Assessing Environmental Sanitation Knowledge, Practices, and Challenges in Takalau, Birnin Kebbi: A Data-Driven Approach to Community Health Improvement

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Abstract- ***Environmental sanitation remains a critical public health concern, particularly in developing communities where poor sanitation practices contribute significantly to disease transmission and environmental degradation. In Takalau, Birnin Kebbi, Nigeria, inadequate knowledge, limited resources, and infrastructural challenges hinder effective sanitation practices. This study investigates the level of knowledge, current practices, challenges, and strategies for improving environmental sanitation among residents of Takalau, with a focus on the influence of education on these factors. A structured questionnaire comprising 20 items across four constructs: knowledge of environmental sanitation, current sanitation practices, sanitation challenges, and improvement strategies was administered. The reliability of the instrument was confirmed using Cronbach's Alpha ($\alpha > 0.95$ for all constructs). Principal Component Analysis (PCA) was employed to extract dominant factors within each construct, supported by the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity to confirm data suitability for factor analysis. Furthermore, Chi-square tests were conducted to examine the influence of education level on environmental sanitation dimensions. The results showed a high level of knowledge about environmental sanitation among residents (87.13% variance explained by a single component; KMO = 0.919), with all five knowledge items loading strongly (> 0.91). Current sanitation practices were also relatively strong (83.73% variance explained; KMO = 0.906), though challenges such as poor drainage systems, weak law enforcement, and cultural constraints were prominent (87.44% variance explained; KMO = 0.917). Recommended improvement strategies included government enforcement of sanitation laws and community education programs (86.41% variance explained; KMO = 0.912). The Chi-square analysis revealed that education level significantly influenced knowledge ($\chi^2 = 11.047$, $p = 0.011$) and preferred improvement strategies ($\chi^2 = 19.630$, $p = 0.000$), but not current practices or perceived challenges. The study recommends that targeted educational interventions be prioritized to sustain and further improve sanitation knowledge and community-driven improvement strategies. Additionally, policy support is needed to address infrastructural challenges and to promote the enforcement of environmental sanitation laws across all education levels.***

Indexed Terms- ***Environmental Sanitation in Nigeria, Sanitation Practices in Birnin Kebbi, Public Health and Hygiene Awareness, Impact of Education on Sanitation, Sanitation Challenges in Rural Communities.***

I. INTRODUCTION

Environmental sanitation encompasses the systematic management of water supply, waste disposal, and pollution control to safeguard public health by

maintaining a clean environment. Effective sanitation is fundamental to preventing infectious disease transmission especially in densely populated areas prone to outbreaks of cholera, diarrhea, and typhoid fever (WHO, 2015) and remains a significant global health challenge, particularly in developing regions (Adu-Gyamfi, Ogundipe & Amoaka-Attah, 2019).

In Nigeria, inadequate sanitation infrastructure continues to undermine community health, with many areas lacking basic facilities (Ajibade & Adekunle, 2016). The Takalau community in Birnin Kebbi exemplifies these challenges, as efforts by public health authorities have yet to achieve widespread improvements in hygiene practices and waste management.

Nurses, positioned at the forefront of healthcare delivery, are instrumental in advocating and facilitating proper sanitation behaviors. Through community health education, they raise awareness of environmental risk factors and guide individuals and families in adopting hygienic practices (Aluko, Adebayo & Akinola, 2017; Okoh & Ogbonnaya, 2018). Moreover, their role in implementing public health policies ensures sustained adherence to sanitation standards, underscoring the need for nurses to possess a thorough understanding of environmental determinants of disease (Eze, 2020).

Globally, unsafe water, sanitation, and hygiene (WASH) contribute to approximately 1.4 million deaths and 74 million disability-adjusted life years each year, with 395,000 annual fatalities among children under five, 7.6% of all deaths in this age group predominantly in sub-Saharan Africa and South Asia (WHO, 2023; UNICEF, 2022). In Nigeria, where 25% of the population lacks access to basic sanitation services, recurrent outbreaks of cholera, diarrhea, and malaria place a chronic burden on health systems and disproportionately affect vulnerable groups (UNICEF, 2022).

Within Takalau, deficiencies in waste collection, water quality, and hygiene practices heighten residents' exposure to preventable diseases (WHO, 2023). Although various interventions have been introduced, resource constraints and limited awareness persist, indicating a critical knowledge gap regarding local sanitation behaviors.

This study aims to assess the knowledge and practices of environmental sanitation among residents of Takalau, Birnin Kebbi, and to develop recommendations for nursing-led health promotion initiatives. The specific objectives are to:

1. Evaluate residents' understanding of environmental sanitation concepts.
2. Document current sanitation practices within the community.
3. Identify common environmental sanitation challenges faced by residents.
4. Explore strategies to enhance sanitation behaviors.
5. Examine the impact of educational interventions on knowledge, practices, and challenges.

Findings from this research will inform the design of targeted community-based health education programs and contribute to evidence-based policy formulation aimed at improving sanitation infrastructure and behaviors. Insights will be particularly valuable for nursing professionals, public health authorities, and policymakers, aligning with Sustainable Development Goal 6 on clean water and sanitation (Babalola & Onifade, 2019).

Previous studies underscore the inadequacy of sanitation knowledge and practices in rural and semi-urban Nigerian communities (Chukwuemeka, Nwogu & Nwanekezie, 2018). Research in Northern Nigeria revealed poor understanding of waste disposal and water management, leading to unhealthy behaviors (Ibrahim, Garba & Musa, 2021). Moreover, inadequate sanitation has been linked to elevated rates of preventable diseases, highlighting the necessity for focused health education (Olawuyi & Oloruntoba, 2019). By centering on Takalau, this study will add to the growing literature on sanitation practices in Nigeria and offer practical recommendations for risk reduction (Fatusi, Olajide & Balogun, 2020).

The scope of this investigation is confined to adult residents of the Takalau area. Data will be gathered via structured questionnaires to evaluate both knowledge and behaviors related to waste disposal, personal hygiene, and water management. While the findings may inform similar contexts, the study does not extend

to industrial-scale sanitation or issues beyond community-level environmental practices.

1.1 Literature Review

This section provides a comprehensive review of existing literature on environmental sanitation, particularly within the context of public health and nursing in developing countries. It begins with a conceptual literature review, defining key terms related to environmental sanitation, community hygiene, and health education. This section is followed by a theoretical review that connects the study to relevant health promotion models, notably the Health Belief Model, which underpins the study's focus on community-based nursing interventions for improved sanitation. Finally, the empirical review examines prior studies relevant to this research, with particular attention to the knowledge, practices, challenges, and potential strategies for improving sanitation in developing regions. The review aims to establish the need for this research by identifying existing gaps in environmental sanitation awareness and practice among the residents of Takalau, Birnin Kebbi.

1.1.1 Conceptual Literature Review

Over the past few decades, environmental sanitation knowledge and awareness have greatly increased on a global scale. Large-scale awareness campaigns and the incorporation of sanitation concerns into public health programming and education are primarily responsible for this improvement. More than 70% of people worldwide now recognize the value of basic sanitation, especially in high-income nations where public health education is given significant attention, according to the World Health Organization (WHO) and UNICEF (2021). In low- and middle-income countries (LMICs), where access to education and sanitation awareness programs is restricted, knowledge gaps persist despite these advancements. For example, Mara (2017) discovered that high rates of morbidity were caused by rural communities in Southeast Asia's inadequate knowledge of the connection between waterborne disease prevalence and poor sanitation.

Global initiatives such as the Global Handwashing Day campaign have contributed significantly to improving public awareness. A study by Freeman et al. (2020) revealed that incorporating hygiene education into school curricula in Latin America and South Asia had a positive impact, raising sanitation knowledge among children and their families. Nevertheless, several structural barriers including socioeconomic inequality, gender disparities, and cultural beliefs continue to undermine the effectiveness of these interventions (Bartram & Cairncross, 2010).

Sanitation practices across the globe vary depending on socioeconomic and infrastructural contexts. Developed nations such as Sweden and Germany have adopted circular economy approaches, recycling over 90% of their waste and utilizing advanced sewage systems to promote environmental sustainability (World Bank, 2021). In contrast, LMICs continue to grapple with unsanitary practices such as open defecation and indiscriminate waste dumping. Strande (2018) reported that approximately 673 million people globally still engage in open defecation, particularly in South Asia and Sub-Saharan Africa. Although WHO's WASH (Water, Sanitation, and Hygiene) program aims to mitigate these issues, progress remains slow due to infrastructure deficits and inadequate funding.

Across Africa, there is significant variation in both knowledge and practices related to environmental sanitation. Urban populations generally exhibit higher awareness levels due to greater exposure to formal education, public health campaigns, and media outreach. In contrast, rural communities often struggle with limited access to information, entrenched traditional beliefs, and infrastructural deficits. Prüss-Ustün (2019) estimates that nearly 25% of African households lack basic sanitation knowledge, which results in practices such as open defecation and unsafe waste disposal.

To bridge these knowledge and practice gaps, numerous governmental and non-governmental interventions have been implemented. The Community-Led Total Sanitation (CLTS) approach, for example, has been introduced in several African countries to promote behavioral change and eliminate open defecation (Kar & Chambers, 2008). In Ethiopia, Tsegaye (2020) found that CLTS interventions successfully reduced open defecation rates by 50% within three years in participating communities. However, the sustainability of such outcomes remains

uncertain, largely due to inconsistent funding, weak institutional support, and inadequate infrastructure.

Africa also faces distinct challenges, including rapid urbanization, seasonal flooding, political instability, and limited governance capacity. These issues frequently disrupt existing sanitation infrastructure and lead to recurrent disease outbreaks. According to UNICEF (2020), approximately 60% of rural households in Africa still lack access to basic sanitation facilities, a statistic that underscores the urgent need for more robust, continent-wide sanitation policies and investments.

In Nigeria, the sanitation landscape reflects many of the challenges observed across the African continent, including infrastructural inadequacies, cultural resistance, and disparities between urban and rural areas. Urban centers such as Lagos and Abuja tend to have higher levels of sanitation awareness and better access to waste collection services and private septic systems. However, these services are often strained by overpopulation and limited government oversight (Opara & Eze, 2019). In contrast, rural areas continue to rely on traditional practices that overlook essential aspects of modern sanitation, such as hygienic waste disposal and water safety.

Several national campaigns have sought to address these issues. The "Clean Nigeria: Use the Toilet" initiative has played a vital role in raising awareness, particularly about the dangers of open defecation. According to the Federal Ministry of Water Resources (2022), the campaign has reached millions of Nigerians, though its impact remains largely concentrated in urban areas. Low literacy levels, cultural norms, and limited community engagement continue to impede effective knowledge transfer in rural regions.

Furthermore, sanitation practices in rural Nigeria are often shaped by socioeconomic conditions and a lack of political will. Open defecation and unregulated waste disposal remain prevalent, especially in the northern parts of the country. The limited reach and enforcement of government policies, coupled with insufficient financial incentives for communities, have hindered significant improvements in sanitation practices nationwide (Opara & Eze, 2019).

The situation in Takalau, a rural community in Birnin Kebbi, exemplifies many of the sanitation challenges observed in underdeveloped regions of Nigeria. Research by Abubakar and Bello (2020) indicates that residents in Takalau rely heavily on indigenous knowledge systems that often lack scientific validity. Sanitation is frequently equated with visible cleanliness, with little understanding of critical components such as water safety, hygienic waste disposal, and disease prevention.

Sanitation practices in Takalau are predominantly traditional and unsustainable. Open defecation is widespread, and household waste is often dumped in open fields or burned, posing significant health and environmental hazards. Despite sporadic attempts by local authorities to introduce modern sanitation practices, such efforts have lacked continuity and community involvement, limiting their effectiveness (Abubakar & Bello, 2020).

Challenges in Takalau include extreme poverty, inadequate infrastructure, and minimal government intervention. Seasonal flooding exacerbates these problems by disrupting already fragile waste management systems, thereby increasing the risk of waterborne diseases such as cholera. A multifaceted strategy is needed to address these issues, including partnerships with NGOs to implement affordable sanitation infrastructure, culturally sensitive public health campaigns, and community education. Enhancing sanitation in Takalau requires robust government involvement, community education, and ongoing assistance from development partners, as highlighted by Abubakar and Bello (2020).

1.1.2 Theoretical Review

The Health Belief Model (HBM) by Glanz, Rimer, & Viswanath (2021) forms the theoretical foundation of this study. Widely applied in health education, HBM explains and predicts health behaviors based on individuals' perceptions of health threats and factors influencing decision-making. It comprises six constructs: *perceived susceptibility*, *perceived severity*, *perceived benefits*, *perceived barriers*, *cues to action*, and *self-efficacy*. These components guide how individuals assess health risks and benefits and determine their likelihood of adopting protective behaviors.

In the context of Takalau, HBM is used to assess how residents perceive the health risks of poor sanitation and the potential benefits of adopting proper hygiene practices. This model helps public health professionals design strategies that address perceived barriers, enhance positive attitudes, and empower the community (Sharma & Romas, 2022).

- Perceived Susceptibility refers to beliefs about the risk of contracting diseases. Residents who see themselves at risk from poor sanitation (e.g., due to open defecation or stagnant water) are more likely to engage in preventive actions (Rosenstock, Stretcher, & Becker, 1988). Understanding these perceptions helps tailor health education to local concerns.
- Perceived Severity involves the belief in the seriousness of health consequences. If residents understand that diseases like cholera and typhoid can have serious health and economic effects, they may be more motivated to adopt improved sanitation practices (Champion & Skinner, 2008).
- Perceived Benefits relate to beliefs in the effectiveness of protective behaviors. If residents believe that improved hygiene reduces disease risk, they are more inclined to act (Glanz et al., 2021). Identifying these beliefs aids in promoting sanitation benefits in community health campaigns.
- Perceived Barriers include obstacles such as cost, cultural practices, or lack of infrastructure. In Takalau, challenges like inadequate waste disposal facilities or expensive latrine construction may hinder sanitation practices (Janz & Becker, 1984). Interventions must address these specific local barriers.
- Cues to Action are triggers that prompt behavior change, such as health campaigns or visible disease outbreaks. In Takalau, these could include sanitation drives or health education sessions (Sharma & Romas, 2022). Identifying effective cues helps shape successful public health strategies.
- Self-Efficacy refers to confidence in one's ability to perform a behavior. High self-efficacy supports sustained sanitation behaviors. In Takalau, this can be enhanced through practical training, such as latrine construction and waste management (Bandura, 1997). Empowering residents can lead to greater community involvement in sanitation improvement efforts.

1.1.3 Empirical Review

The multifaceted nature of the problem has been highlighted in recent literature on environmental sanitation knowledge, especially in low- and middle-income nations. The main areas of research have been the level of public awareness, the effectiveness of educational initiatives, and the social factors that influence differences in sanitation practices and knowledge. When combined, these studies show a recurring discrepancy between awareness and behavior that is influenced by a variety of factors, including socioeconomic status, infrastructure, cultural norms, and the availability of health information.

For instance, Adeleke, Musa, & Ishola (2023) highlighted the health implications of limited sanitation knowledge in low-income Nigerian households, revealing that only 38% of respondents demonstrated adequate awareness. The study found a clear association between poor knowledge and higher incidences of cholera and dysentery, emphasizing the need for targeted sensitization and improved infrastructure. This concern was further echoed by Musa et al. (2023), whose quasi-experimental study demonstrated that culturally appropriate sanitation education delivered in local languages significantly enhanced knowledge by 62% among the intervention group pointing to the critical role of cultural context in public health messaging.

However, while knowledge is an important first step, it does not always translate into practice. Ahmed, Yusuf, & Bello (2022) found that despite 70% of participants in urban slums possessing basic sanitation knowledge, only 45% applied this knowledge due to environmental and infrastructural constraints. This disconnect between knowledge and action was similarly reflected in Olatunji et al. (2021), who observed that low literacy among market women in Ibadan contributed to minimal awareness and poor hygiene behaviors. Both studies stress the importance

of policy interventions and sustained education to overcome structural and contextual barriers.

Beyond individual knowledge, educational institutions and media channels have also been instrumental in shaping sanitation practices. UNICEF (2020), through a longitudinal study across sub-Saharan Africa, demonstrated that school-led sanitation programs could drive household-level change, with children serving as effective conduits of sanitation awareness. In a similar vein, Kyei-Nimakoh et al. (2021) showed that frequent exposure to mass media sanitation messages in Ghana significantly improved community awareness. These findings suggest that both formal education systems and mass communication can play synergistic roles in promoting sanitation knowledge on a scale.

Socioeconomic and geographical disparities also remain key determinants of sanitation knowledge. Agwu, Chika, & Obiora (2022) revealed that individuals with higher education levels in Southern Nigeria displayed significantly better understanding, while those in rural areas lagged due to limited access to health information. This regional disparity suggests a pressing need for decentralized health education programs that are tailored to local contexts and delivered through trusted community structures.

Shifting focus from knowledge to practice, several studies have highlighted the often-poor state of sanitation behaviors in underserved communities. Eze et al. (2022) found that a significant proportion of urban and peri-urban residents still rely on unsafe waste disposal methods and contaminated water sources, resulting in elevated risks of respiratory and waterborne diseases. Likewise, Oladimeji et al. (2023) pointed to low compliance with hygiene guidelines in rural areas, where inadequate facilities and cultural perceptions hinder proper sanitation.

Structural deficiencies were a recurrent theme in studies across multiple regions. For example, Banda, Chilima, & Mkandawire (2021) in Malawi noted that while latrine access was relatively high, usage remained low due to persistent stigmas. This finding highlights the importance of embedding trusted community health workers to facilitate behavior change. Aboagye et al. (2022) used spatial analysis to demonstrate how urbanization in Ghana has outpaced sanitation infrastructure, leaving most residents dependent on poorly maintained shared facilities, an issue that requires policy-level interventions.

Schools also serve as critical points for sanitation intervention. Akinyele, Adebayo, & Kolawole (2020) found that despite awareness among students, a lack of essential resources like water and soap hindered hygiene practices in Lagos public schools. The study recommended that sanitation education be embedded into school curricula alongside regular facility maintenance, reinforcing both knowledge and practice.

Globally, similar challenges and solutions have emerged. UNICEF (2021) reported the success of community-led total sanitation (CLTS) programs across Africa, which mobilized collective action and improved long-term sanitation behaviors. Likewise, WHO (2022) emphasized that policy implementation must be accompanied by ongoing maintenance and community engagement to ensure sustained progress.
In Nigeria, recent local efforts have demonstrated the effectiveness of community-based interventions. Nwankwo et al. (2023) found that health education programs led by nurses in rural communities fostered significant improvements in sanitation practices, largely due to the trust nurses command within the community. Similarly, Akpan, & Okoye (2023) reported that participatory action research led to marked reductions in sanitation-related diseases, affirming the power of community ownership and leadership in driving change.

Other studies have highlighted structural and economic barriers. Eke et al. (2023) documented widespread open defecation in southeastern Nigeria due to the absence of functional toilets and unreliable waste collection. Olawale and Ibrahim (2022) found that in northern Nigeria, only 25% of households had access to improved latrines, with blocked drains contributing to vector-borne disease outbreaks. Internationally, Abebe et al. (2021) pointed to similar issues in Ethiopian slums and rural areas, where poverty and limited access to clean water compounded sanitation challenges. These findings underscore the importance of public-private partnerships and

government subsidies in addressing infrastructural gaps.

The case of India's Swachh Bharat Mission, evaluated by Gupta et al. (2021), also reveals that while infrastructure development is essential, behavioral resistance and water supply limitations can undermine progress. This highlights the need for consistent, culturally aware behavior change campaigns that go hand-in-hand with infrastructure upgrades.

Altogether, the literature suggests that improving sanitation knowledge and behaviors in underserved communities requires an integrated approach, one that combines health education, infrastructural development, cultural sensitivity, and policy support. Theoretical models like the Health Belief Model offer valuable frameworks for designing and evaluating interventions, especially those led by public health nurses.

For the community of Takalau in Birnin Kebbi, such insights offer a strong foundation for intervention design. By conducting cross-sectional surveys, interviews, and observational studies, this study aims to uncover the specific knowledge gaps, practices, and barriers to sanitation. The findings will inform culturally relevant, nursing-led health promotion strategies to enhance sanitation practices and reduce preventable disease burdens in the community.

II. MATERIALS AND METHODS

2.1 Research Design

This study adopts a descriptive cross-sectional survey design to evaluate the knowledge and practices of environmental sanitation among residents of Takalau, Birnin Kebbi. The design is appropriate because it allows the collection of data at a single point in time and provides a comprehensive understanding of the population's knowledge, practices, challenges, and potential solutions regarding environmental sanitation.

2.1.1 Study Setting: Geographical Location and Characteristics

The study was conducted in Takalau, a densely populated area located in Birnin Kebbi, Kebbi State, Nigeria. Birnin Kebbi, the state capital, is characterized by a predominantly agrarian economy, a semi-arid climate, and a mix of urban and rural settlements. Takalau is known for its residential communities and public spaces, which makes it a suitable site for studying environmental sanitation practices.

2.1.2 Target Population

The target population includes all household heads and residents aged 18 years and above in Takalau, Birnin Kebbi. This population is chosen because they are directly involved in and knowledgeable about the household and communal sanitation practices in the area.

2.1.3 Sampling

The sample size will be determined using the Cochran (1977) formula:

$$n = \frac{z^2 p(1-p)}{e^2} \quad (3.1)$$

Where:

n = required sample size

z = standard normal deviate (1.645 for 90% confidence level)

p = estimated prevalence of knowledge or practice of environmental sanitation (assumed to be 50% or 0.5 since no prior data is available)

e = margin of error (7.2% or 0.072)

Substituting:

$$n = \frac{(1.645)^2 * 0.5(1-0.5)}{0.072^2} = \frac{(1.645)^2 0.5(0.5)}{0.072^2} = 130$$

Therefore, a sample of 130 respondents will be used for this study.

2.1.4 Sampling Technique

A stratified random sampling technique will be employed to ensure representativeness, with the strata based on neighborhoods within Takalau. Households will be randomly selected from each stratum.

The inclusion criteria for this study are as follows: residents must be aged 18 years and above, have lived in Takalau for at least one year, and be willing to participate in the study.

The exclusion criteria are that residents who are under 18 years old, have lived in Takalau for less than one year, or are unwilling to participate in the study will not be included.

2.1.5 Instruments for Data Collection

Data will be collected using a structured questionnaire administered via Google form questionnaires for ease of data entry for data analysis.

The questionnaire has the sociodemographic characteristics section and 20 items, divided as follows:

i. Knowledge of environmental sanitation: 5 items.
ii. Sanitation practices: 5 items.
iii. Sanitation Challenges: 5 items.
iv. Improvement strategies: 5 items.

2.2 Validity and Reliability of Instruments

The questionnaire was reviewed by experts in survey data analysis to ensure clarity and relevance of items to the objectives of the study. The reliability of the questionnaire will be assessed using Cronbach's alpha (Cronbach, 1951) method in Equation (3.2).

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k}\sigma_i^2}{\sigma_t^2}\right) \quad (3.2)$$

Where:

k = number of items in the scale

σ_i^2 = variance of the ith item

σ_t^2 = total variance of the scale (sum of item variances and covariances)

2.3 Method of Data Collection

The questionnaire was self-administered by trained field assistants. Data collection lasted for two weeks, with each field assistant covering approximately 5 households daily, ensuring the target sample size was reached.

2.4 Method of Data Analysis

The following statistical methods were applied in this study for the data analysis.

i. Descriptive statistics (frequency distribution) to summarize sociodemographic characteristics of respondents.
Descriptive statistics, particularly frequency distributions, are widely used in public health research to describe and summarize the characteristics of study populations (Salkind, 2010).
ii. Cronbach's Alpha to assess the reliability of the responses from the residents. Cronbach's Alpha is a widely accepted measure for assessing the internal consistency and reliability of scale-based survey instruments (Tavakol & Dennick, 2011).
iii. Factor analysis via principal components analysis (PCA) to identify the most significant items in each construct (knowledge, practice, challenges and possible ways of improving sanitation practices).
Principal Components Analysis (PCA) is commonly employed to reduce dimensionality and identify key components in multi-item constructs (Jolliffe & Cadima, 2016).
v. One-way Chi-square analysis to explore the impact of educational background on knowledge, practice, challenges and possible ways of improving sanitation practices using the PCA score(s) in (iii) above respectively.
The Chi-square test is frequently used to examine the association between categorical

variables and assess group differences in public health and social research (McHugh, 2013).

2.5 Ethical Considerations

Approval for the study will be obtained from the Kebbi State College of Nursing Sciences. Participants will be informed about the purpose of the study, assured of confidentiality, and asked to provide their consent prior to participation. Respondents will also be given the option to withdraw from the study at any stage without facing any repercussions.

III. RESULTS

3.1 Analysis of the Sociodemographic Characteristics of the Respondents

3.1.1 Frequency Distribution

Table 1: Frequency Distribution of the Sociodemographic Characteristics of the Respondents (n = 130)

Sociodemographic	Levels	Frequency	Percent	Valid Percent	Cumulative Percent
Age Group	18 - 24 years	35	26.9	26.9	26.9
	25 - 34 years	42	32.3	32.3	59.2
	35 - 44 years	25	19.2	19.2	78.5
	45 - 54 years	18	13.8	13.8	92.3
	55 years and above	10	7.7	7.7	100.0
	Total	130	100.0	100.0	
Gender	Female	61	46.9	46.9	46.9
	Male	69	53.1	53.1	100.0
	Total	130	100.0	100.0	
Marital Status	Single	57	43.8	43.8	43.8
	Married	60	46.2	46.2	90.0
	Divorced	5	3.8	3.8	93.8
	Widowed	8	6.2	6.2	100.0
	Total	130	100.0	100.0	
Education Level	No formal education	43	33.1	33.1	33.1
	Primary	57	43.8	43.8	76.9
	Secondary	19	14.6	14.6	91.5
	Tertiary	11	8.5	8.5	100.0
	Total	130	100.0	100.0	
Occupation	Farmer	41	31.5	31.5	31.5
	Trader	35	26.9	26.9	58.5
	Student	33	25.4	25.4	83.8
	Civil servant	21	16.2	16.2	100.0
	Total	130	100.0	100.0	
Residency Duration	Less than 1 year	25	19.2	19.2	19.2
	1 - 5 years	37	28.5	28.5	47.7
	6 - 10 years	35	26.9	26.9	74.6
	Above 10 years	33	25.4	25.4	100.0
	Total	130	100.0	100.0	

3.1.2 Graphical Representation

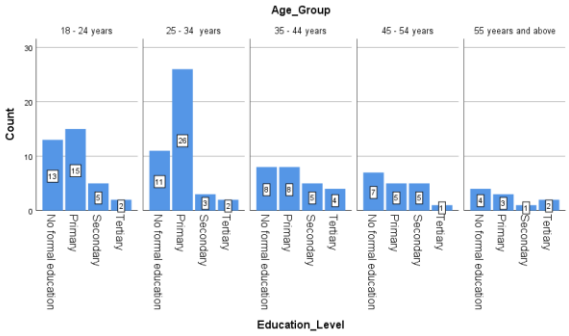

Figure 1: Simple Bar Chart of the Educational Level of Respondents paneled by their Age Group

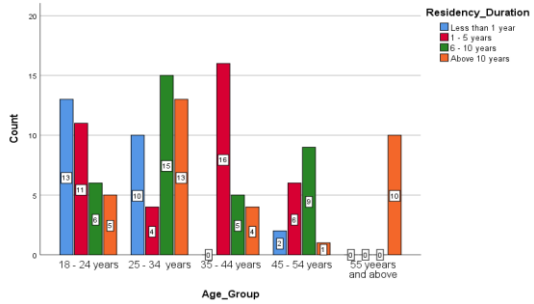

Figure 2: Multiple Bar Chart of the Age Group and Residency Duration of Respondents

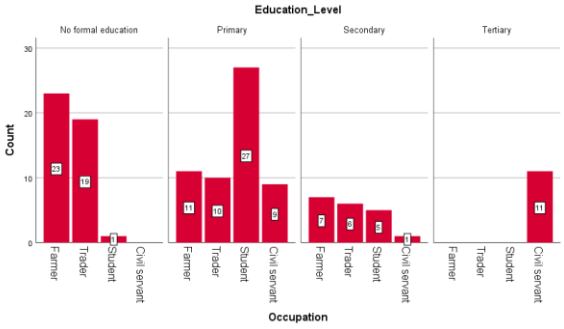

Figure 3: Simple Bar Chart of the Occupational Status of Respondents paneled by their Educational Level

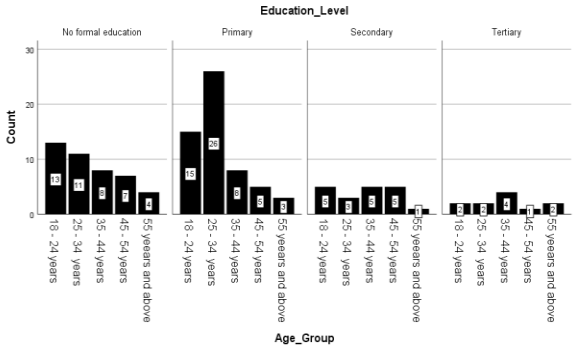

Figure 4: Simple Bar Chart of the Age Group of Respondents paneled by their Educational Level

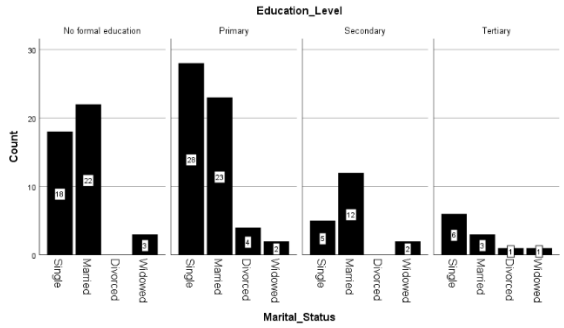

Figure 5: Simple Bar Chart of the Marital Status of Respondents paneled by their Educational Level

The frequency distribution of the sociodemographic characteristics of the respondents in Table 1 provides a strong indication of the validity and reliability of the responses obtained. The data reflects a diverse and balanced demographic representation across various key categories. The age distribution spans all relevant adult age groups, with the highest proportion (32.3%) between 25 and 34 years, followed by 26.9% in the 18 to 24 years category, suggesting active participation by younger and middle-aged adults who are likely to be more involved in sanitation practices. Gender representation is relatively balanced, with males comprising 53.1% and females 46.9%, minimizing the risk of gender bias in the findings. The marital status of respondents also varies, with a near even split between singles (43.8%) and married individuals (46.2%), alongside smaller proportions of divorced and widowed respondents, indicating inclusiveness of different household experiences that may influence sanitation behavior. Educational background is notably varied, with a substantial portion (33.1%) having no formal education, and 43.8% having only primary education. This reflects the local educational

context and enhances the generalizability of findings to similar rural settings. Occupation-wise, the spread among farmers (31.5%), traders (26.9%), students (25.4%), and civil servants (16.2%) ensures perspectives are captured from individuals with different socio-economic roles. Lastly, the distribution of residency duration shows that both recent settlers and long-term residents participated, with 28.5% residing between 1–5 years and 25.4% above 10 years, thereby adding depth to the reliability of responses concerning local sanitation practices. The cross-tabulation distributions of the sociodemographic characteristics were further visualized in Figures 1 – 5.

Overall, the demographic composition of the sample supports the credibility and robustness of the data, providing a dependable foundation for assessing the level of knowledge and practice of environmental sanitation in the study area.

3.2 Reliability Test of Responses

Table 2: Cronbach's Alpha Reliability Test of Responses

Construct	Cronbach's Alpha	N of Questions
Knowledge of Environmental Sanitation	0.963	5
Current Sanitation Practices	0.951	5
Environmental Sanitation Challenges	0.964	5
Strategies for Improvement	0.960	5
Overall	0.850	5

The findings of the Cronbach's Alpha reliability test, which was used to evaluate the internal consistency of the questionnaire items under each study construct, are shown in Table 2. All four of the specific constructs: Knowledge of Environmental Sanitation (0.963), Current Sanitation Practices (0.951), Environmental Sanitation Challenges (0.964), and Strategies for Improvement (0.960) have Cronbach's Alpha values that are significantly higher than the generally recognized cutoff of 0.70, indicating exceptional reliability. The reliability of the respondents' responses is strengthened by these high values, which imply that the items within each construct consistently measure the same underlying concept. The questionnaire's strong internal consistency is further supported by its overall reliability coefficient of 0.850.

These results collectively validate the instrument as a reliable tool for assessing the level of knowledge and practice of environmental sanitation among the residents of Takalau, Birnin Kebbi, Nigeria.

3.3 Results Addressing Research Questions

3.3.1 What is the level of knowledge about environmental sanitation among people living in Takalau, Birnin Kebbi?

Table 3: KMO and Bartlett's Test for Suitability of Responses on the Level of Knowledge about Environmental Sanitation for Factor Analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.919
Bartlett's Test of Sphericity	Approx. Chi-Square	750.071
	df	10
	Sig.	.000

Table 4: Total Variance Explained by the Extracted Principal Component for Level of Knowledge about Environmental Sanitation

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.357	87.133	87.133	4.357	87.133	87.133
2	.210	4.208	91.341			
3	.176	3.525	94.866			
4	.131	2.630	97.496			
5	.125	2.504	100.000			
Extraction Method: Principal Component Analysis.						

Table 5: Component Matrix of the Factor Loadings of Items on the Extracted Principal Component for Level of Knowledge about Environmental Sanitation

Items	Component 1
Using improved sanitation facilities and proper waste disposal significantly reduces the risk of disease.	.946
Local laws regulate environmental sanitation practices.	.946
Poor environmental hygiene negatively impacts the quality of life.	.930
Poor sanitation, improper waste disposal, stagnant water, and open defecation pose significant health risks.	.927
Proper waste disposal is essential for maintaining a healthy environment.	.917
Extraction Method: PCA	

The level of knowledge about environmental sanitation among people living in Takalau, Birnin Kebbi, is notably high, as evidenced by the results of the factor analysis. The Kaiser-Meyer-Olkin (KMO) value of 0.919 indicates excellent sampling adequacy, suggesting that the data is highly suitable for factor analysis. Furthermore, Bartlett's Test of Sphericity is statistically significant ($\chi^2 = 750.071$, df = 10, $p < 0.001$), confirming that the correlation matrix is not an identity matrix and that there are sufficient interrelationships among the knowledge items to justify dimensional reduction through factor analysis.

As shown in Table 4, only one principal component was extracted, with an eigenvalue of 4.357, accounting for 87.133% of the total variance. This suggests that a single latent factor strongly underpins all five knowledge items, reflecting a high level of internal consistency and indicating that the respondents' understanding of environmental sanitation is coherent and focused.

The component matrix in Table 5 further reinforces this conclusion, as all five items loaded very highly on the extracted component, with factor loadings ranging from 0.917 to 0.946. These high loadings indicate that respondents uniformly recognized the importance of improved sanitation facilities, proper waste disposal, the role of local regulations, the health risks of poor sanitation, and the environmental benefits of proper waste management.

Overall, the statistical evidence clearly demonstrates that residents of Takalau possess a high and unified level of knowledge about environmental sanitation. This strong awareness is essential for fostering effective sanitation practices and promoting public health in the community.

3.3.2 What are the current sanitation practices of residents in Takalau, Birnin Kebbi?

Table 6: KMO and Bartlett's Test for Suitability of Responses on the Current Sanitation Practices for Factor Analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.906
Bartlett's Test of Sphericity	Approx. Chi-Square	634.264
	df	10
	Sig.	.000

Table 7: Total Variance Explained by the Extracted Principal Component for Current Sanitation Practices

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.187	83.735	83.735	4.187	83.735	83.735
2	.245	4.892	88.627			
3	.231	4.628	93.255			
4	.189	3.770	97.025			
5	.149	2.975	100.000			
Extraction Method: Principal Component Analysis.						

Table 8: Component Matrix of the Factor Loadings of Items on the Extracted Principal Component for Current Sanitation Practices

	Component
	1
Recyclable waste is separated from general waste.	.924
Waste is disposed of through approved channels.	.921
Shared sanitation facilities are commonly used, but many are poorly maintained	.913
Community sanitation programs are actively participated in, and household surroundings are regularly cleaned.	.909
Household members are encouraged to adopt proper sanitation practices.	.908
Extraction Method: PCA	

The current sanitation practices of residents in Takalau, Birnin Kebbi, reflect a consistent and organized approach to environmental hygiene, as supported by the results of the factor analysis. The Kaiser-Meyer-Olkin (KMO) measure yielded a value of 0.906, indicating excellent sampling adequacy and confirming that the dataset is appropriate for factor analysis. In addition, Bartlett's Test of Sphericity was statistically significant ($\chi^2 = 634.264$, df = 10, $p < 0.001$), showing that the correlation matrix contains sufficient relationships among the variables to proceed with dimensional reduction.

As shown in Table 7, one principal component was extracted with an eigenvalue of 4.187, accounting for 83.735% of the total variance in responses. This high percentage demonstrates that all five items used to measure current sanitation practices are strongly influenced by a single underlying factor. It suggests that the sanitation practices among respondents are not only uniform but also reflective of a shared behavioural pattern regarding hygiene and waste management.

The component matrix in Table 8 further validates this finding, as each item loaded highly on the single extracted component, with factor loadings ranging from 0.908 to 0.924. These loadings confirm strong contributions of each item to the common factor, indicating that respondents consistently reported practices such as separating recyclable waste, using approved waste disposal channels, cleaning household surroundings, participating in community sanitation programs, and encouraging proper sanitation practices among household members.

In conclusion, the analysis reveals that residents of Takalau demonstrate a relatively high level of engagement in sound sanitation practices, supported by a strong internal consistency among reported behaviours. This reflects positively on community efforts toward maintaining environmental cleanliness and public health.

3.3.3 What are the common environmental sanitation challenges faced by the community?

Table 9: KMO and Bartlett's Test for Suitability of Responses on the Common Environmental Sanitation Challenges for Factor Analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.917
Bartlett's Test of Sphericity	Approx. Chi-Square	762.656
	df	10
	Sig.	.000

Table 10: Total Variance Explained by the Extracted Principal Component for Common Environmental Sanitation Challenges

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.372	87.444	87.444	4.372	87.444	87.444
2	.200	4.004	91.448			
3	.173	3.464	94.912			
4	.144	2.887	97.799			
5	.110	2.201	100.000			
Extraction Method: Principal Component Analysis.						

Table 11: Component Matrix of the Factor Loadings of Items on the Extracted Principal Component for Common Environmental Sanitation Challenges

	Component
	1
Poorly designed drainage systems	.950
Financial and infrastructural constraints limit proper sanitation practices.	.944
Cultural practices hinder environmental sanitation.	.929
Poor enforcement of sanitation laws affects the environment.	.929
Inadequate waste management services are a major issue.	.923
Extraction Method: PCA	

The findings on common environmental sanitation challenges faced by the community in Takalau, Birnin Kebbi, demonstrate a strong consensus among respondents regarding the key issues impeding effective sanitation. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.917, indicating excellent suitability of the data for factor analysis. Bartlett's Test of Sphericity was also highly significant ($\chi^2 = 762.656$, $df = 10$, $p < 0.001$), confirming that the correlation matrix is factorable and that the variables are sufficiently interrelated for principal component extraction.

According to Table 10, a single principal component was extracted with an eigenvalue of 4.372, accounting for 87.444% of the total variance. This result implies that the five items collectively reflect a common underlying factor representing the environmental sanitation challenges in the area. The high percentage of explained variance signifies that these challenges are uniformly experienced and reported by respondents across the community.

The component matrix in Table 11 supports this conclusion, with all five items showing high factor loadings on the single extracted component, ranging from 0.923 to 0.950. These strong loadings indicate that all identified challenges: poorly designed drainage systems, financial and infrastructural constraints, cultural barriers, weak enforcement of sanitation laws, and inadequate waste management services are central and widely recognized obstacles to achieving effective environmental sanitation in Takalau.

In summary, the analysis confirms that the community faces a clearly defined set of sanitation-related challenges, with infrastructural, regulatory, socio-cultural, and service delivery factors playing prominent roles. These insights can help inform targeted interventions aimed at addressing these critical areas for improved public health and environmental conditions.

3.3.4 What are the possible ways of improving environmental sanitation practices of people living in Takalau, Birnin Kebbi?

Table 12: KMO and Bartlett's Test for Suitability of Responses on the Possible Ways of Improving Environmental Sanitation Practices for Factor Analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.912
Bartlett's Test of Sphericity	Approx. Chi-Square	729.860
	df	10
	Sig.	.000

Table 13: Total Variance Explained by the Extracted Principal Component for Possible Ways of Improving Environmental Sanitation Practices

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.321	86.412	86.412	4.321	86.412	86.412
2	.226	4.523	90.935			
3	.184	3.688	94.623			
4	.162	3.236	97.859			
5	.107	2.141	100.000			
Extraction Method: Principal Component Analysis.						

Table 14: Component Matrix of the Factor Loadings of Items on the Extracted Principal Component for Possible Ways of Improving Environmental Sanitation Practices

	Component 1
Government enforcement of sanitation laws is critical.	.950
Advocating for better sanitation infrastructure from local authorities.	.936
Provision of more waste bins will improve sanitation.	.926
Financial support for low-income families will enhance sanitation.	.921
Community education programs and regular community clean-up initiatives on sanitation are essential.	.914

Extraction Method: PCA

The analysis of possible ways to improve environmental sanitation practices in Takalau, Birnin Kebbi, reveals a strong and unified response from the community. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.912, which is considered excellent and confirms that the sample is suitable for factor analysis. Bartlett's Test of Sphericity was also statistically significant (χ^2 = 729.860, df = 10, $p < 0.001$), indicating that the intercorrelations among the variables are adequate for extracting a meaningful factor structure.

As shown in Table 13, only one principal component was extracted, with an eigenvalue of 4.321, accounting for 86.412% of the total variance. This high percentage of explained variance suggests that the five items measuring strategies for improving sanitation are strongly related and represent a single underlying factor or construct.

The component matrix in Table 14 supports this finding, with all items showing high loadings ranging from 0.914 to 0.950 on the extracted component. This indicates that each strategy is a critical contributor to improving environmental sanitation in the community. The most strongly endorsed strategy is the enforcement of sanitation laws by the government (loading = 0.950), followed by advocacy for improved infrastructure (0.936), increased waste bin availability (0.926), financial support for low-income households (0.921), and community-based education and clean-up efforts (0.914).

In summary, the data suggest that the community in Takalau recognizes a multifaceted approach as necessary for improving environmental sanitation. This includes institutional enforcement, infrastructure development, economic support, and grassroots education and participation, all of which are essential components of a comprehensive sanitation improvement strategy.

3.3.5 Does education level impact the knowledge, practice, challenges and possible ways of improving environmental sanitation practices of residents of Takalau, Birnin Kebbi?

Table 15: One-way Chi-square Analysis for the Impact of Education on Environmental Practices Weighted by the Extracted PCA for Each Construct.

Construct	Chi-Square	df	Asymp. Sig.
Level of Knowledge of environmental sanitation	11.047	3	0.011
Current sanitation practices	6.961	3	0.073
Common environmental sanitation challenges	6.592	3	0.086
Possible ways of improving environmental sanitation practices	19.63	3	0.000

The results presented in Table 15 provide insight into whether the education level of residents in Takalau, Birnin Kebbi, significantly influences their knowledge, practices, challenges, and proposed solutions related to environmental sanitation. A one-way Chi-square analysis was conducted using the principal component scores derived from factor analysis for each construct.

- Level of Knowledge of Environmental Sanitation: The Chi-square value is 11.047 with 3 degrees of freedom and a p-value of 0.011. This indicates a statistically significant relationship between

education level and knowledge of environmental sanitation ($p < 0.05$). Thus, residents with higher education levels are likely to possess greater awareness and understanding of environmental sanitation.

- Current Sanitation Practices: The Chi-square value is 6.961 with 3 degrees of freedom and a p-value of 0.073. Although suggestive, this result is not statistically significant at the conventional 0.05 level. Therefore, while there may be some variation in sanitation practices by education level, it is not strong enough to be deemed significant.
- Common Environmental Sanitation Challenges: With a Chi-square value of 6.592 and a p-value of 0.086, the relationship between education level and perceived challenges is also not statistically significant. This implies that individuals across different educational backgrounds experience similar challenges in maintaining environmental sanitation.
- Possible Ways of Improving Environmental Sanitation Practices: This construct yielded a Chi-square value of 19.63 with 3 degrees of freedom and a p-value of 0.000, indicating a highly significant relationship. Education level greatly influences residents' perspectives on effective strategies for improving environmental sanitation.

Education level significantly impacts the residents' knowledge of environmental sanitation and their views on improvement strategies, but it does not significantly affect their current sanitation practices or perceived challenges. This highlights the importance of educational interventions in enhancing understanding and engagement in long-term solutions, even if practical behaviors and challenges are influenced by other socio-economic or infrastructural factors.

IV. DISCUSSION OF FINDINGS

4.1 Key Findings

Table 16: Key Findings Based on the Results of the Research

Research Question	Key Findings
1. What is the level of knowledge about environmental sanitation among people living in Takalau, Birnin Kebbi?	The factor analysis revealed that residents of Takalau have a high level of knowledge about environmental sanitation with 87.13% variance explained.
2. What are the current sanitation practices of residents in Takalau, Birnin Kebbi?	The factor analysis showed that the residents practice proper sanitation, including separating recyclable waste, proper waste disposal, and community sanitation involvement, with 83.74% variance explained.
3. What are the common environmental sanitation challenges faced by the community?	Key challenges include poorly designed drainage systems, financial and infrastructural constraints, cultural practices, poor enforcement of sanitation laws, and inadequate waste management services, with 87.44% variance explained.
4. What are the possible ways of improving environmental sanitation practices in Takalau?	The findings suggest that government enforcement of sanitation laws, better sanitation infrastructure, provision of more waste bins, financial support for low-income families, and community education programs are critical for improving sanitation practices, with 86.41% variance explained.
5. Does education level impact on the knowledge, practice, challenges, and possible ways of improving environmental sanitation practices?	Education level significantly impacts the knowledge and possible ways of improving environmental sanitation, with a Chi-Square value of 11.047 ($p = 0.011$) for knowledge and 19.63 ($p = 0.000$) for improvement strategies. It has a moderate impact on sanitation practices and challenges.

4.2 Alignment of Findings with Past Literature Findings

Table 17: Key Findings and Alignment with Past Literature Findings

Study Findings	Alignment with Past Literature
High level of knowledge about environmental sanitation among residents	Contrary to Adeleke et al. (2023), who found only 38% had adequate knowledge, this study reveals a significantly higher knowledge level, suggesting regional variations or recent awareness efforts. Ahmed et al. (2022) similarly found high knowledge levels but low practice due to systemic barriers.
Proper sanitation practices such as waste separation, disposal, and community involvement are common.	Musa et al. (2023) showed that culturally relevant education improved sanitation practices by 62%, aligning with the finding of positive behaviors in Takalau. However, Eze et al. (2022) and Oladimeji et al. (2023) identified open dumping and low compliance in other regions, underscoring geographical differences.
Major challenges include poor drainage, weak enforcement of laws, financial constraints, and lack of waste services	Echoes findings by Olawale and Ibrahim (2022) and Eke et al. (2023), who identified infrastructural and enforcement gaps as major barriers. WHO (2022) also emphasized the lack of community engagement and maintenance programs as contributors to sanitation system breakdowns.
Suggested improvements include stronger enforcement, more bins, infrastructure upgrades, and education campaigns	Consistent with recommendations by Adeleke et al. (2023), Akpan et al. (2023), and UNICEF (2020), that called for policy enforcement, infrastructure investment, and educational outreach. Nwankwo et al. (2023) further emphasized the impact of community and nurse-led health programs on behavior change.
Education level significantly impacts knowledge and strategies for improvement	Supported by Agwu et al. (2022), who found that individuals with higher education demonstrated better sanitation knowledge and attitudes. Also aligns with Olatunji et al. (2021), where low literacy levels hindered sanitation understanding among market women.

4.3 Implications of Findings to Nursing

The findings of this study have several important implications for nursing practice, particularly in the areas of community health and public health promotion. Firstly, the high level of sanitation knowledge and positive practices among residents of Takalau suggest that nurses can play a pivotal role in sustaining and scaling these behaviors through continued health education and advocacy. Community health nurses are strategically positioned to lead sanitation awareness campaigns, provide culturally sensitive education, and mobilize households to adopt hygienic practices.

Secondly, the identified challenges such as poor drainage, weak enforcement of sanitation laws, and lack of waste disposal infrastructure highlight the need for nurses to advocate for policy changes and collaborate with local authorities to address environmental determinants of health. Nurses can serve as liaisons between the community and policymakers, ensuring that health perspectives are integrated into sanitation and infrastructure planning.

Finally, the correlation between education level and sanitation knowledge underlines the importance of targeting health messages appropriately. Nurses should tailor health promotion strategies to the literacy levels of different population segments, using local languages and practical demonstrations to enhance understanding and compliance.

4.4 Limitations of the Study

Firstly, the use of self-reported data through questionnaires may have introduced response bias, as participants could overstate positive sanitation behaviors. Secondly, the cross-sectional design limits the ability to establish causal relationships between education level and sanitation practices. Thirdly, the study was conducted only in Takalau, Birnin Kebbi, which may affect the generalizability of the findings to other communities with different socio-cultural and infrastructural contexts.

4.5 Summary of the Study

This study explored the impact of educational attainment on environmental sanitation knowledge, practices, challenges, and improvement strategies among residents of Takalau, Birnin Kebbi. Utilizing a cross-sectional survey design, data was collected through structured questionnaires distributed via Google Forms to ensure ease of data entry and analysis. A stratified random sampling technique was employed to ensure representativeness across neighborhoods.

Descriptive statistics, factor analysis (principal components analysis) and chi-square tests were used to analyze the data. Key findings revealed that education level had a statistically significant impact on respondents' knowledge of environmental sanitation and their suggestions for improvement strategies, while its influence on current practices and challenges was not statistically significant. The study also found that although many residents demonstrated awareness of sanitation practices, actual implementation was hindered by infrastructural and socio-economic barriers.

The findings align with past literature that emphasizes the role of education, targeted health campaigns, and infrastructure in improving sanitation outcomes. The study recommends intensified community-based education, infrastructural support, and culturally sensitive intervention programs. The implications for nursing practice include the integration of community health nurses in sanitation education and advocacy to promote behavior change and improve public health outcomes.

4.6 Conclusion

This study concludes that educational attainment plays a significant role in shaping residents' knowledge and perspectives on strategies for improving environmental sanitation in Takalau, Birnin Kebbi. While education positively influences awareness and proposed interventions, it does not automatically translate into improved sanitation practices or reduced challenges, indicating the presence of systemic and infrastructural barriers. The findings underscore the need for a multifaceted approach that combines education with community engagement, policy support, and infrastructural development. To foster sustainable environmental sanitation, stakeholders—including public health professionals, community nurses, and local authorities—must collaborate to implement context-specific interventions that are both educational and action-oriented.

4.7 Recommendations

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

1. Community-Based Health Education: There should be sustained and culturally relevant health education campaigns led by nurses and community health workers to improve knowledge and translate it into effective sanitation practices.
2. Integration of Sanitation Education into School Curricula: Educational institutions should incorporate environmental sanitation topics into school curricula to build early awareness and long-term behavioral change.
3. Government and Stakeholder Collaboration: Government agencies, NGOs, and community leaders should work together to improve sanitation infrastructure, such as waste disposal systems, public toilets, and water supply.
4. Targeted Interventions for Low-Education Groups: Special attention should be given to residents with lower educational attainment through simplified communication methods and participatory learning approaches.
5. Policy Support and Enforcement: Local authorities should develop and enforce policies that promote

proper sanitation practices, while also ensuring the availability of basic amenities that support hygienic living conditions.

4.8 Suggestions for Further Studies

Future research should explore longitudinal approaches to assess the long-term impact of sanitation education interventions on behavior change among residents. Studies can also employ mixed methods designs to gain deeper qualitative insights into the cultural and socioeconomic factors affecting sanitation practices. Additionally, comparative studies across different communities or states in Nigeria would help identify regional disparities and tailor interventions accordingly. Researchers may also consider evaluating the role of specific actors, such as community health nurses, in promoting sustained environmental sanitation practices. Finally, further studies could integrate Geographic Information System (GIS) tools to map sanitation risk zones for targeted policy action.

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