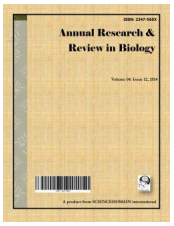

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Impacts of Crude Oil on Reproductive Indices of Residents of Oil Producing Area; a Case Study of Olomoro

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Authors' contributions

This work was carried out in collaboration between all authors. Author AON carried out the bench work, author KKA managed and supervised the experimental protocol, author OO performed the statistical analysis, author MOO wrote and monitored the first draft of the manuscript and authors CE and BCN managed the literature searches.

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ABSTRACT

Several toxic effects of crude oil and some of its products on reproduction have been reported. High rate of child malnutrition and mortality, including increased birth defects and rashes have also been reported in areas impacted by oil development. This study therefore considers the impact of crude oil on reproduction as information in this area is still scanty. With informed consent, blood samples were collected (through the median cubital vein) from a total of one hundred and eighty apparently healthy human subjects (60 males and 30 females) from two locations; Olomoro (an oil producing community) and Owa (a non-oil producing community). Next, socio-economic and educational status of participants where ascertained. Using the Z statistics, student's t-test and analysis of variance (ANOVA), Statistical measures for such parameters as RBC, WBC, PCV, Total serum

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protein (TSP), serum Albumin (SA), Haemoglobin concentration (Hb), FSH, Estrogen and Testosterone were conducted. A Significant reduction was observed in Haemoglobin concentration, TSP and SA of subjects in oil impacted community. Also, Significant reduction in number of surviving children, save deliveries and ante natal attendance was seen, along with a significant increase in the number of assisted delivery, still births, complications and gestation periods in oil impacted community, suggesting a poorer maternal and child health indication in crude oil impacted community. Study also observed a significant reduction in WBC, RBC and PCV of inhabitants of the crude oil impacted community.

Keywords: Crude oil; reproductive indices; haematological parameters.

1. INTRODUCTION

Nigeria is the largest producer of crude oil in Africa and the 11th largest in the world major supplier to Europe and 5th largest supplier to USA in 2002 [1-2]. The southern part of the country especially the Niger Delta region provides most of the space for exploration and exploitation of crude oil [2]. This region has so many rivers, streams and creeks through which freshwater empties into the Atlantic Ocean. These rivers most of the time provide the only sources of drinking water and marine food for the local communities within the region. During exploration, exploitation and refining of crude oil, accident in the form of spillage often occur resulting in the contamination of the environment especially these sources of drinking water, exposing the inhabitants of these communities to danger. Generally, it has been estimated that an average of 11-54 mg/L of the oil is dissolved in our coastal waters [3].

Crude oil is a very complex mixture of compounds composed mainly of carbon, hydrogen and sulphur with carbon and hydrogen as the major components. It is a mineral oil consisting of a mixture of hydrocarbon of natural origin, yellow to black in colour of variable specific gravity and viscosity. It is occasionally found in springs or pools but usually drilled from wells beneath the earth's surface.

A report by the National Resources Defence Council found high rates of child malnutrition and mortality, increased birth defects and rashes in areas impacted by oil development [4]. Inhalation may cause respiratory tract irritation; high concentration will cause depression in the central nervous system with headache, drowsiness, dizziness, nausea and lack of coordination as accomplice. In South Louisiana, Chronic ingestion of crude oil reportedly resulted in liver hypertrophy, splenic atrophy and degeneration of kidney [5]. Seiichi et al. observed that diesel exhaust has a potential influence on the male reproductive system through its effects on leydig cell degeneration, increase in the number of damaged seminiferous tubules, and reduction in daily sperm production in the testis [6]. Available reports have it that crude oil ingestion is nephrotoxic, hepatotoxic, and cardio-toxic in humans and experimental animals. They are also CNS depressants in humans [7]. On haematological parameters such as haemoglobin (Hb), pack cell volume (PCV) and white blood cell count (WBC), studies show that there was significant reduction in Hb and PCV and a rise in WBC [8-12] as a result of crude oil ingestion. Also, significant differences in biochemical blood parameters (Urea, creatinine, total and conjugated bilirubin and cholesterol) has been observed in semi adult rabbits fed with crude oil contaminated diets [13-14].

1.1 Aim of Study

This study examined the impact of crude oil and its products on reproduction. Specifically, the study attempted to examine:

1. The effect of crude oil and its products on the nutritional and health status of petroleum impacted communities.
2. The maternal-child health reproductive indices of petroleum impacted community
3. The haematological and hormonal indices of inhabitants of crude oil impacted communities

2. MATERIALS AND METHODS

2.1 Scope of Study

This study was undertaken to assess the socio-economic, nutritional and health status of individuals in petroleum polluted and non-petroleum polluted communities. The study was conducted in two communities of Olomoro (oil producing) and Owa (non-oil producing), Delta state. Delta State is a 16,842/km^2 area of land in Nigeria that lies approximately between

Longitude 5º00 and 6º.45' East and Latitude 5º00 and 6º.30' North (National gazette, 2007)

2.2 Study Design

Subjects were selected by stratified sampling procedure. A total of one hundred and eighty (180) human subjects were selected as such. Questionnaires were administered to two hundred males and two hundred females in each of the communities. Another aspect of the experiment involved collection of blood samples from each sampled subjects in both communities.

2.3 Ethical Clearance

Ethical approval was obtained from the Research and Ethics committee of the college of Health Sciences, Delta State University, Abraka, Delta State. Before investigation, a Consent form was administered to participants in order to have their permissions. Those whose permission was not granted were left without contempt.

2.4 Selection Criteria

Communities were selected based on their long period of crude oil exploration and on the bases of their population and socio-economic status.

2.5 Procedure

Questionnaires were administered to a total of five hundred and eighty (580) human subjects from two selected communities; Olomoro (an oil producing community) and Owa (a non-oil producing community) made up of two hundred male and two hundred female subjects each. Blood samples were collected (through the median cubital vein) from a total of one hundred and eighty apparently healthy human subjects (60 males and 30 females per community) after their consent have been duly obtained for analysis of RBC, WBC, PCV, Total serum protein (TSP), serum Albumin (SA), Hemoglobin concentration(Hb), FSH, Estrogen and Testosterone.

2.6 Analytical Approach

Data generated from this study were analysed using the Z-statistics, student's t-test and analysis of variance (ANOVA). The results are presented as means and standard deviations.

3. RESULTS

See below for results, following analysis.

Table 1. Showing academic and economic status of sampled communities

Groups	COIC	NCOIC	Z-value	P- value	Remark
Income	11,100+ 1,510	11,406+ 1,041	3.3	P<0.001	*
Academic Level	1.190+ 0.75	1.647+ 1.3	7.06	P<0.001	*

Results are presented as mean ± SD. COIC=Crude Oil Impacted Community, NCOIC=Non Crude Oil Impacted Community

Table 2. Showing nutritional status of subjects in sampled communities

Community	NCOIC	COIC	Z-value	P-value	Remark
Self-feeding assessment(400)	0.741 + 0.44	0.639 + 0.41	2.2	p < 0.05	*
Community feeding assessment (400)	0.340 +0 48	0.028+ 0.028	8.83	p < 0.05	*
Hb Male (100)	14.87+ 2.5	12.72+ 3.0	5.8	p < 0.05	*
Hb Female (100)	13.72+ 2.5	10.39+ 2.3	1.6	p > 0.05	
TSP (160)	8.76+ 1.7	6.87+ 1.5	3.8	p < 0.05	*
SA (160)	4.1+ 0.8	2.66+ 0.76	4.0	p < 0.05	*

Results are presented as mean ± SD. COIC=Crude Oil Impacted Community, NCOIC=Non Crude Oil Impacted Community

Table 3. Showing availability & utilization of health centre

Community	NCOIC	COIC	Z-Value	P- value	Remarks
Numbers of Hospital	4.0±1.9	1.0±0.3	15.5	p < 0.001	*
Utilization	1.3±80.7	1.0±0.8	3.57	p < 0.001	*
No of illness Per year	3.34±2.0	2.87±2.4	1.80	p > 0.05	

Results are presented as mean ± SD. COIC=Crude Oil Impacted Community, NCOIC=Non Crude Oil Impacted Community

Table 4. Showing Maternal and child health and reproductive indicators

Community	NCOIC	COIC	Z-value	p - value	Remarks
No. of children alive/mother	7.58 ± 0.36	5.13±.2.9	8.44	p < 0.05	*
No of safe deliveries	5.28±3.0	4.91±2.8	0.9	p > 0.05	*
Assisted deliveries	0.14±0.4	0.34±0.68	2.5	p < 0.05	*
Still Birth	0.26±0.6	0.74±0.98	4.8	p < 0.05	*
Complication Frequency	0.26±0.4	0.5±0.5	3.8	p < 0.05	*
Ante naval Attendance	0.9±0.3	0.8±0.39	2	p < 0.05	*
Gestation period GP	9.04±0.2	9.25±0.5	3.5	p > 0.05	
Fertility rate	0.38	0.20			
Community	NCOIC	COIC	Z-Value	p - Value	Remarks
No. of children alive/mother	7.58±0.36	5.13±.2.9	8.44	p < 0.05	*
No of safe deliveries	5.28±3.0	4.91±2.8	0.9	p > 0.05	
Assisted deliveries	0.14±0.4	0.34±0.68	2.5	p < 0.05	*
Still Birth	0.26±0.6	0.74±0.98	4.8	p < 0.05	*
Complication Frequency	0.26±0.4	0.5±0.5	3.8	p < 0.05	*
Ante naval Attendance	0.9±0.3	0.8±0.39	2	p < 0.05	*
Gestation period	9.04±0.2	9.25±0.5	3.5	p > 0.05	
Fertility rate	0.38	0.20			

*Results are presented as mean ± SD. COIC=Crude Oil Impacted Community, NCOIC=Non Crude Oil Impacted Community. *=significant at p < .05*

Table 5. Environmental pollution assessment

Community	NCOIC	COIC	Z-Value	P- Value	Remarks
Spillage %	0	100		p < 0.05	*
Gas flaring %	0	100		p < 0.05	*
Smoke %	0	100		p < 0.05	*
Suitability of drinking H_20	2.1+ 0.79	1.02+ 0.9	90.75	p < 0.05	*

Results are presented as mean ± SD. COIC=Crude Oil Impacted Community, NCOIC=Non Crude Oil Impacted Community

Table 6. Haematological indices and hormonal changes in humans Male subjects

	NCOIC	COIC	t-cal	p-value	R
PCV	44.6± 5.2	37±.5	5.77	p < 0.05	*
WBC	5.5 ±1.2	4.4±5.5	5.5	p < 0.05	*
RBC	4.7 ±±0.5	3.9±0.5	6.5	p < 0.05	*
FSH	3.9 ±1.4	3.5± 1.5	1.33	p > 0.05	
Testosterone	4.0 ±1.0	2.4 ±1.2	5.5	p < 0.05	*

Results are presented as mean ± SD. COIC=Crude Oil Impacted Community, NCOIC=Non Crude Oil Impacted Community, PCV=Packed Cell Volume, WBC=White Blood Cells, RBC=Red Blood Cells, FSH=Follicle Stimulating Hormone

Table 7. Haematological indices and hormonal changes in humans female subjects

	NCOIC	COIC	t-cal	p-value	R
PCV	37.2 ±4.4	30 ±4.7	3.42	p < 0.05	*
WBC	4.0± 0.6	3.1 ±0.5	4.0	p < 0.05	*
RBC	4.0 ±0.5	3.3 ±0.5	3.9	p < 0.05	*
FSH	3.2 ±1.3	4.2 ±1.6	1.78	p < 0.05	
Estrogen	3.4 ±1.4	4.8± 1.6	2.33	p < 0.05	*

Results are presented as mean ± SD. COIC=Crude Oil Impacted Community, NCOIC=Non Crude Oil Impacted Community, PCV=Packed Cell Volume, WBC=White Blood Cells, RBC=Red Blood Cells, FSH=Follicle Stimulating Hormone

4. DISCUSSION

This study indicates that crude oil and crude oil products have some negative effects on reproduction. Our results show the following.

4.1 Economic and Educational Status

No significant difference in economic and literacy level of subjects in oil impacted community compared to non-oil producing community. This result supports our selection criteria, indicating that both communities are matched to some extent.

4.2 Nutritional Assessment

Significant reduction was seen in nutritional assessment, Haemoglobin concentration, Total serum protein and serum albumin of subjects in oil impacted community, suggesting a reduced nutritional status of the oil impacted community. This may be related to the reduce growth and yield of plants grown in this crude oil impacted land which serve as the main source of food for the community inhabitants [15]. This low nutritive value of food stuff produced in oil impacted community may be responsible for the reduced nutritional status of inhabitants. We are yet to find similar reports on nutrition of crude oil impacted communities. Reductions in Hb concentrations have been reported by Okoro et al. They suggested that constituents of crude oil and some of its products such as lead can interfere with iron and copper metabolism, bringing about a reduction in haemoglobin concentrations. The reduction in total serum protein and serum albumin of subjects in crude oil impacted community is an evidence of reduced nutritional status.

4.3 Reproductive Assessment

A significant reduction was observed in the number of surviving children, number of safe deliveries, ante natal attendance and a significant increase in number of assisted delivered, still birth, complications and gestation periods in oil impacted community. This suggests a poorer maternal and child health in crude oil impacted community. Studies assessing these parameters in oil producing communities have not been sported however some authors have observed detrimental effects of crude oil and crude oil products on human reproduction. For instance, diesel exhaust inhalation has been reported to affect male reproduction in humans [6]. High rate of child malnutrition and mortality, increased birth defects and rashes have also been reported in areas impacted by crude oil development [4]. By extension, malnutrition will have a negative bearing on pregnancy and child birth and this may be a way through which crude oil may have produced the observed changes in the parameters stated above.

It has been reported that crude oil passes through the placenta and induce microsomal enzymes transiently [16-17] this may be injurious to the immature liver and kidneys of the foetus. Also maternal p450 induction results in increased drug metabolism, and may lead to therapeutic failure in pregnant women exposed crude oil, and further compound the management of such women [17].

4.4 Haematological Impact

We observed a significant reduction in WBC, RBC and PCV of inhabitants of the crude oil impacted community; this is in agreement with the findings of Okoro et al.

Significant reduction in PCV, WBC and PCV of male and female rats treated with crude, oil, petrol, kerosene, Diesel, Contaminated water, and cadmium chloride for five weeks supports our earlier findings in community studies and suggest that the Acute effect of crude oil and its products on blood may be mediated by a cytotoxic effect which may cause increased destruction of blood cells. Reduction in PCV and RBC is in agreement with the report of Dede and Igboh who reported that long-term exposure of Wister rats to crude oil contaminated water induced anaemia, resulting in premature destruction of RBC [10-12]. This is also in agreement with the findings of Cowell and Anderson et al. [18-19]. Also, Reductions in WBC count have been observed. Dudley et al. reported a reduction in WBC which was attributed to immune-toxicity including decreased weight of the marrow, reduced cellularity and deficit in hormonal response after acute exposure to Kerosene. Marieb (1995) also reported that a decrease in WBC could be due to reduction in WBC migration [20-21]. Also okoro et al. observed a decrease in WBC of male and female humans exposed to petroleum fumes.

Significant increase in WBC of male and female rats treated with crude oil, petrol, kerosene, Diesel, contaminated water, and cadmium chloride for mine weeks. This indicates a

leukemoid reaction which may be a result of response of the blood forming tissues to the cytotoxic effect of crude oil and its product. Our results agree with that of conwell, Krisslia and Veena, Gautman and chowdhury, Dede and Kagbo and Dede and Igboh [10-12].

4.5 Homonal Impact

We observed a non-significant decrease in FSH with a significant decrease in testosterone levels of male inhabitants of crude oil impacted community. This observation agrees with the findings of Olawale et al. There was also a non-significant increase in FSH and a significant increase in estrogen of their female counterparts.

Available studies posit that certain environment chemicals capable of mimicking or modulating effects of gonadotrophic hormone interfere with reproductive morphology and behaviour [21]. Since hormones function at very low levels, any alteration in such reproductive hormone levels may have adverse effect on reproduction, and this is of serious health concern. Our observation of a significant decrease in testosterone levels of male indigenes of crude the oil impacted community is in agreement with Olawale et al. This may be due to the low concentration of crude oil in the brackish. Development as it has been observed that crude oil and crude oil products cross the placenta [17].

4.6 Benefits of Study

Data generated from this study will provide objective basis for the development of policies for a comprehensive medical care and rehabilitation of the inhabitants of crude oil impacted communities. This is especially so, as the outcome of the study shows poor reproductive indices in crude oil impacted community.

5. CONCLUSION

Crude oil and its products, including trace elements like cadmium contained in crude oil may have adverse effect on reproduction indices of oil producing communities, either by their effects on blood cells, which is a determinant of the capacity to maintain pregnancy (supply nutrients and oxygen) and alterations in levels of reproductive hormones which usually function physiologically at small and highly regulated concentrations or by cytotoxic effects on reproductive organs and cells (sperm and ovum). Co-administration of vitamin C may attenuate the effects of crude oil especially on blood cells and reproductive hormones.

6. RECOMMENDATIONS

For further studies, we make the following recommendations:

1 That further studies be designed to involve more oil producing communities.

To government agencies, we make the following recommendations:

1 That more attention be given to the environmental needs of the oil producing communities.
2 There is need for provision of good health care delivery system for oil producing communities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Eyong EU, Umoh IB, Ebong PE, Efeng MU, Antia AB, Akpa AO. Haematotoxic effects following ingestion of crude oil polluted shelfish. Nig Journal of Physiological science. 2004;19(1-2):1-6.
2. Eyong EU. Heamatoxic effect following ingestion of Nigeria crude oil polluted shellfish by rats. Nigeria Journal of Physiological Sciences. 2005;19(1-2):1-6.
3. Idoniboye BE, Andy AJ. Effect of oil pollution on aquatic environment. In Proceedings of 1985 Seminar on Petroleum Industry and the Nigerians Environment; 1985.
4. Kimberling J. Amazon crude national resources defence council; 1991.
5. Saiorzorta PH, Lennart M. Steroid hormone determination. Journal of Chromatography. 2008;1192(1):1-8.
6. Seiichi, Ken T. The effect of diesel exhaust on marine male reproductive function. Journal of Health Science. 2004;50(3): 210–214.
7. Gabriel L. Introduction toxicology occupational and environmental in basic and clinical pharmacology. (7th edition) Appleton and Lange. 1998;945-955.
8. Eyong EU, Umoh IB, Ebong PE, Efeng MU, Antia AB, Akpa AO. Haematotoxic

effects following ingestion of crude oil polluted shelfish. Nig Journal of Physiological Science. 2004;19(1-2):1-6.

9. Dede, Kagbo. A study on the acute toxiological effects of commercial diesel fuel in rats using hematological parameters. Journal of Applied Science and Environmental Management. 2000; 6(1):84–86.
10. Dede EB, Igboh NM, Ayalogun OA. Chronic toxicity study of the effect of crude petroleum (Bonny light), kerosene and gasoline on rats using hematological parameters. Journal of Applied Science and Environmental Management. 2002; 6(1):60–63.
11. Dede EB, Kagbo HD. Acute toxicological effects of diesel fuel in rats. Journal of Applied Science and Environmental Management. 2001;5(1):83-84.
12. Dede EB, Kagbo HD. A study on the acute toxicological effects of commercial diesel fuel in Nigeria in rats using haematological parameters J. App. Sci. Enviro. Mgt. 2002; 6(1):84-86.
13. Ovuru SS, Berepubo NA, Nodu MB. Biochemical blood parameter in semi adult rabbits experimentally fed crude oil contaminated diet. African Journal of Biotechnology. 2004;3(6):343–345.
14. Ovuru SS, Berepubo NA, Nodu MB. Biochemical blood parameter in semi-adult rabbits experimentally fed crude oil contaminated diet. African J. of Biotechnology. 2004;3(6):343-345.
15. Akpofure EA, Efere ML, Ayawei P. Oil spillage in Nigeria's Niger delta psycho morphological an empirical overview. 2002;1-3.
16. Okoro AM, Ani EJ, Ibu JO, Akpogume BA. Effect of petroleum products inhalation on some haematological indices of fuel attendants in calabar. Nig Journal of Physiologycal Sciences. 2006;21(1-2):17-75.
17. Khan S, Marton M. Rahimtula AD, Payne JF. Can J. Physiol Pharmacol Dec. 1987; 65(12):2400-2408.
18. Cowell EB. Oil pollution in perspective in the ecological effects of oil pollution on littoral communities. The Petroleum Institute London. 1971;224-34.
19. Anderson JW, Neff JM, Acox B, Highlower GM. Characteristic of dispersion and water-soluble extract of crude and refined oils and their toxicity to estuarine crustaceans and fish marbiol. 1974;27:75-88.
20. Marieb EN. Human anatomy and physiology 3rd ed. Benjamin and Cummings Pub. Co. California. 1995;585–611.
21. Dudley AA, Rambaud Cousson A, Thalji A, Jubeh II, Ahmad HM, Libdeh BA. Accidental kerosene ingestion: A 3-year prospective study. Ann Trop Paediatr. 2001;11:155-61.

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