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Original Research Article

Impact of gas flaring in Ubeji metropolis of Delta State Nigeria: a comparative survey of environment health effects

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ABSTRACT

Background: The impact of gas flaring in Ubeji metropolis, relative to other communities of Delta is of interest. This study assessed the environmental impact of gas flaring in Ubeji metropolis of Delta State. The objective of this study is to study the comparative assessment of the environmental impacts of gas flaring on five communities of unequal distance from gas flaring site.
Methods: Questionnaire survey was used to evaluate three research questions that included the level of knowledge in the survey communities regarding health impact of gas flaring; prevalence level of assessed health conditions in Ubeji metropolis relative to communities farther from or nearer to Warri gas flaring site; and perceived impact of gas flaring on air quality indicated by health and environmental toxicity indices.
Results: Descriptive evaluation of data shows Ubeji appears to have the highest proportion of persons suffering respiratory problems, but the figure for family members is less than some other communities. The respondents nearer flaring site show more awareness compared to those farther away. Critical evaluation showed no directional change in prevalence of disease linked to gas flaring. There is linear relationship between 'distance to gas flare site' and 'toxic impact on air quality'.
Conclusions: This report submits further data to the discourse that, on the basis of nearness to gas flaring site, there is significant difference between communities experience of environmental and health impact.

Keywords: Environmental health impacts, Gas flares, Niger Delta communities

INTRODUCTION

With the discovery of crude oil in the Niger Delta region of Nigeria, gas flaring activities has progressively increased in the region.[1] Available evidence suggests that increases in the concentrations of air pollutants as a result of gas flaring in the Niger Delta have contributed significant impacts on the health of local people.[2,3] Moreso, flaring may further contribute to local and regional environmental problems, such as acid rain with attendant impact on agriculture and physical infrastructure amongst others.[4,5]

Suffice to say that the covert and slow action of the hazards created by oil exploration and exploitation has been of growing concern, especially their contribution to the disease burden in host communities of oil exploration activities such as Niger Delta region of Nigeria.[6] It is known that environmental air pollution from gas flaring causes acid rain amongst other deleterious effects that constitute public health concern in Nigeria,[5] including cardiovascular diseases, diabetes mellitus and oxidative stress amongst others.[7,8] There are reports implicating acid rain in non-accidental deaths as well as in diabetes and cardiorespiratory.[9-11] Further, oil exploitation has increased the rate of environmental degradation and has

perpetuated food insecurity, which is potentiating stress.[12-14] It is noteworthy that stress causes or worsens diabetes and associated cardiovascular diseases.[15-17]

Objectives

The main objective of this paper is to assess the environmental impact of gas flaring on the quality of air in Ubeji metropolis of Delta State. The specific objectives are to assess the environmental impacts of gas flaring on the built environment of Ubeji metropolis, compared with communities farther away from gas flaring sites – in terms of prevalence of diabetes, heart diseases, haematological abnormalities, lung cancer, and stress.[1,2,7,8]

METHODS

Research design

This was a descriptive survey and involved three approaches. First, interviews were used as one of the sources of collecting primary data. The interviews were held with nurses and doctors in the hospitals. Questionnaire was used as the second source of data collection. Questionnaires were administered to the hospital laboratory departmental records, nurses, doctors and patients that would be present at the time of visitation. Direct observation was used as third approach and this occurred during delivery and retrieval of forms from the respondents.

Study place and period

This study would be undertaken in Ubeji community of Warri South Local Government Area of Delta State. Ubeji is located on the lower Niger Delta plain and is host to the Warri Refining and Petrochemical Company and the Nigeria Gas Company. Ubeji has a population of about 10,000 inhabitants as reported by the 2006 Nigeria's National Population Census. The people are predominantly engaged in small-scale agriculture and fishing and the main ethnic group is Itsekiri.

Selection criteria

The participants selected for survey included healthcare workers in the health facilities as well as adults in the selected homes. In the homes comprising parents and children, the latter was excluded.

Sampling procedure

A stratified and systematic sampling technique was used to administer 293 questionnaires to hospitals around. The community and environs were stratified into four zones (Ifie-kporo community, Ubeji (GbokodoItsekiri) community, Jeddo community, and Ekpan community) to insure that every section of its metropolis participated. One other hospital from other geographical zone of the State was included for comparison (Eku Government hospital) all in delta state. Section A was used to elicit bio data of respondents such as age, sex, marital status, religion and nationality. While section B elicited information on the knowledge and effect of the gas flared in their environment.

Ethical approval

A letter of introduction was collected from the department of Public and Community Health, Novena University, Ogume, Delta State in order to seek approval from the various hospitals in the different communities where the research would be carried out. To clear any misconceptions about the intentions of the study, an explicit overview of what the research entails and how the results will be utilized, was given to the respondents. Privacy and confidentiality of the respondents in order to gain confidence from them were adhered.

Statistical analysis

The data collected were analysed using descriptive statistics of frequency counts and percentages. Proportions of respondents were evaluated in percentages; while graphical comparisons were performed using Microsoft Excel chart plotting tool.

RESULTS

The following research questions were set in order to help find answers or solution to the research problems.

- What is the level of assessed health conditions in Ubeji metropolis?
- What is the level of assessed health conditions in communities farther away from gas flaring?
- What is the impact of gas flaring on human health (heart diseases and diabetes)?

Descriptive evaluation of data shows the age distribution of the respondents in the study area. For instance, at Ifie-Kporo community, 50/ 60 respondents were within the age group of 20-50 years; while in Eku community, 16/17 respondents agreed to fall within the age group of 20-50 years (Table 1).

The graphical presentation of comparison in terms of percentage proportion respondents show that Ubeji appears to have the highest proportion of persons suffering respiratory problems, but the figure for family members is less than half of the indication from Ifie and Jeddo (Figure 1). Furthermore, the proportion of persons suffering from stress among Ubeji respondents appear to be relative less than other communities (Figure 2).

Research question 1

Level of knowledge in survey communities regarding health impact. Evaluation of knowledge showed higher

frequency of affirmative responses in communities nearer the gas flare site (Table 2; $p<0.01$). A graphical presentation of the absolute frequency (%) of positive responses within communities indicated greater awareness with nearness to the gas flare site. Further evaluation of relative frequency i.e., considering all affirmative response of knowledge, showed that the respondents from within 3 km distance to/from flaring site are more aware (≈22%) compared to those farther away (<20%) (Figure 3).

Table 1: Descriptive statistics of respondents including their own medical history.

		Ifie	Ekpan	Ubeji	Jeddo	Eku
Number (N) of respondents		60	55	69	52	17
Age: respondents within 20–50 years		50	55	59	49	16
Distance from 'Warri' gas flare (km)		0.5	2.2	3.6	4	49
Marital status	Married	16	18	54	34	7
	Single	44	37	15	18	10
Occupation	Civil servant	13	17	18	12	15
	Others	47	38	51	40	2
Do you suffer?	Respiratory	3	5	18	5	0
	Stress	57	50	51	52	17
Does your family member suffer?	Cancer	-	-	-	-	-
	Diabetes	1	-	-	13	-
	Heart disease	-	3	-	-	-
	Anaemia	-	-	-	-	-
	Respiratory	9	4	5	8	-
	Stress	50	48	64	31	17

*None of the respondents in the survey indicated to be in farming, fishing or trading occupation.

†None of the respondents indicated to be suffering from diabetes, or heart disease.

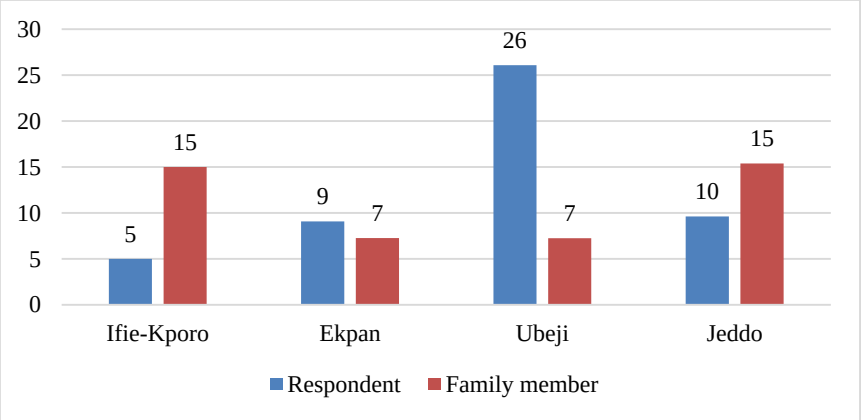

Figure 1: Proportion (%) of respondents suffering respiratory problems in each community.

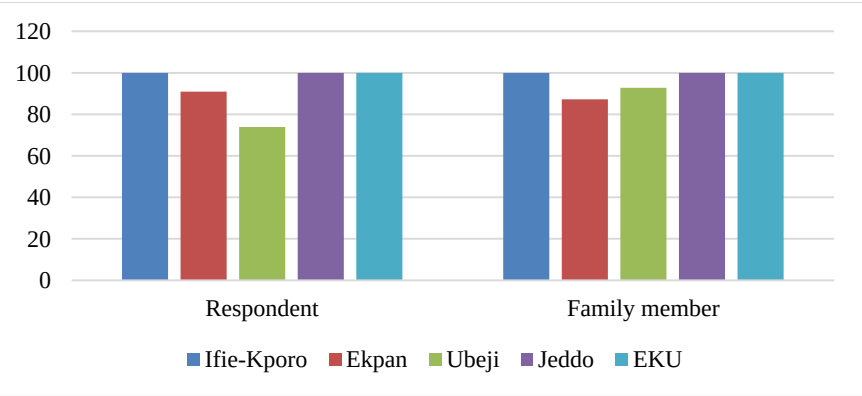

Figure 2: Proportion (%) of respondents suffering stress in each community.

Table 2: Percentage of positive responses regarding knowledge of impact of gas flaring in communities.

	Ifie (n=60)		Ekpan (n=55)		Ubeji (n=69)		Jeddo (n=52)		EKU (n=17)	
	N	%	N	%	N	%	N	%	N	%
Does gas flaring contribute to air pollution in your area?	59	98	55	100	69	100	52	100	17	100
Do air pollutants have detrimental impacts on human health?	60	100	55	100	69	100	44	85	17	100
Does exposure to air pollutants from gas flared cause to respiratory problem?	60	100	55	100	68	99	52	100	17	100
Does gas flaring contribute to climate change in your locality?	52	87	52	95	64	93	45	87	5	29
Is the release of black carbon experience in your area linked to gas flare?	57	95	51	93	69	100	52	100	3	18
Do you think gas flaring is affecting your health?	66	100	54	98	69	100	37	71	9	53
Do you think gas flaring is affecting any of your family?	47	78	53	96	62	90	33	63	3	18
Have you heard of Acid rain?	59	98	55	100	66	96	52	100	17	100

%: absolute frequency of response in community.

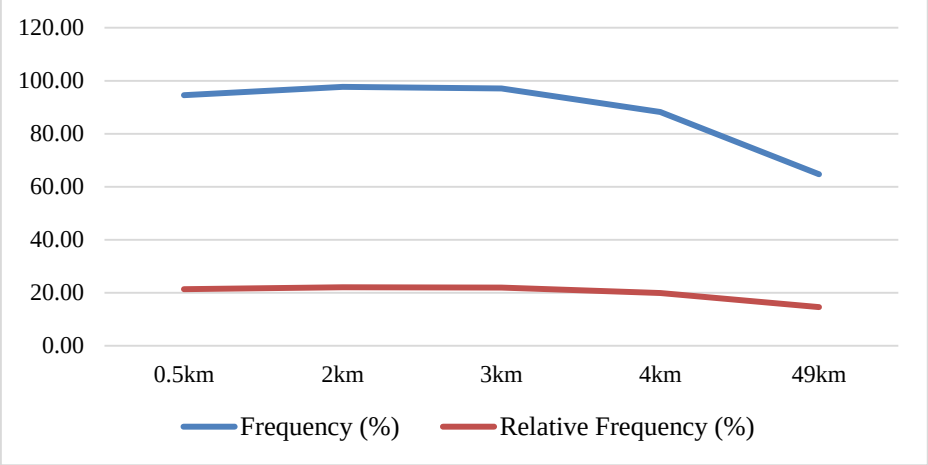

Figure 3: Frequencies of positive response to questions on knowledge.

Research question 2

Level of assessed health conditions in Ubeji metropolis relative to communities farther from 'Warri' gas flaring site. There is statistical significant difference in diseases linked or perceived to be associated with gas flares (Table 3). However, critical evaluation showed no directional change in all cases. For instance birth deformities in communities nearer the gas flare site, but low birth weight appear to be more frequent in the farthest community.

Research question 3

Impact of gas flaring on air quality indicated by health and environmental (WHO, 2003) toxicity indices. Based on the number of respondents who categorically indicated agreement (positive) or disagreement (negative) in toxic impart of gas flaring in communities, excluding those who were unsure; positive respondents in each community were reviewed as percentage of participants in their cohort. The average of positive responses to all the questions are compared (Figure 4).

There is linear relationship between 'distance to gas flare site' and 'toxic impact on air quality'; although statistical significance was not achieved. For instance, 61% affirmed toxic impact at Ifie that is 0.5 km from the site, compared to 32% at Eku that is 49 km away. Ubeji community comes in the middle in both distance and indicated level of impact, while responses from Jeddo community appear to mar the linearity (Figure 4). A critical evaluation of data presented in Table 1 revealed a relatively highest level of ill-health among family members of respondents from Jeddo compared to the other communities (Figure 5).

Table 3: Categorical responses to questions regarding health conditions in communities.

	Ifie (n=60)		Ekpan (n=55)		Ubeji (n=69)		Jeddo (n=52)		EKU (n=17)	
	0.5 km		2.2 km		3.6 km		4 km		49 km	
Responses	Pos (+)	Neg (-)	Pos (+)	Neg (-)	Pos (+)	Neg (-)	Pos (+)	Neg (-)	Pos (+)	Neg (-)
There are many of these cases in your clinic that are associated with gas flaring	48	4	45	4	62	5	105	0	3	11
These cases frequently present to my clinic in weekly basis	28	12	8	12	0	8	34	0	0	9
Complain of eye irritation by residents is common and associated with gas flaring history	58	2	53	0	63	0	52	0	8	9
Cases of deformities in children is common and associated with gas flaring	8	8	9	3	5	12	0	18	0	11
Low birth weight is common and associated with gas flaring	12	8	12	12	1	3	7	0	11	3
Gas flaring impact negatively on the red blood cell	41	4	52	2	66	0	52	0	9	0
Lung cancer linked to exposure of gas flaring is common	48	8	55	0	66	1	52	0	17	0
Chronic obstructive pulmonary disease linked to exposure of gas flaring is common	52	4	52	3	61	2	52	0	12	0
Cardiovascular disease linked to high level of exposure of gas flaring is common	52	0	48	2	62	0	52	0	14	3
Complain of skin irritation by residents is common and associated with gas flaring	54	0	47	3	68	1	52	0	0	9
Majority of patients with diabetes are living nearer to gas flaring towns	12	20	16	21	12	54	39	13	0	12
Majority of patients with symptoms of stress are living in/near gas flaring towns	56	0	44	7	65	4	52	0	0	17

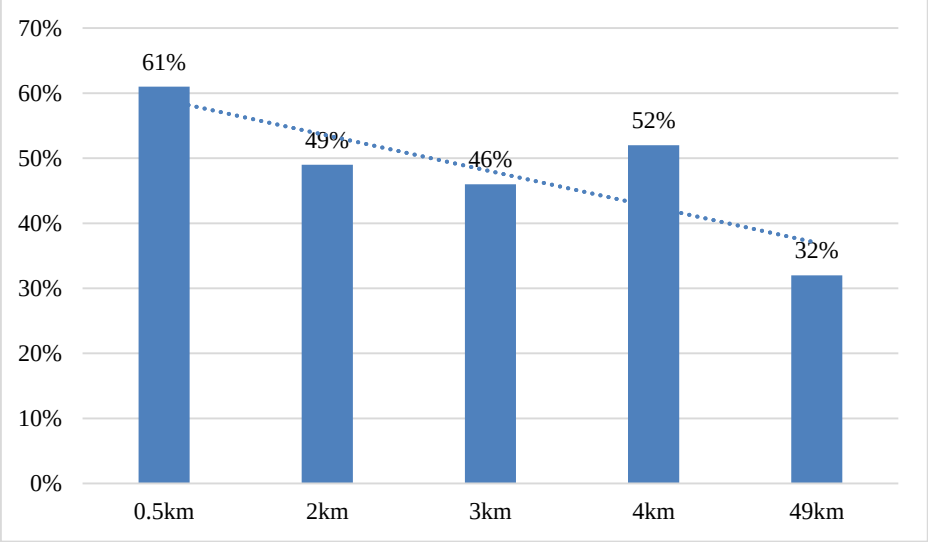

Figure 4: Linearity of toxic impact of gas flaring on air quality with proximity to site.

Hypothesis testing

The null hypothesis was that there is no significant difference between Ubeji metropolis and communities farther away from flaring site in the impacts of gas flares. Comparison with the closest (Iffie) and farthest (Eku) communities showed significance $p>0.05$ (Table 4). Analysis of variance test rejected the null hypothesis (Figure 6).

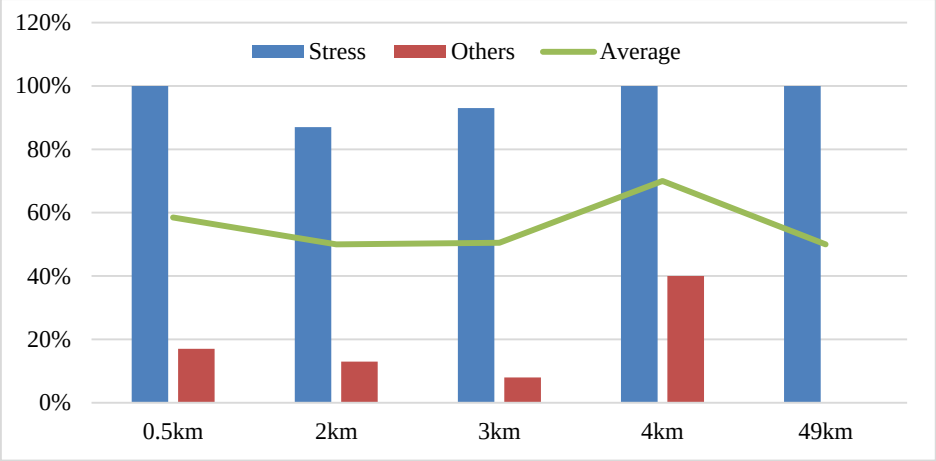

Figure 5: Levels of ill-health in family members of respondents.

Table 4: Percentage of positive responses on health and toxic impacts in communities.

	Ifie (0.5 km)	Ekpan (2 km)	Ubeji (3 km)	Jeddo (4 km)	EKU (49 km)
Are there cases of wet and dry deposition of acidic particles in your area?	70	78.18	95.65	100	0
Do you use rain water?	56.67	21.82	11.59	0	94.12
Do your family ever used rain water but were advised to stop?	43.33	27.27	17.39	25	0
Did your family house roof get damaged by rain water?	65	96.36	95.65	100	29.41
Does gas flaring impact negatively on crop yield in your area?	70	21.82	8.696	36.54	35.29
There are many of these cases in your clinic that are associated with gas flaring	80	81.82	89.86	201.9	17.65
These cases frequently present to my clinic in weekly basis	46.67	14.55	0	65.38	0
Complain of eye irritation by residents is common & associated with gas flaring history	96.67	96.36	91.3	100	47.06
Cases of deformities in children is common & associated with gas flaring	13.33	16.36	7.246	0	0
Low birth weight is common & associated with gas flaring	20	21.82	1.449	13.46	64.71
Gas flaring impact negatively on the red blood cell	68.33	94.55	95.65	100	52.94
Lung cancer linked to exposure of gas flaring is common	80	100	95.65	100	100
Chronic obstructive pulmonary disease linked to exposure of gas flaring is common	86.67	94.55	88.41	100	70.59
Cardiovascular disease linked to high level of exposure of gas flaring is common	86.67	87.27	89.86	100	82.35
Complain of skin irritation by residents is common & associated with gas flaring	90	85.45	98.55	100	0
Majority of patients with Diabetes are living nearer to gas flaring towns	20	29.09	17.39	75	0
Majority of patients with symptoms of stress are living in/near gas flaring towns	93.33	80	94.2	100	0

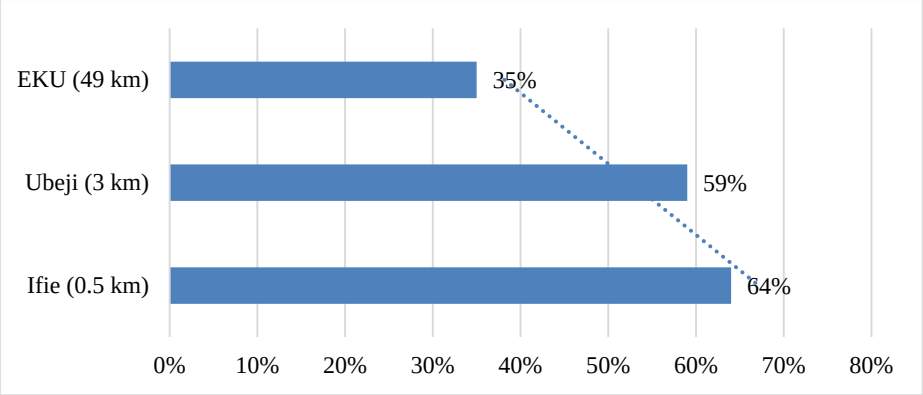

Figure 6: Comparison of Ubeji with other communities.

DISCUSSION

The graphical presentation of comparison in terms of percentage proportion respondents show that Ubeji appears to have the highest proportion of persons suffering respiratory problems, but the first figure presented in the results show family members is less than half of the indication from Ifie and Jeddo. Further, second figure in the results show the proportion of persons suffering stress among Ubeji respondents appear least relative to other communities.

On the first research question: What is the level of knowledge in survey communities concerning health impact from gas flaring? Eight questions were used to provide answers. For instance, Table 2 shows 98% of the respondents from Ifie community 100% of other communities indicated that gas flaring contribute to air pollution in their area. This finding corroborates the report on increased water acidity being attributed to gas flares.[18,19]

On the evaluation of "research question 1" which was on level of knowledge, figure three revealed that respondents farther away from the gas flaring site appear less knowledgeable about the impact of gas flares. Also Seyyednejad, reported chronic bronchitis and emphysema as some of the diseases caused by air pollution.[20]

On the second research question regarding level of assessed health conditions in Ubeji metropolis relative to communities farther from Warri gas flaring site; twelve questions were used. Results revealed that there was statistical significant difference in diseases linked or perceived to be associated with gas flares, as indicated on Table 3. However, critical evaluation shows no directional change in all cases. For instance, birth deformities in communities nearer the gas flare site, but low birth weight appear to most frequent in the farthest community.

Five questions were used in answering the third research question and the results show culpability. For instance, up to one-third of the respondents from Ifie community confirmed cases of wet and dry deposition of acidic particles in the area. However, a few respondents declined to comment. Also revealed in this study was impact as indicated by the health indices that there is a potential linear relationship between 'distance to gas flare site' and 'toxic impact on air quality'; but statistical significance was not achieved. For instance, 61% affirmed toxic impact at Iffie at 0.5 km distance from the site, compared to 32% at Eku 49 km away. Ubeji community comes in the middle in both distance and indicated level of impact, as shown in figure four. While responses from Jeddo community appear to be an outlier in the linearity. A critical evaluation of the data presented in Table 1 further revealed a relatively highest level of ill-health among family members of respondents from Jeddo compared to the other communities, as shown in Figure 5. The study also recorded higher level of sickness with nearness to flaring site. This finding was in consonant with the report of.[19,21]

In testing the hypothesis – that there would be no statistical significant difference between Ubeji metropolis and communities farther away from flaring site in the impacts of gas flares, the result showed differences in percentage of positive responses on health and toxic impacts in communities ($p<0.03$). With particular regard to Table 4, comparison with the closest (Iffie) and farthest (Eku) communities showed significant difference. Further analysis of variance show as presented in figure 6 statistically significant linearity ($p<0.05$); hence the null hypothesis is rejected.

CONCLUSION

Gas flaring is globally known to constitute a great number of negative implications on the environment. This study presents data on how the built environment has been negatively impacted by gas flaring. The impacts that gas flaring has on buildings are chronic and present a major problem. It does not only affect human health but shelter, as well as sources of food supply, land, vegetation and water. The study findings also contributes data to advance the discourse that there exist a correlation between distance to gas flaring sites and the development

of certain ailments reported in individuals in the studied communities.

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This work, especially including data collection was by OAA as MPH research. NIO participated in the research conceptualization and design as preamble to PhD work. JOA was involved in conceptualization, data collection and discussion of results. EUN was involved in all aspects of the work including performing the statistical analysis.

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Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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