**Factors Associated with Household Sanitation and Feacal Sludge Management (FSM) in Rural Communities of Ikwerre Local Government Area of Rivers State, Nigeria**

**ABSTRACT**

**Background:** The WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene has established global norms to benchmark progress in House Sanitation and Faecal Sludge Management. This study assessed the factors Associated with household sanitation and Feacal Sludge Management (FSM) in Rural Communities of Ikwerre Local Government Area of Rivers State, Nigeria

**Materials and Methods:** The study adopted a community-based cross-sectional study design to assess household sanitation and associated challenges in Ikwerre Local Government Area of Rivers State. The study was conducted in Ikwerre Local Government Area. Ikwerre LGA is one of the 23 Local Government Areas of Rivers State. A multi-stage sampling technique was used to select 200 households. From these households, individuals who met the inclusion criteria were purposively selected resulting in a total of 360 respondents. At the end of the survey, aggregate data were downloaded and exported into the IBM Statistical Product and Service Solutions (SPSS, version 20.0) software for analysis.

**Result:** The result showed the socio-demographic characteristics distribution of respondents from the study areas, 189 respondents (52.5%) were males while 171 respondents (47.5%) were females. Males were a little bit higher than females. The overall faecal sludge management practice among respondents in the LGAs revealed that 32.7% of respondents in rural communities of Ikwerre LGA had good faecal sludge management practice as against 67.3% with poor FSM practice. shows the logistic regression analysis of factors influencing FSM practice among respondents in Ikwerre LGA. Respondents who had poor knowledge about FSM were three times more likely to have poor FSM practices than those with good knowledge (OR= 2.821, CI= 1.524-5.222, p= 0.001).

**Conclusion:** was concluded that household sanitation and FSM have continued to pose a challenge in peri-urban areas everywhere around the developing world. The government should develop a plan and policy to discourage open defecation in rural LGAs and also sensitize the communities on the dangers associated with open defecation.

**Keywords:** Factors, Household, Sanitation, FSM, Rural, Communities, Rivers State, Nigeria.

**Background**

The WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene has established global norms to benchmark progress in House Sanitation and Faecal Sludge Management. The Joint Monitoring Programme service benchmark for progress in sanitation services established improved/unimproved facility type classification and criteria relating to the level of service provided to households (UNICEF and WHO, 2017). The SDG 6 agenda is to ensure the availability and sustainable management of water and sanitation for all. Goal 6.1 seeks to achieve universal and equitable access to safe and affordable drinking water for all by 2030. Goal 6.2 seeks to make access to adequate and equitable sanitation and hygiene for all and end open defecation, paying attention to the needs of women and girls and those in vulnerable situations by 2030. Goal 6.3 is to improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally by 2030 (UNICEF and WHO, 2017).

Sanitation encompasses preventing human contact with faeces and handwashing with soap. Human health is important, and a clean environment through sanitation will inhibit/stop the transmission of disease, primarily through the faecal-oral route (SuSanA, 2008). It has been reported by the WHO that improved sanitation can reduce the incidence of diarrhoea, which is the leading cause of malnutrition and stunted growth in children (WHO, 2017).

Improved sanitation facilities are simply designed to hygienically separate excreta from human contact. There are three main ways to meet the criteria for having a safely managed sanitation service (SDG 6.2). People should use improved sanitation facilities that are not shared with other households, and excreta should either be treated and disposed of in situ, stored temporarily and then emptied; transported and treated off-site or transported through a sewer with wastewater and then treated off-site (UNICEF/WHO, 2017). The functional operations and process flow of an On-site Sanitation (OSS) are characterized by access to toilets, emptiness, transport, treatment and disposal or reuse and this is referred to as the 'sanitation service (delivery) chain' (Figure 1). The chain has been widely used for analysing the physical flow of faecal sludge through the system (Trémolet, 2011; WSP, 2014; Blackett, Hawkins & Heymans 2014).

 Figure 1: Sanitation service chain. Source: IRCWASH, (2016)

The different components of the sanitation service chain are described as follows:

i. Access to the toilet (containment): The provision of sanitation technologies, such as pit latrines and septic tanks have helped in the storage of human excreta and eradicate the practices of open defecation or lack of adequate sanitation facilities.

ii. Emptying and transport: The human excreta stored up in septic tanks and pit latrines gradually fill up over time. The sludge is collected and emptied into a disposal truck and transported to a designated treatment site.

iii. Treatment: The treatment of the FS is done such that its solid and liquid fractions do not harm public health and the environment.

iv. Disposal: Safe disposal of treated FS, especially the part which does not provide value for resource recovery or reuse. It is critical to ensure the isolation of the waste from human and environmental contact.

v. Re-use: FS contains resources such as nutrients, energy and water, all of which have intrinsic values.

**Household Sanitation Ladder**

Access to adequate sanitation is of crucial importance to public health with over 50 pathogens transmitted in excreta, including those responsible for diarrheal disease, schistosomiasis, and soil-transmitted helminth infections. It was reported in the year 2000, that despite the importance of access to adequate sanitation, 2.6 billion people in the world (42%) lacked access to basic sanitation (UNICEF & WHO, 2014). In 2002, sanitation was incorporated into the Millennium Development Goal (MDG) target for water. It aimed at halving the proportion of people without sustainable access to basic sanitation by 2015. After ten years, it was estimated by the United Nations that 2.4 billion people still lacked access to basic sanitation; this poses a great threat to the sanitation target (UNICEF & WHO, 2014).

The WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) monitored progress toward the MDG targets. As such, the JMP categorised sanitation facilities as either “improved” or “unimproved” (Figure 2), this was done primarily based on the technology in use by the household (UNICEF & WHO, 2010; Kvarnstrom et al., 2011). However, a facility will be designated as “unimproved” if shared by more than one household (UNICEF & WHO, 2010). In addition, shared sanitation facilities were classified as “unimproved” when there is no plan for individual users to keep the facility clean or well maintained, and thus considered to pose a higher health risk. Similarly, concerns have been raised around accessibility, particularly at night, or if there is a fee, which might result in some users resorting to unhygienic practices for some of the time (Cairncross et. al., 2006). These issues were of particular concern for more vulnerable groups, including women and children (Biran et al., 2011).

The Joint Monitoring Programme has considered raising the threshold for excluding shared facilities from two to five households. However, a strong evidence base for adopting a diﬀerent threshold for the post-2015 SDG is currently lacking (UNICEF & WHO, 2010). Since 2008, the JMP had presented a disaggregated “sanitation ladder” with ascending “rungs” of service levels: open defecation, unimproved, shared and improved (Figure 2) (UNICEF & WHO, 2010). Moving up the rungs of the ladder is assumed to result in an improvement in the hygienic quality of the facility, and thereby a reduction in health risks for users (UNICEF & WHO, 2010).

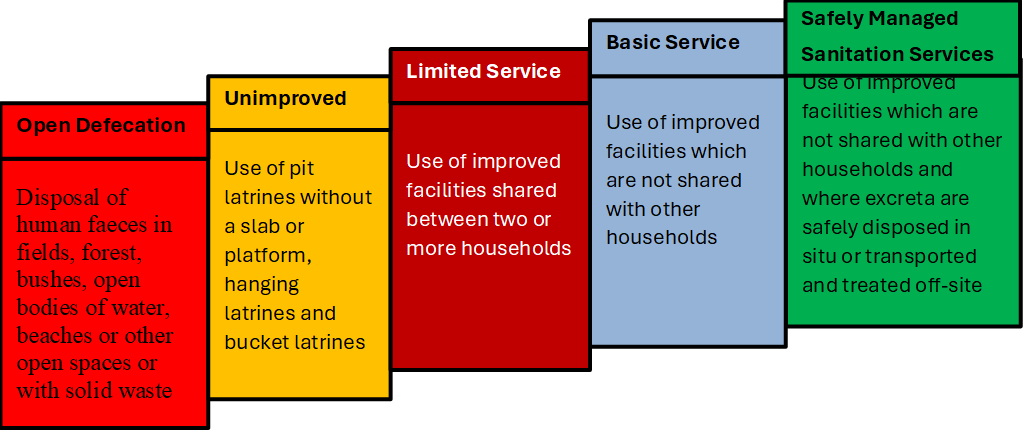


Figure 2: Household Sanitation Ladder. Source: UNICEF/WHO, (2017)

The safe disposal of human excreta is of paramount importance for the health and welfare of populations living in low-income countries as well as the prevention of pollution to the surrounding environment. More than 40 % of the world’s population - about 2.5 billion people - still practice open defecation or use pit latrines that do not safely contain their waste. Another 2.1 billion people who live in urban areas are only containing their waste and not disposing of it safely (Bill & Melinda Gates Foundation, 2010). On-site sanitation (OSS) systems are the most popular means of handling excreta in low-income countries. The OSS facilities aim at treating human waste at its source and can provide a hygienic and affordable method of waste disposal (Rose et al., 2015). For example, in urban areas of Ghana and Tanzania, 85% of inhabitants are served by OSS facilities. In urban areas of the Philippines, 98% rely on OSS facilities (Montangero & Strauss, 2004). When these sanitation facilities need emptying, there are often inadequate equipment and financial incentives for the sanitary disposal of faecal sludge meaning that pits remain full and unusable or if emptied, sludge is disposed of directly into the environment contaminating water resources (Ingallinella et al., 2002).

Poor sanitation and FSM expose household members to diseases, particularly of gastrointestinal nature. Diarrhoea, the leading cause of malnutrition and stunted growth in children, rise predominantly in a situation of poor sanitation and inappropriate faecal handling. WHO in 2017 reported that Diarrheal disease is the second leading cause of death in children under five years old and has an annual mortality rate of around 525, 000 children under five years of age. Globally, there are nearly 1.7 billion cases of childhood diarrheal disease every year, making it a significant cause of malnutrition in children under five years old. A significant proportion of diarrheal disease can be prevented through safe drinking-water and adequate sanitation and hygiene.

Diarrhoea is usually a symptom of an infection in the intestinal tract, which can be caused by a variety of bacterial, viral and parasitic organisms. Infection is spread through contaminated food or drinking-water, or from person-to-person contact as a result of poor hygiene. Interventions to prevent diarrhoea, including safe drinking-water, use of improved sanitation and handwashing with soap to reduce disease risk. Water contaminated with human faeces, for example, from sewage, septic tanks and latrines are of particular concern (WHO, 2017).

The World Health Organization (WHO) estimate that 2.2 million people die annually from diarrheal diseases caused by human excreta and the lack of adequate personal and domestic hygiene. These have also been implicated in the transmission of many infectious diseases, including cholera, typhoid, hepatitis, polio, cryptosporidiosis, ascariasis, and schistosomiasis. The occurrence of these improper waste and excreta management has infected about 10% of the population of the developing world with intestinal worms (Murray and Lopez, 1996; WHO, 2000a).

**Statement of the Problem/Justification for the Study**

The need for appropriate sanitation solutions in urban and peri-urban settlements is a growing concern, as the world's population has shifted to being predominantly urban within the last decade (UNICEF, 2014; WHO, 2014). The primary hazard of lack of sanitation is exposure to pathogens from untreated or insufficiently treated excreta by transmission via the faecal-oral route (WHO, 2005). In Ikwerre Local Government Area which is predominantly a peri-urban settlement, the researcher’s personal observations have shown little sanitation infrastructure, frequent person-to-person contacts, and poor environmental conditions which has facilitated the transmission of faeces associated infections, resulting in frequent bouts of diarrhea in young children (Baum, Luh & Bartram, 2013). To put this observation in perspective, it is estimated that lack of access to safe, clean drinking water and basic sanitation, as well as poor hygiene cause nearly 90% of all deaths from diarrhea, mainly in children. Irrespective of the increase in world developmental strides, 670 million people in developing countries still defecate in the open while 1.6 billion people (22%) had handwashing facilities that lacked soap and water (WHO/UNICEF, 2019). In Nigeria, 47 million of the population practice open defecation which has led to contaminated water supply, especially in states like Rivers State with a high-water table. It is against this backdrop that this study strives to assess household sanitation and associated challenges in rural communities of Ikwerre Local Government Area of Rivers State.

**Methods**

**Study design and data source**

The study adopted a community-based cross-sectional study design. This research design was adopted because it assesses household sanitation and associated challenges in Ikwerre Local Government Area of Rivers State. The study was conducted in Ikwerre Local Government Area. Ikwerre LGA is one of the 23 Local Government Areas of Rivers State hosting companies, many markets, motor parks which generate large tones of wastes daily.

**Study area and population**

The population of the study consisted of 1000 middle-aged households comprising adults between the ages of 35-60 who reside in Ikwerre LGA of Rivers State. All middle-aged adults between 35-60 years of age who reside in Ikwerre LGA of Rivers State for at least one year prior to the study were selected for the study while adults below 35 years old were excluded as well as those who met the inclusion criteria but are too ill and debilitated. Temporary residents such as visitors were also excluded.

**Sampling and data collection process**

Surveys were carried out by data collectors using the quantitative method. A multi-stage sampling technique was used to select 200 households. From these households, individuals who met the inclusion criteria were purposively selected resulting in a total of360 respondents.

**Statistical analyses**

At the end of the survey, aggregate data were downloaded and exported into the IBM Statistical Product and Service Solutions (SPSS, version 20.0) software for analysis. Univariate analysis was used to determine proportions and summary statistics. Data were presented in tables and graphs. Bivariate analysis was used to determine the association between socio-demographic characteristics, knowledge on FSM, household sanitation, perceived health risk of FSM, household toilet sharing, water source and FSM practice using Chi-Square Test (**χ2**) and Fisher’s exact test was used to test for the association where we have a cell value of less than 5. Multivariate analysis was used to identify factors associated with household sanitation and faecal sludge management practice using Multiple Logistic Regression Test. Level of significance was determined at p-value less than 0.05.

**Result**

**Socio-demographic distribution of respondents**

Table 1 showed the socio-demographic characteristics distribution of respondents from the study areas, 189 respondents (52.5%) were males while 171 respondents (47.5%) were females. Males were a little bit higher than females. Also, from the table 88 respondents (24.4%) fell within the age range of 35-40 years, 19.4% fell within 41-45 years, 23.6% fell within 46-50 years, and 13.8% fell within 51-55 years while 18.6% fell within 56-60 years of age. The age range of 35-40 years was found to be higher in the study sample.

From the above table, 27.2% of the respondents had tertiary education, 34.7% had secondary education, 26.4% had primary education and 11.7% had no formal education. The marital status from table 1 shows 27.8% are single, majority (31.9%) are married, 9.7% are divorced, 5.6% are separated, 13.6% are widows while 11.4% are cohabiting.

From the table 1, it can be deduced that majority of the respondents are self-employed (27.5%), 13.6% are government employees, 22.8% are non-government employee, a low percentage of 5.8% are non-paid, 9.2% of the respondents are students, 4.2% are home makers, 2.5% are retired while 14.4% are unemployed. It can also be deduced from the above table that majority (59.4%) of the respondents are Christians, 24.2% are Islamic while 16.4% belong to the traditional religion.

**Table 1 Socio-demographic distribution of respondents**

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | | Frequency (n=360) | Percentage (%) |
| Sex | Male  Female | 189  171 | 52.5  47.5 |
| Age | 35 – 40  41 – 45  46 – 50  51 – 55  56 – 60 | 88  70  85  50  67 | 24.4  19.4  23.6  13.8  18.6 |
| Level of Education | No formal education  Primary  Secondary  Tertiary | 42  95  125  98 | 11.7  26.4  34.7  27.2 |
| Marital Status | Single  Married  Divorced  Separated  Widow  Cohabiting | 100  115  35  20  49  41 | 27.8  31.9  9.7  5.6  13.6  11.4 |
| Occupation | Government employee  Non-Government employee  Self-employed  Non-paid  Student  Home maker  Retired  Unemployed | 49  82  99  21  33  15  09  52 | 13.6  22.8  27.5  5.8  9.2  4.2  2.5  14.4 |
| Religion | Christianity  Islam  Traditional | 214  87  59 | 59.4  24.2  16.4 |

**Household sanitation management practices among Respondents in Rural Communities of Ikwerre Local Government Area**

Data presented in Table 2 shows the household sanitation management practices among respondents in rural communities of Ikwerre Local Government Area. The result indicated 77% of the respondent store faeces from my household toilet in pit toilets/septic tanks, 84% dispose of children’s excreta in toilet or latrine, 5% throw off children’s stool usually into garbage or left in the open. Furthermore, 81% have sewage storage facility (septic tank/pit) in their compound that is accessible to evacuation trucks, 5% confirmed that faeces are observed in and/or around the latrine compartment and left to dry while 68% have separate toilets provided for male and female members of their households to promote confidence in the use of toilets. Also, the result shows that 80% of respondents have toilets that are well lighted to keep the toilets clean at all times, 9% have toilets that are usually abandoned when the septic tanks/latrines are filled and members of their household practise open defecation, 71% empty the contents of the septic tank/pit in their house once every year while 84% provide washing hand basin, disinfectant and soap as well as regular water supply in all the toilets in their homes.

**Table 2.** **Household sanitation management practices among Respondents in Rural Communities of Ikwerre Local Government Area**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| S/N | Variables | Agree | | Unsure | | | Disagree | | |
|  |  | **n** | **%** | **n** | | **%** | **n** | **%** | |
| 1 | Faeces from my household toilet are store in pit toilets/septic tanks | 278 | 77.3 | 10 | | 2.7 | 72 | 20 | |
| 2 | Children’s excreta are usually disposed of in toilet or latrine | 303 | 84.2 | 13 | 3.6 | | 44 | | 12.2 |
| 3 | Children’s stool is usually thrown into garbage or left in the open | 17 | 4.7 | 89 | 24.7 | | 254 | | 70.6 |
| 4 | Sewage storage facility (septic tank/pit) in my compound is accessible to evacuation trucks | 290 | 80.6 | 21 | 5.8 | | 49 | | 13.6 |
| 5 | Faeces are observed in and/or around the latrine compartment and left to dry | 5 | 1.4 | 105 | 29.2 | | 250 | | 69.4 |
| 6 | Separate toilets are provided for male and female members of my household to promote confidence in the use of toilets | 245 | 68.1 | 54 | 15 | | 61 | | 16.9 |
| 7 | The toilets are well lighted to keep the toilets clean at all times | 287 | 79.7 | 43 | 11.9 | | 30 | | 8.3 |
| 8 | Toilets are usually abandoned when the septic tanks/latrines are filled and members of my household practise open defecation | 32 | 8.9 | 54 | 15 | | 274 | | 76.1 |
| 9 | I empty the contents of the septic tank/pit in my house once every year | 256 | 71.1 | 34 | 9.4 | | 70 | | 19.4 |
| 10 | Every toilet in my house has washing hand basin, disinfectant, and soap as well as regular water supply | 304 | 84.4 | 12 | 3.3 | | 44 | | 12.2 |

The overall faecal sludge management practice among respondents in the LGAs revealed that 32.7% of respondents in rural communities of Ikwerre LGA had good faecal sludge management practice as against 67.3% with poor FSM practice (Figure 3).

**Figure 3: Overall FSM Practices among respondents at Ikwerre LGA**

**Perceived Health Risks of Sanitation Management Practices among Respondents in Rural Communities of Ikwerre Local Government Area**

Table 3 shows the perceived health risk of faecal sludge management practice among respondents in Ikwerre LGA. 12% of the respondents in Ikwerre LGA reported that some of their household members had an eye infection in the last one week. Also, 17% of respondents in Ikwerre LGA said that members of their household had frequent bouts of diarrhoea and skin itches within a short period of time. Majority of the respondents in Ikwerre LGA agreed that faecal matter occurred during an evacuation can contaminate resources. Similarly, 25% of the respondents in Ikwerre LGA were aware that a poor evacuation process could cause diseases to the household members. Majority of the respondents in Ikwerre LGA did not believe that there is a likelihood that emptying of faecal sludge will contaminate water resources irrespective of the precautions taken. 33% agreed that poor health outcomes could be associated with inadequate household management of septic sludge, 30% confirmed that the risk of parasitic infections is high due to the presence of sewage pathogens in the environment while 23% agreed that there is a likelihood that the emptying of FS will contaminate water resources irrespective of the precautions taken.

**Table 3: Perceived Health Risks of Sanitation Management Practices among Respondents in Rural Communities of Ikwerre Local Government Area**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variables | Agree | | Unsure | | Disagree | |
| n | % | n | % | n | % |
| Members of my household have had eye infections within short period of time | 44 | 12.3 | 28 | 7.7 | 288 | 80 |
| Members of my household have had frequent bouts of diarrhoea and skin itches within a short period of time | 60 | 16.6 | 16 | 4.4 | 284 | 78.8 |
| If faecal sludge occurs during the evacuation, it can contaminate resources | 90 | 25 | 224 | 62.2 | 46 | 12.7 |
| Insanitary faecal sludge management could predispose households to faeco-oral diseases | 89 | 24.7 | 244 | 67.7 | 27 | 7.5 |
| Leave fresh faecal sludge exposed in the compound | 96 | 24.5 | 246 | 68.3 | 18 | 5 |
| Households are exposed to faecal microorganisms from poor evacuation practice that could cause diseases | 102 | 28.3 | 220 | 61.1 | 14 | 3.9 |
| Faecal sludge buried on-site or discharged into a drain is hazardous to the health of people living in the area | 107 | 29.7 | 214 | 59.4 | 39 | 10.8 |
| Faecal coliforms could be in the air as aerosols and affect the households due to frequent faecal sludge evacuation in  the area | 104 | 28.9 | 220 | 61.1 | 36 | 6.1 |
| Flies could transmit pathogens from sewage in the environment to man | 278 | 77.2 | 49 | 13.6 | 33 | 9.2 |
| Water source could be contaminated from direct and, or indirect infiltration of faecal sludge to the environment | 109 | 30.3 | 214 | 59.4 | 37 | 10.2 |
| The risk of parasitic infections is high due to the presence of sewage pathogens in the environment | 108 | 30 | 212 | 58.9 | 40 | 11.1 |
| Poor health outcomes could be associated with inadequate household management of septic sludge | 120 | 33.3 | 234 | 65 | 6 | 1.7 |
| There is a likelihood that the emptying of FS will contaminate water resources irrespective of the precautions taken | 82 | 22.8 | 152 | 42.2 | 126 | 35 |

The proportion of respondents in Ikwerre LGA with good perception of health risk associated with FSM was lower compared to those with poor perception (Figure 4).

**Figure 4: Perception of households on Health Risk associated with Faecal Sludge Management**

Table 3 shows theassociation between other factors and FSM practice among respondents in Ikwerre LGA. The proportion of respondents (45.3%) who had good knowledge on FSM and had good FSM practice was significantly higher than the proportion of respondents (22.7%) who had poor knowledge (**χ2** = 11.232, p= 0.001). Similarly, the proportion of respondents (96.6%) who had improved sanitation with good FSM practice was significantly higher than the proportion of respondents (15.0%) who had unimproved sanitation (**χ2** = 83.646, p= 0.001).

Also, the proportion (47.2%) of respondents who had water source that had good FSM practice were significantly higher compared to those who didn’t have (15.6%) (**χ2** = 22.122, p= 0.001). The proportion (22.4%) of respondents who shared toilets that had good FSM practice was significantly lower compared with those who didn’t share (47.5%) (**χ2**= 13.549, p= 0.001). There is a statistically significant association between toilet locations and FSM practice (**χ2**= 49.487, p= 0.001).

**Table 4:** **Association** **between** **Factors and FSM Practice among Respondents in Ikwerre LGA**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **FSM Practices** | | **Total**  **N= 360** | **χ2** | p-value |
| **Poor**  **n (%)** | **Good**  **n (%)** |
| **Knowledge on FSM**  Poor  Good | 156 (77.3)  86 (54.7) | 46 (22.7)  72 (45.3) | 202  158 | 11.232 | **0.001\*\*** |
| **Household sanitation**  Unimproved  Improved | 230 (85.0)  13 (14.3) | 41 (15.0)  77 (96.6) | 270  90 | 83.646 | **0.001\*\*** |
| **Perceived Health risk of FSM**  Poor  Good | 176 (66.2)  66 (70.6) | 90 (33.8)  28 (29.4) | 266  94 | 0.329 | 0.566 |
| **Have a water source**  Yes  No | 103 (52.8)  140 (84.4) | 92 (47.2)  26 (15.6) | 195  165 | 22.122 | **0.001\*\*** |
| **Household toilet sharing**  Yes  No | 165 (77.6)  77 (52.5) | 48 (22.4)  70 (47.5) | 213  147 | 13.549 | **0.001\*\*** |
| **Toilet locations**  Within household/building  Outside household/building | 64 (40.7)  178 (88.2) | 94 (59.3)  24 (11.8) | 158  202 | 49.487 | **0.001\*\*** |

**\*\*significant**

Table 5 shows thelogistic regression analysis of factors influencing FSM practice among respondents in Ikwerre LGA. Respondents who had poor knowledge about FSM were three times more likely to have poor FSM practices than those with good knowledge (OR= 2.821, CI= 1.524-5.222, p= 0.001). Respondents who had unimproved sanitation were 34 times more likely to have poor FSM practices compared to those who had improved sanitation practices (OR= 34.091, CI= 13.592-85.506, p= 0.001). Similarly, respondents who had no water source were four times more likely to have poor FSM practices than those who had water sources (OR= 4.847, CI= 2.441-9.623, p= 0.001). Also, respondents who didn’t share toilet facility were 97% likely to have good FSM practices (OR= 0.319, CI= 0.172-0.593, p= 0.001). Also, respondents who had a toilet facility within the household/building were 99% likely to have good FSM practices (OR= 0.092, CI= 0.045-0.189, p= 0.001).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **OR** | **95% CI** | | **P-value** |
| **Lower** | **Upper** |
| **Knowledge on FSM**  Poor  Good (RC) | 2.821  1.00 | 1.524 | 5.222 | **0.001\*\*** |
| **Household sanitation**  Unimproved  Improved (RC) | 34.091  1.00 | 13.592 | 85.506 | **0.001\*\*** |
| **Have a water source**  No  Yes(RC) | 4.847  1.00 | 2.441 | 9.623 | **0.001\*\*** |
| **Household sharing toilet**  No  Yes (RC) | 0.319  1.00 | 0.172 | 0.593 | **0.001\*\*** |
| **Toilet locations**  Within household/building  Outside household/building **(RC)** | 0.092  1.00 | 0.045 | 0.189 | **0.001\*\*** |

**Table 5: Regression Analysis of Factors Influencing FSM Practice among Respondents in Ikwerre LGA.**

**RC- (Reference category- Poor), \*\*significant**

**Discussion**

**Household sanitation management practices among Respondents in Rural Communities of Ikwerre Local Government Area**

Findings showed various household sanitation management practices adopted by respondents in Ikwerre Local Government Area. A large proportion of respondent store faeces from household toilet in pit toilets/septic tanks and others dispose of children’s excreta in toilet or latrine while some respondents throw off children’s stool usually into garbage or left in the open. Findings also showed that respondents in Ikwerre LGA also indulge in unhygienic household sanitation practices such as open defecation, improper use of latrines and toilets and abandonment of toilets when the septic tanks/latrines are filled. This finding is in line with the report from Bill and Melinda Gates Foundation, which reported that people who live in rural areas practice more of open defecation (Bill & Melinda Gates Foundation, 2010). However, a higher proportion of households have faeces in and/or around the latrine compartment and left to dry and toilets do not have washing hand basin, disinfectant, and soap as well as regular water supply this corroborates World (2002) finding that over 90% of the people in peri-urban areas used pit latrines.

**Perceived Health Risks of Sanitation Management Practices among Respondents in Ikwerre Local Government Area**

Poor sanitation and FSM expose household members to diseases, particularly of gastrointestinal nature. Diarrhoea, the leading cause of malnutrition and stunted growth in children, rises predominantly in the situation of poor sanitation and inappropriate faecal handling. The study revealed that the perceived health risk for rural Ikwerre LGA is low. It was reported by the WHO that water contaminated with human faeces could predispose people to health challenges (WHO, 2017). It was gathered that most people in the community are affected by diseases because of poor faecal management. Respondents identified that improper FSM could lead to an epidemic in the community. It was also evident from the study that most respondents in the rural areas defecate inside river (open defection) and take their water source for drinking from the river. This act exposes them to the diverse water-related and faeco-oral diseases. It was gathered that almost all the resident in the rural community wash clothes and defecate in the same river where they fish and drink from. On the other hand, improved sanitation has been shown to decrease diarrhoeal disease by 25 per cent, and there are also notable differences in its reduction depending on the type of improved water and sanitation implemented (Wolf et al., 2018).

**Factors Affecting FSM Practice in Ikwerre LGA**

The study identified knowledge on FSM, household sanitation, having a water source, sharing of toilet and toilet locations (other factors) as factors influencing FSM practice. The study revealed that knowledge of FSM was significantly associated with FSM practice as a highly significant proportion of respondents who had good knowledge on FSM had good FSM practice. Similarly, it was reported from this study that respondents who had poor knowledge on FSM were two times likely to have poor FSM practice. There was a statistically significant relationship between household sanitation and FSM practice, a significantly higher proportion of respondents with good household sanitation, had good FSM practice while those with unimproved household sanitation were 34 times likely to have poor FSM practice. This was supported with reports of the study conducted on the influence of households and community level sanitation on faecal sludge management practice which revealed that a significantly higher proportion of respondents with poor sanitation have poor FSM practice (David et al., 2014). Furthermore, this study also revealed that a significantly high proportion of respondent with high perceived health risk of FSM had good FSM practice. Respondents who have water source had good FSM practice compared to those who didn’t have. This agreed with the report of a study which revealed that most people who have a water source have poor faecal sludge management practice (WHO/UNICEF, 2013).

The study showed that toilets sharing and where located were significantly associated with FSM practice. Respondents who didn’t share the toilet and whose toilets were located within the building were 97% and 99% less likely to have poor FSM practice respectively. This was supported by a study conducted in Ibadan, which revealed that respondents who have toilet facilities in their houses were more likely to have good FSM practice (Oloruntoba et al., 2019).

**Strengths**

The study adopted a community-based cross-sectional study design which assessed household sanitation and associated challenges in Ikwerre Local Government Area of Rivers State. **The** surveys were carried out with a multi-stage sampling technique was to select participants Univariate analysis was used to determine proportions and summary statistics. Bivariate analysis was used to determine the association between socio-demographic characteristics, knowledge on FSM, household sanitation, perceived health risk of FSM. Also, multivariate analysis was used to identify factors associated with household sanitation and faecal sludge management practice using Multiple Logistic Regression. Strengths of this study include its use of trained data collectors who are independent (not employed by FSM companies) and its inclusion of 118 out of 120 FSM staff in the states allowing generalizability of its results.

**Weakness**: Its limitations include reliance on self-reporting by staff which was subjected to social desirability bias.

**Conclusions**

The study identified knowledge on FSM, household sanitation, perceived health risk of FSM, having a water source, sharing of toilet and toilet locations as factors influencing FSM practice in rural communities of Ikwerre LGA. From the study, it was concluded that household sanitation and FSM have continued to pose a challenge in peri-urban areas everywhere around the developing world. The reason for this stems from lack of incentives in sanitation service provision in low-income areas coupled with absence of policy to address the problem. The study showed that it is imperative to pay a close attention to household sanitation and FSM in rural areas.

**Recommendations**

Based on the findings and conclusion of this study, the following recommendations are made.

1. Community sensitization to increase the level of knowledge of households on faecal sludge management in rural communities of LGAs.
2. The government should develop a plan and policy to discourage open defecation in rural LGAs and also sensitize the communities on the dangers associated with open defecation.
3. There is need for health and sanitation officers to educate community stakeholders on the relevance of good sanitation and its positive effect on the health of the people most especially in rural LGAs.
4. Government, as a matter of policy, should establish a sanitary FSM facility to limit the indiscriminate discharge of evacuated faecal sludge in highly prone locations to debar public health catastrophe.

**List of Abbreviations**

CI: Confidence Interval

FS: Faecal Sludge

FSM: Faecal Sludge Management

JMP- Joint Monitoring Programme

LGA- Local Government Area

MDG- Millenium Development Goals

OR: Odds ratio

OSS: On-site Sanitation

SSTs: Secondary Settling Tanks

UNICEF- United Nation International Children Emergency Fund

WHO: World Health Organization

**Declarations**

**Ethics approval and consent to participate.**

The study followed the ethical principles guiding the handling of the human participants in research. Prior orientation of participants was carried out regarding objectives and the possible impact of the study, emphasizing the right of the subject to non-participation. Adequate information about the research was given to the research participants with a form requesting for their informed consent, which was treated formally and adequately informed that they could withdraw from the research at any point in the research with all information given being used for the purpose of the research only.

**Consent for publication**

Consent participation and publication was received from all participants whose data appears in this study.

**Availability of data and materials**

Data employed in this study are available from the authors upon reasonable request.

**Reference:**

1. Baum, R., Luh, J., & Bartram, J. (2013). Sanitation: a global estimate of sewerage connections without treatment and the resulting impact on MDG progress. *Environmental science & technology,* 47(4), 1994-2000.
2. Bill & Melinda Gates Foundation (2010). Water, Sanitation & Hygiene Fact Sheet. Global development program. [www.gatesfoundation.org](http://www.gatesfoundation.org)
3. Bill & Melinda Gates Foundation. (2012). Business analysis of faecal sludge management: Emptying and transportation services in Africa and Asia. Draft Final Report.
4. Biran, A. Jenkins, M. W. Dabrase, P. Bhagwat, I. (2011). Patterns and determinants of communal latrine usage in urban poverty pockets in Bhopal, India. Trop Med. Int. Health: 854−862.
5. Blackett, I. Hawkins, P. and Heymans, C. (2014). Targeting the urban poor and improving services in small towns. The missing link in sanitation service delivery: A review of fecal sludge management in 12 cities Water and Sanitation Program (WSP) Research Brief. WSP, World Bank.
6. Cairncross, S., Blumenthal, U., Kolsky, P., Moraes, L., Tayeh, A. (1996). The public and domestic domains in the transmission of disease. Tropical Medical International Health Journal; 1: 27–34
7. Ingallinella, A., Sanguinetti, G., Koottatep, T., Montangero, A., Strauss, M., Jimenez, B., Spinosa, L., Odegaard, H., and Lee, D. (2002). The challenge of faecal sludge management in urban areas- strategies, regulations and treatment options. Water Science and Technology, 46(10), 285–294.
8. IRCWASH. (2016). Thinking about the finish line: Sustainable sanitation services for all. Accessed on <http://www.ircwash.org/projects/sustainable-sanitation-and-hygiene-all>
9. Kvarnström, E., McConville, J., Bracken, P., Johansson, M., Fogde, M. (2011). The sanitation ladder a need for a revamp? J. Water Hyg Develop, 1 (1), 3−12.
10. Montangero, A., Koné, D., Strauss, M. (2002). Planning Towards Improved Excreta Management. In: Proceedings, 5th IWA Conference on Small Water and Wastewater Treatment Systems, Istanbul, Turkey, Sept. 24-26.
11. Rose, C., Parker, A, Jefferson, B., Cartmell, E. (2015). The characterization of feces and urine: a review of the literature to inform advanced treatment technology. Critical Reviews in Environmental Science and Technology 45(17): 1827–1879.
12. SuSanA. (2008). Towards more sustainable sanitation solutions. Sustainable Sanitation Alliance (SuSanA).
13. Trémolet, S. (2011). Identifying the potential for results-based financing for sanitation. World Bank, Water and Sanitation Program (WSP) Scaling Up Rural Sanitation Initiative. WSP Working Paper. Washington, DC: The World Bank
14. UNICEF/WHO. (2010). Progress on Sanitation and Drinking Water; 2010 update. Joint Monitoring Programme for Water Supply and Sanitation.
15. UNICEF/WHO. (2014). Progress on drinking water and sanitation. 2014 update.
16. UNICEF/WHO. (2014). Progress on Drinking -Water and Sanitation. Estimates on Sanitation and Drinking -Water: Update: 9.
17. UNICEF/WHO. (2019). World Health Organization and United Nations Children’s Fund Joint Monitoring Programme for Water Supply and sanitation (JMP). Fact sheet on Drinking Water and Sanitation. ISBN: 978-92-415-1623-5
18. WHO (2017). Update and MDG Assessment. Available: <http://www.wssinfo.org>
19. WHO. (2005). Sanitation and hygiene promotion: Programming guidance. (WSSCC) Water Supply and Sanitation Collaborative Council, International Environment House, Geneva, Switziland. ISBN 92 4 159303 2.
20. WHO/UNICEF (2017). Sanitation and hygiene promotion. Update and MDG Assessment. Available: <http://www.wssinfo.org>
21. WHO/UNICEF. (2017). Sanitation and hygiene promotion. Update and MDG Assessment. Available: <http://www.wssinfo.org>
22. Wolf, J., Hunter, P. R., Freeman, M. C., Cumming, O., Clasen, T., Bartram, J., Higgins, J. P. T., Johnston, R., Medlicott, K., Boisson, S. & Pruss-Ustun, A. (2018). Impact of drinking water, sanitation and handwashing with soap on childhood diarrhoeal disease: updated meta-analysis and meta-regression. *Tropical Medicine and International Health* 23(5), 508–525.
23. World Bank AFTU 1 & 2 (2002). *Upgrading low-income urban settlements: Country Assessment Report, Zambia.*
24. WSP (Water and Sanitation Program), (2014). The missing link in sanitation service delivery: A review of fecal sludge management in 12 cities. Research Brief. Washington, DC: World Bank.