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Comparing Household Environmental Health Indicators between Oil-bearing and Non-oil-bearing Communities in the Niger Delta Region of Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author OM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors OM and BEE managed the analyses and literature searches of the study. The two authors read and approved the final manuscript.

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ABSTRACT

Background: Household environmental health indicators have contributed to the quality of life of the populace in regions of the world where they have been made available. This study compared the indicators of household environmental health between oil-bearing and non-oil-bearing communities located in the Niger Delta region of Nigeria.
Methods: An analytical, cross-sectional household survey was carried out among 601 households in six oil-bearing and non-oil-bearing selected communities located within the Niger Delta region of Nigeria. Multistage sampling was employed, and an interviewer-administered questionnaire used to elicit data on the household environmental health indicators in the communities. The scores across the six indicator domains were summed and categorized into acceptable and unacceptable status.
Results: Water sources in both oil-bearing 230 (76.4%) and non-oil-bearing communities 177 (59.0%) were sanitary. Sanitary sewage 250 (83.1%) and sullage disposal 210 (69.8%) was practiced by most households in oil-bearing areas. The minority of respondents in both oil-bearing

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26 (8.6%) and non-oil-bearing 41 (13.7%) communities practiced sanitary refuse disposal. Households in oil-bearing communities had twelve times greater odds of having a satisfactory environmental health status compared to households in non-oil-bearing communities (Adjusted O.R: 11.70, 95% C.I: 7.75-17.65).

Conclusion: Households in oil-bearing communities fared better in all household environmental health indicators. There is a need to address the economic and social determinants of health among households in the Niger Delta to improve household environmental health indicators.

Keywords: Environmental health indicators; oil-bearing communities; Niger Delta.

1. INTRODUCTION

Every human deserves to be treated with respect, dignity and fairness in line with declarations in the International Covenants enforceable by law. [1] These rights are necessary for a dignified human existence. In achieving the right to the highest attainable standard of health, the UN Committee on Economic, Social and Cultural Rights issued an authoritative interpretation that expounded the right to health to "*not only to timely and appropriate health care but also to the underlying determinants of health, including access to safe and potable water and adequate sanitation, an adequate supply of safe food, nutrition and housing, healthy occupational and environmental conditions, and access to health-related education and information, including sexual and reproductive health"* [2, 3].

The health status of vulnerable community dwellers is a sensitive indicator of a society's overall well-being. Countries that respect adherence to basic human rights have been reported to promote changes that contribute to establishment of sustainable development programs in their regions. These include access to potable water, adequate sanitation, safe food, housing, healthy occupational and environmental conditions amongst others [2]. Household environmental health indicators have contributed to the quality of life of the populace in regions of the world where they have been made available [4, 5].

The same can however not be said of other regions of the world where they either inadequately or not available, especially in developing countries. [4, 6-8] In Nigeria, reports have shown that majority of the populace still does not have access to potable water supply [4, 9], make use of unsanitary waste disposal methods as well as engage in the pollution of surface water with various waste products [10-12]. The Nigerian populace is also faced with poor quality housing conditions [9,13,14], and make use of biomass fuels for cooking and lighting, thus contributing to further environmental degradation [15-18].

Within certain parts of the Niger Delta region of Nigeria, reports show the presence of deficiencies in aspects of environmental health [6,7,19]. Although the thinking is that the burden of crude oil exploratory activities further worsens the already poor environmental health indicators [20, 21] it is unclear from literature that this is the case in the Niger Delta region of Nigeria. It is therefore imperative to provide up-to-date evidence on the state of household environmental health indicators in crude oil bearing and non-crude oil-bearing households within the Niger Delta region of Nigeria. This study therefore compared the household environmental health indicators between oil-bearing and non-oil-bearing communities in the Niger Delta region and thus provided reference data that would be useful in guiding relevant future decisions and actions of relevant government and non-governmental stakeholders.

2. MATERIALS AND METHODS

This research was conducted in the Niger Delta region of Nigeria which occupies about 70,000 km² and makes up 7.5% of Nigeria's land mass. Oil exploration in the states located within the Niger Delta including Bayelsa, Rivers, Delta, Akwa Ibom, Cross River, Edo, Abia, Imo and Ondo states; is the major source of foreign exchange for the country. An analytical, cross sectional household survey was employed in the conduct of this research. Communities sampled in this study included those where oil exploration activities had been going on for a minimum of ten years as well as communities without any history of oil exploration activities. 601 households were recruited to participate in this study using a multistage sampling technique. This involved a purposive sampling of Rivers, Bayelsa and Delta states out of the nine states in the Niger Delta

because of the large volume of oil exploration activities presently going on in them. Also, a simple random sampling of one LGA per selected state from a sampling frame of all the LGAs involved in oil exploration activities and those not involved in it was done. Finally, purposive sampling of two communities in each selected LGA was done based on the presence or absence of oil exploration sites, minimal security risk and geographical accessibility. A total of six communities, Sampou and Nedugo in Bayelsa State, Ibada-Elume and Oton-Yasere in Delta state, and Omerelu and Mbodo-Aluu in Rivers State, were selected. Sampou, Ibada-Elume and Omerelu are communities without any oil exploration activities, while Nedugo, Oton-Yasere and Mbodo-Aluu are communities which have been host to oil exploration activities for the past 10 years. Within each selected community, a community household enumeration list used for a recent measles supplemental immunization campaign was used as a sampling frame. Systematic sampling was done using a sampling interval calculated by dividing the total number of households by the sample size for each community. Sampling commenced from the centre of the community or the town hall. The first house to be selected was by the toss of a coin between the two houses closest to the centre/hall.

An interviewer-administered questionnaire was used as the instrument for collection of data from the respondents. The questionnaire elicited their socio-demographic information as well as data on the household environmental health indicators of the communities. Indicators assessed included their drinking water sources and its safety, sewage, refuse and sullage disposal methods; the quality of housing as well as the cooking fuels used by households. They were assured that every piece of information provided would be kept in the strictest confidence. They were also informed that their participation was voluntary and that if at any time they felt uncomfortable during any part of the survey, they were free to decline response to particular questions or stop the interview all together. All collected data was entered into a Microsoft Excel spreadsheet and then transferred to the IBM Statistical Package for Social Sciences version 23 for analysis. Descriptive statistics included frequency distribution and median of the various parameters. The assessed environmental health indicators were then grouped as either being sanitary/acceptable/adequate or unsanitary/ unacceptable/inadequate in nature and allotted scores of 1 and 0 respectively. The scores across the six indicator domains were then summed and categorized into 2 groups namely: acceptable and unacceptable environmental health status having a summed score of between 4 to 6 and 0 to 3 respectively. The Chi-square test, univariate and multivariable regression analysis was used to ascertain significant differences between values from oil-bearing and non-oil-bearing communities.

3. RESULTS

A total of 601 households participated in this study with 202 (33.6%) from Bayelsa State, 198 (32.9%) from Delta State and 201 (33.4%) from Rivers State evenly distributed among 3 oil-bearing and 3 non-oil-bearing communities. Each of these study groups (oil-bearing and non-oil-bearing communities) had a median household density of 3 persons per household and a median adult household density of 1 adult per household. This is shown in Table 1.

3.1 Household Environmental Health Indicators

In this study, several indicators were assessed including those relating to source of drinking water, waste disposal methods, type of housing and fuel types used for cooking. As regards source of drinking water primary water source was from boreholes for both oil-bearing 208 (69.1%) and non-oil-bearing 163 (54.3%) communities. Majority of the water sources were found to be sanitary for both oil-bearing 230 (76.4%) and non- oil-bearing 177 (59.0%) areas. Regarding waste disposal methods, majority of the respondents from oil-bearing areas 250 (83.1%) disposed their sewage using the water closet. However, a large proportion of respondents in non-oil-bearing areas 144 (48.0%) adopted open dumping sewage disposal methods. Likewise, majority of the respondents from oil-bearing areas 210 (69.8%) disposed their sullage via the soak-away pit. Majority of respondents in non-oil-bearing areas 198 (66.0%) disposed their sullage via open dumping disposal methods. Concerning their refuse collection practices, majority of the respondents collected refuse using bins 224 (74.4%) in oil-bearing areas and by open collection 194 (64.7%) in non-oil-bearing areas. On their methods of waste disposal, majority of the respondents practiced open refuse dumping in both oil-bearing 241 (80.1%) and non-oil-bearing 259 (86.3%) communities. This data is shown in Table 2.

Regarding the type of housing in the communities, it was found that majority of the respondents in both oil-bearing 296 (98.3%) and non-oil-bearing 278 (92.7%) communities lived in houses built with concrete and roofed with zinc sheets. Regarding their types of kitchen, most households in oil-bearing communities had their kitchens attached to their houses 228 (75.7%) and most households in non-oil-bearing communities had their kitchens detached from their houses 169 (56.3%). Assessment of the major cooking fuels showed that most households used kerosene 136 (45.2%) and domestic gas 103 (34.2%) in oil-bearing areas whereas most households used firewood 212 (70.7%) and kerosene 77 (25.7%) in non-oil-bearing areas. This data is shown in Table 3.

Table 1. Summary statistics of household membership across study groups

Variables	Number of households (%)	
state	**Oil-bearing (%)**	**Non-oil-bearing (%)**
Bayelsa	101 (33.6)	101 (33.7)
Delta	98 (32.6)	100 (33.3)
Rivers	102 (33.9)	99 (33.0)
Community		
Ibada-Elume	0.0	100 (33.3)
Omerelu	0.0	99 (33.0)
Sampou	0.0	101 (33.7)
Mbodo	102 (33.9)	0
Nedugo	101 (33.6)	0
Oton	98 (32.6)	0

Median household density: 3 persons per household
Adult median household density: 1 adult per household

Table 2. Comparison of water sources and waste disposal methods in oil-bearing and non-oil-bearing communities

Variables	Study group		Chi-square
	Oil-bearing (%)	**Non-oil-bearing (%)**	**(p-value)**
Primary source of water			
Borehole	208 (69.1)	163 (54.3)	106.09 (<0.001*)
Well	12 (4.0)	47 (15.7)	
Rain	5 (1.7)	9 (3.0)	
Surface water	5 (1.7)	62 (20.7)	
Vendors	63 (20.9)	16 (5.3)	
Packaged water	8 (2.7)	3 (1.0)	
Method of sewage disposal			
Water closet	250 (83.1)	85 (28.3)	192.20 (<0.001*)
Pier	9 (3.0)	7 (2.3)	
Pit	10 (3.3)	64 (21.3)	
Open dumping	32 (10.6)	144 (48.0)	
Method of sullage disposal			
Soak-away pit	210 (69.8)	102 (34.0)	76.99 (<0.001*)
Open dumping	91 (30.2)	198 (66.0)	
Method of refuse collection			
Bin	224 (74.4)	106 (35.3)	92.71 (<0.001*)
Open collection	77 (25.6)	194 (64.7)	
Method of refuse disposal			
Open dumping	241 (80.1)	259 (86.3)	45.76 (<0.001*)
Composting	4 (1.3)	18 (6.0)	
Burning	18 (6.0)	22 (7.3)	
Sanitary land fill	4 (1.3)	1 (0.3)	
Refuse collectors	34 (11.3)	0 (0.0)	

Table 3. Comparison of housing, kitchen, and cooking fuel characteristics among oil-bearing and non-oil-bearing communities

Variables	Study group		Chi-square
	Oil-bearing (%)	Non-oil-bearing (%)	(p-value)
Type of house			
Mud and zinc	5 (1.7)	22 (7.3)	11.27 (<0.001*)
Concrete and zinc	296 (98.3)	278 (92.7)	
Type of Kitchen			
Attached	228 (75.7)	62 (20.7)	183.1(<0.001*)
Detached	48 (15.9)	169 (56.3)	
None	25 (8.3)	69 (23.0)	
Major Cooking fuel			
Firewood	48 (15.9)	212 (70.7)	212.6 (<0.001*)
Kerosene	136 (45.2)	77 (25.7)	
Charcoal	1 (0.3	0 (0.0)	
Domestic gas	103 (34.2)	5 (1.7)	
Electric stove	1 (0.3)	1 (0.3)	
Combination	12 (4.0)	5 (1.70	

3.2 Sanitary Condition/practices of Household Environmental Health Indicators

Assessment of the sanitary conditions of the different household environmental health indicators explored in this study showed that most of the water sources in both oil-bearing 230 (76.4%) and non-oil-bearing communities 177 (59.0%) had good sanitary water. Also, sanitary sewage 250 (83.1%) and sullage disposal 210 (69.8%) was practiced by majority of households in oil-bearing areas. However, only a minority of respondents in both oil-bearing 26 (8.6%) and non-oil-bearing 41 (13.7%) communities in this study practiced sanitary refuse disposal. Majority of respondents used acceptable cooking fuels in oil-bearing communities 240 (83.0%). Overcrowding was however found to be a problem in both study groups. These differences were found to be significant ($p \leq 0.05$). These are shown in Table 4.

Table 4. Comparison of household environmental health indicators among oil-bearing and non-oil-bearing communities

Variables	Study group		Chi-square	C.O.R.
	Oil-bearing (%)	Non-oil-bearing (%)	(p-value)	(95% C.I)
Sanitary water				
Yes	230 (76.4)	177 (59.0)	20.84	2.25
No	71 (23.6)	123 (41.0)	(<0.001*)	(1.58-3.20)
Sanitary sewage disposal				
Yes	250 (83.1)	85 (28.3)	182.38	12.40
No	51 (16.9)	215 (71.7)	(<0.001*)	(8.38-18.35)
Sanitary sullage disposal				
Yes	210 (69.8)	102 (34.0)	77.00	4.48
No	91 (30.2)	198 (66.0)	(<0.001*)	(3.18-6.31)
Sanitary refuse disposal				
Yes	26 (8.6)	41 (13.7)	3.84 (0.05*)	0.60
No	275 (91.4)	259 (86.3)		(0.36-1.00)
Acceptable cooking fuel				
Yes	240 (83.0)	83 (28.1)	178.07	12.51
No	49 (17.0)	212 (71.9)	(<0.001*)	(8.40-18.64)
House population				
Crowded	145 (48.2)	194 (64.7)	16.62	1.97
Adequate	156 (51.8)	106 (35.3)	(<0.001*)	(1.42-2.73)

**C.O.R: Crude Odds Ratio; C.I.: Confidence Interval*

3.3 Environmental Health Status

Considering the summation of sanitary conditions and practices of the assessed household environmental health indicators in this study, it was found that oil-bearing communities presented with a more satisfactory environmental health status 195 (64.8%) compared to non-oil-bearing communities 43 (14.3%). The households in oil-bearing communities were found to be eleven times more likely to have a satisfactory environmental health status compared to households in non-oil-bearing communities. (Crude O.R: 10.99, 95% C.I: 7.37-16.41) When adjusted for rural/semi-urban designation of the communities, the households in oil-bearing communities were found to be twelve times more likely to have a satisfactory environmental health status compared to households in non-oil-bearing communities (Adjusted O.R: 11.70, 95% C.I: 7.75-17.65). This is shown in Fig. 1.

4. DISCUSSION

This study found that the primary water source was from boreholes in both oil-bearing and non-oil-bearing communities. These were mostly in sanitary condition and fit for consumption. This source of water has been highlighted as part of the fresh water sources that should be made accessible to all communities. [22] However, privately owned boreholes do not have an effective central monitoring and managing system that ensures the sustained provision of potable water as seen in pipe-borne water. [3, 4, 23, 24] There is need for major improvements in making domestic potable water available to the populace to attain the Sustainable Development Goals (SDGs) of improving water availability, accessibility, quality, and utilization [5]. This study found surface water and water vendors to be the second most common source of water in non-oil-bearing and oil-bearing communities, respectively. This may be because oil exploration activities have been shown to pollute surface water resulting in a myriad of health problems [25-27] and environmental pollution [20, 28]. There is need for the enforcement of the laws and penalties that protect the environment from pollution [29-31].

This study found that majority of the respondents from oil-bearing areas disposed their sewage and sullage using the water closet and soak-away pits systems. However, in non-oil-bearing communities, open dumping of sewage and sullage was a common practice. This is in contrast to similar research which showed that only a minority of the population engaged in that disposal method [12,32]. In these studies, a sizeable proportion of their populations utilized the water closet and soak-away pit as sewage and sullage disposal methods. Proper disposal of sewage and sullage cannot be over-emphasized considering how this protects the environment and humans from harm. There is therefore need for improved action in waste handling in Nigeria. The relative disparities in the economic status of persons living in oil-bearing communities as

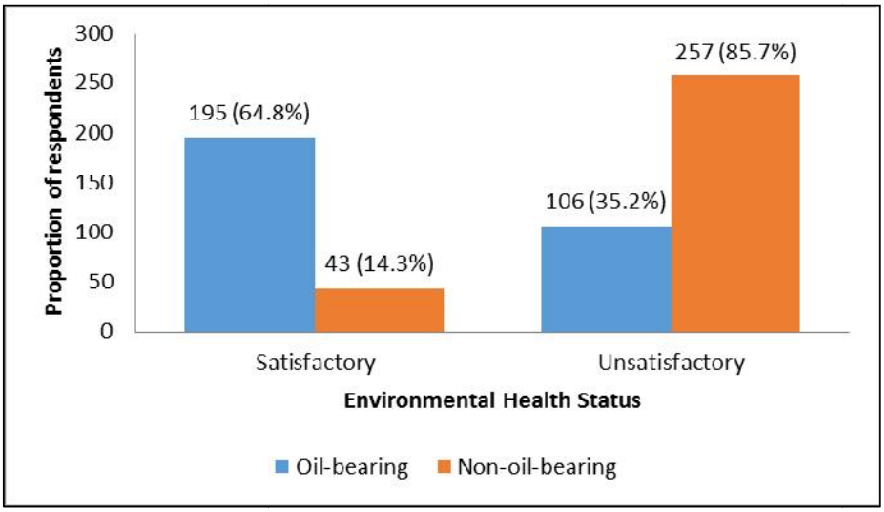

Fig. 1. Comparison of environmental health status of household in oil-bearing and non-oil-bearing communities

**Crude O.R: 10.99, 95% C.I: 7.37-16.41; Adjusted O.R: 11.70, 95% C.I: 7.75 – 17.65*

compared to those living in non-oil-bearing communities may be responsible for the significant difference in the use of sanitary sewage and sullage disposal methods.

Majority of the respondents collected refuse using bins in oil-bearing areas and by open collection in non-oil-bearing areas. Majority of the respondents however practiced open dumping of refuse in both categories of communities. This practice of open dumping of refuse was also a similar finding in a recent study which focused on waste disposal problems and management in Ughelli, Delta State, Nigeria. Sunday [11] The open dumping of waste products results in a number of health problems including the spread of infectious diseases, pollution of surface and groundwater sources as well as problems related with air pollution [33,34]. This puts these communities at risk and requires the urgent attention of the government and public health authorities for interventions that discourage this practice [34].

Most households in oil-bearing communities had their kitchens attached to their houses and most households in non-oil-bearing communities had their kitchens detached from their houses. Having attached kitchens as a major building characteristic was a similar finding in the study by Mbazor [9] and this has been stated as one of the determinants of quality housing [19]. This implies that homeowners in oil-bearing communities likely have a better economic status. Overcrowding was also found to be more of a problem among households in non-oil-bearing communities. This finding is in agreement with similar studies conducted in Nigeria [6,13]. Overcrowding imposes a huge burden on the available resources and amenities of the houses which exposes the occupants to disease transmission, inadequate ventilation, stunted mental development amongst others [13,14]. The availability of good quality housing provides the bedrock for stable communities and social inclusion. It does not only ensure the safety and wellbeing of people, but promotes beauty, convenience and aesthetics in the overall built-up environment [14].

Majority of respondents were found to use acceptable cooking fuels in oil-bearing communities while residents in the non-oil-bearing areas were found to mainly use firewood. The use of biomass fuels has been reported as a major environmental and public health challenge in developing countries. [35] Apart from the associated ill-health, the consumption of firewood has been reported to contribute to the occurrence of environmental hazards including deforestation, soil erosion, air pollution as well as desertification in Nigeria [17]. There is therefore need to shift focus from the use of firewood as an energy source for cooking to the use of domestic gas and other healthier energy sources [16,36].

The study showed significantly better environmental health indices among households in oil bearing communities compared to non-oil-bearing communities. Households in oil bearing communities performed significantly better in all household environmental health indicators than households in non-oil-bearing communities. The implication of this finding is that while oil exploration has direct links to land and water pollution, as shown by many researchers, [37-39] it may not have adverse effects on the household indicators studied. The underlying reason for this may be the fact that persons living in oil bearing communities likely have economic advantages over persons living in non-oil-bearing communities [40]. Boreholes, water closets, acceptable buildings, liquefied petroleum gas or kerosene and acceptable housing conditions are all a function of purchasing power. Oil exploration companies provide opportunities for individuals to earn better and therefore be able to afford better environmental household conditions. It is therefore important for interventions to tackle the social determinants of health and poverty.

This study did not consider the environmental conditions outside the households, neither did it control for household wealth and income which are likely to be major confounding variables in this study. These are areas for further research.

5. CONCLUSION

Environmental health status of households in both oil and non-oil-bearing communities is still below par. Households in oil-bearing communities fared better in all household environmental health indicators. There is need to address the economic and social determinants of health among households in the Niger Delta to improve household environmental health indicators.

CONSENT AND ETHICAL APPROVAL

Ethics approval for this research was obtained from the Research Ethics Committee of the University of Port Harcourt. Permission to carry out the study was obtained from the Local Government headquarters of each community and the community gatekeepers. The consent of

the respondents was sought before the administration of the study instrument.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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