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Context Matters: A Multi-Country Analysis of Individual- and Neighborhood-Level Factors Associated with Women’s Sanitation Use in Sub-Saharan Africa

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Abstract

Objectives: To identify cross-national trends in factors associated with women’s sanitation use in sub-Saharan Africa.

Methods: Using data from Demographic and Health Surveys conducted in 14 SSA countries between 2008 – 2014, we modeled women’s sanitation use in relation to various individual- and neighborhood-level factors.

Results: Substantial variation exists between countries in the strength and direction of factors associated with sanitation use. Particularly significant associations across the region included access to different water sources, years of education, family size, age, living in a female-headed household, being married and wealth. Neighborhood-level poverty, ethnic diversity and urbanization were important factors in a majority of countries.

Conclusions: International development goals for sanitation are frequently framed in terms of availability, implicitly suggesting that if facilities are accessible, they will be used. A more nuanced view that takes into account not only the existence of facilities but also the factors influencing their use is needed to understand the dynamics of women’s sanitation use in the region. Policies focused on availability may not yield the desired public health benefits from improved sanitation in sub-Saharan Africa. Context-relevant factors must be addressed concurrently to achieve sanitation development goals.

Keywords: women; Sanitation; sub-Saharan Africa; DHS data; multi-country

Introduction

Approximately 2.4 billion people worldwide lack access to safe toilet facilities today.¹ Lack of access to sanitation remains a persistent problem in the Global South.²,³ In sub-Saharan Africa (SSA) recent reports suggest only 30% of the population use safe sanitation.¹ Even within the region, access to sanitation varies by

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country, with reported ranges of 15-93%. The health consequences of lack of access to sanitation around the world are well established. Poor sanitation has been linked to water-borne diseases such as diarrhea, typhoid, and other parasitic infections. In developing countries, in particular, almost half of the population has, at one time, suffered from diseases associated with lack of access to sanitation. Evidence also suggests that poor sanitation is one of the biggest killers of children under five through diseases like diarrhea and cholera.

Access to sanitation is often understood to be a function of availability, not choice or other constraining factors. Recently, however, discussions of factors that may influence sanitation use such as preference, willingness to pay, and experiences of health improvements have begun to appear in the literature. Some research has also identified psycho-social factors, e.g. religious and cultural rules as important drivers of sanitation use.

Scarce research on the factors that influence sanitation use has addressed neighborhood-level characteristics. For example, lack of access roads, broken or non-existent central water supply and/or sewer infrastructure, high population densities, complicated land ownership dynamics, and environmental barriers can make it difficult to build and maintain safe sanitation facilities in certain neighborhoods. Other studies suggest that the social environment can also influence individuals’ ability and desire to use existing sanitation options. Neighborhood-level factors such as crime rates, security lighting, 24-hour toilet facilities, and community safety may also exert an influence.

Women are disproportionately burdened by the persistent lack of access to safe sanitation. Recent studies have suggested a number of factors that may be associated uniquely with women’s sanitation use and, consequently, their health and well-being. For example, women’s experiences and/or fear of physical and sexual violence associated with having to walk to and use sanitation facilities, particularly in more violent neighborhoods (e.g. informal settlements), have forced many to revert to forms of sanitation that increase their risk of direct contact with untreated waste (e.g. plastic bags or bucket toilets). Other research suggests that women’s sanitation use may be affected by their fear of contracting infections from unclean sanitation facilities.

The objective of this study was to examine the association between a number of socio-economic factors at the individual and neighborhood levels and women’s reported sanitation use across 14 countries in sub-Saharan Africa. This study (1) focused specifically on the associations between different factors and sanitation use, (2) explored individual- and neighborhood-level factors associated with sanitation use across countries, and (3) aimed to identify possible trends in the region that may have public health policy implications.
Methods

Data and Sample

We used cross-sectional data from the Demographic and Health Surveys (DHS) from 14 countries in sub-Saharan Africa, including Cameroon (CMR), Côte d’Ivoire (CIV), Democratic Republic of Congo (DRC), Gabon (GAB), Ghana (GHA), Kenya (KEN), Malawi (MWI), Mali (MLI), Mozambique (MOZ), Nigeria (NGA), Sierra Leone (SLE), Togo (TGO), Uganda (UGA), and Zambia (ZMB). In general, DHS datasets provide nationally representative data on general health and population indicators. The DHS surveys, at present, provide the most comprehensive source of information that may identify socio-cultural factors associated with women’s sanitation use in sub-Saharan Africa. All women, ages 15-49, from selected households are eligible to be interviewed in the DHS; however, one of the gender-specific factors used in this study (e.g. experiences of recent non-partner violence) required that the analytic sample include only women who completed the domestic violence module of the DHS. Details about the specific sampling strategies used in the DHS datasets have been documented elsewhere.

Measures

For this analysis, a three-level categorical variable was created to correspond to each type of reported sanitation methods: a private facility (any facility not shared with any other household including flush or pour-flush toilet, pit latrine, composting toilet, or hanging toilet/hanging latrine); a toilet facility shared by additional households; or open defecation [OD] (‘no facility/bush/field/bucket’). The study focuses on OD and use of shared facilities versus private because OD and shared facilities, in particular, have been associated with adverse health outcomes.

Individual-level, socio-economic factors included age, marital status, household wealth quintile, respondent’s employment status, level of education, residence in a female-headed household, and family size. As previous studies have suggested that attitudes in certain non-Christian religions may influence sanitation practices, a binary Christian/non-Christian variable was also included. A variable for women’s primary drinking water source was also used, given earlier research that suggests people’s sanitation use may be influenced by the availability of water. Some scholars have also suggested that women, in particular, may revert to unimproved sanitation alternatives rather than walk to a shared or public facility if they do not feel safe outside their homes. A binary variable, recent non-partner violence, was therefore created from women’s survey responses about sexual and physical violence in the past 12 months.

The models have a number of neighborhood-level indicators that are commonly used as proxy variables to identify high-crime, high-violence, or structurally disorganized/disadvantaged communities. These included the proportion of female headed-households in the neighborhood, the proportion of households in a neighborhood reporting no employment, the proportion of households in a neighborhood who fall in the lowest wealth quintile, and the proportion of households in a neighborhood that have at least
one woman reporting recent non-partner violence. A neighborhood ethnic diversity index calculated using a diversity entropy method commonly used in multi-level analyses was also included.\textsuperscript{38,40}

\textbf{Analysis}
All data analyses were conducted using Stata/MP v.14. Fourteen separate two-level, multinomial logistic regressions were run using the user-written program \textit{gllamm}.\textsuperscript{41} Women’s individual responses were nested in communities. Communities were represented by DHS primary sampling units\textsuperscript{31} of about 20-200 people because they are the most consistent measure of community between DHS datasets and have been used to represent community in a number of multi-level studies using DHS data.\textsuperscript{42-45}

\textbf{Results}
\textbf{Sample Characteristics}
A total of 102,399 women completed the domestic violence module across the 14 countries selected for this study. As item non-response indicated minimal missing data (less than 5%) on all independent, dependent, and control variables in each country, a method of hot-deck imputation was utilized to fill in missing values.\textsuperscript{46} The final analytic sample consisted of 102,399 surveys (level 1) collected in 7,268 communities (level 2) in 14 countries. Descriptive statistic ranges are summarized in Table 1. Frequencies for all countries are presented in Appendix 1.

Women’s reported use of sanitation facilities was extremely varied within and across all countries included in this study. Reported practices of OD ranged from 2.5% (Gabon) to 54.2% (Togo). Reported use of private facilities ranged from 12.7% (Ghana) to 63.4% (Cameroon) with ranges for reported use of shared facilities from 9.9% (Mozambique) to 64.3% (Sierra Leone). Figure 1 provides relative-risk ratios and confidence intervals for the associations between individual- and neighborhood-level factors and sanitation use in each country. Detailed results from the two-level regressions are provided in Appendix 2.

\textbf{Open Defecation (OD) Versus Private Facility Use}
Wealth was the most common individual-level factor associated with OD compared to private toilet use. Relative risk ratios ranged from 0.46 [CI(95%) 0.274-0.77] in Mali to 0.08 [CI(95%) 0.034-0.180] in Cameroon. Access to public or open water compared to private sources emerged as another important factor in 10 of the countries. Relative risk for public vs. private water sources in those countries ranged from 1.30 [CI(95%) 1.007-1.689] in Mozambique to 11.44 [CI(95%) 5.533-23.641] in Ghana. Relative risk for open vs. private sources ranged from 1.54 [CI(95%) 1.171-2.034] in Mozambique to 9.56 [CI(95%) 6.333-14.417] in Togo. In half the countries, residing in a female-headed household was associated with higher risk of OD relative to risk of private sanitation use. Relative risk ratios in those countries ranged from 1.45 [CI(95%) 1.268-1.665] in Nigeria to 2.28 [CI(95%) 1.760-2.944] in Malawi. Religion was also an important factor, but
the direction and size of the relative risk varied, e.g. RRR=0.16 [CI(95%) 0.079-0.332] in Mali and RRR=2.36 [CI(95%) 1.404-3.955] in Cameroon.

Education and family size were important individual-level factors. Increasing family size and increasing years of education were associated with lower relative risk of OD compared to private facility use in 13 of the 14 countries. For example, each additional year of education was associated with lower risk of OD relative to risk of private facility use. Relative risk ratios for years of education in the 13 countries ranged from 0.95 [CI(95%) 0.912-0.985] in Sierra Leone to 0.82 [CI(95%) 0.784-0.855/0.755-0.898] in Kenya/Gabon.

Important neighborhood-level factors associated with risk of using OD relative to private facility use included urban area (8 countries), diversity (4 countries), and poverty (12 countries). The direction and magnitude of the neighborhood-level associations varied by country. For example, urban area ranged from RRR=0.21 [CI(95%) 0.088-0.500] in Gabon to 6.40 [CI(95%) 2.24-18.279] in Uganda; diversity ranged from RRR=0.18 [CI(95%) 0.073-0.427] in Mali to 2.29 [CI(95%) 0.999-5.232] in Togo; and poverty ranged from RRR=0.97 [CI(95%) 0.955-0.979] in Gabon to RRR=1.08 [CI(95%) 1.068-1.098] in Kenya.

**Shared Toilets versus Private Toilets**

Several demographic and household structure variables emerged as important factors associated with use of shared relative to private facilities. In most of the countries, living in a female-headed household, being married, and using public or open water sources were positively associated with women using shared rather than private toilets. Family size, age, and education, on the other hand were associated with lower risk of using shared facilities relative to private ones in most countries. For example, for each additional year of education, the risk of a woman using shared facilities relative to using private facilities was lower (3% lower risk [CI(95%) 0.947-0.992/0.942-0.992] in Sierra Leone/Mali to 10% lower risk [CI(95%) 0.882-0.92] in Kenya).

At the neighborhood-level, the urban factor was associated with higher risk of using shared relative to private sanitation in 11 countries—ranging from 1.69 [CI(95%) 1.243-2.301] in the DRC to 4.42 [CI(95%) 3.144-6.225] in Gabon. Neighborhood diversity was also associated with higher risk of shared relative to private facility use in a number of countries with the risk ranging from 1.29 [CI(95%) 1.058-1.566] in Malawi to 2.42 [CI(95%) 1.774-3.309] in Mozambique. The direction and size on the relative risk for neighborhood-level poverty and family disorganization varied between countries.

**Discussion**

Results suggest that predictors such as wealth, family size, education, water source, religion, and living in a female-headed household are the most prominent individual-level factors associated with OD relative to private facility use across the 14 countries. Neighborhood location (urban versus rural), diversity and poverty were the most prominent community-level factors associated with OD relative to private facility use. Demographic variables, such as family size, age, being married, living in a female-headed household, and
years of education were the most prominent individual-level factors associated with shared relative to private facility use. Whether or not a respondent resided in an urban or rural area was the most common neighborhood-level factor associated with use of shared relative to private toilets across the study countries. Neighborhood-level poverty, family disorganization, and diversity were also important factors associated with shared relative to private facility use in a majority of countries.

The results of this study showed that wealth at the individual level was associated with lower risk of OD relative to private toilet use in almost all countries, and neighborhood-level poverty was also associated with higher relative risk of OD in most countries. These findings are consistent with literature reporting that wealth is empirically linked to demand for and adoption of improved sanitation technologies. Neigh-
borhood location also emerged as an important factor associated with OD and shared relative to private facility use. The results are consistent with literature that suggests shared facilities are more common in cities and with studies that suggest OD is common in both rural areas and informal settlements in urban areas. Results from this study also suggest that women with increasing years of education have lower risk of using OD relative to private toilets. Again, this is consistent with findings from literature that suggest education and knowledge are linked to individuals’ ability to adopt new methods of urine/feces disposal. Health-related education and awareness are often considered leading factors influencing user sanitation preferences and decisions. In fact, many community-focused sanitation adoption and implementation programs rely largely on health education and training. Other common demographic variables associated with use of OD and shared facilities relative to private facilities in this study included family size, being married, living in a female-headed household, and having access to different water sources. These individual-level factors were not only common across the countries in this sample, but the direction of the association was also consistent. For example, family size was consistently associated with lower risk of using OD or shared relative to private toilets and female headed households, marriage, and access to shared water sources – both improved and unimproved - were generally associated with higher risk of using OD or shared relative to private facilities. According to the Joint Monitoring Programme (JMP), unimproved sanitation, which includes OD and use of shared toilet facilities, is particularly persistent in disadvantaged households and communities, especially in sub-Saharan Africa. Several of these demographic variables have been associated with household or neighborhood-
level social or economic disadvantage in recent literature. Female headship and family size (number of children), for example, are sometimes used as variables in structural disadvantage measures at the household and neighborhood levels. In these results, however, family size is associated with lower risk of using OD and/or shared facilities relative to private ones, which does not seem to indicate structural disadvantage. One explanation, as suggested by recent evidence from a study using DHS data from Kenya, is that more children (family size) can increase a woman’s decision-making power in the home and, relatedly, her ability to demand improved sanitation. Access to water is also a common factor in measuring household or community disadvantage. For example, 93% of the people still using open water sources (e.g. rivers, lakes, or
unprotected surface water) as their primary water source are located in disadvantaged rural communities, particularly in sub-Saharan Africa.¹

Results from this study also yielded less common and/or less consistent associations between several factors and sanitation use. For example, married women in the study had higher risk of using OD or shared relative to private facilities in almost all countries in the study. Literature does not highlight marriage as a common factor associated with sanitation use. Neither is marriage frequently associated with household or community-level disadvantage. Some literature suggests that it is a cultural taboo for a child-in-law to use the same toilet facility as the parents-in-law in some African communities,⁵² which might provide an explanation for why some married women might use OD or a shared instead of a private facility in a family setting. Yet, this cultural belief is unlikely to fully explain the association. Being a non-Christian also emerged as an important factor associated with women’s use of OD or shared relative to private facilities in this study; however, the direction and magnitude of the risk varied between countries. These results suggest, as several previous studies have⁵⁰,⁵⁴, that religion may be an important factor in women’s sanitation use; however, the binary Christian/non-Christian measure available for this analysis does not provide enough detail about different religions.

Another unexpected finding was that, in several of the countries, being employed was associated with higher risk of OD or shared facility use relative to private facility use. Employment is usually associated with structural advantage and, consequently, one might expect the relative risk of women using OD or a shared facility to be lower for women who are employed. Perhaps women are unable to access sanitation facilities while at work. These findings highlight the need for more precise information on the nature and location of employment and access to and use of facilities while at work.

Many of the neighborhood-level variables in this study varied in direction and magnitude across different countries. This may be largely due to the variability of different methods of urine/feces disposal at the neighborhood level. There may be a uniformity of available sanitation methods in one neighborhood—e.g. an urban neighborhood in which every member of the neighborhood has access to a private, household sanitation facility that feeds into a government sewerage system or a rural neighborhood in which all households have access to pit latrines. In a number of other settings, however, the availability of different sanitation methods may vary considerably.³ For example, residents in a single sampling unit in an informal settlement in a city in Kenya may utilize a variety of different sanitation methods, such as public toilets; private, household facilities; sites for OD; bags or buckets in the home; and/or plot toilets (toilets shared by a cluster of houses or a building). The results from this study suggest that neighborhood-level characteristics may influence sanitation use, but they may also highlight the need to look at the unique context of each neighborhood.

In addition to the more commonly recognized factors associated with sanitation use in the literature (e.g. wealth, access to water, and demographics), this study also yielded associations between neighborhood-level violence and sanitation use in several countries. While the relative risk was small compared to
some of the other factors, these results should not be neglected. Violence was associated with lower risk of OD or shared relative to private facility use in some countries (Nigeria, Uganda). This is contradictory to some studies that suggest that women who defecate in the open or use shared/public facilities are at higher risk of experiencing physical or sexual violence as a result of having to go outside the house at night. On the other hand, these findings may be consistent with literature that suggests women may adopt alternative sanitation strategies to avoid OD or shared/public toilets if they fear they are at risk of experiencing violence. Also, neighborhood-level violence is often associated with social disorganization. Results suggesting a positive relative risk association between neighborhood-level violence and OD or use of shared facilities may be similar to findings that OD or shared sanitation are associated with poorer and/or more socially disorganized neighborhoods. On the other hand, results that suggest a negative relative risk association may reflect literature that suggests women who fear physical or sexual violence in their neighborhoods are likely to develop sanitation strategies that keep them from having to go outside their houses.

While this was the first attempt to quantitatively explore individual and neighborhood-level factors associated with sanitation, it had limitations. First, this study used cross-sectional data; thus, causal claims about the factors influencing sanitation use cannot be made. Second, this study used data from nationally-representative surveys that were not focused on sanitation use. Consequently, there were limited factors available across all datasets that were theoretically appropriate for inclusion, and these variables are sometimes problematic in sanitation analyses. Other factors that are often associated with sanitation use in literature, such as cleanliness of toilets, distance to toilets, level of privacy, characteristics of toilet construction (e.g. doors and locks) were not included in DHS surveys. Neighborhood-level variables were constructed based on primary sampling units (PSU) in the surveys. While this is a common practice with multi-level analyses, it is limited in its ability to truly represent neighborhood-level characteristics. Lastly, due to confidentiality issues, sampling weights at the neighborhood (PSU) level are not provided with DHS data, limiting the ability to do weighted, nationally representative, multi-level analyses.

Conclusion
This was the first multi-country study to look at the factors associated with sanitation use. Findings from this study suggest that there are numerous individual-level (wealth, access to different water sources, age and education) and household structure (family size and female headship) variables that should be considered important factors associated with sanitation use. Sanitation use is not only a technical issue, but also a social one. While there are a number of small studies that have looked at factors that influence sanitation preferences, behaviors, use, and adoption, there is little information about common factors across a variety of contexts. Findings from this study suggest that household and neighborhood disadvantage, in particular, may be key factors in sanitation use. This is important as it highlights the connection between the social environment and a critical public health issue. Sanitation coverage continues to be a persistent problem,
particularly in SSA. While this may be the result of a number of regional, national, political, or economic issues, social organization may be a key factor in sanitation use. Although our study is an important first step in pushing the development and research agenda to focus on a broader perspective of sanitation use, it also highlights a need for better and more research into this dilemma.

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### Appendix 1. Frequencies for descriptive statistics (n = 102,399)

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冯泽 卡尔 拉尔森


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*Standard errors corresponding to neighborhood-variance (level 2 variance)*

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*Standard errors corresponding to neighborhood-variance (level 2 variance)*

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### SHARED

#### Individual-level factors

| Non-Christian | 0.58 | 0.000 | 0.471-0.725 | 0.66 | 0.068 | 0.420-1.032 |
| Married | 1.50 | 0.000 | 1.271-1.762 | 1.78 | 0.000 | 1.342-2.369 |
| Employed | 1.12 | 0.090 | 0.983-1.265 | 1.35 | 0.001 | 1.130-1.622 |
| Age | 0.97 | 0.000 | 0.965-0.980 | 0.98 | 0.000 | 0.968-0.989 |
| Years of education | 0.95 | 0.000 | 0.932-0.969 | 0.97 | 0.009 | 0.942-0.992 |
| Family size | 0.90 | 0.000 | 0.873-0.925 | 0.92 | 0.000 | 0.894-0.949 |
| Female-headed household | 1.65 | 0.000 | 1.394-1.950 | 1.25 | 0.128 | 0.939-1.654 |
| Public water source | 3.06 | 0.000 | 2.426-3.866 | 1.26 | 0.110 | 0.949-1.672 |
| Open water source | 2.68 | 0.000 | 2.040-3.511 | 1.30 | 0.149 | 0.911-1.851 |
| Wealth above the median | 0.76 | 0.000 | 0.669-0.868 | 1.24 | 0.066 | 0.986-1.549 |
| Recent non-partner violence | 0.96 | 0.791 | 0.695-1.319 | 0.91 | 0.594 | 0.652-1.278 |

#### Neighborhood-level factors

| Urban | 1.85 | 0.000 | 1.421-2.402 | 2.21 | 0.000 | 1.486-3.301 |
| Female-headed households | 0.99 | 0.089 | 0.988-1.001 | 1.00 | 0.752 | 0.983-1.013 |
| Household unemployment | 0.99 | 0.001 | 0.986-0.996 | 0.99 | 0.002 | 0.978-0.995 |
| Households in lowest wealth quintile | 0.99 | 0.001 | 0.986-0.997 | 1.00 | 0.610 | 0.990-1.006 |
| Diversity | 1.29 | 0.012 | 1.058-1.566 | 0.73 | 0.067 | 0.523-1.022 |
| Recent non-partner violence | 1.03 | 0.095 | 0.995-1.065 | 1.03 | 0.016 | 1.005-1.053 |

### OPEN DEFECATION

#### Individual-level factors

| Non-Christian | 0.82 | 0.229 | 0.584-1.137 | 0.16 | 0.000 | 0.079-0.332 |
| Married | 1.41 | 0.011 | 1.082-1.826 | 1.23 | 0.582 | 0.592-2.543 |
| Employed | 1.23 | 0.041 | 1.008-1.511 | 1.14 | 0.530 | 0.757-1.719 |
| Age | 0.97 | 0.000 | 0.963-0.986 | 1.00 | 0.889 | 0.977-1.021 |
| Years of education | 0.87 | 0.000 | 0.837-0.896 | 0.91 | 0.054 | 0.819-1.002 |
| Family size | 0.92 | 0.000 | 0.876-0.962 | 0.93 | 0.032 | 0.867-0.994 |
| Female-headed household | 2.28 | 0.000 | 1.760-2.944 | 0.99 | 0.988 | 0.512-1.933 |
| Public water source | 2.55 | 0.000 | 1.576-4.139 | 1.24 | 0.698 | 0.412-3.757 |
| Open water source | 3.04 | 0.000 | 1.815-5.083 | 1.70 | 0.359 | 0.546-5.306 |
| Wealth above the median | 0.24 | 0.000 | 0.192-0.313 | 0.46 | 0.003 | 0.274-0.770 |
| Recent non-partner violence | 0.92 | 0.772 | 0.541-1.578 | 0.88 | 0.733 | 0.431-1.808 |

#### Neighborhood-level factors

| Urban | 0.90 | 0.724 | 0.509-1.598 | 0.92 | 0.920 | 0.187-4.541 |
| Female-headed households | 0.99 | 0.094 | 0.979-1.002 | 1.00 | 0.935 | 0.961-1.044 |
| Household unemployment | 0.99 | 0.176 | 0.985-1.003 | 0.97 | 0.004 | 0.952-0.990 |
| Households in lowest wealth quintile | 1.01 | 0.170 | 0.997-1.015 | 1.04 | 0.000 | 1.023-1.054 |
| Diversity | 1.24 | 0.222 | 0.878-1.749 | 0.18 | 0.000 | 0.073-0.427 |
| Recent non-partner violence | 0.99 | 0.675 | 0.928-1.050 | 1.03 | 0.341 | 0.970-1.092 |
| Neighborhood variance (null) | 1.48 | 0.197 | 0.599-1.598 | 0.92 | 0.920 | 0.187-4.541 |
| ICC (null) | 31.08 | 75.93 |
| Neighborhood variance (full model) | 1.58 | 0.212 | 0.924-1.221 | 5.65 | 0.972 | 0.989-0.992 |
| ICC (full model) | 32.44 | 63.20 |

---

1Standard errors corresponding to neighborhood-variance (level 2 variance)

This article is protected by copyright. All rights reserved.
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*Standard errors corresponding to neighborhood-variance (level 2 variance)
### Individual-level factors

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### Neighborhood-level factors

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### Open Defecation

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### Neighborhood variance (null) (null) | 5.13 | 0.506 | 7.48 | 0.715 |
| ICC (null)       | 60.95        |       | 69.44  |       |
| Neighborhood variance (full model) | 4.38 | 0.533 | 3.81 | 0.457 |
| ICC (full model) | 57.12        |       | 53.65  |       |

*Standard errors corresponding to neighborhood-variance (level 2 variance)
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<td>RRR</td>
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**Individual-level factors**

- **Non-Christian**
  - Uganda: 1.78 (0.001: 1.265-2.502)
  - Zambia: 1.045 (0.499-1.325)
- **Married**
  - Uganda: 1.58 (0.002: 1.183-2.099)
  - Zambia: 1.575-2.066
- **Employed**
  - Uganda: 0.97 (0.838: 0.741-1.275)
  - Zambia: 0.891-1.111
- **Age**
  - Uganda: 0.97 (0.000: 0.961-0.989)
  - Zambia: 0.976-0.988
- **Years of education**
  - Uganda: 0.99 (0.520: 0.957-1.023)
  - Zambia: 0.923-0.954
- **Family size**
  - Uganda: 0.79 (0.000: 0.756-0.830)
  - Zambia: 0.822-0.859
- **Female-headed household**
  - Uganda: 1.36 (0.045: 1.006-1.827)
  - Zambia: 1.676-2.240
- **Public water source**
  - Uganda: 1.83 (0.001: 1.267-2.634)
  - Zambia: 1.364-1.862
- **Open water source**
  - Uganda: 0.83 (0.209: 0.614-1.113)
  - Zambia: 1.187-1.723
- **Wealth above the median**
  - Uganda: 0.87 (0.321: 0.665-1.143)
  - Zambia: 0.614-0.815
- **Recent non-partner violence**
  - Uganda: 1.18 (0.488: 0.744-1.856)
  - Zambia: 0.861-1.405

**Neighborhood-level factors**

- **Urban**
  - Uganda: 4.18 (0.000: 2.825-6.191)
  - Zambia: 1.695-2.926
- **Female-headed households**
  - Uganda: 1.01 (0.114: 0.998-1.020)
  - Zambia: 0.985-1.002
- **Household unemployment**
  - Uganda: 1.01 (0.185: 0.997-1.018)
  - Zambia: 1.000-1.017
- **Households in lowest wealth quintile**
  - Uganda: 1.02 (0.000: 1.014-1.028)
  - Zambia: 0.984-0.994
- **Diversity**
  - Uganda: 0.91 (0.618: 0.638-1.306)
  - Zambia: 1.154-1.646
- **Recent non-partner violence**
  - Uganda: 0.95 (0.024: 0.915-0.994)
  - Zambia: 0.979-1.017

**Open Defecation**

- **Individual-level factors**
  - **Non-Christian**
    - Uganda: 1.67 (0.179: 0.792-3.503)
    - Zambia: 1.067-4.049
  - **Married**
    - Uganda: 1.39 (0.241: 0.801-2.416)
    - Zambia: 1.129-1.708
  - **Employed**
    - Uganda: 1.18 (0.535: 0.700-1.987)
    - Zambia: 0.901-1.255
  - **Age**
    - Uganda: 0.98 (0.074: 0.950-1.002)
    - Zambia: 0.972-0.990
  - **Years of education**
    - Uganda: 0.85 (0.000: 0.789-0.921)
    - Zambia: 0.857-0.904
  - **Family size**
    - Uganda: 0.81 (0.000: 0.745-0.887)
    - Zambia: 0.876-0.934
  - **Female-headed household**
    - Uganda: 1.43 (0.196: 0.832-2.450)
    - Zambia: 1.300-1.992
  - **Public water source**
    - Uganda: 1.09 (0.868: 0.385-3.103)
    - Zambia: 1.187-2.043
  - **Open water source**
    - Uganda: 1.17 (0.567: 0.687-1.988)
    - Zambia: 2.266-4.965
  - **Wealth above the median**
    - Uganda: 0.11 (0.000: 0.050-0.232)
    - Zambia: 0.140-0.239
  - **Recent non-partner violence**
    - Uganda: 0.62 (0.304: 0.252-1.538)
    - Zambia: 0.651-1.439

- **Neighborhood-level factors**
  - **Urban**
    - Uganda: 6.40 (0.001: 2.240-18.279)
    - Zambia: 0.233-0.659
  - **Female-headed households**
    - Uganda: 1.00 (0.922: 0.979-1.024)
    - Zambia: 0.989-1.020
  - **Household unemployment**
    - Uganda: 1.02 (0.132: 0.995-1.035)
    - Zambia: 0.993-1.022
  - **Households in lowest wealth quintile**
    - Uganda: 1.07 (0.000: 1.053-1.078)
    - Zambia: 0.999-1.015
  - **Diversity**
    - Uganda: 0.68 (0.326: 0.313-1.471)
    - Zambia: 0.698-1.306
  - **Recent non-partner violence**
    - Uganda: 0.99 (0.785: 0.916-1.069)
    - Zambia: 0.941-1.014
  - **Neighborhood variance (null)**
    - Uganda: 8.58 (1.405): 4.06 0.305
  - **ICC (null)**
    - Uganda: 72.28
  - **Neighborhood variance (full model)**
    - Uganda: 1.79 (0.543): 3.97 0.413
  - **ICC (full model)**
    - Uganda: 35.19

1 Standard errors corresponding to neighborhood-variance (level 2 variance)

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<th>Variable</th>
<th>Range (Percentages except where noted)*</th>
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<td>2.5 (Gabon) – 54.2 (Togo)</td>
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<td>12.7 (Ghana) – 63.4 (Cameroon)</td>
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<td>Employed</td>
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<tr>
<td>Age</td>
<td>28.9 years (Uganda) – 30.2 years (Sierra Leone)</td>
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<tr>
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<td>10.6 (Mali) – 36.7 (Ghana)</td>
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<td>15.4 (Uganda) – 72.7 (Malawi)</td>
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<td>Open Water Source</td>
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<td><strong>Wealth above the median</strong></td>
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<td><strong>Recent non-partner violence</strong></td>
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<td><strong>Neighborhood-level factors</strong></td>
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<td>12.6 (Malawi) – 65.1 (Gabon)</td>
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<td>Women Reporting Recent Non-Partner Violence</td>
<td>1.2 (Malawi) – 5.8 (Kenya)</td>
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*Frequencies for all countries are presented in Appendix 1
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Figures 1. Relative risk ratios and confidence intervals (95%) for factors associated with OD and shared compared to private facilities for all countries.