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Environmental Risk Factors And Temporal Trends In Infant Mortality, Rural Kwara South, Kwara State, Nigeria: A Five-Year Analytical Review (2019-2023)

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ABSTRACT
This study titled environmental risk factors and temporal trends in Infant mortality, Rural Kwara South, Kwara State, Nigeria: A Five-Year Analytical Review (2019–2023) examined the environmental determinants of infant mortality and variations in mortality trends across rural communities in Kwara South Senatorial District, Nigeria. The research was guided by two null hypotheses, the study investigated major environmental risk factors contributing to infant mortality and assessed the temporal trends from 2019 to 2023, Kwara South Senatorial District, Kwara State, Nigeria. Quantitative data were collected through the Environmental Risk Factors and Infant Mortality Questionnaire (ERFIMQ), while qualitative figures were obtained from interviews and focus group discussions (FGDs) with women of childbearing age and healthcare workers. Findings revealed that poor water quality, inadequate sanitation, limited healthcare access, and air pollution were major contributors to infant mortality. Statistical analysis showed significant relationships between environmental risk factors and infant mortality, as well as significant variations in mortality trends across the five-year period. The study concluded that infant mortality in rural Kwara South is largely preventable through targeted environmental and healthcare interventions. In the light of the above, the study recommends that, government and community stakeholders prioritize clean water provision, improved sanitation, and expanded maternal healthcare services to reduce infant mortality and enhance rural child survival outcomes among others.
Keywords: Infant Mortality, Environmental Risk Factors, Rural Health, Sanitation

INTRODUCTION
Child health remains a critical foundation for the social and economic development of any nation, as it determines the future strength of the human resource base. Within global population and health discourse, infant mortality has consistently been regarded as one of the most sensitive indicators of population health, living conditions, and environmental quality (WHO, 2021). It mirrors the complex interaction among social, biological, and ecological variables that shape human survival in early life. The Centers for Disease Control and Prevention (CDC, 2022) defines infant mortality as the death of a child before his or her first birthday, and classifies it into perinatal, neonatal, and post-neonatal stages. Each representing different windows of exposure to environmental and health system risks. This categorization not only

assists in medical diagnosis but also provides a spatial and temporal lens for evaluating developmental inequalities and the effectiveness of public health interventions.

Despite global progress in reducing child mortality, infant deaths remain serious health challenge in developing countries, particularly in rural environments where health and infrastructural inequalities are deeply rooted. UNICEF (2023) reports that, Nigeria remains one of the five countries with the highest under-five and infant mortality rates globally, accounting for a significant share of sub-Saharan Africa's total burden. Environmental risk factors such as contaminated drinking water, inadequate sanitation, indoor air pollution, unsafe waste disposal, and exposure to disease vectors are among the most persistent causes of infant death (World Bank, 2022). The rural poor, who depend largely on natural resources for survival, are particularly exposed to these risks due to inadequate access to clean water, basic health services, and modern infrastructure. Consequently, infant mortality in such settings reflects both environmental vulnerability and developmental marginalization, reinforcing the need for geographically grounded research.

Globally, significant improvements have been recorded in child survival, yet these advances have not been evenly distributed. According to UNICEF (2019), neonatal deaths declined by nearly 50% between 1990 and 2018 from five million to about 2.5 million, mainly due to improved maternal healthcare and sanitation in developed nations. However, sub-Saharan Africa continues to account for over 40% of the world's newborn deaths, with an average of 27 deaths per 1,000 live births (WHO, 2022). In Nigeria, the infant mortality rate remains alarmingly high, averaging 89,700 neonatal deaths annually (Okwuwa & Adejo, 2020 & Reinhard et al., 2014). The persistence of these figures highlights the inadequacy of existing interventions and the urgent need for contextualized studies that examine the environmental determinants of infant deaths across different geographical zones.

The NDHS (2018) report also revealed that according to geo-political zones infant mortality rate was 58 deaths per 1,000 live birth in North Central; 73 deaths per 1,000 live birth in North East; 80 deaths per 1,000 live birth in South West; 48 deaths per 1,000 live birth in South East; 49 deaths per 1,000 live birth in South South; and 43 deaths per 1,000 live birth in South West. For the North Central State, the NDHS report shows that infant mortality rate was 46 deaths per 1,000 live birth in FCT – Abuja; 40 deaths per 1,000 live birth in Benue State; 93 deaths per 1,000 live birth in Kogi State; 52 deaths per 1,000 live birth in Kwara State; 64 deaths per 1,000 live birth in Nasarawa State; 57 deaths per 1,000 live birth in Niger State; and 65 deaths per 1,000 live birth in Plateau State. This underscoring the need for localized investigations that reflect the unique environmental realities of rural communities.

Accessibility to clean water in many rural communities in Nigeria has remained a mirage (Omoteso and Akanbi, 2018); access to potable water in the study is not in any way better as over many of these rural communities lacked any water infrastructure, many of the bore holes are dysfunctional (Elites Network for Sustainable Development (2023). These environmental conditions directly increase infant exposure to waterborne diseases such as cholera, diarrhea, and dysentery, which are major causes of infant deaths (Trieber, 2021; Adedini et al. 2015; Adewuyi et al. (2018) and Budsha et al. (2022). In addition to unsafe water, the availability and quality of healthcare facilities have a direct impact on infant survival. The Nigeria Demographic and Health Survey (NDHS, 2018) reports that only 39% of births occur in health facilities, while the majority of 59% take place at home, often skilled birth attendants. Rural women are particularly disadvantaged due to distance from healthcare centers, low education levels, and financial barriers. Shobiye et al. (2022) and Slinkard et al. (2018) observed that infants born to mothers who attended fewer than four antenatal care sessions were significantly more likely to die within their first year.

In rural Kwara South, Oyetunde (2023) documented that about 316 communities lack accessible healthcare facilities, further compounding the risk of preventable infant deaths. Air pollution both outdoor and indoor represents another major but often overlooked contributor to infant mortality. Studies have shown that prolonged exposure to particulate matter, carbon monoxide, and other pollutants increases the likelihood of respiratory infections and sudden infant death syndrome (Karimi & Shokrinezhad, 2020; Reinhard et al., 2014). In rural households where biomass fuels such as firewood and charcoal are commonly used for cooking, infants are frequently exposed to smoke during early life. Essentially, without a clear understanding of the specific environmental determinants and their temporal patterns, efforts to reduce infant mortality in rural Kwara South will remain fragmented and ineffective.

Therefore, it is essential to provide empirical evidence that can guide sustainable publicl health and environmental management policies aimed at safeguarding infant lives in the region. Based on this, the present study seeks to address two fundamental research questions: What are the major environmental risk factors contributing to infant mortality in the rural areas of Kwara South Senatorial District? What are the temporal trends in infant mortality in these rural areas between 2019 and 2023? Null hypothesis which stated that there is no significant relationship between environmental risk factors and infant mortality in the study area and there is no significant variation in the trend in infant mortality from 2019 to 2023 in Kwara South Senatorial District.

RESEARCH METHODOLOGY

Study Area

Kwara South Senatorial District, located between latitudes 4°60′ and 5°30′ N and longitudes 8°–9°10′ E, lies in the southern part of Kwara State, Nigeria. It shares boundaries with Edu and Moro LGAs to the north, Ilorin South and Asa to the west, Osun and Oyo States to the south, and Kogi State to the east. The district comprises seven local government areas (INEC, 2015). The region experiences two distinct seasons: a rainy season from March to October, with annual rainfall around 1,500 mm, and a dry season from November to March. Average annual temperature is about 35 °C, dropping to 18 °C in cooler months. Relative humidity ranges from 24% in the dry season to 98% during the wet season. The climate is governed by the Inter-Tropical Convergence Zone (ITCZ), influencing seasonal wind patterns. The area’s soil is predominantly ferruginous tropical and ferrosol, rich in nutrients for food crop cultivation. Vegetation consists mainly of deciduous woodland and wooded savannah, supporting crops like yam, cassava, maize, and cowpea. Forest and savannah vegetation coexist, featuring trees such as iroko and opepe, and grasses like elephant grass and tridax. Anthropogenic activities, especially fuelwood harvesting, have reduced natural vegetation cover.

Geologically, the area lies on basement complex and sedimentary rocks with elevations between 160–680 m. It is well-drained by rivers Oyun and Osin and notable for natural features such as Owu Waterfalls, which support domestic, agricultural, and tourism activities. Kwara South Senatorial District had a population of 706,848 in 2006, projected to reach 263,341 females by 2021 (NPC, 2021). The people are mainly Yoruba (Igbomina, Ekiti, and Ibolo) with minor Fulani and Nupe groups. Farming is the major occupation, producing yam, cassava, maize, and cocoa, while the Fulani engage in cattle rearing. The district has limited industries, including Okin Biscuit and Kamwire Steel, but hosts key educational institutions like Federal Polytechnic Offa and Landmark University. Major markets, diverse religions, and a functional transport network enhance its economic and cultural vitality.

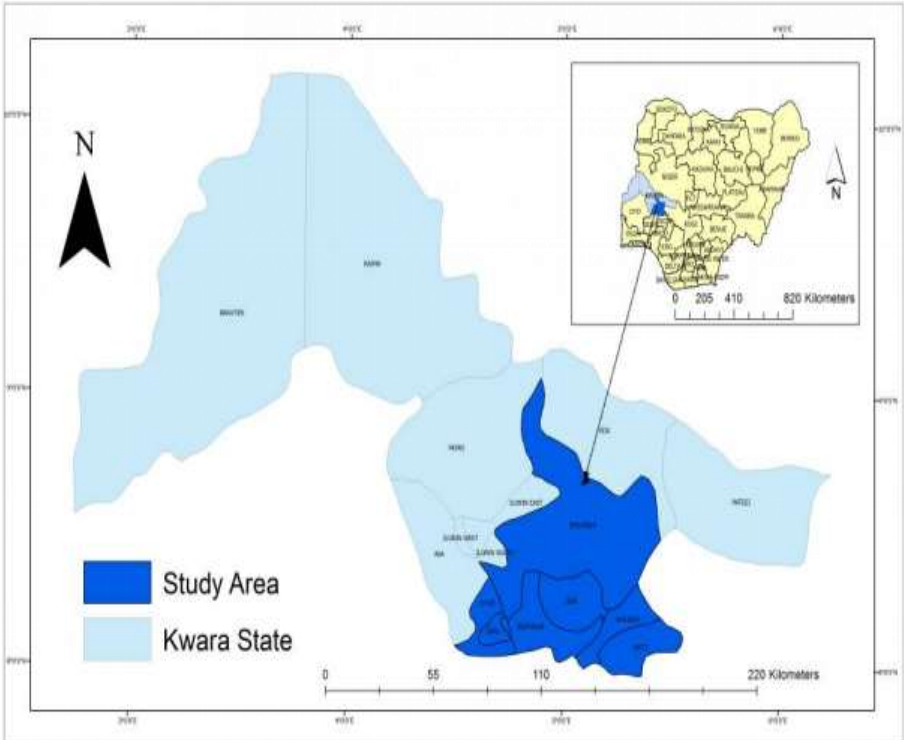

Fig 1: Study Area Source: Adopted from Kwara State Ministry of Lands, Ilorin, (2025).

Research Design

The study adopted a mixed-method research design, combining quantitative and qualitative approaches to provide a comprehensive understanding of environmental risk factors influencing infant mortality. It employed descriptive-correlational and ex-post facto designs. The descriptive-correlational design explored relationships between socio-demographic, and environmental variables without manipulation, while the ex-post facto design analyzed existing hospital records of infant mortality from 2019–2023. Both quantitative and qualitative data were utilized. Quantitative data were collected through structured questionnaires covering demographic and environmental factors such as water quality, sanitation, healthcare, and air pollution, while qualitative data were obtained via in-depth interviews with 24 women (aged 15–49) and Focus Group Discussions (FGDs) with 21 healthcare workers to complement and validate quantitative findings.

Instrument for Data Collection

The study utilized three main data collection instruments: the Environmental Risk Factors and Infant Mortality Questionnaire (ERFIMQ), the Interview Guide (IGERFIM), and the Focus Group Discussions (FGDs). The questionnaire comprised three sections: Section A focused on socio-demographic data such as age. Section B measured environmental risk factors including water quality, sanitation and hygiene, healthcare services, and air pollution; while Section C examined how these factors independently and jointly influence infant mortality trends in rural Kwara South between 2019-2023. Lecturers from the University of Abuja reviewed the instruments to ensure clarity, accuracy, and relevance to the study objectives.

RESULTS

Table 1: Distribution of the Respondents according to Demographic Characteristic

Characteristics	Frequency (n = 400)	Valid % (100.0)
Age Group (years)		
Age at First Marriage		
15 – 19	52	13.0
20 – 24	122	30.5
25 – 29	81	20.2
30 – 34	58	14.5
35 – 39	38	9.5
40 – 44	27	6.8
45 – 49	22	5.5
Birth Interval		
12 month (1 year)	102	25.5
18 month (1 year 6 months)	94	23.5
24 months (2 years)	149	37.2
36 months (3 years)	23	5.8
48 months (4 years)	32	8.0

Source: Author's Fieldwork, 2024

Table 1 presents the demographic distribution of respondents according to age group and birth interval in rural areas of Kwara South Senatorial District. The data reveal that a significant proportion of women (30.5%) entered into marital union between the ages of 20 and 24 years, followed by 20.2% who married between the ages of 25 and 29 years. A smaller proportion (13%) married as early as 15–19 years, while only 6.8% and 5.5% married at ages 40–44 and 45–49 years respectively. This distribution suggests that early and mid-twenties constitute the dominant age bracket for first marriage among women in the district. These findings are consistent with the National Bureau of Statistics (2017), which places the Nigerian childbearing age range between 15 and 49 years. The data further reflect entrenched cultural norms that promote early marriage in rural communities. This view was reinforced by a key informant in Isare-Opin, Ekiti Local Government Area, who remarked that:

"*Societal expectations and cultural traditions influence women to marry at a younger age*" (IDI, Isare-Opin, 2024).

Early marriage, in turn, has implications for maternal and child health, as it often corresponds with early childbearing and limited access to health education and resources.

Furthermore, birth interval data also provide valuable insights into reproductive health patterns among respondents. The largest proportion of women (37.3%) maintained a two-year birth interval, while 25.5% and 23.5% reported intervals of one year and one and a half years respectively. Only a small proportion (5.8%) maintained a three-year interval, and 8% reported spacing births by four years. The predominance of short birth intervals (less than two years) indicates a high reproductive turnover rate among rural women, which can adversely affect maternal recovery and infant survival. Supporting this interpretation, a focus group in Irra, Oyun Local Government Area, discussant report indicates that:

"Women with short intervals between two pregnancies have insufficient time to restore their nutritional reserves, which might affect foetal growth. Growth retardation and prematurity led to low birth weight, which is a strong determinant of infant mortality" (FGD, Auxiliary Nurse, 2024).

This demographic profile thus underscores the vulnerability of women and infants in rural Kwara South. Early marriage, frequent childbirth, and short inter-pregnancy intervals combine to increase exposure to health complications, malnutrition, and environmental risks factors that collectively elevate the risk of infant mortality in the region.

Research Question One: *What are the major environmental risk factors contributing to infant mortality in the rural areas of Kwara South Senatorial District?*

The study identified

several environmental risk factors influencing infant mortality in the rural communities of Kwara South Senatorial District. These include inadequate potable water, poor sanitation and hygiene practices, limited healthcare accessibility, and exposure to air pollution.

Table 2: Respondents' Opinion on Water as an Environmental Risk Factor in the Study Area

	Frequency (n = 400)	Valid % (100.0)
Awareness of Environmental Risk Factors		
Yes	310	77.5
No	69	17.2
No response	21	5.3
Available Water Sources		
Well	112	28.0
Pipe borne water	60	15.0
Borehole	98	24.5
Rain	31	7.8
Stream/River	56	14.0
Water vendor	43	10.7
Accessibility of Water Sources		
< 1km	188	47.0
1 – 2km	47	11.7
2 – 3km	52	13.0
4 – 6km	79	19.8
6km and above	34	8.5
Method of Water Treatment before Drinking		
Boiling	128	32.0
Filtration	93	23.3
Use of water guard	48	12
Chlorination	19	4.7
Decantation	16	4.0
None	96	24.0
Regularity of Water Treatment		
Every day	52	13.0
Every week	116	29.0
Every month	78	19.5
Every three months	83	20.8
Not regularly	71	17.7
Regularity of Cleaning Water Storage Container		
Daily	64	16.0
Twice a week	75	18.7
Weekly	77	19.3
Twice a month	95	23.7
Monthly	87	22.3

Source: Author's Fieldwork, (2024). explicit

The findings show that most respondents in rural Kwara South depend on wells, boreholes, and streams for drinking water, revealing inadequate access to safe water. Long distances to water sources expose families to environmental stress and reduce time for proper childcare and hygiene. Limited water treatment practices indicate low health awareness and infrastructural challenges. The use of unsafe water sources, especially during the dry season, highlights the severe impact of environmental scarcity on community health. These conditions contribute to waterborne diseases that increase infant mortality rates.

Seasonal fluctuations further intensify risks as clean water becomes scarce. The findings demonstrate that poor water access, unsafe treatment methods, and environmental stressors are major risk factors. Overall, water scarcity and inadequate sanitation remain key environmental determinants of infant mortality. Improving water infrastructure and public health practices is crucial. Strengthening environmental management can reduce preventable infant deaths in rural Kwara South. Qualitative evidence from in-depth interviews further illuminated the environmental realities contributing to infant mortality in rural Kwara South. Participants described how

"*both humans and animals often drink from the same stream,"exposing households to severe contamination risks*.

Such shared water use reflects a lack of protected water sources and effective sanitation infrastructure, leading to high levels of microbial pollution. The contamination of drinking water through animal waste and surface runoff directly increases the incidence of diarrhoeal diseases, cholera, and other waterborne infections among infants, who are the most physiologically vulnerable. This situation demonstrates how environmental degradation and poor rural water management translate into preventable infant deaths. The account from Ora community (IDI, 2024) underscores the intersection between human behaviour, environmental exposure, and health outcomes. These findings reinforce the central argument of this study that unsafe and unprotected water sources are a critical environmental risk factor influencing temporal trends in infant mortality. The local experiences mirror broader global patterns where lack of access to safe water remains a primary determinant of infant deaths, particularly in under-resourced rural settings.

Table 3: Distribution of the Respondents on Sanitation and Hygiene as Environmental Risk Factor in the Study Area

	Frequency (n = 400)	Valid % (100.0)
Type of Available Household Toilet Facility		
Bush (open defacation)	147	36.8
Flush Toilet	83	20.7
Pit Toilet	116	29.0
Bucket	54	13.5
Location of Household Toilet Facility		
Within the House	98	24.5
Outside the House	224	56.0
Attached to another residence	55	13.7
Others (specify)	23	5.75
Regularity in Sanitizing Toilet Facility		
Everyday	85	21.3
Every week	126	31.5
Once in a week	56	14.0
Twice a week	36	9.0
Not regularly	97	24.3
Means of Sanitizing Toilet Facility		
Soap detergent	147	36.8
Water	183	46.8
Disinfectants	51	12.7
Others specify	19	4.7
Method of Solid Waste Disposal		
Open deposit	104	26.0
In pit	122	30.5
Drainage/Water channel	86	21.5
Any of the above	88	22.0
Location where Baby is Bathed		

In the bathroom	128	32.0
Within the compound	223	55.7
By the well side	37	9.3
By the river bank	12	3.0

Source: Author's Fieldwork, (2024).

Poor sanitation emerged as another major contributor to infant mortality in the study area. About 36.8% of respondents practiced open defecation, 29% used pit toilets, and only 20.7% had flush toilets. More than half (56%) had toilets located outside the home, and 24.3% admitted irregular cleaning practices. Solid waste was primarily disposed of through open deposits (26%) or in pits (30.5%), while 55.7% bathed infants in open compounds or near wells. Focus group discussions revealed that open defecation and poor sanitation contributed to outbreaks of diarrhoea and cholera diseases strongly associated with infant deaths. This aligns with WHO (2019) and Mundi (2022), which attribute roughly 9% of global under-five mortality to poor sanitation and hygiene practices.

Table 4: Distribution of the Respondents on Healthcare Facilities and Services as Environmental Risk Factor in the Study Area

	Frequency (n = 400)	Valid % (100.0)
Available Health Facilities		
Primary health center	177	44.3
Chemist shops	72	18.0
Private hospital	118	29.5
Pharmacy	33	8.3
None	0	100.0
Accessibility of Healthcare Facilities		
Less than 2km	84	21.0
2 – 4km	159	39.8
5 – 7km	40	10.0
8 – 10km	61	15.3
11 – 13km	56	14.0
Provision of Free Healthcare Services		
Yes	74	18.5
No	326	81.5
Preferred Healthcare Institution for Antenatal Services		
Primary health center	195	48.8
Private hospital	106	26.5
Private clinic	65	16.3
Local birth attendants	34	8.5
Access to Postnatal Healthcare Services		
Yes	297	74.3
No	103	25.8

Source: Author's Fieldwork, (2024)

The study found uneven healthcare distribution across rural communities. Primary health centers accounted for 44.3% of available facilities, while 29.5% of respondents relied on private hospitals and 18% on chemists. Access distances varied: 21% lived within 2 km of a facility, but 29% travelled between 5–13 km. Only 18.5% received free healthcare services, while 48.8% attended public hospitals for antenatal care. Despite 74.3% reporting access to postnatal services, long distances, poor infrastructure, and cost barriers limited regular utilization. These factors exacerbate delays in seeking care during emergencies, contributing to avoidable infant deaths, consistent with Adebayo et al. (2021), who emphasized distance and affordability as critical barriers to rural healthcare access in Nigeria.

Table 5: Respondents' Opinion on Air Pollution as an Environmental Risk Factor in the Study Area

	Frequency (n = 400)	Valid % (100.0)
Types of Cooking Fuel		
Firewood	241	60.3
Kerosene	46	11.5
Charcoal	113	28.3
Location where daily meals are cooked		
In the kitchen	273	68.3
In the passage way	31	7.8
Within the compound	96	24.0
Regularity of Cooking		
Once in a day	231	57.8
Twice in a day	101	25.3
Thrice in a day	68	17.0
Congestion of Living Environment		
Yes	106	26.5
No	294	73.5
Ventilation of Living Room		
Yes	207	51.8
No	193	48.3

Source: Author's Fieldwork, (2024).

Indoor air pollution also featured prominently. About 60.3% of respondents used firewood as their main cooking fuel, 28.3% used charcoal, and only 11.5% used kerosene. Although 68.3% cooked indoors, 24% cooked in open compounds with limited ventilation. Nearly half (48.3%) reported poor airflow in their living rooms. Respondents confirmed that smoke from biomass fuels, open waste burning, and poor ventilation worsened respiratory infections among infants an observation supported by Ashrafuzzaman et al. (2023), who linked solid fuel use in rural Nigeria to increased neonatal and infant morbidity.

Research Question Two: *What are the temporal trends in infant mortality in these rural areas between 2019 and 2023?*

The analysis presents the temporal trends in infant mortality across the rural areas of Kwara South Senatorial District between 2019 and 2023. Understanding these temporal patterns is crucial for identifying emerging risks, evaluating the effectiveness of past interventions, and guiding future public health strategies aimed at reducing infant mortality in the study area.

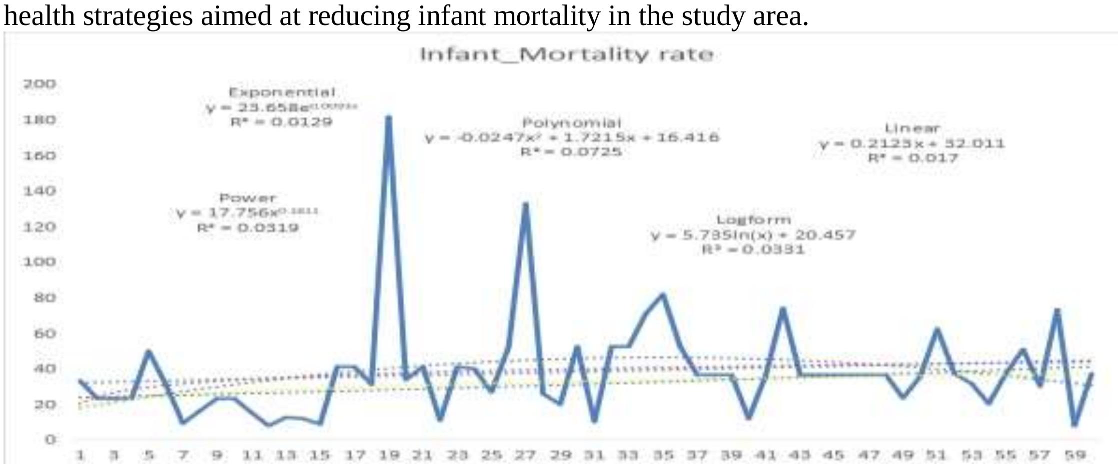

Figure 2: Trendline Analysis of Infant Mortality in Kwara South Senatorial District (2019-2023)

Source: Author's Field work, (2024).

The analysis of infant mortality rates between 2019-2023 revealed a fluctuating pattern. Rates rose sharply from 23.4 per 1,000 live births in 2019 to 52.6 in 2021, before declining to 37.7 in 2022 and 37.4 in 2023. The 2020–2021 period recorded the steepest increase (76.9% and 27.1%), attributed to poor healthcare access and seasonal disease outbreaks, while the decline after 2021 reflected gradual improvements in health interventions. Descriptive statistics indicated a mean infant mortality rate of 38.5 per 1,000 live births and high variability across years, especially in 2020 and 2021. The highest monthly averages occurred in July (55.1) and March (52.8), suggesting seasonal influences, particularly during the rainy season when waterborne and vector-borne diseases peak. The positive skewness in the data suggests that higher mortality rates were more frequent, underscoring persistent health challenges. This pattern aligns with Okechukwu et al. (2015), who observed similar regional disparities in infant mortality across Nigeria's geopolitical zones. Despite minor improvements in 2022–2023 in infant mortality, rural Kwara South remains characterized by environmental and infrastructural conditions that expose infants to preventable deaths.

Testing of Hypotheses

Ho1: There is no significant relationship between environmental risk factors and infant mortality in the study area.

Table 6: Summary of Pearson Chi-square Analysis Results

Ho: Water		**P-Value**
Pearson chi-square	3.176[a]	.000
Likelihood ratio	3.597	.012
N of valid cases	400	
Ho: Sanitation and Hygiene		
Pearson chi-square	3.287[a]	.004
Likelihood ratio	3.608	.021
N of valid cases	400	
Ho: Healthcare Services		
Pearson chi-square	3.463[a]	.009
Likelihood ratio	4.714	.017
N of valid cases	400	
Ho: Air Pollution		
Pearson chi-square	4.079[a]	.013
Likelihood ratio	3.881	.028
N of valid cases	400	

Source: SPSS Output, (2024).

The Pearson Chi-square results presented in table 6 revealed that three key environmental factors water quality (p = 0.000), sanitation and hygiene (p = 0.004), and healthcare services (p = 0.009) have statistically significant relationships with infant mortality in the study area, as their p-values were below the 0.05 significance threshold. However, air pollution (p = 0.013) showed a weaker level of association. These findings suggest that inadequate access to clean water, poor sanitation practices, and limited healthcare services are major contributors to infant mortality in rural communities of Kwara South Senatorial District.

Table 7: Multiple Regression Analysis Results

Variables	**Unstandardized Coefficients (β)**	**Standard Error**	**Standardized Coefficients**	**t**	**Sig.**
	B	**SE**	**Beta (β)**		
(Constant)	13.681	4.972		2.594	
Water quality	.297	.148	.351	4.346	.000
Sanitation/hygiene	.286	.134	.332	4.263	.003
Healthcare services	.255	.157	.314	4.014	.007
Air pollution	.198	.176	.283	3.872	.012

a: Dependent Variable: Infant Mortality

*** p > 0.05 = No significant relationship**

Source: SPSS Output, (2024).

Further evidence from the multiple regression analysis (table 7) confirmed that all four environmental risk factors jointly influenced infant mortality, with each showing a positive predictive relationship. Among them, water quality (β = .351, p = 0.000) emerged as the strongest predictor, followed by sanitation and hygiene (β = .332, p = 0.003), healthcare services (β = .314, p = 0.007), and air pollution (β = .283, p = 0.012). The results indicate that improvement in water quality and sanitation infrastructure would significantly reduce infant deaths in the area. Overall, the null hypothesis of no significant relationship between environmental risk factors and infant mortality was rejected, affirming that environmental conditions remain critical determinants of infant survival in rural Kwara South.

Ho2: There is no significant variation in the trend in infant mortality from 2019 to 2023 in Kwara South Senatorial District.

Table 9: ANOVA on trend in infant mortality in Kwara South Senatorial District

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	58754.31	4	14688.58	7.708376	0.000628	2.866081
Within Groups	38110.69	20	1905.535			
Total	96865	24				

Source: SPSS Output, (2024).

The one-way ANOVA results presented in table 9 show a P-value of 0.000628, which is lower than the 0.05 level of significance, and an F-value (7.71) greater than the F-critical value (2.87). This indicates that there were statistically significant variations in infant mortality rates across the years 2019 to 2023 in Kwara South Senatorial District. The result implies that infant mortality did not remain constant during the study period but fluctuated significantly across the local government areas. Consequently, the null hypothesis stating that there is no significant variation in the trend of infant mortality from 2019 to 2023 is rejected, confirming that temporal changes occurred in the infant mortality pattern within the district.

DISCUSSION

This study investigated environmental risk factors influencing infant mortality in rural areas of Kwara South Senatorial District, Nigeria. The demographic data revealed that most respondents were aged 30–34, predominantly married. And findings showed that the key environmental risk factors contributing to infant mortality were poor water quality, inadequate sanitation and hygiene, limited healthcare services, and air pollution. Poor water sources and improper sanitation practices increased disease transmission risks, aligning with findings by Mebrahtom et al. (2022) and Ghafoori (2022). Insufficient access to antenatal and healthcare services was also linked to higher infant deaths, consistent with Adedini et al. (2015) and Adewuyi et al. (2018). Furthermore, households using solid fuels faced increased infant mortality due to air pollution, corroborating Budsha et al. (2022).

Temporal trend analysis from 2019–2023 showed fluctuations: infant mortality rose sharply between 2019–2021 but declined from 2021–2023. ANOVA results confirmed significant variations in mortality trends across years. Statistical tests revealed strong correlations between environmental factors and infant mortality, with water quality, sanitation, and healthcare access showing the strongest influence. Overall, the study concludes that environmental risk factors significantly affect infant mortality in Kwara South. These findings support previous research emphasizing that improved sanitation, clean water, better healthcare services, and reduced air pollution are vital to lowering infant deaths in rural Nigeria,

CONCLUSION AND RECOMMENDATIONS

This study examined the environmental risk factors and temporal trends in infant mortality between 2019 and 2023 in the rural areas of Kwara South Senatorial District, Nigeria. The findings revealed that infant mortality in the study area is strongly influenced by environmental conditions, particularly those related to water, sanitation, hygiene, healthcare accessibility, and household environmental practices. Factors such as the sources of drinking water, methods of water treatment, frequency of cleaning water storage containers, types of toilet facilities, solid waste disposal methods, access to healthcare services, type of cooking fuel, and indoor air quality were identified as critical determinants of infant mortality.

Analysis of the temporal trends indicated noticeable fluctuations in infant mortality rates across the five-year period. Mortality rates rose sharply between 2019 and 2021, followed by a gradual decline from 2022 to 2023. This pattern suggests that variations in environmental quality, healthcare access, and public health interventions over time directly influenced infant survival in the rural communities. The study therefore concludes that there exists a significant relationship between environmental risk factors and infant mortality in the study area. Addressing these environmental determinants requires an integrated approach that combines community engagement, policy intervention, and sustainable infrastructural development. Improving water supply systems, sanitation, healthcare services, and environmental hygiene is essential to reducing infant deaths and improving overall child health outcomes in Kwara South Senatorial District.

Based on the findings and conclusions, the following recommendations are proposed:

1. The Kwara State and local governments should prioritize the provision of safe and potable water in rural communities to reduce the incidence of waterborne diseases associated with infant mortality.
2. Authorities should invest in the construction of modern sanitation facilities and promote proper hygiene practices among households, especially among women of reproductive age. Public enlightenment campaigns should also focus on waste management and environmental cleanliness.
3. Adequate funding should be allocated to strengthen healthcare infrastructure in rural areas. Efforts should include expanding access to maternal and child health services such as antenatal, delivery, and postnatal care, as well as training community health workers to educate mothers on issues like malnutrition, infectious diseases, and personal hygiene.
4. The state government should develop community-based sensitization programs through local media such as radio and community forums to raise awareness on the health risks of indoor air pollution and the benefits of using clean cooking fuels.
5. Local government authorities should conduct periodic environmental health assessments to identify emerging risk factors. Continuous data collection and research on environmental influences on infant mortality should be supported to facilitate evidence-based policy formulation and sustainable interventions.

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