

Assessing Haematological Effects of Gas Flaring in Oil Producing Areas in Delta State of Nigeria

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Abstract

Background: Oil and gas flaring are among the sources of environmental pollution which poses serious threats to health of the people within the environment. The aim of this study was to investigate the effects of gas flaring activities on haematological parameters of the residents of oil and gas communities in Delta State. **Materials and Methods:** Subjects for the study were drawn from the represented groups in the oil and gas production environments and compared to the non-gas flaring environment which was the control location with no history of petroleum hydrocarbon (PHC) pollution. Sixty subjects of age range 18 to 65 years old were tested on some haematological parameters which includes; haemoglobin (Hb) concentration, packed cell volume (PCV), total red blood cell count (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC), total white blood cell (WBC) and erythrocyte sedimentation rate (ESR). **Results:** The result showed that the PCV, RBC, ESR and WBC counts were significantly decreased ($P < 0.05$) while Hb, MCV and MCHC did not change significantly ($P < 0.05$) when compared to the control ($P < 0.05$). **Conclusion:** Exposure to flaring of gas in the oil producing communities of Delta State of Nigeria have caused marked deterioration in haematological parameters and this may increase the risk of anaemia.

Key words: Anaemia, Flaring activities, Haematological parameters, Oil production.

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I. Introduction

The world's dependence on crude oil products has increased over time as a result of global increase in population¹. Oil and gas flaring in Nigeria dates back to 1958, when oil well was first discovered and drilled in the Niger-Delta region of Nigeria². Flaring (burning of waste gas) continues to be common practice in Africa. According to Caseiro *et al.*, industrial gas flaring (GF) occurs when flammable gas is disposed of by burning, most commonly done at the tip of a stack³. This can either take place as a measure for pressure relief or to dispose of unwanted gas. In the upstream oil and gas (UOG) industry in particular, gas flaring occurs when the associated gas can't be sold easily and is not used on-site for energy generation. Especially in insufficiently developed energy markets where companies seem to be spared from enough economic or political incentives to collect, or convert the gas^{4, 5}.

Gas flaring has potential harmful effects on the health and livelihood of the communities of Niger Delta, as it releases a variety of poisonous chemicals including nitrogen dioxide, sulphur dioxide, carbon monoxide, methane, particulates, and volatile organic compounds like benzene, toluene, xylene and hydrogen sulphide, as well as carcinogens like dioxins⁶. Gas flaring has been condemned severally in different countries of the world. Though, the practice is still obtainable in some countries with many calling for a stop. Ajugwo (2013) noted reluctance on the part of government and policy makers as a factor that causes flaring of gases among industries⁷. The difficulties faced by local communities from gas flares are a sufficient justification for

ending gas flaring practice. He recommended that fines by defaulting companies should be so exorbitant so as to deter them while the gas can be processed and produced into cooking/domestic gas.

Haematological changes are commonly used to determine the body status and to assess the impact of gas, environmental, nutritional and pathological stress⁸. Haematological testing is very useful and widely used in the clinical practice. Haematological parameters provide valuable information on the immune status of individual depending on environmental and genetic background⁹.

The objective of this study was to assess the effects of gas flare on some haematological parameters of residents in gas flaring communities in Delta State of Nigeria.

II. Material And Methods

Materials used include, haematology analyser (Sysmex K-21N, made in Japan), syringes and needles, EDTA specimen bottles and methylated spirit.

Study Design: The study was designed to be observational study and grouped into two groups.

Study Location: The study area is located in the Western Niger-Delta, Delta State, Nigeria and covers an area of some 950 square kilometres. The producing fields are in the 1960s located onshore in the Delta State of Nigeria approximately 45 kilometres east of Warri, Southern Nigeria and covers an area of 1,095 square kilometres. The licence includes Utorogu flow station, Utorogu gas plant, Ughelli East, and Ughelli West which were developed in the following producing fields; Afiesere, Eriemu, Evwreni, Kokori, Oweh, Olomoro-Oleh and Uzere West¹⁰.

Kokori in Ethiope East Local Government Area of Delta State is one of the gas flaring locations. It lies approximately between longitudes 6° 04' 00" and latitudes 5° 40' 00". Its land area is 196sqkm. The entire kokori land is flat and situated in the evergreen tropical forest zone which is dominated by the oil palm tree. Afiesere in Ughelli north Local Government Area lies between longitude 6° East and latitude 5° 32' 31" North. Its land area is 12m, 39.37ft, 472.44 above sea level. Evwreni also in

Ughelli North North Local Government Area, lies between Longitude 6°, 04' 58" East and Latitude 5° 24' 00" North. Its land area is 13m, 42.65ft, 511.81 above sea level. Eriemu, also in Ughelli North Local Government Area, lies between Longitude 6° 02' 00" East and Latitude 5° 35' 00" north.

Otujeremi in Ughelli south Local Government Area, where the Utorogu facility is located lies between Longitude 5° 52' 41.8" East and Latitude 5° 26' 17.4" N. Iwhreka is in Ughelli south Local Government Area and harbours one of the facilities under study. It lies between Longitude 5° 52.3' East and Latitude 5° 27' 22.1' north. Ekakpamre a town in Ughelli south Local Government Area also hosts one of the facilities under study. It lies between Longitude 5° 54' 00" East and 5° 31' 00" north. Olomoro-olehin Isoko south Local Government Area, lies between longitude 6° 09' 00" East and Latitude 5° 25' 00" north, Uzere, also a town in Isoko south L.G.A where gas flaring activities is located, lies between Longitude 6° 10' East and Latitude 5° 12' north, Oweh is also a town in Isoko North Local Government Area, an oil producing area of Delta state, Nigeria¹⁰.

This was a tertiary care teaching hospital based study done in Department of General Medicine, at Dr. Ram Manohar Lohia Combined Hospital, Vibhuti Khand, Gomti Nagar, Lucknow, Uttar Pradesh.



Fig. 1: Map of Delta State of Nigeria, showing oil producing areas (Source: Oseh *et al.*,¹⁰).

Study Duration: November 2018 to November 2019.

Sample size: 60 donors.

Sample size calculation: The sample size was calculated based on random selection of sample in the area.

Subjects and selection method: The study population was drawn from people living around the oil producing communities where gas flaring was taking place and people living in the areas where gas flaring was not taking place.

With dyslipidemia were as follows:

Group A-Control group (N=12), those living in the areas where gas flaring was not taking place

Group B-Test group (N=48) –Those living in the areas where gas flaring was taking place

Inclusion criteria:

1. Those living close to gas flaring areas
2. Male and Female
3. Aged ≥ 10 years,
4. People living in the area for up to 5 years

Exclusion criteria:

1. Pregnant women;
2. Donors with medical history of anaemia or anaemic related diseases.
3. Donors on drugs
4. Donors undergoing menses

Procedure methodology

After written informed consent was obtained, a well-designed questionnaire was used to collect the data of the recruited donors.

Sampling collection

Samples of exactly 5 ml of blood were collected from the veins of participating respondents after cleansing with cotton wool and methylated spirit. This was then transferred into a sterile labelled test tube containing ethylene diamine tetra acetic acid (EDTA), an anticoagulant. It was immediately used for measuring haematological indices; haemoglobin (Hb) in g/dl, packed cell volume (PCV) in %, white blood cell count (WBC) in $\times 10^6/l$, red blood cell count (RBC) in $\times 10^{12}/l$ and red blood cell indices (MCV, MCH and MCHC),

using haematology analyser (Sysmex K-21N, made in Japan). Erythrocyte sedimentation rate (ESR) in mm/hr was also measured using Westergren method.

All blood samples were collected by professionally trained laboratory scientist(s) registered with Medical Laboratory Science Council of Nigeria (MLSCN) and Doctors registered with Nigeria Medical and Dental Council (NMDC) respectively. Collected samples were stored under refrigeration and subsequently transferred to an analytical Laboratory in Nigeria.

Laboratory analysis of full blood count

This was done using EDTA blood with sysmex KN-21N, (Manufactured by sysmex corporation, japan), a three-part auto analyzer able to run 19 parameters. Standardization, calibration of the instrument and processing of samples were done according to the manufacturer's instructions¹¹.

Principle

The Beckman counter method of sizing and counting particles uses measurable changes in electrical resistance produced by non-conductive particles suspended in an electrolyte. A suspension of blood cells passes through a small orifice simultaneously with an electric current. A small opening (aperture) between electrodes is the sensing zone through which suspended particles pass. In the sensing zone, each particle displaces its volume of electrolyte. Beckman coulter measures the displaced volume as a voltage of the particle. The quantity of suspension drawn through the aperture is for an exact reproducible volume.

Procedure

Each blood sample was mixed well and then approximately 20µl was aspirated by allowing the analyser's sampling probe into the blood sample and depressing the start button. Results of the analysis were displayed after about 30 seconds, after which the analyser generated a paper copy of the results on thermal printing paper.

Statistical analysis

The results of this study were subjected to statistical analysis using SPSS statistical software version 25 using independent "T" test. Test for significance was done at 0.05 level of significance.

III. Results

The comparison of Haematological parameters between Non-Gas flaring and Gas flaring in the study areas is shown in Table 1. The results of this study revealed a significant ($p < 0.05$) decrease in Hb, ESR, WBC and MCV of Oweh and Otujeremi when compared to the control group while PCV, MCHC and MCV had a non-significant ($p > 0.05$) decrease when control group was compared to test group (Table 1).

Table 1. Comparison of Haematological Parameters between Non-gas Flaring Areas and Gas Flaring Areas

	Group	MEAN	±STD	P-VALUE
Haemoglobin concentration (g/dl)	Control	14.13	±3.27	0.014*
	Test Group (Gas Flaring)	12.39	±1.65	
Pack cell volume (%)	Control	42.39	±9.83	0.585 ^a
	Test Group (Gas Flaring)	41.50	±2.74	
Red blood cell ($\times 10^6/\mu\text{L}$)	Control	6.66	±2.24	0.000*
	Test Group (Gas Flaring)	4.87	±0.49	
Erythrocyte Sedimentation Rate (mm/h)	Control	12.41	±3.14	0.000*
	Test Group (Gas Flaring)	7.83	±3.69	
White blood cell ($\times 10^3/\text{mm}^3$)	Control	12.18	±2.30	0.048*
	Test Group (Gas Flaring)	10.26	±4.58	

Mean Corpuscular Concentration (%)	Hemoglobin	Control	29.01	±3.95	0.499 ^a
		Test Group (Gas Flaring)	27.88	±8.37	
Mean Corpuscular Hemoglobin (pg)		Control	35.40	±0.00	0.000*
		Test Group (Gas Flaring)	29.55	±8.26	
Mean Corpuscular Volume (fL)		Control	62.80	±14.38	0.864 ^a
		Test Group (Gas Flaring)	61.80	±27.63	

Data was expressed as mean ±SD. Significance was tested at $P \leq 0.05$. Data was analysed using independent t-test and values were considered significant at $P < 0.05$. * = means significant at $P < 0.05$ and a⁻ means not significant.

IV. Discussion

This work has so far assessed the haematological indices of people living in the oil producing communities of Delta State where gas flaring takes place. Haematological indices are among the the blood markers used in diagnosing anaemia in patients. The decreases in Hb, ESR, WBC and MCV of people of Oweh and Otujeremi communities when compared to the control group is suggesting that there was harmful effect on the haemopoietic system of the test group. This may have resulted to anaemia in the affected groups. This could be attributed to the fact that air pollutants such as benzene, naphthalene, carbon monoxide, toluene, and xylene affect the formation of blood (haemopoeisis) in bone marrow, spleen and lymph nodes. Benzene is a known systematic toxicant in human at any concentration, when inhaled for prolonged period, with haematotoxic and bone marrow depressant effects. Related studies have also reported a decrease in PCV, Hb and RBC count among petrol station attendants, and a contradicting dose dependent increase in PCV in crude oil gavigated guinea pigs^{12, 13, 14}. Naphthalene, if inhaled or ingested in large amount, is known to destroy the membrane of red blood cells leading to its breakdown. This may have also contributed to the deterioration in the observed parameters as well as the change in morphology. Some studies reported a reduction^{13, 15, 16}, as observed in this study while others reported an increase^{12, 17}. The decrease in WBC count may be associated to stress induced in the haemopoietic pathway.

V. Conclusion

The results of this study have so far shown that gas flaring had adverse effects on the blood of those people living in the communities where the gas flaring was taking place in Delta State of Nigeria. This may have resulted in anaemic situations in the affected people, thus, more likely to be anaemic.

Recommendations

The oil and gas companies should as a matter of urgency put in place measures to reduce the burden already inflicted on the exposed persons while instituting actions to monitor, minimize gas flaring and other public health challenges due to gas flaring and related issues.

Conflict of interest: Authors declare that there was no conflict of interest

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