ORIGINAL ARTICLE

Acute health effects of a crude oil spill in a rural community in Bayelsa State, Nigeria

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Abstract

***Background**: In May 2000, there was a breach in the crude oil pipeline belonging to a major oil company in Etiama Nembe, in Bayelsa State, Nigeria. This study is to investigate if the residents in the affected community suffered an increase in self reported symptoms that might be attributable to exposure to the spilled crude oil.*

***Method**: A retrospective cohort study, with a comparison control group was carried out, using an interviewer - administered questionnaire and focus group discussions as the study tools. Exposure status was assigned on the basis of geographical location. The questionnaire was administered to male respondents in both the exposed and unexposed communities; while the focus group discussions were held only with adult women in the exposed community.*

***Results**: A total of 420 questionnaires were administered and retrieved from both study groups. There were no significant differences in the age, cigarette smoking or the history of chemical allergy between the exposed and the unexposed groups; though the respondents in the exposed communities were significantly better educated (p-value < 0.005). There were significant differences in the period prevalence for diarrhea (OR = 4.6, p-value < 0.0001), sore eyes (OR = 10.93, p-value <0.0001), itchy skin (OR = 13.48, p-value < 0.00001) and occupational injuries (OR = 5.29, p-value < 0.0005). These increases were further elaborated by the discussants in the focus group discussions.*

***Conclusions**: Exposure to the mists and fumes generated by a crude oil spill some acute health effects, albeit mild and transient. This increase in the disease burden of the exposed communities should be recognized and given adequate attention by all the stakeholders.*

***Keywords**: Pipeline oil spill, acute health effects, rural community, Nigeria.*

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Introduction

On 16th May, 2000, there was a breach in the crude oil pipeline belonging to a major oil company in Nigeria. This breach occurred a few kilometers from Etiama Nembe, in Bayelsa State, Nigeria. Though the breach was repaired after a few days, it was however estimated that more than 2, 500 barrels of crude oil was spilled into the surrounding water bodies, forest and farms, seriously contaminating an area of about 20 hectares. The wrangling over the cause of the spillage delayed its cleaning, such that the cleaning was only commenced several weeks after the spillage was controlled.

The Nigerian crude oil is classified as "light" and "sweet", low in sulphur and similar in quality to the North Sea varieties. The volatile nature of the spilled crude oil, and the rotting fishes and animals killed by the spill, formed strong pungent fumes and mists that were dispersed into the residential areas of the Etiama Nembe community and the neigbouring 112 communities, farming and fishing settlements, prompting health concerns. Apart from the respiratory contact, the residents of these communities were also exposed to the spilled oil through ingestion and dermal absorption, since the contaminated river was used for drinking, bathing, recreational, and fishing purposes.

Crude oil is a mixture of several chemicals, including heavy metals, (particularly zinc), sulphur, polycyclic aromatic hydrocarbons (PAH), and volatile organic compounds (VOC) like benzene, toluene, ethylbenzene and xylene[1]. Exposure to PAH is believed to be capable of causing breathing difficulties, vomiting, abdominal pains, and dermatological problems, while VOC can cause such neurological complaints as headache, nausea, dizziness and somnolence[2]

This study was conducted four weeks after the spill was cleaned up, and is part of the official investigation to assess the health and environmental impacts of the spill. The part of the study being presented was designed to determine the immediate health effects of exposure to the oil spill, especially as similar studies involving the grounding of tanker ships had noticed significant increases in physical and psychological symptoms in the exposed general population [3 - 7]. While there have been several published studies on the environmental impact of crude oil spills in Nigeria[8, 9], there is virtually none on the health impact. An internet search on Medline, African Index Medicus and the African Journals on Line conducted on 25th February

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2008 did not yield any study, neither did a manual search. This study would therefore provide valuable information on the Nigerian situation, for emergency response, in the event of future occurrences. Unlike in the other health impact studies that involved grounded oil tanker ships[3 - 7], crude oil spills in Nigeria are likely to be more devastating, because they typically occur very close to the residential quarters of the affected communities, and often involve the contamination of resources that support the communities[10]. According to official statistics, at least 300 oil spills of various magnitudes occur in the Niger delta region of Nigeria every year, but independent assessors put the true figure at ten times the official figure[10].

Methodology

Study site: Although, the oil spill took place in Etiama, most of the 112 closely located communities, farming and fishing settlements that made up the Nembe clan were also affected. However, only the 30 most affected communities that are located closest to the spill site were included in the study. The Nembe communities are located in the south-eastern part of Bayelsa State, south-south Nigeria, and share boundaries with the Atlantic Ocean. They have a riverine terrain, with several rivulets, islands, and mangrove forest. As at the time of the spill in 2000, the communities had an estimated population of 206, 628 (projected with the 1991 National census); made up mostly of fisher folk and subsistence farmers.

Study design: A retrospective cohort study design was used, with an interviewer-administered, semi-structured questionnaire and focus group discussion as the study tools. The focus group discussion was included to make the study more robust, and for its low cost, speed of data collection, and for its convenience in the prevailing conditions of the study[11]. Exposure was assigned on the basis of geographic location, to residents of the Nembe communities at the time of the spillage. The unaffected communities in the Kolukoma/ Opokuma Local Government Area of Bayelsa State were used as the control. These communities have the same terrain, and share boundaries with the Nembe communities, but had little oil exploration and exploitation activities.

Sample size estimation: The study was designed to detect a 6.5% difference in proportion between the exposed and the control group with an alpha error of 5%, acceptable beta error of 20%, and a statistical power of 80%, assuming a 3.5% symptom rate in the controls. This is consistent with assumptions used in the tanker *Braer* study in Shetland, Scotland[7]. The required sample size was thus determined to be 136, but made up to 210 to take care of non-responses.

Data collection: Seven questionnaires were administered to male residents of each of the 30 exposed communities, especially those that were either involved in cleaning up the spill, or actively engaged outdoors, in their occupational activities in or close to the severely impacted areas. In the control communities, the questionnaires were administered to adult males chosen using systematic random sampling technique, with a sampling fraction of one in three, starting from the community's town hall.

The questionnaires were semi-structured, interviewer-administered and collected information on the socio-demographic characteristics of the respondents, their activities in the period before the spill was cleaned up, history of smoking and chemical allergies, the symptoms suffered during the period, and what they thought were the role of the oil spill in producing ill health. The symptoms suffered during the period were assessed by a symptom check list developed using cues from previous studies [3 - 7]. For symptoms like headache, dizziness and sore throat that were assessed, the use of such subjective measures has been considered the most valuable approach in a community-based study[12].

To further explore the impact of the oil spill on other members of the exposed communities, focus group discussions were held with ten women in each of the study communities, using standard method[11]. The discussion started with a clarification of the link between a cause and an effect. It was established that a cause must precede the effect, and that the magnitude of the effect should, in most cases, be related to the amount of exposure to the cause. With this background, the discussants were asked to enumerate all the health problems experienced during the oil spill, and encouraged to relate the magnitude of the exposure to the severity of the symptoms.

Data analysis: Data handling and analysis were carried out using EPI-INFO version 2002, Microsoft word, and manually. Summary measures were calculated for each outcome of interest. Differences in proportions were assessed with the Chi-square test, while the association between different exposure variables and symptoms was calculated using odds ratios (OR). For all statistical tests, P- value of 0.05 or less was considered statistically significant

Results

A total of 420 questionnaires were administered and retrieved. As shown in Table I, there were no significant

differences in the age, cigarette smoking or the history of chemical allergy between the exposed and the unexposed groups. But the respondents in the exposed communities were significantly better educated (p-value < 0.005), mainly due to the higher number of respondents with tertiary education. Though there was a significant difference in the occupational classifications of the respondents, the respondents in both communities were mainly engaged in farming, fishing and logging, with very few engaged in paid employment in the civil service or in the oil companies (10.95% in the exposed communities, and 7.14% in the unexposed communities).

Table II shows that the six week period prevalence of almost all the symptoms experienced between 19th May and 30th June 2000, was significantly increased in the exposed communities. There were remarkable increases in the period prevalence for diarrhea (41.43% in the exposed vs 13.33% in the unexposed), sore eyes (32.86% vs 4.29%), itchy skin (49.05% vs 6.67%) and occupational injuries (24.29% vs 5.71%).

These observations were also made by the discussants in the focus group discussions held in the exposed communities. The discussants noted a significant increase in the number of people in their communities with itchy skin, scratchy throat, cough, dizziness, and watery, red eyes; even amongst residents that did not venture into the directly impacted areas. The high increase in the prevalence of itchy skin was attributed to the use of the contaminated water for bathing, and contact during fishing, and while waddling through to get to the farm, while increase in the incidence of diarrhea was not only attributed to the scarcity of safe drinking water (even the rainwater was contaminated), but mainly due to the consumption of the animals and fish killed by the spillage. The discussants also noted a significant increase in the number of people that sustained occupational injuries during the period. At least ten people that were in the forest during rainstorm were hit by falling trees, whose roots were compromised by the spill, while several palmwine tappers were said to have sustained serious injuries when they fell off from the raffia palm made greasy by the spilled oil.

Table I: The characteristics of study participants by exposure categories

Variable	Exposed (%)	Unexposed (%)	p-value
1. Age group			
0 19 years	32 (15.24%)	37 (17.62%)	
20 39 years	116 (55.24%)	109 (51.90%)	X2 = 2.4
40 59 years	53 (25.24%)	59 (28.1%)	p-value > 0.05
>/ 60 years	9 (4.29%)	5 (2.38%)	
2. Educational level			
No education	26 (12.38%)	36 (17.14%)	
Primary	57 (27.4%)	83 (39.53%)	X2 = 16.67
Secondary	89 (42.38%)	77 (36.67%)	p-value < 0.001
Tertiary	38 (18.1%)	14 (6.67%)	
3. Occupation at the time of the oil spillage			
Fishing	79 (37.62%)	91 (43.33%)	
Farming	58 (27.62%)	77 (36.67%)	
Logging	31 (14.76%)	19 (9.05%)	X2 = 12. 56
Paid employment	23 (10.95%)	15 (7.14%)	p-value < 0.025
No employment	19 (9.05%)	8 (3.81%)	
4. History of cigarette smoking	39 (18.57%)	34 (16.19%)	>0.05
5. History of chemical allergy	17 (8.01%)	15 (7.14%)	> 0.05
6. Total Petroleum Hydrocarbon (TPH) in community water supply (one community in each category)	3.61 ppm	0.01 ppm	

Table II: Symptoms reported by respondents by exposure categories and associations

Variable	Exposed (%)	Unexposed (%)	O/R	p-value
Malaise	49 (23.33%)	33 (15.77%)	1.63	<0.05
Headache	76 (36.19%)	27 (12.86%)	3.84	<0.001
Nausea	48 (22.86%)	11 (5.24%)	5.36	<0.001
Diarrhoea	87 (41.43%)	28 (13.33%)	4.6	<0.0001
Sore eyes	69 (32.86%)	9 (4.29%)	10.93	<0.0001
Sore throat	63 (30%)	13 (6.19%)	6.49	<0.0001
Cough	56 (26.67%)	17 (8.1%)	4.13	<0.001
Itchy skin	103 (49.05%)	14 (6.67%)	13.48	<0.00001
Rashes	90 (42.86%)	13 (6.19%)	11.37	<0.0001
Occupational injuries	51 (24. 29%)	12 (5.71%)	5.29	<0.001

Discussion

The pattern of the symptoms reported in this study is consistent with those of the previous studies that involved grounded oil tanker ship[3 7]. However, the period prevalence for each of the symptoms reported in this study is much higher. This could be attributed to the fact that unlike in the other studies, this study was on an oil spill that occurred very close to a rural community, in a developing country, where the community depends almost entirely on the environment for sustenance.

The contact with the mists and fumes generated by the oil spill have been attributed to the symptoms of sore eyes, nausea, headache, sore throat, cough, and even occupational injuries [1, 2, 6]. The period prevalence reported for sore eyes during the grounding of the tanker *braer* in Shetland, Scotland[7] was 28%; and 19.7% during the grounding of the *Sea Empress* oil spill in south west Wales[5] , but a period prevalence of

32.86% was recorded in the study. This difference can be attributed to the increased contact with the fumes and mists, in the course of occupational activities, without protective gadgets[6]. The inhabitants of the exposed communities in this study derived their sustenance from the environment, and still had to scrape out a living, even while the environment is still seriously contaminated.

The prevalence of diarrhea and itchy skin in the *Braer* study[7] was 8% and 15% respectively, and 10.1% and 13.9% in the *Sea Empress* study[5]. These are much less than the 41.43% and 49.05% reported in this study. The differences in the prevalence of diarrhea can be attributed not only to the consumption of the fishes and animals killed by the oil spill, but also due to the scarcity of safe drinking water experienced by the residents of the exposed communities at the time of the oil spill. The higher prevalence of itchy skin in this study could be due to the use of the contaminated water bodies in the exposed communities for bathing and fishing.

While there are plausible reasons for the higher period prevalence reported in this study, the possibilities of bias, particularly those related to the ulterior motives of the respondents in the exposed communities should not be discountenanced. In Nigeria, and most countries of the world, huge compensations are paid to exposed communities for damages caused by oil spillages. There has been evidence in Nigeria that some people actually cause oil spill for the financial compensations and the work opportunities that come from it. According to official statistics, 28% of all major crude oil spillage in Nigeria are due to sabotage[10]. Therefore chances are that the respondents in the exposed communities might exaggerate the health effects to attract higher compensations. This study was however able to deal with this possible bias through the use of focus group discussions for data collection, that started only after the relationships between cause and effects were clearly established.

It is an incontrovertible fact that exposure to the mists and fumes generated by a crude oil spill can have some acute health effects, albeit mild and transient. This increase in the disease burden of the exposed communities is barely recognized by the stakeholders in Nigeria, such that contingency plans are often not made to take care of these health needs. This stance is often encouraged by Nigeria's Oil Pipeline Act which provides for compensation payments only when the oil spillage was not caused by the individual's own default, or on account of the malicious act of a third person[13]. This gave the oil companies the knee jerk response of blaming most spills on sabotage. Although the officials of the Department of Petroleum Resources were supposed to verify this claim, in the presence of the representatives of the affected communities, there is often no genuinely independent expert to dispute the oil companies' claims[10]. The Etiama oil spill was blamed on sabotage, so the affected communities had little or no medical assistance.

Conclusion

Exposure to the mists and fumes generated by a crude oil spill some acute health effects, albeit mild and transient. This increase in the disease burden of the exposed communities should be recognized and given adequate attention by all the stakeholders.

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References

1. Bosch X. Exposure to oil spill has detrimental effect on clean-up workers' health. Lancet 2003; 361: 147.
2. Agency for Toxic Substances and Disease Registry. US Toxicological Profile for Fuel-oils. Washington Dc. Department of Health and Human Services, Public Health Service. 1995.
3. Morita A, Kusaka Y, Deguchi Y, Moriuchi A, Nakanaga Y, Iki M, Miyazaki S, Kawahara K. Acute health problems among the people engaged in the cleanup of the Nakhodka oil spill. Environmental Research Section A. 1999; 81: 185 194.
4. Janjua NZ, Kasi PM, Nawaz H et al. Acute health effects of the Tasman Spirit oil spill on residents of Karachi, Pakistan. BMC Public Health 2006, 6: 84.
5. Lyons RA, Temple MF, Evans D, Fone DL, Palmer SR. Acute health effects of the Sea Empress oil spill. J Epidemiol Community Health 1999; 53: 306 310.
6. Suarez B, Lope V, Perez- Gomez B. Acute health problems among subjects involved in the cleanup operation following the Prestige oil spill in Asturias and Cantabria (Spain). Environmental Research 2005; 99: 413 424.
7. Campbell D, Cox D, Crum J, Foster K, Brewster D. Initial effects of the grounding of the tanker Braer on health in Shetland. BMJ 1993; 307: 1251 1255.
8. Osuji LC, Onojake C. The Ebocha 8 oil spillage II: Fate of associated metals six months after. AJEAM RAGEE. 2004; 9: 78 87.

9. Inoni OE, Omotor DG, Adun FN. The effect of oil spillage on crop yield and farm income in Delta State, Nigeria. Journal of Central European Agriculture 2006; 7 (1): 41 48.
10. Human Right Watch. The Price of Oil. 1999. Available at http://www.hrw.org/reports/1999/nigeria/index.htm.
11. Araoye MO. Research methodology with statistics for health and social sciences. Ilorin . Nathandex publishers. 2003. 119-120.
12. Schierhout GH, Myers JE. Is self-reported pain an appropriate outcome in ergonomic-epidemiologic studies of work-related musculoskeletal disorders? Am J Ind Med 1996; 30: 93 98.
13. Oil Pipelines Act, Cap 338, Section 11 (5). Laws of the Federation of Nigeria 1990.