

Original Research Article

Integrated Household Environmental Health Conditions and Their Independent Predictors in an Urban Nigerian Community: A Community-Based Cross-Sectional Study

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Abstract: Household water, sanitation, waste management, food hygiene and housing conditions interact to shape environmental health risks. This study assessed these domains together and identified independent predictors in an urban Nigerian community. A community-based cross-sectional survey included 747 adults responsible for household environmental practices in Uselu Community, Edo State. One ward and one geographical cluster were randomly selected, followed by complete household enumeration. An interviewer-administered questionnaire assessed perceived drinking-water quality and handling, refuse and sewage disposal, food-safety practices and housing conditions. Descriptive statistics and multivariable logistic regression were used. Favourable perceived drinking-water quality and handling was reported by 732 (98.0%) households, sanitary sewage disposal by 696 (93.2%), good food-safety practices by 658 (88.1%) and good housing conditions by 606 (81.1%). However, 266 (35.6%) practised insanitary refuse disposal. Females had higher odds of sanitary refuse disposal than males (aOR=2.23; 95% CI: 1.61-3.07), while low socioeconomic status was associated with lower odds (aOR=0.52; 95% CI: 0.30-0.90). Insanitary refuse disposal predicted lower odds of sanitary sewage disposal (aOR=0.26; 95% CI: 0.14-0.48) and good food-safety practices (aOR=0.56; 95% CI: 0.35-0.90). Most assessed conditions were favourable, but unsafe refuse disposal remained a substantial deficiency and clustered with poorer sanitation and food hygiene. Integrated, equity-oriented interventions should combine affordable waste services, sanitation, hygiene promotion and proportionate environmental enforcement. Interpretation

should consider the cross-sectional design, self-reported measures and single-cluster sampling.

Keywords: Environmental Health; Environmental Sanitation; Food Safety; Housing; Solid Waste Management; Urban Health

INTRODUCTION

Household environmental health is shaped by the conditions in which water is obtained and stored, excreta and refuse are managed, food is prepared, and people are housed. Deficiencies in these domains increase exposure to enteric pathogens, vectors, indoor pollutants and other preventable hazards. International guidance, therefore, treats safe water, sanitation, hygiene, housing and environmental management as complementary components of disease prevention rather than isolated services (World Health Organization, 2018; World Health Organization, 2024a; World Health Organization and United Nations Children's Fund, 2023).

Rapid urbanisation makes this integrated perspective particularly important. Population growth can improve access to services, but it can also outpace municipal waste collection, drainage, sanitation and affordable housing. In Nigeria, unsafe refuse disposal, inadequate wastewater management, intermittent water services and environmental contamination remain important concerns despite national WASH commitments (United Nations Children's Fund, 2022; Federal Ministry of Water Resources and Sanitation, 2023). Solid-waste challenges have also been documented in Benin City and other Nigerian settings (Ogbonna, 2019; Chikwe and Ibeh, 2023).

Most Nigerian studies evaluate water, sanitation, food hygiene, waste management or housing separately. This can obscure the clustering of environmental risks within the same household. A household constrained by poverty or weak municipal services may simultaneously experience unsafe waste disposal, poor sanitation and suboptimal food hygiene. Evidence that WASH indicators jointly reflect faecal contamination risk further supports multidomain assessment (Wolf et al., 2019).

This study therefore assessed perceived household drinking-water quality and handling, refuse disposal, sewage disposal, food-safety practices and housing conditions in Uselu Community, Edo State. It also examined independent predictors of sanitary refuse disposal, sanitary sewage disposal and favourable food-safety practices. The findings are intended to support integrated and equity-sensitive urban environmental-health planning.

MATERIALS AND METHODS

A community-based analytical cross-sectional study was conducted from March to April 2025 in Uselu Community, Egor Local Government Area, Edo State, Nigeria. Uselu is an urban community within the Benin metropolitan area, with mixed residential,

commercial and institutional land use and increasing demand for water, sanitation, drainage and waste-management services.

Eligible participants were household heads or other responsible adults aged at least 18 years who had lived in the community for six months or longer and were directly involved in household water management, sanitation, refuse disposal, food preparation or housing maintenance. Critically ill persons, individuals unable to communicate adequately and those who did not consent were excluded. Only one respondent was interviewed per household.

The minimum sample size was calculated with Cochran's formula for a single population proportion, using a prevalence of 50%, 95% confidence level and 5% precision, which yielded 384 participants (Cochran, 1977). A two-stage cluster procedure was used. Uselu II ward was selected from the ten political wards by simple random sampling. The ward was divided into two naturally occurring geographical clusters by the Ugbowo-Lagos Expressway, and one cluster was randomly selected. All eligible households in the selected cluster were then enumerated. A total of 747 completed interviews were included in the analysis.

Data were collected with a semi-structured interviewer-administered questionnaire adapted mainly from the environmental-health modules of the 2018 Nigeria Demographic and Health Survey (National Population Commission and ICF, 2019). The instrument covered sociodemographic characteristics, drinking-water source and handling, refuse and sewage disposal, food-safety practices and housing conditions. Environmental-health specialists and epidemiologists reviewed the questionnaire for content relevance and clarity. It was pretested among approximately 5% of the calculated sample in a neighbouring urban community; pretest data were excluded.

Trained research assistants administered the questionnaire in English or the respondent's preferred local language. Responses were entered into Google Forms on password-protected devices. Mandatory fields and daily checks reduced missing data and inconsistencies.

Socioeconomic status was classified as high, middle or low using a Nigerian scheme combining education, occupation and household income (Ibadin and Akpede, 2021). Composite percentage scores were created for perceived drinking-water quality and handling, food-safety practices and housing conditions. Items were coded in the direction of healthier practice and summed; scores of at least 70% were classified as favourable. Sensitivity checks using 65% and 75% thresholds did not materially alter the direction or statistical significance of the principal associations.

The drinking-water measure incorporated source, reported colour, taste and odour, treatment, storage and retrieval practices. Because no microbiological or physicochemical testing was performed, it is reported as perceived drinking-water quality and handling rather than objective water safety. Refuse disposal through recognised collection services or approved sites was classified as sanitary; indiscriminate dumping, disposal into drains and

inappropriate open burning were classified as insanitary. Sewage disposal was classified according to whether the facility hygienically separated excreta from human contact. The food-safety index covered hand hygiene, storage, protection from pests, separation of raw and cooked food, reheating and kitchen hygiene. The housing index covered structural condition, crowding, ventilation, cooking environment, sanitation, drainage and environmental hazards.

Data were analysed with IBM SPSS Statistics version 27 (IBM Corp., 2020). Continuous variables were summarised with means and standard deviations where appropriate; categorical variables were summarised with frequencies and percentages. Three multivariable binary logistic regression models were reported for sanitary refuse disposal, sanitary sewage disposal and favourable food-safety practices. Adjusted odds ratios (aORs), 95% confidence intervals (CIs) and two-sided p-values were presented, with statistical significance set at $p < 0.05$. No problematic multicollinearity was detected (variance inflation factors < 5), and Hosmer-Lemeshow tests were non-significant. Pseudo- R^2 values were interpreted only as descriptive measures of model performance. Reporting was guided by the STROBE statement (von Elm et al., 2007).

Ethical considerations

Permission to conduct the survey was obtained from relevant community stakeholders and administrative authorities. Participants received information about the study, voluntary participation, confidentiality and their right to withdraw, and written informed consent was obtained. Identifiers were excluded from the analytical dataset, and electronic data were password-protected. Prospective institutional research ethics committee approval was not obtained before data collection; this governance limitation is disclosed transparently. The survey procedures nevertheless followed principles of voluntary participation, privacy and risk minimisation described in the Declaration of Helsinki (World Medical Association, 2025).

RESULTS AND DISCUSSION

The 747 respondents had a mean age of 37.0 ± 12.95 years; 50.5% were female, 76.2% lived in households of five persons or fewer, and 85.9% had at least secondary education (Table 1). This young, educated urban profile is important because global and African evidence links education, wealth and urban residence with better water, sanitation and hygiene access. Nigerian analyses show the same advantage among urban and wealthier households (Azeez et al., 2023; World Health Organization and United Nations Children's Fund, 2023). The favourable findings may partly reflect selection of one relatively advantaged cluster and should not be generalised beyond the study area.

Table 1: Sociodemographic characteristics of respondents (n=747)

Characteristic	Frequency (n)	Percentage (%)
Age group (years)		
18-29	252	33.7
30-39	209	28.0

Characteristic	Frequency (n)	Percentage (%)
40-49	170	22.8
≥50	116	15.5
Mean±SD (years)	37.0±12.95	-
Sex		
Female	377	50.5
Male	370	49.5
Household size		
≤5 persons	569	76.2
>5 persons	178	23.8
Educational level		
No formal education	28	3.7
Primary	77	10.3
Secondary	387	51.8
Tertiary	255	34.1
Monthly household income		
<₦70,000	169	22.6
₦70,000-₦139,999	247	33.1
≥₦140,000	331	44.3

SD, standard deviation.

The environmental-health profile was favourable but uneven. Perceived drinking-water quality and handling were favourable in 98.0% of households, sanitary sewage disposal in 93.2%, food-safety practices in 88.1% and housing conditions in 81.1%; sanitary refuse disposal was lower at 64.4% (Table 2 and Figure 1). Globally, 27% of people lacked safely managed drinking water and 43% lacked safely managed sanitation in 2022, with sub-Saharan Africa recording particularly slow progress (World Health Organization and United Nations Children's Fund, 2023). Nigerian national analysis reported 73% use of improved water sources and 55% use of improved sanitation (Azeez et al., 2023). Uselu's higher estimates are encouraging but not directly comparable because they derive from self-reported composite measures in one urban cluster rather than the stricter criteria for safely managed services.

The 98.0% drinking-water result represents favourable perception and handling, not microbiological safety. International monitoring defines safely managed water by source type, accessibility, availability and freedom from contamination; appearance, taste and odour cannot demonstrate these conditions (World Health Organization and United Nations Children's Fund, 2023). Across sub-Saharan Africa, water treatment varies with education, knowledge, product availability and risk perception (Atalay et al., 2024). In Nigeria, 73% used improved sources but only about 8% reported household treatment (Azeez et al., 2023). Uselu's result may reflect safer storage and higher education, but self-report and the study-specific threshold may also inflate it. Household education on covered storage and hygienic retrieval should therefore be accompanied by periodic microbiological and physicochemical testing.

Solid waste was the weak link: 35.6% of households practised insanitary disposal. Globally, rapidly growing cities often generate waste faster than collection and disposal systems expand (United Nations Human Settlements Programme, 2024). Studies in Ethiopia and Ghana similarly report open dumping or burning where collection is irregular, disposal points are distant and enforcement is weak (Eshete et al., 2024; Barimah et al., 2025). The finding is also comparable with Benin City evidence: 36% of households in one survey managed waste independently, while monthly collection encouraged street littering and on-site burning (Amedu et al., 2020); earlier local research identified persistent infrastructure and collection gaps (Ogbonna, 2019). Unsafe disposal can block drains, worsen flooding, support vectors, expose residents to smoke and contaminate water or food. Education should be combined with reliable collection schedules, affordable charges, accessible approved disposal points and fair enforcement against dumping and open burning.

Table 2: Household environmental-health conditions and selected housing characteristics (n=747)

Domain/characteristic	Classification	n (%)
Perceived drinking-water quality and handling	Favourable	732 (98.0)
	Unfavourable	15 (2.0)
Refuse disposal	Sanitary	481 (64.4)
	Insanitary	266 (35.6)
Sewage disposal	Sanitary	696 (93.2)
	Insanitary	51 (6.8)
Food-safety practices	Good	658 (88.1)
	Poor	89 (11.9)
Housing conditions	Good	606 (81.1)
	Poor	141 (18.9)
Persons per room	≤2	606 (81.1)
	>2	141 (18.9)
Adequate natural ventilation	Yes	622 (83.3)
	No	125 (16.7)

Composite classifications were based on the operational definitions described in the Methods.

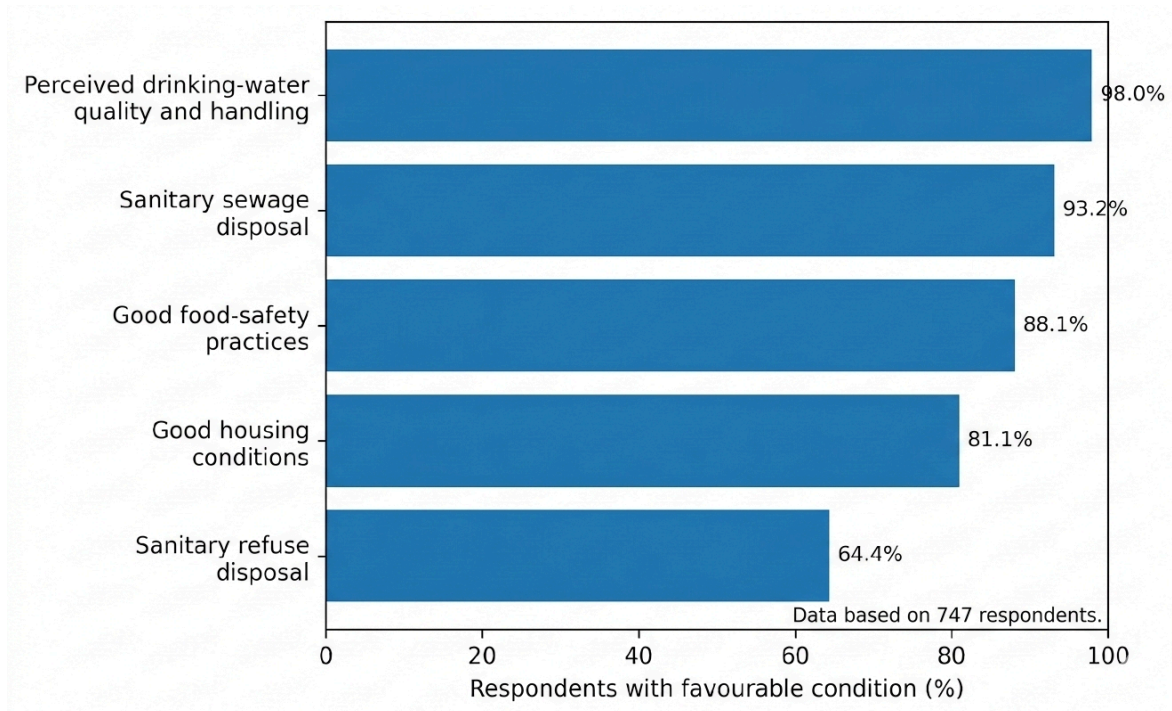


Figure 1: Distribution of favourable household environmental-health conditions among respondents (n=747).

Female respondents had more than twice the adjusted odds of sanitary refuse disposal, whereas low socioeconomic status reduced the odds by 48% relative to high status (Table 3). Globally, women and girls often carry disproportionate household water, sanitation and hygiene responsibilities while having less influence over infrastructure and financing (World Health Organization and United Nations Children's Fund, 2023). African household waste practices are likewise shaped by service access, resources and social roles. In Nigeria, analysis of 5,000 households found that disposal choices varied with gender pattern, education, household size, tenure, toilet and water access, region and urban residence (Uma et al., 2020). This supports the observed direction, although respondent sex is not equivalent to sex of the household head and the cross-sectional association is not causal. Low-income households may be unable to pay collectors or may live where services are unreliable. Equity-oriented programmes should therefore subsidise underserved areas and engage men and women without transferring additional unpaid sanitation work to women.

Table 3: Independent predictors of sanitary refuse disposal

Predictor	aOR	95% CI	p-value
Sex			
Male	1.00	Reference	-
Female	2.23	1.61-3.07	<0.001
Socioeconomic status			
High	1.00	Reference	-
Middle	0.78	0.52-1.15	0.206

Predictor	aOR	95% CI	p-value
Low	0.52	0.30-0.90	0.019

aOR, adjusted odds ratio; CI, confidence interval. Cox-Snell $R^2=0.066$; Nagelkerke $R^2=0.091$; Hosmer-Lemeshow $p>0.05$; VIF <5 .

Age had only a small association with sanitary sewage disposal; the more compelling result was clustering. Households practising insanitary refuse disposal had about 74% lower odds of sanitary sewage disposal, while insanitary refuse and sewage disposal independently reduced the odds of good food-safety practices (Table 4). Globally, water, excreta, waste, hands, food and flies are recognised as connected contamination pathways (Wolf et al., 2019). African evidence likewise shows that sanitation and hygiene share household and neighbourhood determinants. Nigerian studies identify wealth, education, residence, household structure and service availability as major predictors of sanitation access (Abubakar, 2017; Azeez et al., 2023). The associations may therefore reflect common financial and service constraints rather than direct causation; the cross-sectional design cannot establish temporal order.

Good food-safety practices were reported by 88.1% of households, above the 54% pooled African estimate and the 17.6%-86.0% range reported across included studies (Soboksa et al., 2025), but broadly consistent with favourable Nigerian findings (Fasoro et al., 2016). Differences in education, instruments, cut-offs and social desirability bias may explain the contrast. The African review identified latrines, handwashing facilities, liquid-waste disposal, knowledge, education and wealth as determinants, supporting the links observed here. The pathway is biologically plausible: exposed refuse attracts flies and rodents, while unsafe sewage disposal increases opportunities for enteric pathogens to reach hands, utensils and food. Food-safety education should therefore be integrated with sanitation and waste management rather than delivered alone.

Table 4: Independent predictors of sanitary sewage disposal and favourable food-safety practices

Outcome/predictor	aOR	95% CI	p-value
Sanitary sewage disposal			
Age (per one-year increase)	0.974	0.949-0.999	0.043
Male	1.00	Reference	-
Female	0.646	0.348-1.199	0.166
Sanitary refuse disposal	1.00	Reference	-
Insanitary refuse disposal	0.255	0.136-0.478	<0.001
Favourable food-safety practices			
Sanitary refuse disposal	1.00	Reference	-
Insanitary refuse disposal	0.559	0.347-0.902	0.017
Sanitary sewage disposal	1.00	Reference	-
Insanitary sewage disposal	0.365	0.176-0.756	0.007

aOR, adjusted odds ratio; CI, confidence interval. Sewage model: Cox-Snell $R^2=0.044$, Nagelkerke $R^2=0.113$. Food-safety model: Cox-Snell $R^2=0.057$, Nagelkerke $R^2=0.110$. Hosmer-Lemeshow $p>0.05$ and $VIF<5$ for both models.

Housing conditions were favourable for 81.1% of respondents; 83.3% reported adequate natural ventilation, and 81.1% had no more than two persons per room. Globally, healthy housing includes structure, crowding, ventilation, sanitation, drainage, neighbourhood hazards and affordability (World Health Organization, 2018). Across African cities, these conditions are uneven, especially in informal settlements. Uselu's profile contrasts with an Enugu urban-slum study in which poor housing and overcrowding were common (Ogbonna et al., 2024), illustrating that “urban” communities are not homogeneous. However, the composite score may conceal individual defects, and self-report cannot replace inspection for dampness, mould, structural hazards or indoor smoke.

The public-health response should therefore join municipal capacity with household action. Egor Local Government and state agencies should map underserved streets, publish reliable collection schedules, expand affordable collection and approved disposal points, and enforce anti-dumping rules without penalising households lacking a realistic service. Environmental-health officers, primary healthcare teams and community leaders should reinforce safe storage, food hygiene, excreta management and shared household responsibility. Surveillance should combine disaggregated household indicators with water testing, environmental inspection and service-coverage data.

Assessing five domains together and analysing 747 interviews made the clustering of risks visible. Nevertheless, cross-sectional data cannot establish causality; self-report is vulnerable to recall and social-desirability bias; water and housing were not objectively tested or inspected; and the study-specific 70% threshold requires external validation. All respondents came from one selected cluster, so between-cluster variability could not be estimated, confidence intervals may be too narrow and generalisation is limited. Low pseudo- R^2 values indicate that service frequency, disposal distance, charges, enforcement, tenure and neighbourhood governance were not captured. The absence of prospective institutional ethics committee review is an additional governance limitation. Overall, solid-waste management remained the principal weakness.

CONCLUSION

Households in the surveyed Uselu cluster reported favourable conditions for perceived drinking-water quality and handling, sewage disposal, food safety and housing. Solid-waste disposal was the major deficiency, and lower socioeconomic status was associated with poorer refuse disposal. The relationships among refuse disposal, sewage disposal and food-safety practices indicate that household environmental risks cluster rather than occur independently. Public-health action should therefore combine affordable municipal waste services, sanitation improvement, household hygiene promotion and equity-sensitive enforcement. Objective water testing, environmental inspection and multicentre studies are needed to confirm and extend these findings.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

AVAILABILITY OF DATA AND MATERIALS

The data and study materials supporting the findings are available from the corresponding author on reasonable request, subject to ethical, confidentiality and data-protection requirements.

ARTIFICIAL INTELLIGENCE DISCLOSURE

Generative artificial intelligence was used only for language refinement and formatting. It was not used to generate or analyse data, perform statistical analyses or determine the conclusions. All AI-assisted content was reviewed and approved by the authors, who retain full responsibility for the manuscript.

References

1. Abubakar, I. R. (2017). Access to sanitation facilities among Nigerian households: determinants and sustainability implications. *Sustainability*, 9(4): 547. doi:10.3390/su9040547.
2. Amedu, E. I., Emejulu, M. J. and Aighewi, I. T. (2020). Household solid waste management survey in Benin City agglomeration, Edo State, Nigeria. *Nigerian Research Journal of Engineering and Environmental Sciences*, 5(1): 296-305.
3. Atalay, Y. A., Gebeyehu, N. A. and Gelaw, K. A. (2024). Household water treatment practice and associated factors in sub-Saharan Africa: a systematic review and meta-analysis. *Environmental Health Insights*, 18(1): 11786302241281651. doi:10.1177/11786302241281651.
4. Azeez, O., Henderson-Mitchell, R. J., LaFavor, M. C. and Gregg, A. (2023). Socioeconomic predictors of access to improved water sources, sanitation facilities, and household water treatment in Nigeria. *Journal of Water, Sanitation and Hygiene for Development*, 13(11): 875-884. doi:10.2166/washdev.2023.169.
5. Barimah, A. J., Addo, H. O., Dumba, J., Kwame, K. E. N., Atteh, L. A. and Juliana, K. M. (2025). Assessing solid waste disposal practices and environmental impacts in three communities of Ghana's Ahafo Region. *Scientific Reports*, 15(1): 42180. doi:10.1038/s41598-025-25962-w.
6. Chikwe, O. and Ibeh, E. (2023). Comparing sewage and solid waste disposal methods among households in urban and rural local government areas of Anambra State. *Global Journal of Pure and Applied Sciences*, 29(2): 13-21.
7. Cochran, W. G. (1977). *Sampling Techniques*. 3rd ed. New York, NY: John Wiley & Sons.
8. Eshete, A., Temesgen, H., Gemechu, T., Alemu, A. and Daba, M. (2024). Investigation of environmental and health impacts of solid waste management problems and associated factors in Asella Town, Ethiopia. *Heliyon*, 10(6): e28203. doi:10.1016/j.heliyon.2024.e28203.
9. Fasoro, A. A., Faeji, C. O., Oni, O. I. and Oluwadare, T. O. (2016). Assessment of food safety practices in a rural community in southwest Nigeria. *Food and Public Health*, 6(3): 59-64.
10. Federal Ministry of Water Resources and Sanitation (2023). *National Action Plan for the Revitalization of Nigeria's WASH Sector*. Abuja, Nigeria: Federal Ministry of Water Resources and Sanitation.
11. Ibadin, M. O. and Akpede, G. O. (2021). A revised scoring scheme for the classification of socioeconomic status in Nigeria. *Nigerian Journal of Paediatrics*, 48(1): 26-33. doi:10.4314/njp.v48i1.5.
12. IBM Corp. (2020). *IBM SPSS Statistics for Windows, Version 27.0*. Armonk, NY: IBM Corp.

13. National Population Commission (Nigeria) and ICF (2019). *Nigeria Demographic and Health Survey 2018*. Abuja, Nigeria and Rockville, MD: National Population Commission and ICF.
14. Ogbonna, D. N. (2019). Solid waste management in Benin City: the challenges and prospects. *Journal of Applied Sciences and Environmental Management*, 23(1): 163-167.
15. Ogbonna, S. N., Ochie, C. N. and Aniwada, E. C. (2024). Urban slum housing quality and its public health implications in Nigeria: a case of urban slum residents in Enugu Metropolis. *BMC Public Health*, 24(1): 3231. doi:10.1186/s12889-024-20764-7.
16. Soboksa, N. E., Hareru, H. E., Nxusani, Z. N., Nedzingahe, V. and Mbhenyane, X. G. (2025). A systematic review and meta-analysis of household food safety and hygiene practices and their determinants in Africa. *BMC Nutrition*, 11(1): 220. doi:10.1186/s40795-025-01190-3.
17. Uma, K. E., Nwaka, I. D., Nwogu, M. U. and Obidike, P. C. (2020). What are the triggers of household decision-making on waste disposal choices? A gender differentiated analysis. *Heliyon*, 6(12): e05588. doi:10.1016/j.heliyon.2020.e05588.
18. United Nations Children's Fund (2022). Water, Sanitation and Hygiene (WASH) in Nigeria. Abuja, Nigeria: UNICEF. Retrieved on 1 August 2026 from: <https://www.unicef.org/nigeria/water-sanitation-and-hygiene>.
19. United Nations Human Settlements Programme (2020). World Cities Report 2020: The Value of Sustainable Urbanization. Nairobi, Kenya: UN-Habitat.
20. United Nations Human Settlements Programme (2024). World Cities Report 2024: Cities and Climate Action. Nairobi, Kenya: UN-Habitat.
21. von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C. and Vandenbroucke, J. P. (2007). The Strengthening the Reporting of Observational Studies in Epidemiology statement: guidelines for reporting observational studies. *PLoS Medicine*, 4(10): e296. doi:10.1371/journal.pmed.0040296.
22. Wolf, J., Johnston, R., Hunter, P. R., Gordon, B., Medlicott, K. and Prüss-Ustün, A. (2019). A Faecal Contamination Index for interpreting heterogeneous diarrhoea impacts of water, sanitation and hygiene interventions and community sanitation coverage, with a focus on low- and middle-income countries. *International Journal of Hygiene and Environmental Health*, 222(2): 270-282. doi:10.1016/j.ijheh.2018.11.005.
23. World Bank (2024). *Poverty, Prosperity, and Planet Report 2024*. Washington, DC: World Bank.
24. World Health Organization (2018). *WHO Housing and Health Guidelines*. Geneva, Switzerland: World Health Organization. Retrieved on 1 August 2026 from: <https://www.who.int/publications/i/item/9789241550376>.
25. World Health Organization (2024a). *Compendium of WHO and Other United Nations Guidance on Health and Environment*. Geneva, Switzerland: World Health Organization.
26. World Health Organization and United Nations Children's Fund (2023). *Progress on Household Drinking Water, Sanitation and Hygiene 2000-2022: Special Focus on Gender*. Geneva, Switzerland: WHO and UNICEF.
27. World Medical Association (2025). World Medical Association Declaration of Helsinki: ethical principles for medical research involving human participants. *Journal of the American Medical Association*, 333(1): 71-74. doi:10.1001/jama.2024.21972.



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