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Assessment of Association between Gas Flaring and Prevalence of Diseases: Delineation of Opinion from Perception

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Background: Pollutants are released into the atmosphere by gas flaring, and these cause a range of health problems, including heart disease and respiratory disorders. This article assesses the opinion and perception of the community regarding association between gas flaring and prevalence of diseases.
Methodology: This research followed a descriptive quantitative approach. Purposive survey using 2 Likert scale questionnaires was adopted, and the first questionnaire collected data on distance to gas flare site, health status and family health history, amongst others. The second collected data on perception and knowledge-based opinions regarding association and correlation. Summated Likert scale were collated and descriptive and correlation analysis between distance to gas flare site and number of diseases in respondents and their families were done.
Results: In this purposive survey, there is no correlation between nearness to gas flare and prevalence of diseases. There appears no difference in communities proximal to flare sites

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compared to non-host communities farther from site. Multivariate analysis further shows that no statistically significant difference between groups, except in comparison of perceptions. **Conclusion:** This investigation shows a variation from previous observation in this series i.e. that distance to gas flare site is a potential factor influencing community members' perception about their health impact, but the surveyed opinion of healthcare workers differs. This implies that nearness to gas flare sites mediate perception of negative health impact and this calls for further research to delineate perception from knowledge-based opinion.

Keywords: Communities; perception; association; prevalence; diseases; gas flare; human health; negative impact; Niger Delta.

1. INTRODUCTION

Gas flaring releases toxic compounds into the atmosphere, and this affects the health and wellbeing of the people living near the gas flare sites. The adverse health effects are speculated to include substantial reduction in life expectancy as well as food security [1]. Greenhouse gases (GHG) cause acid rain with attendant negative outcomes in the health of the people [2,3]; and this can be exacerbated by gas flare [1]. Hence, gas flare may constitute additive health risk for those who live and/or work in communities near the gas-flaring activities [4]. It has been narrated that these health outcomes range from dermatological diseases, haematological abnormalities or blood dyscrasias, malignancies and respiratory diseases, among others [5,6].

Other studies albeit based on rats have implicated gas flare on haematological abnormalities inclusive of high eosinophil count (i.e. symptom of allergic or hypersensitivity inflammatory reaction) as well as leucopaenia and rouleaux formation, among others. Histopathologic studies on lung cancer has indicated damage to the respiratory system [7]. A corroborating report highlights haematological abnormalities, respiratory disease, and skin irritation [8]. Further, there has been linkage of gas flaring to an increase in the occurrence of non-communicable diseases such as cardiovascular diseases and diabetes [9] and there are also suggestions of mental health issues, which implies stress [10,11].

In a recent report of qualitative study that evaluated the perception determinants among community and healthcare providers [12], 4 themes: cultural beliefs, hospital-related factors, level of environmental hazard, and personal experiences are highlighted as influencing the peoples' sensitivities to effect of oil pollution. In other words, perceptions of the impact of gas flaring on human health is influenced by several factors that may culminate in unconscious bias. Indeed, other studies have shown that up to 25% of the people do not believe that gas flare impacts health, whereas 75.0% believe otherwise [1]. Against this backdrop, this study evaluates if there is correlation between peoples' perception and hospital cases.

1.1 What is Known

Diseases are caused by a variety of factors hence the concept of determinants of health. However, studies of causalities or positive association between air pollution and diseases are often biased and lacking quality [13,14].

1.2 What is Unknown

The correlation between gas flaring and prevalence of diseases.

1.3 Objective

Assess the association and possible correlation between gas flaring and prevalence of diseases.

1.4 Hypothesis

There is a strong correlation between nearness to gas flare and prevalence of diseases i.e. communities proximal to flare sites compared to non-host communities farther from site.

2. METHODS

Summary of design, data and statistical analysis for this work are as follows:

2.1 Design

Descriptive purposive survey using Likert scale questionnaire.

2.2 Questionnaires

Two questionnaires were used for this study. The first questionnaire collected data on distance to gas flare site, health status and family health history, amongst others. Specifically, participants were asked to indicate if they or any of their immediate family members are living with cancer, diabetes, heart disease, respiratory problems and/or stress. The number of diseases out of 5 in individual respondent (out of 5), plus family (out of 10) were collated.

In the second questionnaire, opinions of healthcare practitioners were surveyed using 12 Likert-scaled questions (Table 1). Among the questions were 5 that specifically focused on 'association' of gas flare to some ill-health. Another 4 questions (#6 – 9) were on whether certain ill-health was 'linked' i.e. correlated to gas flaring; and one question (Q2) was used to check level of hospital visits. The sum of each respondent's ratings on the scale for all 10 questions were collated as 'summated scale' value. Further, in the second questionnaire, there were 2 questions (Q11 & 12) to assess perception.

2.3 Selection Criteria

In the first questionnaire, all participants who indicated to be either living, or have someone in the family living with any of the 5 ill-health were included. In the second survey, selection was purposively limited by occupation to exclude farmers and traders, in order to achieve polling of knowledge-based opinion on prevalence of ill-health.

2.4 Statistical Analysis

Descriptive and correlation analyses. First statistical evaluation was correlation among distance to gas flare site versus number of diseases in respondents and their families. Second statistics was descriptive analysis of the Likert scale responses and followed by another correlation of summated scale versus distance to gas flare site and number of diseases in respondents with their families. Given response 3 being unsure, the range of 2.5 – 3.4 was used as cut-off to categorize respondents into 'agree' versus 'disagree'.

Table 1. 12 items questionnaire* for the 2nd dataset

SN	Questions	Theme
1	Many of these cases in your clinic are associated with gas flaring	Association
2*	Cases frequently present to my clinic in weekly basis	Clinic**
3	Complain of eye irritation by residents is common	Association†
4	Cases of deformities in children is common & associated with gas flaring	
5	Low birth weight is common & associated with gas flaring	
6	Gas flaring impact negatively on the red blood cell	Link
7	Lung cancer linked to exposure of gas flaring is common	
8	Chronic obstructive pulmonary disease linked to exposure of gas flaring is common	
9	Cardiovascular disease linked to high level of exposure of gas flaring is common	
10	Complain of skin irritation by residents is common & associated with gas flaring	Association
11*	Majority of patients with diabetes are living nearer to gas flaring towns	Perception
12*	Majority of patients with symptoms of stress are living in/near gas flaring towns	

**Respondents to this knowledge-based opinion questionnaire were limited to civil servants and other white-collar professionals including healthcare workers*
***Health facility of where respondent works*
†Questions used to assess association
SN: serial number of questions in questionnaire

3. RESULTS

The first dataset included 339 respondents, which comprised 63% males and 37% females. Among them, stratified age-groups or <20 years, [20 – 35], [36 – 50], [51 – 70] and >70 years old constituted 5.8%, 28.2%, 38.8%, 20.6% and 6.7%, respectively. Distribution of respondents into stratified 'distance-to-flare site groups show that 10.6% lived or worked within 1 Km distance while majority (54.9%) are in the 2 – 5 Km range (Table 2).

On evaluation of frequency of diseases among participants, 3.2% appear apparently healthy while a majority (81.4%) has one out of five ill-health (Table 3a). All respondents had family members with ill-health with 10.6% having one ill-health and majority (66.4%) living with at least 2 out of 10 (Table 3b). There were 25.7% and 52.8% respondents free from stress and respiratory disease, respectively.

On the Likert scaled dataset from second questionnaire, responses in which the average for a question were above 3.4 and below 2.5 are considered agreement and disagreement, respectively. Given summated scale being expected to be a minimum of 10 and maximum of 50, the range of 25 – 34 is taken as cut-off whereby respondent's sum below <25 is considered disagreement and above ≥35 is agreement. Averaged responses (i.e. knowledge-based opinion on health) fall in the 'agree' range for all 'link'/correction questions and 2 of 5 'association' items. Responses to other questions fall in the 'unsure' range. None is in the 'disagree' range and analysis of variance shows significant difference (Fig. 1, $p < 0.0001$).

Summated scales for 5-Association, 4-Link, 10-item-Opinion and 2-Perception questions were correlated with distance to flare site, and the results are shown in Table 4. Opinions are moderately significantly correlated with perception, but not statistically significant with distance to flare site. MANOVA test between the stratified 'distance-to-flare' groups show differences in summated scale, except only on perception (Table 5).

Table 2. Frequency distribution of participants by stratified 'distance-to-flare'

Group	Frequency	Percent
≤ 1 Km	36	10.6
2 – 5 Km	186	54.9
6 – 10 Km	78	23.0
11 – 20 Km	11	3.2
≥ 20 Km	28	8.3
Total	339	100.0

Table 3a. Frequency of diseases (out of 5 ill-health conditions) in participants

N*	Frequency	Percent
0	11	3.2
1	276	81.4
2	43	12.7
3	9	2.7
Total	339	100.0

*Key: *Number of ill-health out of 5*

Table 3b. Frequency of diseases (out of 10 ill-health conditions) in participants and families

N**	Frequency	Percent
1	37	10.9
2	225	66.4
3	41	12.1
4	22	6.5
5	12	3.5
6	2	0.6
Total	339	100.0

*Key: **Number of ill-health out of 10*

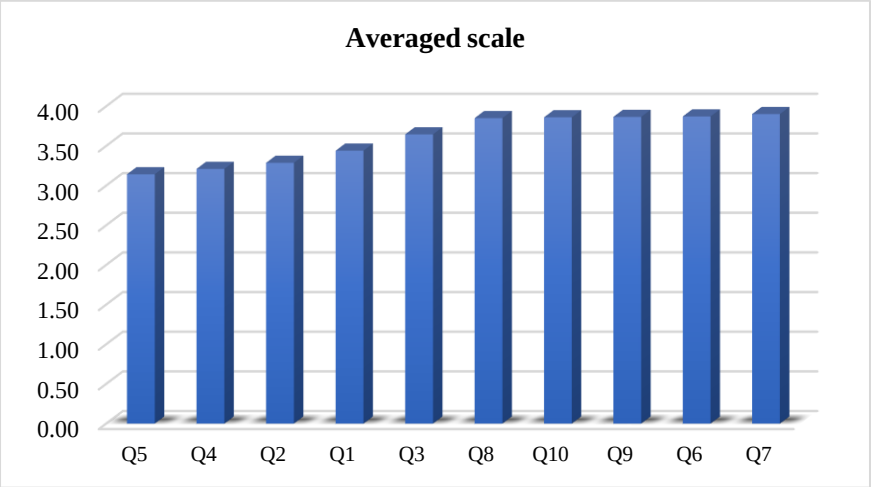

Fig. 1. Averaged Likert scale (Y axis) responses to knowledge-based health questions

Table 4. Results of Pearson correlation

	5_Assoc	4_Link	2_Percepts	10_Opinions	Dist-to-flare
5_Assoc	1				
4_Link	0.680108	1			
2_Perception	0.463245	0.448636	1		
10_Opinions	0.930617	0.888247	0.503883	1	
Dist-to-flare	0.010989	0.092604	-0.09995	0.020772	1

Table 5. Multiple Comparisons (excerpt of output)

			LSD				
Dependent Variable	**(I) Distance. Group**	**(J) Distance. Group**	**Mean Difference (I-J)**	**Std. Error**	**Sig.**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Perception.s2	1.00	2.00	-.8578*	.39625	.032	-1.6395	-.0762
		3.00	-.7849	.45102	.083	-1.6745	.1048
		4.00	.6500	.68422	.343	-.6996	1.9996
		5.00	.5000	.64083	.436	-.7640	1.7640
	2.00	1.00	.8578*	.39625	.032	.0762	1.6395
		3.00	.0730	.33770	.829	-.5932	.7391
		4.00	1.5078*	.61544	.015	.2939	2.7218
		5.00	1.3578*	.56682	.018	.2398	2.4759
	3.00	1.00	.7849	.45102	.083	-.1048	1.6745
		2.00	-.0730	.33770	.829	-.7391	.5932
		4.00	1.4349*	.65205	.029	.1487	2.7211
		5.00	1.2849*	.60637	.035	.0888	2.4810
	4.00	1.00	-.6500	.68422	.343	-1.9996	.6996
		2.00	-1.5078*	.61544	.015	-2.7218	-.2939
		3.00	-1.4349*	.65205	.029	-2.7211	-.1487
		5.00	-.1500	.79524	.851	-1.7186	1.4186
	5.00	1.00	-.5000	.64083	.436	-1.7640	.7640
		2.00	-1.3578*	.56682	.018	-2.4759	-.2398
		3.00	-1.2849*	.60637	.035	-2.4810	-.0888
		4.00	.1500	.79524	.851	-1.4186	1.7186

Table 6. Correlation result

	5_Impacts	10_Impacts	2_Envir	2_Occ	Distance-to-site
5_Impacts	1				
10_Impacts	0.801165	1			
2_Environment	0.375464	0.376612	1		
2_Occupation	0.425149	0.524726	-0.14462	1	
Distance-to-site	-0.08351	-0.22204	-0.2172	-0.05187	1

4. DISCUSSION

This study assessed the association and possible correlation between gas flaring and prevalence of diseases and it was hypothesized that there is strong correlation between nearness to gas flare and prevalence of diseases i.e. communities proximal to flare sites compared to non-host communities farther from site. To this end, the study surveyed prevalence of 5 types of ill-health among participants and evaluated groups based on stratified distance-to-flare site. The study also surveyed opinions of healthcare practitioners on prevalence of ill-health (Table 1).

Results show that over 65% of respondents live or work within 5 Km of the flare site (Table 2), but only 3.2% indicated being apparently healthy while 15.4% (12.7 + 2.7) had co-morbidities (Table 3a). A report from Netherlands in 1992 highlighted <30% prevalence of chronic ill-health among individuals [15]. A report from Australia in 2014 indicated approximately 12% hypertension and 5% anxiety [16], and a report from Belgium in 2015 indicated about 23% prevalence comorbidity among individuals [17]. However, these various studies are neither related to gas flaring, nor focused on distance to industrial activities that pollute the environment. Therefore, the 15.4% prevalence of comorbidities among the respondents observed in this study population is in agreement with studies elsewhere, and also contributing epidemiological data related to gas flaring activities.

Further, every respondent has a family history of at least one of the ill-health conditions. More specifically, 89.1% had at least 2 ill-health conditions when respondent and family member weree added (Table 3b). A study that assessed family history of diseases, reported that 12% to 36% had at least one of 4 chronic diseases [18]. However, the study was not on gas flaring and not from Niger Delta Nigeria. Therefore, while the observation of approximately 90% prevalence in this study is high comparatively, one contribution to epidemiology from this report is family health statistics from Niger Delta Nigeria and in relation to gas flare.

When opinions of healthcare workers were assessed on Likert scale, responses are on average indicative of agreement that the enquired ill-health condition are associated or linked to gas flare, although unsure on some questions of association (Fig. 1). Pertinently, agreement is strongest for respiratory problems and unsure on hospital visit i.e. knowledge-based opinion of healthcare workers failed to corroborate the prevalence of respiratory diseases. Further, correlations analysis of the summated Likert scale with regard to 10 opinion questions versus distance-to-flare site and perception questions in Table 4 shows that:

- Distance-to-flare: no correlations with the summated Likert scale (r = 0.021), or perception (r = -0.099).
- Perception: Moderate correlation to the 10_opinions (r = 0.504), but weakest when compared to association and link questions

Therefore, the hypothesis is rejected and surmised that there is no strong correlation between nearness to gas flare and prevalence of diseases. That is, prevalence of ill-health, especially of individuals, may not differ in communities proximal to flare sites compared to non-host communities farther from site. This observation, especially about perception, can be explained by the concept of perception determinants i.e. that cultural beliefs, hospital-related factors, level of environmental hazard, and personal experiences influence respondents' perceptions on the impact of gas flaring on their personal and family health [1,12].

Multivariate analysis further shows no statistically significant difference between groups, except in comparison of perceptions (Table 5). Also. the second correlations show that impacts of gas flare on individuals (5_Impacts) and family (10_Impacts) are moderately to highly correlated to occupations (range of r = 0.375 – 0.801), with distance-to-flare site showing only negative and

low correlation with family health (Table 6). Thus, the hypothesis is rejected and surmised that there is no strong correlation between nearness to gas flare and prevalence of diseases. That is, prevalence of ill-health, especially of individuals, may not differ in communities proximal to flare sites compared to non-host communities farther from site. What these results contribute is that distance to gas flare site is a potential factor influencing community members' perception about the health impact. It has been suggested "that residential proximity to industrial activity has a negative impact … both direct and mediated by individuals' perceptions…" [10], and a report from one of the host communities in this study reported on the peoples' perception [19]. Thus, the contribution being posited here is an advancement or rearticulation of concept that nearness to industrial site such as gas flaring mediate perception of negative health impact.

5. CONCLUSION

The results of this study show that distance to gas flare site is a potential factor influencing community members' perception about the health impact and this implies that nearness to gas flare sites mediate perception of negative health impact. Another contribution of this study is that there is considerably a high prevalence of ill-health in the communities surveyed. Furthermore, the findings suggest that there is no strong correlation between nearness to gas flare sites and prevalence of diseases. That is, prevalence of ill-health, especially of individuals, may not differ in communities proximal to flare sites compared to non-host communities farther from site. It is recommended that the government and oil companies provide adequate health education for the communities, especially to address the people's perceptions that do not seem to match records of hospital visits. More studies on the assessment of association between gas flaring and the prevalence of diseases should be carried out to validate these findings.

CONSENT

Consent was implied by respondents returning their completed questionnaire.

ETHICAL APPROVAL

This study is part of a doctoral thesis at Charles Sturt University, Australia; with Ethics approval (protocol number H20004).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Adewale OO, Mustapha U. The Impact of Gas Flaring in Nigeria. International Journal of Science, Technology and Society. 2015;3(1):40-50.
2. Goyer RA, Bachmann J, Clarkson TW, Ferris BG Jr., Graham J, Mushak P, Perl DP, Rall DP, Schlesinger R, Sharpe W, et al. Potential human health effects of acid rain: report of a workshop. Environ Health Perspect. 1985;60:355-368.
3. Nduka JK, Orisakwe OE. Precipitation chemistry and occurrence of acid rain over the oil-producing Niger Delta region of Nigeria. The Scientific World Journal. 2010;10:528-534.
4. Laurenzi IJ, Bergerson JA, Motazedi K. Life cycle greenhouse gas emissions and freshwater consumption associated with Bakken tight oil. Proc Natl Acad Sci USA. 2016;113(48):E7672-e7680.
5. Obi N, Akuirene A, Bwititi P, Adjene J, Nwose E. Community health perspective of gas flaring on communities in Delta region of Nigeria: narrative review. Int J Sci Rep. 2021;7(3):180-185.
6. Nwankwo CN, Ogagarue DO. Effects of gas flaring on surface and ground waters in Delta State Nigeria. Journal of Geology and Mining Research. 2011;3(5): 131-136.
7. Otitoloju A, Dan-Patrick J. Effects of gas flaring on blood parameters and respiratory system of laboratory mice, Mus musculus. The Environmentalist 2010. 2010;30(4): 340-346.
8. Giwa SO, Nwaokocha CN, Kuye SI, Adama KO. Gas flaring attendant impacts of criteria and particulate pollutants: A case of Niger Delta region of Nigeria. Journal of

King Saud University - Engineering Sciences. 2019;31(3):209-217.
9. Maduka O, Tobin-West C. Is living in a gas-flaring host community associated with being hypertensive? Evidence from the Niger Delta region of Nigeria. BMJ global health. 2017;2(4):e000413-e000413.
10. Downey L, Van Willigen M. Environmental stressors: The mental health impacts of living near industrial activity. Journal of Health and Social Behavior. 2005;46(3): 289-305.
11. Mohai P, Lantz PM, Morenoff J, House JS, Mero RP. Racial and socioeconomic disparities in residential proximity to polluting industrial facilities: Evidence from the Americans' Changing Lives Study. American Journal of Public Health. 2009;99(S3):S649-S656.
12. Oghenetega OB, Ojengbede OA, Ana G. Perception determinants of women and healthcare providers on the effects of oil pollution on maternal and newborn outcomes in the Niger Delta, Nigeria. International Journal of Women's Health. 2020;12:197-205.
13. Eze IC, Hemkens LG, Bucher HC, Hoffmann B, Schindler C, Kunzli N, Schikowski T, Probst-Hensch NM. Association between ambient air pollution and diabetes mellitus in Europe and North America: systematic review and meta-analysis. Environ Health Perspect. 2015;123(5):381-389.
14. Dendup T, Feng X, Clingan S, Astell-Burt T. Environmental risk factors for developing type 2 diabetes mellitus: A systematic review. International Journal of Environmental Research and Public Health. 2018;15(1).
15. Knottnerus JA, Metsemakers J, Höppener P, Limonard C. Chronic illness in the community and the concept of 'social prevalence'. Family Practice. 1992;9(1): 15-21.
16. Ghosh A, Charlton KE, Girdo L, Batterham M. Using data from patient interactions in primary care for population level chronic disease surveillance: The Sentinel Practices Data Sourcing (SPDS) project. BMC Public Health. 2014;14:557.
17. Van den Akker M, Vaes B, Goderis G, Van Pottelbergh G, De Burghgraeve T, Henrard S. Trends in multimorbidity and polypharmacy in the Flemish-Belgian population between 2000 and 2015. PLoS One. 2019;14(2):e0212046.
18. Carroll JC, Campbell-Scherer D, Permaul JA, Myers J, Manca DP, Meaney C, Moineddin R, Grunfeld E. Assessing family history of chronic disease in primary care: Prevalence, documentation, and appropriate screening. Can Fam Physician. 2017;63(1):e58-e67.
19. Okwuezolu FA, Adjene JO, Chime HE. Effects of crude oil exploration on the physical and mental health of residents of Okpai community, Delta State, Nigeria. Journal of Complementary and Alternative Medical Research. 2020;9(1): 1-12.

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