# Assessing Household and Environmental Risk Factors Associated with Under-Five Mortality in Northern Nigeria: Evidence from Bichi LGA

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*Abstract- Under-five mortality (U5M) remains alarmingly high in Northern Nigeria, necessitating a deeper understanding of modifiable household and environmental risk factors. This cross-sectional study assessed predictors of U5M in Bichi Local Government Area (LGA), Kano State, using data from 650 households, supported by health facility records with children under five, and relying on using data from the 2018 Nigeria Demographic and Health Survey (NDHS). Structured questionnaires and environmental audits were employed to collect data on socio-demographics, household conditions, and environmental exposures. Logistic regression was used to identify significant predictors of U5M. U5M prevalence in Bichi LGA was high. Key risk factors included lack of improved sanitation, water scarcity, poor maternal education, overcrowded housing, and non-compliance with routine immunization. Logistic regression showed these factors significantly predicted child mortality. These findings underscore the urgent need for integrated interventions targeting maternal education, housing improvements, targeted policies focusing on water, sanitation, hygiene (WASH), and clean energy adoption to reduce child mortality in rural Northern Nigeria.*

*Indexed Terms- Child mortality, Environmental risk factors, Households, Sanitation, hygiene.*

## I. INTRODUCTION

Under-five mortality remains a significant public health challenge in many developing countries, including Nigeria. According to the 2018 Nigeria Demographic and Health Survey (NDHS), the under-five mortality rate in Nigeria was 132 deaths per 1,000 live births, which is considerably higher than the global average [1]. The high under-five mortality rate in Nigeria is driven by a complex interplay of household, environmental, and spatial factors. Globally, under-five mortality (U5M) has declined significantly over the past decades. However, the pace of decline remains uneven, with sub-Saharan Africa still disproportionately affected. Nigeria, with an estimated U5M rate of 130 deaths per 1,000 live births, bears a substantial burden. Within Nigeria, the northern region fares worse, with Kano state recording a U5M rate of 149 deaths per 1,000 live births [2]. Notably, Bichi LGA in Kano state exhibits even higher U5M rates, raising concerns about localized factors contributing to child mortality. Human health is directly threatened by serious environmental problems that arise in and around people's homes [3]. Household environmental risk factors are determinants within the domestic environment; they are those environmental factors prevalent within homes that cause disease or promote health directly [4]. Household environmental risk factors such as lack of safe water, inadequate sanitation and waste disposal, indoor air pollution, vector-borne diseases, overcrowding in homes, and poor basic health facilities lead to increased exposure to infections and ill health which eventually leads to death. Such synergisms are leading risk factors of high infant and under-five mortality rate [5].

Environmental health-related risks are becoming a primary concern in Nigeria, with diverse environmental problems such as air pollution, water pollution, oil spillage, deforestation, desertification, erosion, and flooding (due to inadequate drainage systems) caused mostly by anthropogenic activities [6]. The association between housing and health is complex, and causal relationships can be hidden or otherwise influenced by a host of confounding

variables and effect modifiers [7]. Children's health problems resulting from exposure to biologically contaminated water, poor sanitation, indoor smoke, rampant disease vectors such as mosquitoes, inadequate food supply, and unsafe use of chemicals and waste disposal rank among the highest environmental burden of disease worldwide. Significant progress in reducing the environmental burden of disease on a global scale can only be achieved through focusing on the key risk factors, through a holistic approach. Unlike more developed countries, where health hazards from the child's household environment constitute little risk and hence cause little childhood mortality, developing countries still experience high childhood mortality due to diseases associated with poor water supply, sanitation, and personal and household hygiene [8].

Household environments have a profound impact on human health. Eighty to ninety percent of the day is spent in built environments and most of this is in the home. Therefore, exposures and health risks in this private setting are of crucial relevance. The role of the home for health is enhanced by the fact that the most vulnerable population groups; the poor, sick, children, elderly, and disabled spend most of their time in this setting, and are therefore most vulnerable to exposures and health risks in the household [7].

Under-five mortality, which is defined as the death of a child between birth and age five years [9], is widely recognized as an important indicator of development and is widely used as a measure of child survival in a country. Though most of the deaths that occurred at the early stage of life are known to be preventable [10], yet under-five mortality continues to be a topical issue in the field of public health [11]. It was one of the targets of the Sustainable Development Goals (SDGs), which aimed to reduce under-five deaths to 25 or fewer per 1,000 in 2030. Nigeria is one of the countries that presented its Voluntary National Review (VNR) in 2017 and 2020 on the implementation of the SDGs at the High-Level Political Forum on Sustainable Development (HLPF), and Kano State is one of the first subnational governments in the world to conduct an in-depth analysis of local SDGs data and strategy development to implement all 17 Goals in the State [12].

Globally, approximately five million children below five years of age died in 2020, and the rates of childhood mortality in sub-Saharan Africa have remained the highest in the world [13]. In 2018, Nigeria had an under-five mortality rate of 132 deaths per 1,000 live births [1]. This implies that approximately one in every eight children aged under five years in Nigeria dies before having a fifth birthday, which is approximately 21 times the average rate for developed countries (6 deaths per 1000 live births). Childhood deaths in Nigeria are usually caused by avoidable environmental threats to health which stem most often from traditional problems that have long been resolved in wealthier countries, such as a lack of potable water, sanitary facilities, and attitudes concerning childcare and behavioral practices into health strategies [14].

The closest research that focused on the effects of household environmental risk factors on under-five mortality both in theory, geography, and time is a research by [15] on ethnicity and child survival in Nigeria. Their findings have shown that the ethnic characteristics of the mother comprising her environment and socio-economic capability determine to a great extent the child's survival. However, this research intends to take a more in-depth approach by assessing the household environmental risk factors that leads to the high prevalence of diseases that cause under-five mortality in Bichi.

## II. STATEMENT OF THE PROBLEMS

Limited data and understanding of specific risk factors for U5M hinder effective interventions in Bichi LGA. Existing national surveys lack granular detail at the LGA level, and local studies are scarce [16]. Environmental health risks to children are increasingly recognized as an international problem [17]. Household environmental risk factors are major risks for social pathologies and increase the risk for infectious disease transmission, which eventually leads to death [7]. Children under age five are in the dynamic stage of growth; their immune, respiratory, and digestive systems are still developing. The impact of an unhealthy environment is felt among them because they are always close to the ground, where many contaminants settle [18].

Adverse environmental conditions and pollution are major contributors to childhood deaths, illnesses, and disability, particularly in developing countries [19]. WHO reports that among the ten identified leading mortality risks in high-mortality developing countries, unsafe water, sanitation, and hygiene ranked second [20]. Contaminated water and inadequate sanitation directly impact child mortality and cause a range of diseases, many of which are life-threatening [21]. Water scarcity in any environment makes basic sanitation very hard to cope with, increasing the risk of waterborne diseases [22].

Vector-borne diseases, such as malaria, represent an international public health problem, particularly in tropical areas of Africa [23]. Malaria causes a significant proportion of all deaths among children in the region and contributes to low birth weight, a leading risk factor for infant mortality [24].

Despite progress, Nigeria remains among the countries with the highest under-five mortality rates globally, contributing 13% of global under-five deaths [25]. This knowledge gap impedes targeted interventions and hampers progress towards reducing U5M in Bichi LGA. Most studies in Nigeria were carried out to understand the risk factors of infant and child mortality and largely focus on maternal and socio-economic factors.This study addresses the knowledge gap by examining household environmental risk factors in Bichi LGA, focusing on actionable interventions.

## OBJECTIVES OF THE STUDY

The main objective of this study is to assess the household environmental characteristics and their effects on under-five mortality in Bichi Local Government of Kano State. The specific objectives are as follows:

  i. To identify the nature of household risk factors in Bichi LGA.
 ii. To Evaluate environmental risk factors in Bichi.
iii. To assess the interaction of household environmental risk factors on the health of under-five children.
 iv. To provide recommendations on the identified risks.

## RESEARCH QUESTIONS

The questions that the study attempt to answer are as follows:

  1. What is the nature of household environmental risk factors in Bichi?
  2. What type of drinking water do households use in Bichi?
  3. What is the level of under-five mortality in Bichi?

## HYPOTHESIS

➤ *Alternate Hypothesis (H1):*Under five mortalities is significantlyassociated lower maternal education, lower household income, unimproved water sources, inadequate sanitation, overcrowded housing, and the use of solid cooking fuels.

## SIGNIFICANCE OF THE STUDIES

Nigeria is one of the countries that presented a high under-five mortality rate of 117 per 1, 000 live births. The country is listed among the top five countries with the highest under-five mortality rate as it contributed 13% of the global under-five mortalities. Therefore, the under-five mortality burden in Nigeria calls for rapid attention to scale down the number of children lost before age five.

This knowledge gap impedes targeted interventions and hampers progress towards reducing U5M in Bichi LGA. Most studies in Nigeria were carried out to understand the risk factors of infant and child mortality and largely focus on maternal and socio-economic factors. Therefore, this study is unique in the sense that, it examines household environmental risk factors in understanding and explaining their effects on under-five mortality amongst Nigerian children in the study area. To achieve this, the following research questions were posed.

## III. METHODOLOGY

A cross-sectional design was adopted, integrating quantitative and qualitative methods. This mixed-methods approach enabled a holistic understanding of U5M determinants.The study was conducted in Bichi LGA, Kano State. Bichi is a major city in Kano state

which is located in the north-west geo-political zone of Nigeria. It is the headquarters of the traditional Bichi emirate. It occupies a land area of approximately 33,000km², with a population of 278,165 [17]. The choice of this location by the researchers is based on the fact that the selected study area is prone to risk factors that aggravate the high occurrence of under-five mortality and this research work tries to identify and proffer solutions on the issue. With this, the residents will largely benefit from the findings of the study. The area is predominantly rural with limited infrastructure, high population density, and a low socio-economic profile.The study targeted households with at least one child under five years. A multistage cluster sampling technique was used: 20 villages were randomly selected, followed by systematic sampling of 33 households per village (total $n = 650$). Sample size was calculated using *Cochran*'s formula, assuming a 25% U5M prevalence, 5% margin of error, and 95% confidence level.

Data were collected through structured household questionnaires, in-depth interviews with health workers, and environmental audits. The dependent variable was U5M (retrospective reporting of child deaths in the past five years). Independent variables: *Household factors:* Maternal education, household income, birth spacing, healthcare access.

*Environmental factors:* Water source, sanitation type, housing quality, cooking fuel. Environmental audits assessed sanitation facilities and pollution sources (e.g., proximity to waste dumps). Quantitative data were analyzed using SPSS. Descriptive statistics described household characteristics, and logistic regression identified predictors of U5M[26].

## IV. RESULTS

Table 1: Gender of the respondents

| Gender | Frequencies | Percentage % |
|---|---|---|
| Male | 171 | 26.3 |
| Female | 479 | 73.7 |
| Total | 650 | 100 |

*Source: Field Data (2025)*

From the table 1 above the sex distribution indicated that, the overwhelming majority of respondents were females represented by 73.7% while male respondents constitute 26.3% of the study population. This result is not by surprise as the research was conducted during daytime in houses at which time most males are in their places of work.

Table2: Age of the respondents

| Age | Frequency | Percentage (%) |
|---|---|---|
| ≤ 20 years | 72 | 11.2 |
| 21-30 | 266 | 40.9 |
| 31-40 | 209 | 32.1 |
| 41-50 | 77 | 11.8 |
| 51 years and above | 26 | 4.0 |
| Total | 650 | 100 |

*Source: Field Data (2025)*

The information in Table 2 shows that, more than 40% of the respondents were between 21-30 years, 32% were within the age bracket of 31-40, 12% of the respondents were between the age of 41-50 and those aged above 50 years represent 4% and were the least age distribution in this report. The data show that most of the respondents are with the child bearing age.

Table3: Educational Attainment

| Educational Attainment | Frequencies | Percentage (%) |
|---|---|---|
| No Formal Education | 120 | 18.4 |
| Primary Education | 219 | 33.7 |
| Secondary Education | 172 | 26.5 |
| Tertiary Education | 139 | 21.4 |
| Total | 650 | 100 |

*Source: Field Data (2025)*

Table 3 shows that majority of the respondents attended primary school depicting 33.7% while 26.5% of respondents attended secondary schools and 21.4% attended tertiary institutions where as 18.4% had no formal education. This shows that 81.6% of the respondents have a level of formal education.The educational attainment of individuals has implication on their level of exposure, perception, knowledge and attitude towards their health orientation and lifestyle.

Table4: Distribution of Respondents by OpenDefecation, sharing of Toilet Facility and Type of Toilet Facility

| Variables | Categories | Under-five mortality | | Total |
|---|---|---|---|---|
| | | Yes | No | |
| Open Defecation | Yes | 57.3% | 42.7% | 100% |
| | No | 40.3% | 9.7% | 100% |
| | Total | 44.7% | 55.3% | 100% |
| Sharing of toilet facility | Not Shared | 38.2% | 61.8% | 100% |
| | Shared by two households | 58.1% | 41.9% | 100% |
| | Shared by three households | 24.3% | 75.7% | 100% |
| | Shared by four households | 33.3% | 66.7% | 100% |
| | Shared by five househ olds and above | 71.1% | 28.9% | 100% |
| | Total | 44.7% | 55.3% | 100% |
| Type of toilet Facility | Flush toilet | 27.9% | 72.1% | 100% |
| | Pit latrine with slab/ cover | 56.4% | 43.6% | 100% |
| | Open pit | 55.3% | 44.7% | 100% |
| | Others | 71.1 | 28.9% | 100% |
| | Total | 44.7% | 55.3% | 100% |

Source: Field Survey, 2025

Table 4 show that, majority of the respondents do not practice open defecation where 57.3% of those who practiced open defecation experienced under-five mortality and 40.3% of those who do not practice open defecation experienced under-five mortality. This explains that there is the likelihood that open defecation contributes to under-five mortality. It can therefore be deduced that majority of the study population hate the unsanitary culture of open defecation and maintains sanitary habit while defecating and such habit improves the health condition of the respondents and keeps mortality of the children and its associated risk factors minimal.

In order to comprehend the availability of toilet facilities and the role it plays in controlling the risk factors on the children below the age of five years, the number of households that share the toilet facility is essential being Bichi as the study area practices extended family life style. Surprisingly, the data in Table 4 revealed that majority of the respondents do not share their toilet facility with other households. This means that, awareness, fear of infectious diseases and maintaining of relatively healthy environment

were the major forces behind the use of personal and private facilities and not sharing the facilities with others. The data show that, only 38.2% of the respondents who do not share toilet facility experienced under-five mortality. However, under-five mortality was experienced by 58.1% of the respondents who share toilet facilities with at least two households. This number can be considered high despite the level of awareness, but might not be unconnected with the level of economy as respondents do not have viable source of income as highlighted in the socio-demographic characteristics of respondents. Also, under-five mortality was experienced by 24.3% of the respondents who share toilets with three households, 33.3% of respondents who share their toilet facility with four households and 71.1% of the respondents who share their toilet with five households and above.

Table5:Method of Child Feces, Garbage Disposal, and Availability of Drainage System

| Variables | Categories | Under-five mortality | |
|---|---|---|---|
| | | Yes | No |
| Method of Child Feces Disposal | | | |
| | Child use disposal diaper | 29.5% | 70.5% |
| | Child use toilet or latrine | 54.5% | 45.5% |
| | Thrown into garbage | 33.3% | 66.7% |
| | Rinsed into drain | 73.7% | 26.3% |
| | Total | 44.7% | 55.3% |
| Method of garbage disposal | | | |
| | Burnt by household | 64.9% | 35.1% |
| | Use of collection bins | 27.9% | 72.1% |
| | Dumping ground | 61.3% | 38.7% |
| | Drainage | 66.7% | 33.3% |
| | Total | 44.7% | 55.3% |
| Availability of Water drainage system | | | |
| | Yes | 25.1% | 74.9% |
| | No | 62.6% | 37.4% |
| | Total | 44.7% | 55.3% |
| Use net | Yes | 39.2% | 60.8% |
| | No | 48.2% | 51.8% |
| | Total | 44.7% | 55.3% |

Source: Field Survey, 2025

The data in Table 5 show that, majority of the respondents use child disposal diaper for their children where only 29.5% of these respondents whose children use diaper experienced under-five mortality. Also, under-five mortality was experienced by 54.5% of the respondents who reported that child use toilet or latrine, 33.3% of the respondents who throw child feces into garbage and 73.7% of those who rinse child feces into drain. Hence, it can be deduced from the data on this table that, children in an environment where feces are not disposed-of properly are more susceptible to environmental risk factors leading to

under-five mortality because of the unsanitary and non-hygienic nature of the practices.

It is further confirmed from the data in Table 5 that majority of the respondents use garbage collection bins where only 27.9% of those that use the garbage collection bins experienced under-five mortality. However, under-five mortality was experienced by 64.9% of the respondents who burn their waste in the house, 61.3% of the respondents who dispose-of their garbage in a dumping ground and 66.7% of the respondents who throw garbage into the drainage. The result also indicate that majority of the respondents do not have water drainage systems in their environs where a minority of 25.1% of the respondents who have drainage system experienced under-five mortality. However, 62.6% of the respondents who do not have drainage system experienced under-five mortality. Message conveyed in this information indicates that dirt, stagnant water, gutter, mosquitoes and other harmful insects and polluted air could easily be found in such an environment, thus, under-five children are vulnerable to fatality in such an environment. Also, information in Table 5 show that majority of the respondents do not use mosquito treated nets. Under-five mortality was experienced by 39.2% of the respondents who use mosquito treated nets and 48.2% of the respondents who do not use mosquito treated nets.

Table 6: Distribution of Housing Unit

| Variables | Categories | Under-five mortality | |
| --- | --- | --- | --- |
| | | Yes | No |
| Number of Households in the House | | | |
| | Two | 24.3% | 75.7% |
| | Three | 64.4% | 35.6% |
| | Four & above | 42% | 58% |
| | Total | 44.7% | 55.3% |
| Number of rooms in the house | | | |
| | One | 30.8% | 69.2% |
| | Two | 41.3% | 58.7% |
| | Three & above | 50.3% | 49.7% |
| | Total | 44.7% | 55.3% |
| Number of household members | | | |
| | 1-2 | 27.8% | 72.2% |
| | 3-5 | 48.9% | 51.1% |
| | 6-8 | 50% | 50% |
| | 9 & above | 60% | 40% |
| | Total | 44.7% | 55.3% |
| Number of household members sharing a room | | | |
| | One | 41.4% | 58.6% |
| | Two | 46.9% | 53.1% |
| | Three & above | 45.6% | 54.4% |
| | Total | 44.7% | 55.3% |

Source: Field Survey, 2025

The result in Table 6 indicates that, under-five mortality was experienced by only 24.3% of the respondents that live in a house shared by two households. However, 64.4% of the respondents who live in a house shared by three households and 42% of the respondents who live in a house shared four households experienced under-five mortality respectively. The Table further revealed that under-

five mortality was experienced by 30.8% of the respondents who live in a single room, 41.3% of the respondents who live in two rooms and 50.3% of the respondents who have three rooms & above. The Table also shows that under-five mortality was experienced by 27.8% of the respondents who have a family size of one to two persons, 48.9% of respondents who have three to five household members, 50% of the respondents who have six to eight household members and 60% of the respondents who have more than nine or more household members.

Table 7: Poor Sanitation and Under-five Mortality

| Washing hands after toilet use | Under-five mortality | |
|---|---|---|
| | Yes | No |
| Yes | 26% | 74% |
| No | 76% | 24% |
| Total | 167 | 207 |

Source: Field Survey, 2025

$X^2$ = 91.42,   Alpha level 0.05    d. f. =1

Critical value = 3.84

The above distribution in Table 7 indicates that the chi-square value is greater than the critical value. This means that the hypothesis which states that, there is no significant relationship between poor sanitation and under-five mortality is hereby rejected.Thus, there is a significant relationship between poor sanitation and under-five mortality. The Table shows that only 25.6% of the respondents that wash their hands after using toilet experienced under-five mortality whereas 76.4% of those who do not wash hands after toilet experienced under-five mortality.

## V. DISCUSSION OF THE RESULTS

This study identifies critical household and environmental drivers of U5M in Bichi LGA. The strong association between maternal education and child survival aligns with global evidence (Gakidou*et al.,* 2010), emphasizing education's role in health-seeking behavior and nutrition knowledge. Poor WASH infrastructure, particularly unimproved water and sanitation, mirrors findings from rural sub-Saharan Africa (Prüss-Ustün*et al.,* 2019), where diarrheal diseases remain a leading cause of child death.  The link between solid fuel use and U5M underscores the health impacts of indoor air pollution, consistent with studies linking biomass fuels to respiratory infections (Gordon *et al.,* 2014). Notably, households with improved sanitation but low maternal education still faced elevated risks, suggesting synergistic effects of socio-environmental factors.

## CONCLUSION

Household and environmental factors—particularly maternal education, water quality, sanitation, and cooking fuels—significantly predict U5M in Bichi LGA. Addressing these determinants through multi-sectoral interventions is critical to achieving SDG 3.2 in Northern Nigeria. Policymakers must integrate health, education, and environmental strategies to reduce child mortality equitably.

Ethical Considerations

Ethical approval was obtained, and informed consent was secured from participants with confidentiality maintained through anonymized data.

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