RUANG
Jurnal Perencanaan Wilayah dan Kota
Available online at http://ejournal2.undip.ac.id/index.php/ruang/

Ruang Volume 11 Nomor 2, 2025, 80-92
P-ISSN 1858-3881
E-ISSN 2356-0088

Urban Residential Density and Open Defecation In Osogbo, Osun State, Nigeria

Kepadatan Permukiman Perkotaan dan Praktik Buang Air Besar Sembarangan di Osogbo, Negara Bagian Osun, Nigeria

Adedotun David Oluwatoyin[1*], Olayode Olayiwola[1], Olayode Christiana[1]
[1] Department of Urban and Regional Planning Osun State University, Osogbo
*Corresponding Author. E-mail: david.adedotun@uniosun.edu.ng

ABSTRACT

The study examines the relationship between urban residential density and open defecation in Osogbo to provide a comprehensive database to develop guidelines for policy making. Primary and secondary data sources were used to investigate information on the number of toilets available, places used for open defecation, and reasons for open defecation. A multi-stage sampling approach was adopted, which included stratification of Osogbo into three (3) residential density areas, followed by random selection of respondents in each sampled density. Due to population variation of the residential density areas selected a proportionate sampling technique was used in selecting a sample size of 240 respondents using a ratio of 1:2:3. Differences in observations were tested with the Chi-square statistical technique, while the mean value was used to determine respondents' reasons and places used for open defecation in the study area. Precisely, 54.2% of respondents were involved in open defecation in the high residential density areas, while 50% were involved in the low residential density areas. As high as 62.5% of respondents used open space for defecation in the medium residential density areas, while 50% and 37.5% of respondents used the same in the high and low residential density areas. Absence of toilet facility ranked as the highest reason for open defecation across the 3 residential density areas, with 58.3%, 43.7%, and 62.5% respondents in the high, medium, and low residential density areas. Multiple Analysis of Variance (MANOVA) shows that residential density has no significant relationship with the incidence of open defecation in the study area, with a P-value of .0670. There is a need for a vigorous campaign on the health implications of open defecation on the residents' quality of life and the environment in general.

***Keywords**: Human quality of life, Open defecation, Residential density, Urban area*

ABSTRAK

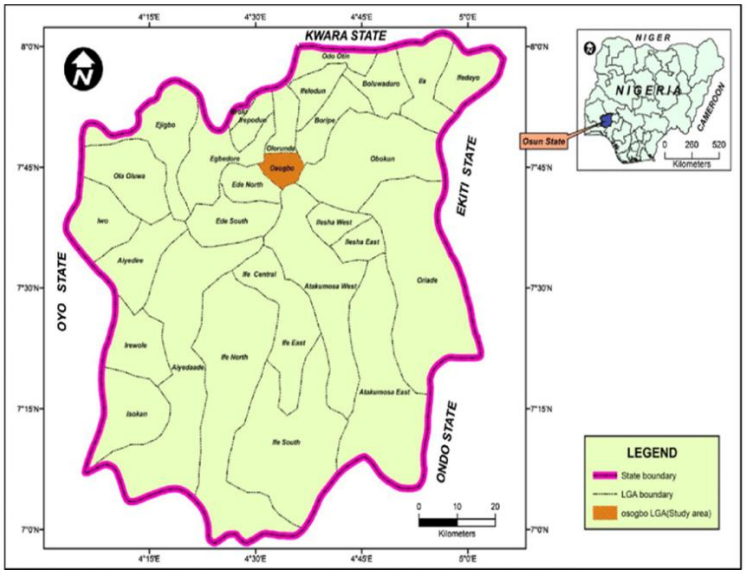
Penelitian ini mengkaji hubungan antara kepadatan permukiman perkotaan dan praktik buang air besar sembarangan (BABS) di Osogbo untuk menyediakan basis data komprehensif sebagai dasar penyusunan pedoman bagi pembuat kebijakan. Sumber data primer dan sekunder digunakan untuk memperoleh informasi mengenai jumlah fasilitas toilet yang tersedia, lokasi yang digunakan untuk BABS, serta alasan dilakukannya BABS.Pendekatan sampling bertingkat (multi-stage sampling) digunakan, dimulai dengan melakukan stratifikasi wilayah Osogbo ke dalam tiga (3) kategori kepadatan permukiman, kemudian dilanjutkan dengan pemilihan responden secara acak pada tiap kategori kepadatan tersebut. Karena adanya variasi jumlah penduduk pada masing-masing kategori kepadatan, teknik proportionate sampling digunakan untuk mendapatkan ukuran sampel sebanyak 240 responden dengan rasio 1:2:3. Perbedaan antar temuan dianalisis menggunakan teknik statistik Chi-square, sementara nilai rata-rata digunakan untuk mengetahui alasan dan lokasi yang digunakan responden untuk melakukan BABS di area studi. Secara spesifik, 54,2% responden melakukan BABS di kawasan permukiman berkepadatan tinggi, sementara 50% melakukannya di kawasan berkepadatan rendah. Sebanyak 62,5% responden di kawasan berkepadatan sedang menggunakan ruang terbuka untuk BABS, sementara di kawasan berkepadatan tinggi dan rendah masing-masing sebesar 50% dan 37,5%. Ketiadaan fasilitas toilet menjadi alasan utama dilakukannya BABS di ketiga kategori kepadatan permukiman, masing-masing sebesar 58,3%, 43,7%, dan 62,5% pada kawasan berkepadatan tinggi, sedang, dan rendah. Hasil analisis Multivariate Analysis of Variance (MANOVA) menunjukkan bahwa kepadatan permukiman tidak memiliki hubungan signifikan dengan kejadian BABS di wilayah studi, dengan nilai P sebesar 0,0670.Diperlukan kampanye yang lebih intensif mengenai dampak kesehatan dari praktik BABS terhadap kualitas hidup warga serta terhadap lingkungan secara umum.

***Kata kunci**:* Kualitas hidup manusia, BABS, Kepadatan permukiman, Kawasan perkotaan

1. Introduction

Urbanization has led to rapid population growth in many developing countries, particularly in sub-Saharan Africa, often outpacing the capacity of cities to provide basic sanitation infrastructure. This mismatch has resulted in the persistence of open defecation (OD) even within urban areas, contributing significantly to environmental degradation, water pollution, and the spread of communicable diseases such as diarrhea and cholera (Babatope, 2023); (Cairncross et al., 2010). Open defecation is a recognized barrier to achieving Sustainable Development Goal 6, which targets universal access to adequate sanitation by 2030 (UNICEF & WHO, 2019). Despite global and national efforts, urban Nigeria still faces high levels of open defecation, with densely populated and underserved areas disproportionately affected (Muktar et al., 2024). Common interventions such as public toilet construction and hygiene education often neglect the spatial and structural determinants of sanitation behavior, particularly the role of residential density. Overcrowding, informal housing, and infrastructural deficits are rarely addressed systematically in sanitation policies, creating implementation gaps (Desai et al., 2015); (Fox et al., 1980).

Emerging research has highlighted the relationship between urban form and sanitation outcomes. Studies suggest that high residential density, especially in low-income settlements, correlates with inadequate toilet access, overburdened waste systems, and higher OD prevalence (Yi et al., 2024); (Palacio et al., 2018). Conversely, when properly managed, urban density can facilitate infrastructure efficiency and coordinated sanitation service delivery (Dempsey et al., 2012). Thus, density-sensitive planning may offer targeted pathways to reduce OD in urban environments. Although numerous studies have investigated sanitation access in urban Nigeria, few have examined the spatial relationship between urban residential density and open defecation in mid-sized cities like Osogbo. Most existing literature either focuses on rural sanitation behaviors or treats urban populations as homogeneous units, overlooking intra-urban variations (Aliyu & Dahiru, 2019); (Desai et al., 2019). Moreover, there is a lack of empirical data linking population density metrics with spatial patterns of OD in Nigerian cities. This limits the development of density-sensitive sanitation policies and interventions. This study aims to examine the relationship between urban residential density and open defecation practices in Osogbo, Nigeria, using spatial analysis and socio-demographic data. The novelty of this research lies in its focus on urban density as a key predictor of sanitation behavior, a dimension underexplored in Nigerian sanitation literature. The hypothesis is that higher residential density, when not supported by adequate infrastructure, correlates with increased OD rates. The scope includes mapping OD prevalence, analyzing density gradients, and identifying spatial clusters of sanitation vulnerability providing actionable insights for urban planners and public health policymakers.



Gambar 1. Map of Osogbo in the context of Osun State, Nigeria (Researchgate.net, edited by the authors', 2024)

2. Method

This study employed a cross-sectional survey design to investigate the relationship between urban residential density and open defecation practices in Osogbo, Nigeria. The research focused on generating empirical evidence through structured household questionnaires and physical environmental observation. Quantitative methods were used to analyze statistical relationships between residential density categories and sanitation behavior. This approach is consistent with established sanitation research protocols in urban settings without geospatial tools (Oyekale, 2017). The study population comprised residential households in Osogbo, stratified into three categories based on residential density: high, medium, and low. A multistage sampling procedure was used. First, neighborhoods were grouped into density categories using administrative zoning data. Ten neighborhoods were randomly selected from each category. Second, 20 households per neighborhood were systematically sampled using every nth household approach, yielding a total of 600 households. A structured questionnaire was developed to gather data on demographic characteristics, toilet access, sanitation practices, and frequency of open defecation. Additionally, environmental observations were conducted at each household to assess the physical presence of toilets and surrounding sanitation conditions. The questionnaire was adapted from national sanitation surveys and validated through expert review. Reliability testing through a pilot study in a non-sampled area produced a Cronbach's alpha of 0.83, indicating strong internal consistency (Nallari, 2015). Data collection was conducted over four consecutive weeks by trained enumerators using paper-based surveys and observation checklists. Household heads or adult representatives were interviewed. Observational checklists included indicators such as availability and functionality of toilet facilities, evidence of open defecation near premises, and waste disposal patterns. This dual method has been validated in non-GIS sanitation studies in similar urban settings (Sahu et al., 2022).

All enumerators received two days of training on interview techniques, ethical protocols, and observation standards. Informed consent was obtained from all respondents. The field team worked under supervision to ensure protocol compliance and data consistency. Key parameters measured included:

- Residential density category: high, medium, or low, based on administrative classification.
- Open defecation incidence: self-reported practice within or near the household.
- Toilet accessibility: presence, type (private/shared), and functional status.
- Sanitation behavior: frequency of open defecation, handwashing practice, and waste disposal behavior.
- Environmental sanitation: observational ratings of visible fecal matter, drainage quality, and waste proximity.

These parameters were defined using WHO-UNICEF Joint Monitoring Programme indicators and adapted for the urban Nigerian context (Sclar et al., 2018).Data were coded and entered into SPSS version 25. Descriptive statistics such as frequency, percentage, and mean were used to summarize household characteristics and sanitation variables. Chi-square tests assessed the association between residential density and reported open defecation. Binary logistic regression models were applied to identify predictors of open defecation, controlling for variables such as income, education, and toilet type. Statistical significance was set at $p < 0.05$. This analytical framework aligns with methodologies used in similar urban sanitation studies without spatial data (Adeniyi & Adewole, 2022).

3. Result and Discussion

3.1 Data Analysis

The collected data were subjected to rigorous analysis employing both descriptive and inferential statistical techniques. Descriptive statistics, including percentages, frequencies, and tabular presentations, were utilized to comprehensively profile respondents' socio-economic characteristics, classify urban residential density, and examine patterns of open defecation practices. Key variables analyzed descriptively included residents' involvement in open defecation, household size, availability of sanitation facilities

(number of toilets), specific locations where open defecation occurs, and the motivations behind these practices. To evaluate the statistical significance of observed differences across residential density categories and other categorical variables, the chi-square (χ^2) test of independence was conducted. This inferential test allowed for assessing the relationship between socio-demographic factors and open defecation behaviors. Furthermore, mean values were calculated to quantify respondents' reasons for practicing open defecation as well as the common locations utilized for such activities. This helped identify predominant factors influencing sanitation behaviors and spatial preferences for open defecation within the study area. Together, these analytical approaches provided a robust framework for understanding the dynamics of open defecation in relation to urban residential density and socio-economic characteristics of the population.

3.2 Residential Density and Types of Toilet

Table 1 shows that 41.7% of the respondents in the high residential density areas use water closet toilet facilities in their houses, while 40.0% and 8.3% of the respondents use pit/latrine and bucket toilet facilities, respectively, in their houses. It is quite unfortunate that as high as 10.0% of the respondents do not have any toilet facility at all in their houses. This justifies why the incidence of open defecation was high in places like Sabo, Oja-oba, Isale-oja, Asubiaro, and Oke-Bale, which are majorly high residential density areas in Osogbo. Again, 56.2%, 25.0%, and 12.5% of respondents use water closet, pit/laterine, and bucket toilet facilities in their houses in the medium residential density areas. What is most surprising is that as high as 15.0% of the respondents in the low residential density areas in Osogbo do not have any toilet facility in their houses. This is mainly due to the level of poverty in the study area. The majority of respondents in this category move into their houses that are yet to be completed. Furthermore, 75.0% and 5.0% of respondents use water closets, pit/latrine, as well as bucket facilities in their houses.

Table 1. Toilet types across the residential density areas (Author's fieldwork, 2024)

Density	Water closet	Pit/Laterine	Bucket	None	Total
High	50	48	10	12	120
%	41.7	40.0	8.3	10.0	100.0
Meduim	45	20	10	5	80
%	56.2	25.0	12.5	6.3	100.0
Low	30	2	2	6	40
%	75.0	5.0	5.0	15.0	100.0
Total	**125**	**70**	**22**	**23**	**240**

Table 1 highlights the types and availability of toilet facilities across different residential density areas in Osogbo. In high residential density areas, 41.7% of respondents have water closet toilets in their homes, while 40.0% use pit or latrine facilities, and 8.3% rely on bucket toilets. Alarmingly, 10.0% of respondents in these densely populated neighbourhoods have no toilet facilities at all. This lack of basic sanitation infrastructure helps explain the high incidence of open defecation in areas such as Sabo, Oja-oba, Isale-oja, Asubiaro, and Oke-Bale, all known for their dense populations. In medium-density areas, the situation appears somewhat better, with a majority of respondents (56.2%) using water closets, 25.0% using pit or latrine facilities, and 12.5% relying on buckets. Despite this improvement, the absence of adequate sanitation facilities still remains a challenge. Perhaps most surprising is the finding in low residential density areas, where 15.0% of respondents reported having no toilet facility at all. This is primarily attributed to poverty and the fact that many residents move into houses that are not yet completed, lacking basic amenities. Among those with facilities, 75.0% use water closets and 5.0% use pit or latrine toilets. The data reveals a clear link between poverty, housing conditions, and access to proper sanitation across all residential densities. The absence or inadequacy of toilet facilities, especially in high-density and poorer neighbourhoods, drives open defecation practices, posing serious health and environmental risks in these communities.

3.3 Residential density and residents' involvement in open defecation

In the high residential density areas, 54.2% of respondents said they practice open defecation, especially at the back of their houses, while 33.3% said they do not practice open defecation at all in their houses. This is because the majority of respondents in this category are enlightened; they know the implications of open defecation on their health and the environment at large (Table 2).

Table 2. Residents' involvement in open defecation (Author's fieldwork, 2024)

Density	Yes	No	Yes and No	Total
High	65	40	15	120
%	54.2	33.3	12.5	100.0
Medium	35	40	5	80
%	43.8	50.0	6.2	100.0
Low	20	15	5	40
%	50.0	37.5	12.5	100.0
Total	**120**	**95**	**25**	**240**

In addition, 4 3.8% and 50.0% of respondents in the medium and low residential density areas practice open defecation in the study area. Again, 12.5%, 6.2%, and 12.5% of respondents in the high, medium and low residential density areas gave mixed answers (Yes and No) for their involvement in the practice of open defecation. The practice of open defecation in the study area exhibits a clear relationship with residential density and levels of awareness among the population. In high-density residential areas, where people live closely together, a significant proportion (54.2%) still engage in open defecation, often in secluded spots like the back of their houses. However, a notable 33.3% refrain from this practice, likely due to higher levels of education and awareness about the negative health and environmental consequences of open defecation. This suggests that even within crowded urban settings, enlightenment and knowledge can significantly influence sanitary behaviours and reduce harmful practices.

Conversely, open defecation remains prevalent in medium and low-density areas, with 43.8% and 50.0% of respondents, respectively, admitting to practicing it. This may indicate that, despite lower population density, infrastructural deficits, such as inadequate access to proper sanitation facilities, persist, or that cultural practices and socioeconomic factors play a stronger role in these communities.The presence of mixed responses (ranging from 6.2% to 12.5%) across all density categories points to a complexity in behaviour, where some individuals may alternate between using latrines and practicing open defecation depending on circumstances like facility availability, privacy, or social norms. Therefore, these findings highlight the multifaceted nature of sanitation challenges in the area, underscoring that improving knowledge alone, while essential, may not fully eradicate open defecation unless accompanied by accessible sanitation infrastructure and community engagement tailored to the unique conditions of each residential density zone.

3.4 Household Size and Number of Toilets

Table 3 shows that in the high residential density areas, 68.3% of respondents within the household of 1 – 4 have only 1 – 2 toilet facilities, while 29.2% of respondents within the household of 5 – 10 have between 3 and 4 toilet facilities (Table 3). In the medium residential density areas, 56.3% of respondents within the household of 1 – 4 have between 1 and 2 toilet facilities, while 37.5% within the household of 5 – 10 have between 3 and 4 toilet facilities. This implies that in most of the households, toilet facilities are not sufficient for the members, which deductively leads them to practice open defecation.

Table 3. Number of toilets and household size (Author's fieldwork, 2024)

Density	Household size	No of toilet facilities	Frequency	Percentage
High	1 – 4	1 - 2	82	68.3
	5 – 10	3 - 4	35	29.2
	11 and above	5 and above	3	2.5
Total			**120**	**100.0**
Medium	1 – 4	1 - 2	45	56.3
	5 – 10	3 - 4	30	37.5
	11 and above	5 and above	5	6.2
Total			**80**	**100.0**
Low	1 – 4	1 - 2	15	37.5
	5 – 10	3 – 4	20	50.0
	11 and above	5 and above	5	12.5
Total			**40**	**100.0**

In the low residential density areas, 37.5% and 50.0% of households between 1 -4 and 5 – 10 have between 1 -2 and 3 – 4 toilet facilities in their houses. Sequel to the information in Table 3, it is very clear that in all the residential density areas in the study area, toilet facilities are not sufficient to cater for the needs of the inhabitants. In as much as there is a shortage of toilet facilities in the house, there is no way some will not be defecating outside when they are pressed, especially the children. The data from Table 3 paints a troubling picture of the availability of toilet facilities across various residential density areas. In the high-density areas, a large majority of smaller households (with 1–4 members) rely on just one or two toilet facilities. Even in larger households (5–10 members), many still share a limited number, usually just three or four. The situation is similar in medium-density areas, where more than half of the smaller households also manage with one or two toilets, while a good number of larger households have slightly more, but still not enough to comfortably meet the needs of all their members.

This shortfall in toilet facilities suggests that, in many homes, the number of people outweighs the number of available toilets. As a result, it's not hard to imagine the pressure this puts on families, especially during times of urgency. For children and even adults, this often means stepping outside to relieve themselves, leading to a rise in open defecation. Even in the low-density residential areas, where homes are generally expected to have better amenities, the pattern remains. Although households in these areas fare slightly better, with some larger households having up to four toilets, it is still not enough to serve everyone adequately, especially during peak usage times. In simple terms, what this tells us is that across all types of neighbourhoods, whether crowded or spacious, many families are dealing with a shortage of toilet facilities. This not only affects daily comfort and hygiene but also has serious implications for public health and environmental cleanliness. Without enough toilets in homes, open defecation becomes an unfortunate, yet unavoidable, reality for many.

3.5 Places Used for Open Defecation

As high as 62.5% of respondents use open space for defecation in the medium residential density area, while 50.0% and 37.5% of respondents use the same in the high and low residential density areas (Table 4). Again, in the high residential density areas, 10.0%, 16.7%, and 19.2% use stream, backyard, and uncompleted buildings for their open defecation In addition, 6.3%, 12.5%, and 15.0% of respondents use stream, backyard, and uncompleted buildings for open defecation in the medium residential density areas. Moreover, 15.0%, 25.0%, and 17.5% of respondents use stream, backyard, and uncompleted buildings for open defecation in the low residential density areas in the study area. Again, 4.1%, 3.7%, and 5.0% of respondents in the high, medium, and low residential density areas use other means for their open defecation. This includes people who use roads, dump sites, and drainages for their defecation.

Table 4. Places used for open defecation across the residential density areas (Author's fieldwork, 2024)

Density	High		Medium		Low	
	Count	%	Count	%	Count	%
Open space	60	50.0	50	62.5	15	37.5
Stream	12	10.0	5	6.3	6	15.0
Backyard	20	16.7	10	12.5	10	25.0
Uncompleted Building	3	19.2	12	15.0	7	17.5
Others	5	4.1	3	3.7	2	5.0
Total	**120**	**100.0**	**80**	**100.0**	**40**	**100.0**

It can be deduced from the study that, the analysis of open defecation practices across different residential density areas reveals a disturbing trend that underscores the sanitation challenges in the study area. In the medium residential density areas, the situation appears most alarming, with as many as 62.5% of respondents admitting to using open spaces for defecation. This is followed by 50.0% in high-density areas and 37.5% in low-density areas, showing that open defecation is prevalent across all residential categories, though more pronounced in the medium-density zones.

Further breakdown shows that in high-density areas, aside from open spaces, other unconventional and unsanitary locations are also being used. About 10.0% of respondents defecate in streams, 16.7% in backyards, and 19.2% in uncompleted buildings. Similarly, in medium-density areas, 6.3% use streams, 12.5% use backyards, and 15.0% defecate in uncompleted buildings. Even in low-density areas, where one might expect better sanitation, the problem persists. 15.0% use streams, 25.0% use backyards, and 17.5% use uncompleted buildings for defecation. What's particularly concerning is that a small but notable percentage of people in all three residential categories, 4.1% in high-density, 3.7% in medium-density, and 5.0% in low-density areas, resort to defecating in places like roadsides, dump sites, and drainages. These practices not only highlight the dire lack of proper sanitation facilities but also pose serious health and environmental risks to the wider community. Therefore, the data paints a stark picture: regardless of whether people live in high, medium, or low residential density areas, many are still forced to defecate in the open due to inadequate toilet facilities. This reinforces the urgent need for improved sanitation infrastructure and public health interventions aimed at curbing open defecation across all parts of the study area.

3.6 Reasons for Open Defecation as Reported by Respondents

Respondents gave reasons for their involvement in the practice of open defecation across the residential density areas in the study area. Absence of toilet facility ranked highest across the 3 residential density areas, with 58.3%, 43.7%, and 62.5% respondents in the high, medium, and low residential density areas (Table 5).

Table 5. Reasons for open defecation across the residential density areas (Author's fieldwork, 2024)

Reason	High	%	Medium	%	Low	%
Poverty	6	5.0	10	12.5	5	12.5
Tradition	4	3.3	5	6.3	2	5.0
Absence of Toilet	70	58.3	35	43.7	25	62.5
Insufficient Toilet	20	16.7	20	25.0	5	12.5
Unsuitable Toilet	20	16.7	10	12.5	3	7.5
Total	**120**	**100.0**	**80**	**100.0**	**40**	**100.0**

Again, 16.7%, 25.0%, and 12.5% of respondents practice open defecation due to insufficient of toilet facilities in their houses. Unsuitable toilet facilities account for 16.7%, 12.5%, and 7.5% of respondents in the high, medium, and low residential density areas. Tradition accounts for just 3.3%, 6.3%, and 5.0% of respondents in the high, medium, and low residential density areas. This implies that tradition does not even support the practice of open defecation in the study area.The reasons behind the widespread practice of open defecation in the study area reveal that the issue is primarily rooted in poor sanitation infrastructure, not cultural tradition. Across all residential density areas, high, medium, and low, the absence of toilet facilities stood out as the leading cause. In high-density areas, 58.3% of respondents cited this as the reason for defecating in the open. Similarly, 43.7% in medium-density and a striking 62.5% in low-density areas reported the same challenge. These figures clearly show that many households simply do not have access to any toilet facilities at all. Another significant factor is the insufficiency of toilet facilities.

Even when toilets exist, they are often not enough to meet the needs of all household members. This issue was reported by 16.7% of respondents in high-density areas, 25.0% in medium-density areas, and 12.5% in low-density areas. Additionally, the unsuitability of existing toilets, possibly due to poor construction, lack of privacy, or unclean conditions, also contributes to the problem. This was mentioned by 16.7%, 12.5%, and 7.5% of respondents in the high, medium, and low residential density areas, respectively. Interestingly, tradition played a minimal role in the continuation of open defecation. Only a small percentage, 3.3% in high-density, 6.3% in medium-density, and 5.0% in low-density areas, claimed cultural or traditional reasons for the practice. This suggests that open defecation in the study area is not a socially or culturally accepted norm, but rather a forced response to the lack of basic sanitation amenities. Hence, the data deduced from the findings strongly imply that with improved access to adequate, sufficient, and suitable toilet facilities, the rate of open defecation could significantly decrease, as it is largely driven by necessity rather than choice.

3.7 Mean Value for the Reasons for Open Defecation by Respondent

Table 6 shows that the absence of a toilet (3.48) has the highest mean value, followed by insufficient toilet facilities. Poverty has a 2.24 mean value while unsuitable toilet facilities have a 1.86 mean value. Tradition has the lowest mean value of 1.12, which implies that tradition in Osogbo does not support open defecation. Those who practice it in the study area do so contrary to tradition and their inadequate knowledge about the effects of open defecation on their health and the environment at large.

Table 6. Mean value analysis for the reasons for open defecation (Author's fieldwork, 2024)

Reason	N	Minimum	Maximum	Mean	Std. deviation
Poverty	121	1	4	2.24	.671
Tradition	113	1	4	1.12	.773
Absence of Toilet	119	1	6	3.48	.813
Insufficient Toilet	115	1	4	3.14	.651
Unsuitable Toilet	111	`1	2	1.86	.543

The data presented in Table 6 provides deeper insight into the underlying factors responsible for open defecation in the study area. The absence of toilet facilities emerged as the most significant contributor, with the highest mean score of 3.48, indicating that many households simply do not have access to any form of sanitation facility. This is followed closely by insufficient toilet facilities, which also recorded a high mean value, reinforcing the point that even when toilets exist, they are often too few to serve all members of a

household adequately. Poverty was another notable factor, with a mean score of 2.24. This suggests that financial constraints limit residents' ability to construct or access proper toilet facilities. Unsuitable toilet facilities, such as those that are poorly designed, unsafe, or unhygienic, had a mean of 1.86, indicating that their condition also discourages usage, leading some to resort to open defecation instead. Interestingly, tradition had the lowest mean value of 1.12, which clearly implies that open defecation is not a culturally accepted practice in Osogbo. This dispels any assumption that the habit is rooted in traditional norms. Rather, those who engage in open defecation are doing so out of necessity, and often due to a lack of awareness of the serious health and environmental risks involved. Thus, the findings suggest that open defecation in Osogbo is not driven by tradition but by structural and socio-economic limitations, particularly the absence or inadequacy of toilets and the impact of poverty. Addressing these gaps through public education and infrastructure development could significantly reduce the practice.

3.8 Mean Value for Places Used for Open Defecation

Backyard has the highest mean value of 3.14, followed by open space with a mean value of 2.95. This implies that the majority of respondents who practice open defecation use the backyard of their houses and open spaces available close to their houses. These open spaces are likely to be undeveloped plots of land close to them in the new sites.

Table 7. Mean value analysis for the places used for open defecation (Author's fieldwork, 2024)

Places	N	Minimum	Maximum	Mean	Std. deviation
Open space	113	1	4	2.95	7.15
Stream	105	1	2	1.15	6.51
Backyard	119	1	6	3.14	.813
Uncompleted building	103	1	2	1.75	5.63
Others	101	1	2	1.03	4.19

Table 7 shows that others have the least mean value of 1.03, followed by those who use stream with a mean value of 1.15. This is because streams are not available in most of the residential density areas in the study area. The data from Table 7 reveals the most commonly used locations for open defecation among residents in the study area. Backyards recorded the highest mean value of 3.14, closely followed by open spaces, which had a mean value of 2.95. This suggests that the majority of respondents who practice open defecation prefer to do so in the immediate surroundings of their homes, particularly in the backyard or in nearby open spaces. These open areas are often undeveloped plots of land, especially common in newly developing residential sites, where infrastructure is still lacking. On the other hand, streams and other unconventional locations, such as roadsides, drainage channels, and refuse dumps, were the least commonly used, with mean values of 1.15 and 1.03, respectively. The low usage of streams is likely due to their limited presence across most residential density areas in Osogbo. Similarly, the "others" category scored low because these locations are generally less accessible or are socially unacceptable for such practices.The analysis highlights that open defecation is largely taking place within or very close to residential compounds, reflecting both the immediacy of need and lack of proper sanitation infrastructure. This pattern poses serious health and environmental concerns, particularly in densely populated neighbourhoods, and points to an urgent need for improved access to safe and private toilet facilities.

3.9 The Interaction between Residential Density and Incidence of Open Defecation

The MANOVA result of the relationship between residential density and open defecation as the criterion variable, as presented in Table 8, shows that residential density has no significant relationship with the incidence of open defecation. This implies that people practice open defecation across the residential density areas in the study area. It is observed in Table 8 that the overall interaction of the predictor variable, residential density, with the incidence of open defecation criterion variables is not significant, as p = .119. The implication of this is that open defecation is not influenced by residential density. There may be a slight variation in the incidence of open defecation across the 3 residential density areas, but this variation is not statistically significant based on the MANOVA result obtained in the Table. The summary of the MANOVA result in Table 8 further provides important insight into the relationship between residential density and the practice of open defecation. According to the analysis, residential density does not have a statistically significant effect on the incidence of open defecation, as indicated by a p-value of .119. This means that although open defecation may appear to vary slightly across high, medium, and low-density residential areas, these differences are not significant enough to conclude that residential density directly influences the behaviour.

Table 8. Interaction between Residential Density and Incidence of Open Defecation (Author's fieldwork, 2024)

Effect	Value	F	Hypothesis df	Sig.	Remark	Observed power a
pillar's Trace	.034	1.549	10.000	.119	Not Sig.	.766
Respondents Wilk's Lambda	.966	1.549	10.000	.119	Not Sig	.766
Hotelling's Trace	.035	1.549	10.000	.119	Not Sig.	.766
Roy's Largest Root	.035	1.549	10.000	.119	Not Sig.	.766

In simple terms, open defecation is a widespread issue that cuts across all residential density types in the study area. Whether people live in crowded neighbourhoods or more spacious areas, the likelihood of them engaging in open defecation is not significantly different. This finding highlights that the practice is not confined to any particular type of residential environment but is rather a general problem driven by other factors, such as lack of toilet facilities, poverty, or poor infrastructure. The implication is clear: efforts to eliminate open defecation should not be limited to specific types of neighbourhoods. Instead, interventions should be broad-based and inclusive, targeting the root causes that cut across all residential categories, such as improving access to functional and affordable sanitation facilities, public awareness, and policy enforcement.

The findings of this study reveal that open defecation (OD) practices in Osogbo occur across all residential density zones and cannot be explained solely by population density. This aligns with Aluko (2024), who found that key determinants of OD in Nigeria are economic conditions and infrastructural access, rather than mere geographic location or density. Although high-density zones recorded the highest prevalence of OD, low-density areas also exhibited significant rates, indicating that urbanization alone does not guarantee improved sanitation access. Moreover, the statistically insignificant relationship between residential density and OD practices (p = 0.119) mirrors the findings of Agha et al. (2024), who noted that behavior change does not always correspond with improvements in physical infrastructure. Factors such as comfort perception, availability of clean and adequate toilet facilities, and education levels often have greater influence over toilet usage decisions than residential characteristics.

Furthermore, the study's finding that lack of toilet facilities and the unsuitability of existing toilets are the main drivers of OD is supported by Babatope (2023). Using Demographic and Health Survey (DHS) data, Babatope demonstrated that toilet quality and privacy significantly impact OD behavior, especially in densely populated, low-income urban settings. This emphasizes that simply building toilets is not enough—accessibility, quality, and social acceptance must also be addressed. Interestingly, this study also

challenges the common perception that OD is culturally driven. With “tradition” scoring the lowest mean value (1.12), it reinforces Onyemaechi (2022), who reported that OD in Osun State is largely shaped by structural deficiencies rather than cultural or religious practices. These findings carry several critical implications. First, sanitation policy interventions should not focus exclusively on densely populated or low-income areas but should adopt a city-wide approach. Second, solutions must go beyond infrastructure provision and incorporate education, toilet quality improvements, and community-based behavioral interventions. This is in line with the social and moral awareness approach suggested by Nyatsikor (2024), who advocated integrating value-based strategies into anti-OD campaigns.Overall, OD in Osogbo is driven by a complex interaction of economic, structural, and behavioral factors. Addressing it requires multi-sectoral, inclusive, and sustained efforts that move beyond reactive measures toward transformational change in urban sanitation systems.

4. Conclusion

This study has shown that open defecation remains a critical public health issue in Osogbo, occurring across all residential density zones. The data indicate that the practice is driven primarily by inadequate sanitation infrastructure, poor toilet quality, and economic constraints rather than population density or cultural norms. A key insight from the analysis is that residential density does not significantly predict open defecation behavior, as evidenced by the lack of statistical significance in the MANOVA test. Instead, residents in both high- and low-density areas reported similar challenges, particularly the absence of toilets and the use of incomplete or shared housing units with inadequate facilities. This finding aligns with prior research which emphasizes that access, maintenance, and affordability of sanitation infrastructure are more relevant than location alone. Furthermore, the reasons cited for open defecation such as poverty, toilet unsuitability, and lack of privacy highlight the need for more inclusive and practical interventions that address both structural and behavioral factors. The results also refute assumptions that tradition plays a dominant role, as only a small proportion of respondents cited it as a reason. These findings suggest that sanitation interventions must be comprehensive, targeting all residential areas with a combination of infrastructure improvements and education programs. Further research should explore the quality and usability of existing toilets, seasonal patterns in defecation behavior, the availability and use of public facilities, and the long-term effectiveness of behavioral change strategies.

To address the persistent challenge of open defecation in Osogbo, a multi-pronged approach is required. The state government, in coordination with local authorities and development partners, should prioritize investments in affordable and accessible sanitation infrastructure, particularly in low-income and densely populated neighborhoods. Public and household toilets should be subsidized, and regulations must require that even incomplete buildings provide at least one functional toilet before occupation. Community-led total sanitation (CLTS) approaches should be introduced to promote behavior change at the grassroots level by engaging residents directly in sanitation decisions and actions. Urban planning regulations must be enforced to ensure developers and landlords comply with sanitation standards, with penalties imposed for non-compliance. Public education campaigns should be expanded to raise awareness about the health risks of open defecation and the importance of toilet use, with schools and markets equipped with appropriate sanitation facilities and hygiene integrated into the school curriculum. Monitoring systems, including regular mapping of open defecation hotspots, can support more effective targeting of interventions. Because poverty remains a major barrier, financial mechanisms such as microfinance and sanitation loans should be made available to help households build or improve toilet facilities. Collaboration among government agencies, NGOs, planners, and health professionals is also essential to ensure that interventions are well-coordinated. Finally, legislative support can help sustain progress by prohibiting open defecation while simultaneously mandating state support for sanitation access.

References

O.B. (2019). Urban Sanitation in Nigeria: the Past, Current and Future Status of Access, Policies and Institutions. Review on Environmental Health 35 (2), 123 – 137. https//doi.org/10.1515/reveh – 2019 – 0025

Adeniyi, A., & Adewole, B. (2022). Sanitation infrastructure and hygiene behavior in low-income urban communities. Sustainable Environment Research, 32, 9. https://doi.org/10.1007/s11869-021-01079-w

Agboola, T.; Egunjobi, Layi. and Olatubara (2007) Housing Development and Management. Published by Department of Urban and Regional Planning, University of Ibadan, Nigeria. Pp 101 – 217.

Agha, A., Osuu, C., Onalu, C. E., & Adewoyin, Y. (2024). Rethinking community-led total sanitation for eradicating open defecation in rural Ebonyi state communities, Nigeria. Journal of Water, Sanitation and Hygiene for Development. https://doi.org/10.2166/washdev.2024.180

Ajiboye, A. (2004). The Socio-cultural Responsiveness of Household Size on Housing Quality in Osogbo, Nigeria. Anthropologist 6 (3): 169 – 174.

Akinola, S. R. (1998). Pattern of Housing Quality in Osogbo, Osun State. Ife Journal of Environmental Design and Management, Obafemi Awolowo University, Ile-Ife. Vol. 1 and 2:109 – 120.

Aliyu, A. A., & Dahiru, T. (2019). Factors associated with safe disposal practices of child's faeces in Nigeria. Nigerian Medical Journal, 60(4), 198–204. https://doi.org/10.4103/nmj.NMJ_3_19

Aluko, O. (2024). The dynamics of household sanitation services and faeco-oral diseases externalities in Osun State, southwest Nigeria. Transactions of the Royal Society of Tropical Medicine and Hygiene. https://doi.org/10.1093/trstmh/trae101

Angel, S. Y. (2010) Making Room for a Planet of Cities. Policy Focus Report. Cambridge, Massachusetts: Lincola Institute of Land Policy

Arimah, B. C. (2002). Effect of Deficient Infrastructure of Health Outcomes in Cities of Developing Countries. In Schulz, V. (ed) Urbanization and the Transition to Sustainability; International Human Dimensions Programme of Global Environmental Management (IHDP) Proceeding No. 6. 320 – 390.

Babatope, E. A. (2023). Household Determinants of Open Defecation in Urban Areas of Nigeria: Evidence from Demographic Health Survey. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4467833

Cairncross, S., Hunt, C., Boisson, S., et al. (2010). Water, sanitation and hygiene for the prevention of diarrhoea. International Journal of Epidemiology, 39(Suppl 1), i193–i205. https://doi.org/10.1093/ije/dyq035

Dempsey, N., Brown, C., & Bramley, G. (2012). The key to sustainable urban development in UK cities? Progress in Planning, 77, 89–141. https://doi.org/10.1016/j.progress.2012.01.001

Desai, R., McFarlane, C., & Graham, S. (2015). The politics of open defecation in Mumbai. Antipode, 47(1), 98–120. https://doi.org/10.1111/ANTI.12117

Desai, R., McFarlane, C., & Graham, S. (2019). The politics of open defecation. In The Right to Sanitation in India. https://doi.org/10.1093/oso/9780199489855.003.0009

Egunjobi, Layi (1997). The Link between Housing and Health in Amole, B. (ed) Habitat Studies in Nigeria: Some Qualitative Dimension; Ibadan, Shaneson C.I Ltd, 92 – 101.

Ezeudu Fox, B. J., Fox, J., & Marans, R. (1980). Residential density and neighbor interaction. Sociological Quarterly, 21(3), 349–359. https://doi.org/10.1111/j.1533-8525.1980.tb00617.x

Harris, Gardiner (2014). "Poor Sanitations in India may Afflict Well-fed Children with Malnutrition", The New York Times, 13 July,2014.

John (2016). "Effect of Njuguna Eliminating Open Defecation on Diarrhea Morbidity: An Ecological Study of Nyando and Nambale.A Vol.16, No.1, 2016. Sub-counties Kenya" BMC. Public Health,

Mabogunje, A.O. (2002) Shelter Provision in Developing Countries. John Willey, London. 130 – 200.

Ministry of Innovation, Science and Technology, 2020, Osogbo. Available from: https//Osun.gov.ng/about/major – towns/ Osogbo. Accessed 20 April, 2022.

Muktar, A., Ibrahim, S., & Yelwa, S. (2024). Geospatial insights into open defecation vulnerability in Gulumbe, Nigeria. SN Social Sciences. https://doi.org/10.1007/s43545-024-00972-z

Nallari, A. (2015). "All we want are toilets inside our homes!": The critical role of sanitation in the lives of urban poor adolescent girls in Bengaluru, India. Environment and Urbanization, 27(1), 73–88. https://doi.org/10.1080/19491247.2015.1016905

Nyatsikor, S. (2024). An Investigation of Biblical Approach to Sanitation in Deuteronomy 23:13: A Model to End Open Defecation in Nigeria and Ghana. International Journal of Research and Scientific Innovation. https://doi.org/10.51244/ijrsi.2024.1102039

Odogwu, G. (2019). Nigeria is the Open Defecation Capital of the World. The Punch (Lagos), May 30, P.26.

Onibokun, Poju. (1990). Urban Housing in Nigeria. Nigeria Institute of Social and Economic Research (NISER), Ibadan.

Onyemaechi, S. (2022). Burden and Determinants of Open Defecation: The Reality across the Rural and Urban Areas of Osun State, Southwest Nigeria. TEXILA International Journal of Public Health. https://doi.org/10.21522/tijph.2013.10.02.art022

Oyekale, A. S. (2017). Assessment of access to and use of improved sanitation in sub-Saharan Africa. Journal of Management and Sustainability, 7(2), 1–14. https://doi.org/10.5539/jms.v7n2p1

Palacio, F., Scherzer, S., & Frøyen, Y. (2018). The value of urban density. Tema. Journal of Land Use, Mobility and Environment, 11, 213–230. https://doi.org/10.6092/1970-9870/5484

Paul, Adepoju. (2019). Why Nigeria's Campaign to End Open Defecation is Failing (Devex, 13 August 2019).

Riva, M.; CURTIS, S. and Norman P. (2011). Residential Mobility with England and Urban Inequalities in Mortality. Social Science and Medicine, 73: 1698 – 1706.

Sahu, P., Sahoo, B. K., & Rout, S. K. (2022). Sanitation status and health outcome nexus in urban Odisha, India: A household-level study. Heliyon, 8(9), e08823. https://doi.org/10.1016/j.heliyon.2022.e08823

Sclar, G. D., Penakalapati, G., Caruso, B. A., et al. (2018). Exploring the relationship between sanitation and mental and social well-being: A systematic review. Health & Place, 53, 1–13. https://doi.org/10.1016/j.healthplace.2017.10.001

UNDP (2018). National Human Development Report 2018 – Achieving Human Development in North East Nigeria, UNDP, Nigeria.

UNICEF and WHO (2019). Progress on Household Drinking Water, Sanitation and Hygiene 2000 – 2017, Special Focus on Inequalities. UNICEF and WHO, New York.

United Nations (2015). Sustainable Development Goals: 17 goals to Transform our World – 2015. https://www.un.org/sustainable development/water- and- sanitation. Accessed 10th December 2022.

WHO and UNICEF (2017). Progress on Drinking Water and Sanitation – 2017 update: WHO Press; 2017. https://www.int/mediacentre/news/releases/2017/launch- version-report-jmp-water-sanitation-hygiene.pdf. Accessed 12th January,2022.

World Health Organization (2000) Regional Guidelines for Developing Healthy Cities Project. New York.

Yi, S., Li, X., Wang, R., et al. (2024). Interpretable spatial machine learning insights into urban sanitation challenges. Sustainable Cities and Society. https://doi.org/10.1016/j.scs.2024.105695