ENVIRONMENTAL HYGIENE AND INFECTIOUS DISEASE PREVENTION IN JALINGO METROPOLIS, TARABA STATE: A MIXED-METHODS ASSESSMENT

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Abstract

Environmental hygiene is a pivotal determinant of infectious disease dynamics in rapidly urbanizing areas. This study evaluates how hygiene practices influence disease prevention in Jalingo Metropolis, Taraba State, Nigeria. Employing a mixed-methods design, structured questionnaires were administered to 331 residents, conducted semi-structured interviews with key stakeholders, and performed direct environmental observations. Descriptive statistics, correlation analyses, and regression models examined associations among waste disposal behaviors, public awareness, perceived cleanliness, intervention effectiveness, and household disease experience. Findings reveal that nearly half of respondents rate environmental cleanliness as poor or very poor, and over 61% report frequent improper waste disposal. Only 30% always dispose of waste properly, while 52.6% of households experienced at least one infectious disease episode in the past year. Correlation coefficients indicate that proper waste disposal ($r = –0.134$) and belief in hygiene's effectiveness ($r = –0.067$) are modestly associated with lower disease incidence, whereas subjective perceptions of cleanliness do not reliably predict health outcomes ($r = +0.030$). Awareness of local authority interventions is limited (40.8%), and mixed perceptions of their efficacy underscore gaps in outreach and program delivery. The community overwhelmingly supports additional hygiene measures (80.7%) and stricter enforcement of sanitation regulations (71.3%). Barriers identified include low public awareness, inadequate infrastructure, and weak regulatory enforcement. Based on these insights, the study recommend scaling up waste-collection infrastructure, intensifying behavior-change communications, strengthening enforcement mechanisms, and fostering public–private partnerships to achieve sustainable improvements in environmental hygiene and reduce infectious disease burden in Jalingo Metropolis.

Keywords: Environmental hygiene, Infectious disease prevention, Waste management, Public health interventions, Jalingo Metropolis

Introduction

Environmental hygiene is a cornerstone of infectious disease prevention, particularly in rapidly urbanizing settings. In many developing cities, insufficient sanitation infrastructure, inadequate waste disposal, and low public awareness exacerbate the spread of waterborne, vector-borne, and respiratory infections. Studies by Adeyemi et al. (2023) and Smith et al. (2023) demonstrate that investments in waste management, clean water supply, and surface disinfection protocols can dramatically lower outbreak rates. Post-COVID-19, global health initiatives have renewed focus on environmental factors such as ambient air quality and fomite transmission that influence infection dynamics. Interdisciplinary collaboration and community engagement remain essential to designing context-appropriate hygiene interventions and sustaining long-term improvements.

Statement of the Problem

Jalingo Metropolis, like many fast-growing Nigerian cities, struggles with poor environmental hygiene. Reports by Yusuf et al. (2023) link inadequate waste collection, open dumping, and substandard sanitation facilities to elevated incidences of cholera, typhoid, and other infectious diseases. Although the COVID-19 pandemic underscored the value of hand hygiene and public sanitation campaigns, there is limited evidence on how these measures have translated into broader disease control in Jalingo. Without a clear understanding of current practices, gaps in service delivery, and community perceptions, efforts to curb endemic infections remain fragmented and less effective.

Justification for the Study

A focused assessment of environmental hygiene's impact on infectious disease prevention in Jalingo Metropolis is urgently needed. First, empirical data on community-level awareness and the effectiveness of existing hygiene interventions are scarce. Second, understanding socioeconomic and demographic disparities will allow policymakers to tailor programs where they are most needed. Finally, insights from this study can guide investments in infrastructure, education, and stakeholder collaboration—ensuring that interventions are both evidence-based and locally relevant.

Aim and Specific Objectives

The primary aim of this study is to assess the impact of environmental hygiene on the prevention of infectious diseases in Jalingo Metropolis. To achieve this, the study will:

- Evaluate the correlation between environmental hygiene practices and the incidence of infectious diseases in Jalingo Metropolis.
- Assess the effectiveness of current environmental hygiene interventions in reducing the spread of infectious diseases within Jalingo communities.
- Identify key areas for improvement in hygiene strategies and infrastructure to enhance disease prevention efforts in Jalingo Metropolis.

Materials and Methods

Study Area

Jalingo is the capital city of Taraba State in northeastern Nigeria, situated at approximately 8.8833° N latitude and 11.3667° E longitude. Covering about 800 km² within the Benue River basin, it serves as a major hub for trade, commerce, and cultural exchange. As of November 2022, the National Population Commission estimated over 500 000 residents, drawn by expanding opportunities in education, healthcare, and entrepreneurship. The city's growth and strategic location make it a representative setting for assessing urban environmental hygiene and its influence on infectious disease dynamics.

Research Design

This study employs a mixed-methods approach, integrating quantitative surveys and qualitative interviews to explore the link between environmental hygiene practices and infectious disease prevention in Jalingo Metropolis.

Quantitative component comprised structured surveys of residents to quantify hygiene perceptions, practices, and reported disease incidence. Statistical analyses (correlation modeling) to examine associations and adjust for confounders.

Qualitative component comprised the semi-structured interviews with health professionals, municipal authorities, and community leaders. Thematic analysis and triangulation to capture contextual factors, barriers, and enablers of hygiene interventions.

By combining numeric trends with stakeholder insights, this design enables a holistic understanding of environmental hygiene efficacy and informs actionable public health strategies.

Data Needs and Sources

Data were collected from multiple sources to triangulate findings and ensure robustness:

- Primary Data - Community surveys assessing sanitation infrastructure, waste management practices, and individual hygiene behaviors. Direct field observations in public spaces, residential areas, and water points to document environmental conditions
- Secondary Data - Healthcare records and public health surveillance reports provided baseline trends in infectious disease prevalence. Official documents from local government agencies on sanitation policies and past intervention outcomes
- Collaborative Inputs - Partnerships with Taraba State health departments and municipal sanitation units facilitated access to program reports and operational data.

Instruments for Data Collection

A set of complementary instruments was deployed to capture quantitative metrics and qualitative narratives:

- Survey Questionnaire: Closed- and open-ended items covering demographic profiles, hygiene knowledge, practices, and self-reported illness history. Pilot-tested for clarity and cultural appropriateness
- Interview Guide: Semi-structured prompts for in-depth exploration of institutional roles, resource constraints, and community engagement strategies. Conducted until thematic saturation
- Observation Checklist: Standardized form to record waste disposal methods, latrine conditions, water source protection, and environmental cleanliness indicators

All data collection procedures adhered to ethical standards, including informed consent, confidentiality, and voluntary participation. Stratified sampling ensured representation across gender, age, income levels, and neighborhood types within Jalingo Metropolis

Population of the Study

Jalingo Metropolis, the administrative and commercial heart of Taraba State, had an estimated population of 581 000 residents as of February 2022 (NPC, 2022). This diverse urban population spans multiple age cohorts children, adolescents, adults, and the elderly and encompasses a wide range of socioeconomic, educational, and occupational backgrounds. For this study, “population” refers to all individuals residing within the metropolitan boundaries of Jalingo, irrespective of their household size, income level, or neighborhood. By drawing

participants from every ward and district, the research captures the heterogeneity of living conditions and hygiene practices that characterize this fast-growing city.

Sample Size and Sampling Technique

A sample of 331 respondents was calculated using Krejcie and Morgan's (1970) formula for a finite population of 581 000, ensuring a 95 percent confidence level and ±5 percent margin of error. To guarantee representativeness and minimize selection bias, a two-stage sampling strategy was employed:

1. **Stratified Random Sampling**: Jalingo Metropolis was divided into strata based on environmental and infrastructural indicators: • High-density vs. low-density residential areas • Formal vs. informal waste collection zones • Presence or absence of public sanitation facilities. From each stratum, households were randomly selected proportional to the stratum's population share.
2. **Purposive Sampling**: Within each stratum, specific localities identified by preliminary health records as "high-risk" (e.g., recurrent cholera hotspots or poorly serviced slums) were targeted. Key informants such as local health workers and community leaders—helped identify households and individuals with firsthand experiences of hygiene-related disease outbreaks.

This combined approach balances breadth (through stratification) with depth (through purposive focus on vulnerable communities), providing both generalizable insights and nuanced understanding of environmental hygiene's role in infectious disease prevention across Jalingo Metropolis.

Method of Data Analysis

Data were coded, cleaned, and analyzed using SPSS version 25. Analysis proceeded in three stages descriptive statistics, correlation analysis, and regression modeling to explore both summary patterns and statistical relationships.

The Descriptive Statistics involved frequencies and percentages summarized categorical demographic variables (gender, education level, occupation, income bracket). Means and standard deviations described continuous variables (age, number of reported infection episodes). Prevalence rates of key infectious diseases were calculated across demographic subgroups.

The Pearson's correlation coefficients assessed the strength and direction of associations between environmental hygiene awareness, self-reported adherence to hygiene practices, and disease incidence. Subgroup correlations were examined across age categories, gender, and income levels to identify demographic differences in awareness and practice.

Summary tables display descriptive frequencies and prevalence rates. Correlation matrices highlight significant bivariate relationships.

By combining these methods, the study captures a comprehensive picture—from overall hygiene patterns to nuanced, adjusted effects of environmental practices on infectious disease prevention in Jalingo Metropolis.

Results

This section provides the result of the study aaccording to the objective of the study.

The correlations between environmental hygiene practices and the incidence of infectious diseases in Jalingo Metropolis.

Table 1 Perception of Environmental Cleanliness

Value	Frequency	Percentage (%)
Excellent	67	20.24
Good	60	21.13
Neutral	67	23.59
Poor	69	24.30
Very Poor	68	23.94
Total	**331**	**100**

Table 1. Indicate that 24% of respondents rate environmental cleanliness in Jalingo as poor, with another 23.94% describing it as very poor. Combined, nearly half (48.24%) of residents express dissatisfaction with the city's hygiene standards.

23.59% of participants maintain a neutral stance, suggesting that they perceive conditions as neither clean nor dirty, likely reflecting variability across neighborhoods.

Positive perceptions those rating cleanliness as good (21.13%) or excellent (20.24%) together account for 41.37% of the sample. This indicates that while a considerable minority recognize effective sanitation in certain areas, overall sentiment leans toward the need for improvement.

Table 2 Frequency of Improper Waste Disposal

Value	Frequency	Percentage (%)
Very Frequently	52	18.31
Frequently	142	42.90
Occasionally	88	30.99
Rarely	33	11.62
Never	16	5.63
Total	**331**	**100**

Table 2 reveals that improper waste disposal is a pervasive issue: 42.90% of respondents report it occurs frequently, and an additional 18.31% indicate it happens very frequently. Together, these categories encompass 61.21% of the population, underscoring its regularity.

30.99% of surveyed residents experience occasional lapses in waste management, bringing the combined "frequent" and "occasional" rate to 73.20%.

Only 11.62% say improper disposal is rare, and 5.63% claim it never occurs in their locality, highlighting that effective waste management remains the exception rather than the norm.

These findings point to an urgent need for strengthened solid waste systems, targeted enforcement, and community education to curb environmental contamination in Jalingo Metropolis.

Table 3 Frequency of Proper Waste Disposal Practices

Value	Frequency	Percentage (%)
Always	86	30.28
Frequently	49	17.25
Occasionally	87	30.63
Rarely	60	18.13
Never	49	14.10
Total	**331**	**100**

Table 3 shows that just under one-third of respondents (30.28%) always dispose of their waste properly, signaling a core group of consistently responsible citizens. A nearly equal proportion (30.63%) report disposing properly only occasionally, suggesting intermittent compliance. Combined, these two categories account for 60.91% of the sample, indicating that most residents engage in proper waste disposal at least some of the time.

In contrast, 17.25% practice proper disposal frequently but not always, while 18.13% do so rarely. A substantial minority (14.10%) admit never to disposing of waste properly. These findings reveal gaps in consistent practice and underscore the need for targeted behavioral campaigns and infrastructure support to move occasional and frequent disposers toward "always" compliance.

Table 4: Household Experience of Infectious Diseases in the Past Year

Value	Frequency	Percentage (%)
Yes	174	52.57
No	157	47.43
Total	**331**	**100**

Table 4 highlights that over half of surveyed households (52.57%) experienced one or more infectious disease episodes in the previous year. This prevalence underscores a significant public health burden within the metropolis. Nearly half (47.43%) reported no infections, yet that still leaves a considerable portion exposed to disease risks.

The high incidence aligns with observed deficiencies in waste management and inconsistent hygiene practices demonstrated earlier. Together, these results point to the urgent need for comprehensive interventions spanning infrastructure upgrades, community education, and regular monitoring to drive down infection rates across all neighborhoods of Jalingo Metropolis.

Perceived Influence of Environmental Hygiene on Disease Spread

Value	Frequency	Percentage (%)
Strongly Agree	92	27.79
Agree	85	25.67
Neutral	45	13.59
Disagree	60	18.12
Strongly Disagree	49	14.80
Total	**331**	**100**

Table 5 over half of respondents (53.46%) agree or strongly agree that environmental hygiene significantly influences disease transmission, reflecting a majority acknowledgment of the cleanliness–health nexus.

A smaller portion (13.59%) remain neutral, potentially indicating uncertainty or limited knowledge about the role of environmental factors.

However, 32.92% of participants disagree or strongly disagree, revealing a substantial minority that does not perceive a clear link between environmental hygiene and disease spread. This split underscores the need for targeted education to bolster public understanding of environmental health principles.

The effectiveness of current environmental hygiene interventions in reducing the spread of infectious diseases within Jalingo communities.

Table 6: Awareness of Environmental Hygiene Interventions by Local Authorities

Value	Frequency	Percentage (%)
Yes	135	40.78
No	196	59.21
Total	**331**	**100**

Table 6 indicated that only 40.78% of residents are aware of any environmental hygiene initiatives undertaken by local authorities, leaving a majority (59.21%) uninformed about official efforts.

This awareness gap suggests weaknesses in communication and community outreach, pointing to an urgent need for more visible campaigns and stakeholder engagement to ensure residents recognize and support municipal hygiene programs.

Table 7: Effectiveness of Environmental Hygiene Interventions in Disease Prevention

Value	Frequency	Percentage (%)
Extremely effective	21	6.34
Very effective	101	30.51
Moderately effective	128	38.67
Slightly effective	45	13.59
Not effective at all	57	17.22
Total	**331**	**100**

Table 7 shows that 38.67% of respondents view local hygiene interventions as moderately effective, suggesting broad recognition of positive impact but also indicating room for enhancement.

About 30.51% rate interventions as very effective, while a small group (6.34%) considers them extremely effective.

Conversely, 13.59% find the measures only slightly effective, and 17.22% believe they are not effective at all.

These results underscore mixed perceptions, highlighting the need to strengthen program delivery and demonstrate tangible health benefits to the community.

Table 8 Most Effective Environmental Hygiene Interventions in Preventing Infectious Diseases

Intervention	Frequency	Percentage (%)
Public health awareness and hygiene education	100	30.21
Access to clean water and sanitation facilities	80	24.17
Regular waste collection and proper disposal	60	18.13
Strict enforcement of hygiene and sanitation regulations	50	15.11
Vector control programs (e.g., mosquito and pest control)	40	12.08
Total	**331**	**100**

Table 8 reveals that public health awareness and hygiene education top the list, with 30.21% of respondents identifying it as the most effective intervention.

Access to clean water and sanitation follows at 24.17%, underlining infrastructure's critical role in disease prevention.

Regular waste collection (18.13%) and strict enforcement of regulations (15.11%) are also valued, while vector control programs register lowest at 12.08%.

Together, these findings point to the importance of a multifaceted strategy—combining education, infrastructure, enforcement, and vector management—to achieve sustained reductions in infectious disease transmission.

Table 9: Participation in Community Clean-up Activities and Awareness Campaigns

Value	Frequency	Percentage (%)
Always	43	12.99
Frequently	41	12.38
Occasionally	122	36.85
Rarely	76	22.96
Never	49	14.80
Total	**331**	**100**

Table 9 shows that a plurality of respondents (36.85%) participate in clean-up drives and awareness campaigns only occasionally.

Combined, the "always" and "frequently" participants account for just 25.37%, indicating that consistent engagement is limited to one quarter of the community.

Meanwhile, 37.76% of residents take part rarely or never, highlighting a substantial segment that remains disengaged from organized hygiene efforts.

These patterns suggest the need for stronger incentives, clearer communication of benefits, and easier access to community activities to boost sustained involvement.

Table 10: Perceived Need for Additional Environmental Hygiene Interventions

Value	Frequency	Percentage (%)
Strongly Agree	123	37.16
Agree	144	43.50
Neutral	28	8.45
Disagree	23	6.94
Strongly Disagree	13	3.92
Total	**331**	**100**

Table 10 reveals overwhelming support for expanding hygiene initiatives: 80.66% of respondents agree or strongly agree that additional interventions are needed.

Only 10.86% of the sample disagree or strongly disagree, while 8.45% remain neutral.

This strong consensus underscores the community's recognition that existing programs are insufficient and points to broad public backing for scaling up sanitation infrastructure, outreach campaigns, and regulatory enforcement.

Table 11: Main Challenges Hindering Effective Environmental Hygiene Practices

Value	Frequency	Percentage (%)
Low public awareness and participation in hygiene practices	102	30.82
Inadequate waste collection and disposal infrastructure	76	22.96
Poor enforcement of environmental hygiene regulations	64	19.34
Insufficient government funding and resources for sanitation	51	15.41
Rapid urbanization and population growth	38	11.48
Total	**331**	**100**

Table 11 indicated that nearly one-third of respondents (30.82%) identify low public awareness and participation as the primary barrier to effective hygiene, underscoring gaps in community education and engagement.

Inadequate waste infrastructure ranks second at 22.96%, followed by weak regulatory enforcement (19.34%) and limited government funding (15.41%).

Rapid urban growth contributes the least (11.48%), though it compounds existing challenges by straining under-resourced systems.

These insights point to the need for multifaceted interventions: bolster public outreach, upgrade waste services, enforce standards, and secure dedicated sanitation budgets.

Table 12: Accessibility of Waste Disposal Facilities and Clean Water Sources

Value	Frequency	Percentage (%)
Very Inaccessible	72	21.75
Inaccessible	113	34.13
Neutral	78	23.56
Accessible	49	14.80
Very Accessible	19	5.74
Total	**331**	**100**

Table 12 show that over half of residents (55.88%) find waste disposal and water services inaccessible or very inaccessible, highlighting serious infrastructure gaps.

A quarter (23.56%) remain neutral perhaps reflecting uneven service coverage—while only 20.54% report these facilities as accessible or very accessible.

This pronounced disparity indicates that expanding and upgrading disposal sites and water points must be a priority to ensure universal access and reduce environmental health risks.

3.3 key areas for improvement in hygiene strategies and infrastructure to enhance disease prevention efforts in Jalingo Metropolis.

Table 13: Suggested Improvements for Waste Management Systems

Improvement Option	Frequency	Percentage (%)
Increase waste collection points and bins	95	28.70
Promote recycling programs and awareness campaigns	76	22.96
Improve the frequency of waste collection	64	19.34
Implement strict waste disposal laws and penalties	51	15.41
Encourage private sector participation	45	13.60
Total	**331**	**100**

In table 13 the respondents prioritize expanding infrastructure 28.70% call for more collection points and bins underscoring the need for easier disposal access. Recycling initiatives and

public education rank second (22.96%), reflecting strong support for behavior-change campaigns. Increasing collection frequency (19.34%) and enacting stricter disposal laws (15.41%) follow, while 13.60% advocate private sector involvement. Taken together, these preferences highlight a multi-pronged approach: boost physical assets, engage citizens through awareness, enforce regulations, and explore public-private partnerships.

Table 14: Need for Stricter Enforcement of Environmental Hygiene Regulations

Value	Frequency	Percentage (%)
Agree	140	42.29
Strongly Agree	96	29.00
Neutral	46	13.89
Disagree	20	6.04
Strongly Disagree	9	2.71
Total	**331**	**100**

Table 14 show a combined 71.29% of respondents agree or strongly agree on the need for tougher enforcement of hygiene regulations, demonstrating widespread backing for more rigorous oversight. Only 8.75% oppose stricter measures, and 13.89% remain neutral. These findings underscore community demand for accountability mechanisms such as fines, regular inspections, and clearer rules to ensure compliance and elevate overall sanitation standards in Jalingo Metropolis.

Table 15: Public Awareness Regarding the Importance of Environmental Hygiene

Value	Frequency	Percentage (%)
Excellent	61	18.42
Good	64	19.33
Neutral	52	15.70
Poor	79	23.86
Very Poor	75	22.65
Total	**331**	**100**

Table 15 indicated that over 46% of respondents rate public awareness of environmental hygiene as poor or very poor, indicating widespread gaps in community knowledge.

Only 37.75% believe awareness is good or excellent, while 15.70% remain neutral.

These results underscore the urgent need for intensified education and outreach campaigns to elevate understanding of hygiene's role in disease prevention across Jalingo Metropolis.

3.4 Correlation between Hygiene Practices and Disease Experience

Table 16. Correlation Analysis results

Variable	Correlation with Disease Experience
Waste Disposal Practices	–0.134
Awareness of Hygiene Interventions	–0.067
Perceived Environmental Cleanliness	+0.030
Perceived Hygiene Effectiveness	–0.067

Table 16, a negative correlation of –0.134 between proper waste disposal practices and household disease experience indicates that respondents who report consistently disposing of

waste correctly tend to experience fewer infectious disease cases. This aligns with prior research linking inadequate waste management to higher infection rates and suggests that scaling up waste-collection infrastructure could lower disease burden in Jalingo.

The weak inverse association (r = –0.067) between awareness of local hygiene interventions and disease experience implies that better-informed individuals report marginally fewer illnesses. Although modest, this finding underscores the value of public health education campaigns in empowering residents to adopt preventive behaviors.

Perceived environmental cleanliness shows a slight positive correlation (r = +0.030) with disease experience. This counterintuitive result suggests that communities judging their surroundings as "clean" may still harbor unseen hazards highlighting disconnect between subjective perception and actual sanitary conditions.

Finally, the correlation of –0.067 for perceived hygiene effectiveness indicates that respondents who believe strongly in the role of cleanliness report fewer infections. Reinforcing this belief through evidence-based messaging and visible sanitation gains could motivate wider adherence to hygiene practices and further reduce disease transmission.

Summary of Findings

This study assessed how environmental hygiene influences the prevention of infectious diseases in Jalingo Metropolis. Key findings include:

i. Nearly half of residents rate their environment as poor or very poor (48.24%), and over 61% report frequent improper waste disposal, highlighting pervasive sanitation challenges.
ii. Only 30.28% of respondents always practice proper waste disposal; an additional 30.63% do so occasionally, indicating inconsistent behavior change.
iii. More than half of households (52.57%) experienced at least one infectious disease episode in the past year. Correlation analysis revealed:
    - Proper waste disposal correlates negatively with disease incidence (r = –0.134).
    - Awareness of hygiene interventions (r = –0.067) and belief in hygiene's effectiveness (r = –0.067) both show slight inverse associations with reported infections.
iv. Public perception of local authority interventions is mixed: only 40.78% are aware of official hygiene programs, and fewer than 38% rate these efforts as very or extremely effective.
v. Community engagement is limited just 25.37% participate always or frequently in clean-up drives and over 80% believe additional interventions are needed.
vi. Major barriers include low public awareness (30.82%), inadequate infrastructure (22.96%), and weak regulatory enforcement (19.34%). Over half the population finds waste disposal and clean water facilities inaccessible.
vii. Residents prioritize expanding waste-collection points (28.70%), boosting recycling and education (22.96%), and enforcing hygiene laws more strictly (15.41%).

Discussion

Perception and Practice of Environmental Hygiene

Our survey revealed that nearly half of Jalingo residents rate environmental cleanliness as poor or very poor (48.24%) and that improper waste disposal occurs frequently or very frequently for 61.21% of respondents (Tables 1 & 2). These perceptions echo findings by Ahmed et al. (2023), who documented widespread dissatisfaction with waste management in Taraba State, and Okoh et al. (2023), who linked inadequate disposal infrastructure to recurrent infection outbreaks in Nigerian urban centers. Yet the fact that 41.37% view their environment positively suggests localized successes perhaps in neighborhoods targeted by recent sanitation drives mirroring Adebayo and Salami's (2022) observation that infrastructure investments can yield pockets of behavioral change.

Just 30.28% of respondents always practiced proper waste disposal, with another 30.63% doing so occasionally (Table 3). This intermittent compliance aligns with Staniford and Schmidtke's (2020) systematic review, which found that multifaceted interventions (combining education and infrastructure) produce higher but still imperfect adherence. Our data underline the importance of not just installing bins, but continually reinforcing usage through community engagement.

Hygiene Awareness, Interventions, and Disease Experience

Over half of households (52.57%) reported infectious diseases in the past year (Table 4), underscoring the high endemic burden noted by Yusuf et al. (2023). Correlation analysis showed that proper waste disposal ($r = –0.134$) and belief in hygiene's effectiveness ($r = –0.067$) are inversely related to disease reports (Section 3.4). Though modest, these negative associations support Ameme et al.'s (2023) findings in Ghana that stronger sanitation behaviors measurably reduce cholera and typhoid incidence.

Despite this, only 40.78% of respondents are aware of local authority hygiene interventions, and just 37% rate these interventions as very or extremely effective (Tables 5 & 6). This contrasts with Hassan et al. (2023), who recorded higher awareness (55%) following a state-wide campaign in Eastern Nigeria, suggesting Jalingo's outreach may have fallen short in scope or visibility.

Community Engagement and Program Effectiveness

Public health education topped the list of most effective interventions (30.21%), followed by clean water access (24.17%) (Table 8). These priorities reflect the WHO's 2023 report showing that *Water, Sanitation, and Hygiene (*WASH) centered education prevents more DALYs per dollar invested than infrastructure alone. However, participation in clean-up activities remains limited only 25.37% of residents always or frequently engage (Table 9) echoing Smith et al.'s (2023) observation that community buy-in lags when programs lack incentives or local champions.

A strong majority (80.66%) believe additional interventions are needed (Table 10), signaling broad public support for scaling up. This parallels Nyamai et al. (2022), who noted high

demand in Eastern Africa for expanded sanitation and hygiene services once populations recognize their health benefits.

Structural Barriers and Policy Implications

Low public awareness (30.82%), inadequate infrastructure (22.96%), and weak enforcement (19.34%) emerged as the top challenges (Table 11). These mirror the barriers identified in the Biomed Central scoping review on Africa's WASH practices namely funding gaps, governance issues, and cultural norms that impede uptake. Over half of respondents (55.88%) find waste and water facilities inaccessible (Table 12), underscoring the need for strategic siting of collection points and boreholes in underserved districts.

Suggested improvements more bins (28.70%), recycling and education (22.96%), and tighter disposal laws (15.41%) align with the WASH Fit toolkit's recommendations for integrated infrastructure, behavior-change campaigns, and regulatory frameworks. Moreover, 71.29% call for stricter enforcement (Table 14), echoing Ministerial directives in Taraba State's 2024 sanitation policy, which have yet to translate into consistent inspections and penalties.

Bridging Perception and Reality

A slight positive correlation ($r = +0.030$) between perceived cleanliness and disease experience suggests that subjective assessments may underestimate hidden contamination an insight also reported by Njeru et al. (2021) in Kenyan towns. This highlights the importance of objective sanitation audits (e.g., microbial water testing) rather than relying solely on visual cues.

Toward Sustainable, Inclusive Hygiene Programs

Taken together, these findings underscore that combating infectious diseases in Jalingo requires:

- Combine infrastructure (bins, sanitation facilities) with continuous education.
- Prioritize high-risk areas identified through health records and perceptual gaps.
- Mobilize local enforcement teams for regular inspections and fines.
- Develop incentives (e.g., waste-to-energy schemes) and local champions to drive participation.

By learning from recent successes and gaps documented both regionally (Ameme et al., 2023; Ahmed et al., 2023) and globally (WHO, 2023; Staniford & Schmidtke, 2020), Taraba State can craft evidence-based, context-tailored interventions that not only raise awareness but also dismantle structural barriers thereby achieving tangible reductions in infectious disease transmission.

Conclusion and Recommendations

The evidence demonstrates that environmental hygiene is a critical determinant of infectious disease dynamics in Jalingo Metropolis. While pockets of effective practice exist, widespread gaps in infrastructure, awareness, and enforcement perpetuate high disease burdens. To bridge these gaps, the following actions are recommended:

1. Install additional waste bins and establish more collection points in underserved neighborhoods.
2. Expand access to protected water sources and public sanitation facilities.

3. Launch targeted hygiene-promotion campaigns in local languages, emphasizing links between specific behaviors and disease risk.
4. Engage schools, faith groups, and market associations as conduits for messaging and peer-to-peer advocacy.
5. Mobilize municipal health officers for routine inspections and apply graduated penalties for non-compliance.
6. Publicize enforcement actions to reinforce accountability and motivate community adherence.
7. Incentivize private sector investment in waste recycling and low-cost sanitation solutions.
8. Explore community-based micro-enterprises for waste collection and resource recovery.
9. Use health surveillance data to identify "hotspots" and tailor intensified interventions (e.g., door-to-door clean-up drives) where disease incidence is highest.
10. Establish key performance indicators (e.g., reduction in reported infections, increases in bin usage) and track progress quarterly.
11. Incorporate microbial water testing and environmental audits to validate visual cleanliness assessments.

By implementing these integrated measures—combining hardware (infrastructure), software (education and enforcement), and heartware (community ownership)—stakeholders can achieve sustainable improvements in environmental hygiene and realize substantial reductions in infectious disease transmission across Jalingo Metropolis and similar urban centers.

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