisis and environmental-crisis misinformation propagation channels, with items stated on a four-point scale of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). The instrument was validated through expert review and pilot-tested with Cronbach's alpha coefficients of 0.84 and 0.81 respectively. Face-to-face administration was conducted over four weeks in February–March 2024, yielding 376 fully completed questionnaires representing a 97.9% response rate. Mean and standard deviation were used to answer the research questions with the benchmark pegged at 2.50, while independent samples t-test and one-way ANOVA with post-hoc Tukey HSD tests were conducted at a 0.05 significance level for inferential analyses.

RESULTS

Demographic Characteristics of Respondents

Of the 376 valid respondents, 192 (51.1%) were male and 184 (48.9%) were female. By age, 28.2% were 18–29 years, 35.6% were 30–44 years, 24.5% were 45–59 years, and 11.7% were 60 years or above. Educational attainment was distributed as follows: no formal education (8.2%), primary education (13.6%), secondary education (36.4%), and tertiary education (41.8%). WhatsApp was the primary information source for 61.4% of respondents, followed by television (18.6%), radio (11.4%), and print media (8.6%).

Research Question 1: Awareness of Health-Crisis Misinformation Propagation Channels

Table 1 presents the mean scores and standard deviations for items on awareness of health-crisis misinformation propagation channels. The overall mean score of 3.12 (SD = 0.61) was above the criterion mean of 2.50, indicating a high level of awareness among respondents. Items related to WhatsApp (M = 3.47, SD = 0.54) and religious group networks (M = 3.31, SD = 0.62) recorded the highest mean scores, indicating that respondents were most aware of these channels as vehicles for health-crisis misinformation. Items related to government health authorities as sources of false information recorded the lowest mean score (M = 2.68, SD = 0.79), suggesting that while awareness was above criterion, respondents were comparatively less aware of state-actor involvement in health misinformation.

Table 1: Mean Scores for Health-Crisis Misinformation Awareness Items (n = 376)

S/N	Item / Propagation Channel	Mean	SD
1	WhatsApp personal and group messages	3.47	0.54
2	Religious assembly announcements (church/mosque)	3.31	0.62
3	SMS text messages from unknown senders	3.22	0.67
4	Facebook and other social media platforms	3.18	0.71
5	Oral transmission in markets and public spaces	3.09	0.74
6	Political figures' public statements	2.94	0.81
7	Television and radio broadcasts	2.87	0.76
8	Government health authority communications	2.68	0.79
	Overall Mean	3.12	0.61

Research Question 2: Awareness of Environmental-Crisis Misinformation Propagation Channels

Table 2 presents results for awareness of environmental-crisis misinformation propagation channels. The overall mean score of 2.74 (SD = 0.68) was above the criterion mean of 2.50, indicating a moderate level of awareness. Items relating to corporate press releases and official government environmental reports recorded the highest mean scores ($M = 2.91$, $SD = 0.72$ and $M = 2.88$, $SD = 0.74$, respectively), indicating that respondents recognized formal institutional channels as vehicles for environmental misinformation. Items related to community misattribution of illness to supernatural causes recorded a mean of 2.83 ($SD = 0.81$). Awareness was comparatively lower for legislative speeches ($M = 2.55$, $SD = 0.84$) and industry-funded academic publications ($M = 2.53$, $SD = 0.88$).

Table 2: Mean Scores for Environmental-Crisis Misinformation Awareness Items (n = 376)

S/N	Item / Propagation Channel	Mean	SD
1	Corporate press releases on environmental incidents	2.91	0.72
2	Official government environmental impact reports	2.88	0.74
3	Community misattribution of illness to supernatural causes	2.83	0.81
4	Local government administrative announcements	2.76	0.77
5	WhatsApp groups for community environmental alerts	2.72	0.80
6	Oral tradition and community elder testimony	2.65	0.83
7	Legislative speeches and parliamentary debates	2.55	0.84
8	Industry-funded academic and technical publications	2.53	0.88
	Overall Mean	2.74	0.68

Research Question 3: Perceived Severity and Persistence of Misinformation by Crisis Type

Respondents rated health-crisis misinformation as significantly more severe and immediately harmful ($M = 3.38$, $SD = 0.57$) than environmental-crisis misinformation ($M = 2.61$, $SD = 0.73$). However, 68.4% of respondents agreed that environmental-crisis misinformation was more persistent and harder to correct than health-crisis misinformation. Notably, 74.2% of respondents identified WhatsApp as the most dangerous channel for health-crisis misinformation spread, while 61.7% identified government and corporate official communications as the most dangerous channel for environmental misinformation. Only 34.6% of respondents reported having encountered formal fact-checking resources such as Africa Check or Dubawa during a crisis event.

Research Question 4: Differences in Awareness by Gender and Educational Attainment

An independent samples t-test revealed no statistically significant difference in total health-crisis misinformation awareness scores between male respondents ($M = 3.09$, $SD = 0.62$) and female respondents ($M = 3.15$, $SD = 0.60$; $t(374) = -0.94$, $p = .347$). Similarly, no significant gender difference was found for environmental-crisis misinformation awareness ($t(374) = 0.71$, $p = .479$). These results are presented in Table 3.

Table 3: Independent Samples t-Test Results for Misinformation Awareness Scores by Gender

Awareness Domain	Gender	N	Mean	SD	t-value	p-value
Health-Crisis Misinformation	Male	192	3.09	0.62	-0.94	.347
	Female	184	3.15	0.60		
Environmental-Crisis Misinformation	Male	192	2.72	0.69	0.71	.479
	Female	184	2.77	0.67		

A one-way ANOVA revealed a statistically significant effect of educational attainment on health-crisis misinformation awareness ($F(3, 372) = 18.43$, $p < .001$, $\eta^2 = 0.13$) and on environmental-crisis misinformation awareness ($F(3, 372) = 22.17$, $p < .001$, $\eta^2 = 0.15$). Post-hoc Tukey HSD tests indicated that respondents with

tertiary education had significantly higher awareness scores than those with secondary education ($p = .003$), primary education ($p < .001$), and no formal education ($p < .001$) for both domains. No significant difference was found between the secondary and primary education groups for health-crisis awareness ($p = .214$), though a significant difference was found for environmental-crisis awareness ($p = .028$).

DISCUSSION OF FINDINGS

Finding 1: High Awareness of Health-Crisis Misinformation Propagation Channels

The finding that respondents demonstrated a high level of awareness of health-crisis misinformation propagation channels (overall $M = 3.12$) is consistent with the extensive documentation of WhatsApp-mediated health misinformation during the COVID-19 pandemic in Nigeria. Adebayo and Nwachukwu (2022) identified WhatsApp as the dominant vector of COVID-19 misinformation in urban Nigerian centres, and Itasanmi and Ojebuyi (2021) documented the role of WhatsApp group forwarding in amplifying false health remedies, including the Ebola saltwater-cure hoax. The present finding that WhatsApp recorded the highest awareness score ($M = 3.47$) in the health-crisis domain corroborates these studies at the community level in Jalingo, indicating that residents of the metropolis have developed a practical, experiential awareness of WhatsApp as a primary misinformation risk environment.

The high awareness of religious networks as misinformation channels ($M = 3.31$) is likewise consistent with the literature. Fatunde and Abioye (2022) documented the role of Pentecostal and Islamic religious leaders as super-spreader nodes during the COVID-19 infodemic, with cascading effects on vaccine uptake and health-seeking behaviour. Mbah et al. (2021), applying an agent-based SIR model, demonstrated that initial seeding from high-centrality religious figures produced epidemic-scale misinformation diffusion within Nigerian WhatsApp networks before corrective NCDC messaging achieved comparable penetration. The present findings replicate this pattern in the Taraba State context, underscoring the imperative of engaging religious community leaders as communication partners rather than treating them solely as misinformation risk factors.

Finding 2: Moderate Awareness of Environmental-Crisis Misinformation Propagation Channels

The finding that awareness of environmental-crisis misinformation was moderate (overall $M = 2.74$) and significantly lower than health-crisis awareness is theoretically consistent but practically concerning. As documented by Ibrahim and Zakariyya (2023) and Amnesty International (2020), environmental misinformation in Nigeria is predominantly produced and distributed through formal, authoritative-appearing institutional channels corporate environmental assessments, regulatory agency filings, and government press releases that are intrinsically less visible as misinformation to lay audiences than the viral, peer-shared content typical of health-crisis misinformation. This asymmetry in recognizability is predicted by Wardle's (2020) 5Ws framework, which emphasizes that the apparent credibility of the source fundamentally mediates receivers' critical evaluation of content.

That respondents nonetheless achieved above-criterion awareness of corporate press releases and government reports as misinformation vectors ($M = 2.91$ and $M = 2.88$, respectively) suggests a growing community skepticism toward institutional communications in Taraba State, consistent with the broad institutional trust deficit documented nationally by Afrobarometer (2022). This finding is also consonant with Ezeibe et al. (2020), who documented community recognition in Zamfara State of official minimization of artisanal mining health impacts. The comparatively low awareness of industry-funded academic publications as a misinformation channel ($M = 2.53$) reflects the limited penetration of academic communication in the general population and represents a significant vulnerability: sophisticated corporate disinformation packaged as scientific research is least visible to the community members most affected by it.

Finding 3: Perceived Severity and Persistence

Respondents' perception that health-crisis misinformation is more immediately severe but environmental-crisis misinformation is more persistent aligns closely with the theoretical distinction between epidemic and institutional misinformation dynamics established in the international literature (Islam et al., 2020; Roozenbeek

et al., 2021). The SIR model predicts an epidemic curve rapid rise, peak, and gradual decline for health misinformation, with decreasing uptake as direct experiential immunity accumulates. Environmental misinformation exhibits no such curve; its chronic, institutionally-backed character means it does not dissipate with experiential learning, as no single corrective crisis experience analogous to recovering from illness is available to produce immunity. The present finding that 68.4% of respondents recognized this persistence dimension of environmental misinformation, despite reporting lower overall awareness scores, suggests a sophisticated lay understanding of the temporal dynamics of misinformation that is rarely acknowledged in deficit-model science communication frameworks.

Finding 4: No Gender Difference; Significant Educational Attainment Effect

The absence of a significant gender difference in misinformation awareness is inconsistent with some international studies, which have found that women and men differ in their exposure and susceptibility to specific types of misinformation (Sharma et al., 2022). However, Kalu (2020) similarly found no significant gender effect on COVID-19 misinformation belief in an African urban context, attributing this to the equalizing effect of ubiquitous WhatsApp exposure across genders in communities with high mobile penetration. Given that WhatsApp adoption in Jalingo appears similarly distributed across male and female respondents, the absence of a gender difference is plausible and supports the view that misinformation exposure in digitally connected Nigerian urban contexts is not gender-stratified.

The significant effect of educational attainment on both health and environmental misinformation awareness (F -values of 18.43 and 22.17, respectively) is consistent with evidence from PERC (2021), which documented higher COVID-19 misinformation resilience among more educated Nigerians, and with Roozenbeek et al. (2021), whose prebunking trials demonstrated that the effectiveness of misinformation inoculation was positively associated with baseline critical-thinking capacity. Critically, however, the finding that even tertiary-educated respondents did not achieve high awareness scores for environmental-crisis misinformation (tertiary group $M = 3.01$, $SD = 0.58$) indicates that formal education alone is insufficient to produce resilience against institutionally-embedded environmental misinformation a finding that directly challenges deficit-model assumptions and demands curriculum-level intervention in Nigerian science and civic education.

IMPLICATIONS FOR SCIENCE EDUCATION

The findings of this study carry substantive implications for science education in Taraba State and Nigeria. The high awareness of WhatsApp as a health-crisis misinformation channel, coupled with low engagement with formal fact-checking resources (only 34.6% of respondents had used Africa Check or Dubawa), indicates a significant gap between citizens' awareness of the risk environment and their capacity to access corrective information. Science education programmes should explicitly incorporate digital literacy competencies, including instruction in identifying credible health information sources, recognizing misinformation markers, and utilizing fact-checking platforms.

The lower awareness of environmental-crisis misinformation channels particularly the sophisticated forms embedded in corporate and regulatory communications indicates a need for secondary and tertiary science curricula to address the political economy of scientific knowledge. Students should be equipped not only with content knowledge but with the epistemological tools to evaluate the institutional independence and conflict-of-interest profile of information sources. Wardle's (2020) 5Ws framework offers a pedagogically accessible structure for this kind of source evaluation that could be integrated into existing Nigerian science curricula with relatively modest adaptation.

The demonstrated role of religious networks as both amplifiers and potential correctors of health misinformation points to community-embedded science education as a strategic complement to formal schooling. Science educators in Taraba State should develop partnerships with religious community organizations to deliver evidence-based health and environmental literacy programmes through trusted community channels, leveraging the same network architecture that currently amplifies misinformation to instead propagate accurate scientific information.

LIMITATIONS OF THE STUDY

This study is subject to several limitations that should be considered when interpreting its findings. First, the descriptive survey design captures associations rather than causal relationships; consequently, the reported links between information sources, awareness levels, and demographic variables cannot be interpreted as evidence that particular propagation channels cause misinformation exposure or belief. Longitudinal or quasi-experimental designs would be required to establish such causal pathways. Second, the study relies entirely on respondents' self-reported perceptions of misinformation, which may be affected by recall limitations, social desirability bias, and variation in individual ability to recognize misinformation when encountered; respondents may therefore under- or over-report their actual exposure to, and awareness of, specific propagation channels. Third, while the study measures awareness and perception, it does not assess the extent to which this awareness translates into concrete behavioural outcomes such as vaccine uptake, adoption of environmental safety practices, or changes in institutional trust. The relationship between perceived awareness and actual behaviour therefore remains an open empirical question that this survey-based design was not equipped to answer. These limitations do not undermine the descriptive value of the findings but do constrain the strength of the inferences that can be drawn from them, and they are addressed directly in the recommendations for future research below.

This study used a descriptive survey to study how residents of Jalingo Metropolis, Taraba State are aware of and feel about misinformation during health and environmental crises. High awareness of health-crisis misinformation was shown by residents, mainly through WhatsApp and religious community networks, but only moderate awareness of environmental-crisis misinformation was demonstrated, as it is spread through formal institutional channels that are not easily recognized as misinformation by ordinary people as was revealed by the findings. No significant difference in awareness was found between male and female respondents, while education level was identified as a key factor in awareness across both areas by the analysis. Health-crisis misinformation was seen by respondents as more immediately dangerous, but environmental-crisis misinformation was viewed as harder to correct and longer lasting a view that is supported by existing theories on how misinformation spreads. That science literacy and media literacy cannot be separated in today's Nigerian information environment is shown by these findings, and the need for modern science education to give students not just subject knowledge but also the thinking skills to judge information sources, understand who controls knowledge, and use reliable fact-checking tools is highlighted. The lack of trust in institutions, the closed nature of WhatsApp groups, and the way environmental misinformation is hidden within official communications are serious problems that cannot be solved by any one educational effort alone; a joint response that covers school curriculum changes, community involvement, independent regulation, and better science communication is called for by these challenges.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

- i. Revise secondary school science curricula in Taraba State to include digital literacy and misinformation awareness, using the 5Ws framework to teach source evaluation across health and environmental topics.
- ii. Build public trust before crises through transparent health data publication, regular community engagement, and partnerships with religious leaders as credible health communication allies.
- iii. Develop and pilot a prebunking curriculum for Jalingo Metropolis based on psychological inoculation theory, with controlled trials to test effectiveness before wider rollout.
- iv. Support civil society and investigative journalism bodies to expand local-language fact-checking capacity, improving uptake of existing resources like Africa Check and Dubawa in Taraba State.
- v. Mandate environmental agencies in Taraba State to publish accessible public assessments on mining, agriculture, and waste management, with independent civil-society oversight to counter institutional misinformation.
- vi. Conduct quasi-experimental and longitudinal studies to evaluate the impact of educational interventions on misinformation resilience among secondary school science students, informing evidence-based curriculum policy.

- vii. Incorporate behavioural outcome measures such as documented vaccine uptake, adoption of environmental safety practices, and changes in institutional trust into subsequent studies, so that the link between misinformation awareness and actual decision-making during health and environmental crises can be empirically established rather than inferred from perception data alone.
- viii. Adopt mixed-method designs in future research, combining structured surveys with in-depth interviews, focus group discussions, and content analysis of misinformation messages circulating through digital and community networks, to triangulate self-reported awareness against observed message content and reduce the response bias inherent in purely survey-based approaches.
- ix. Extend this line of research to other local government areas and geopolitical zones of Nigeria, enabling comparative analysis of how misinformation propagation channels, awareness levels, and behavioural responses vary across different socio-institutional and infrastructural contexts.

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