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Impairments in serum Reproductive Hormones and Heavy Metals among Residents of Gas Flaring Communities in Ogbia Tribe, Niger Delta, Nigeria

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ABSTRACT

Gas flaring activities in Ogbia communities Niger delta region of Nigeria has been on for about sixty (60) years now. These associated flared gases with its constituents are released into the environment, and absorbed into the body of the resident population. This study was therefore aimed at evaluating the effects of the prolong exposure to the flared gases on the serum level of heavy metals and reproductive hormones among residents of these gas flaring communities. A total of 200 adult subjects were involved in the study. It consist of 100 test subjects (50 males and 50 females) randomly selected from communities ≤ 5km from active gas flaring site; and 100 control subjects (50 males and 50 females) from a community about 200km from any gas flaring site. Demographic and socio-economic data of subjects were obtained. 4ml of blood was obtained from each subject and serum used to determine the concentrations of reproductive hormones and heavy metals. The results show significant ($p<0.01$) reduction in serum Leuteinising hormone, Follicle Stimulating hormone, Prolactin, Testosterone, Progesterone and Oestradiol; with a significant ($p<0.01$) increase in the serum concentrations of copper, cadmium, nickel, zinc, mercury, arsenic and vanadium among the test subjects, when compared with subjects in the respective control groups. In conclusion, prolong exposure to gas flaring by residents of Ogbia communities results in an abnormal increase in the serum concentrations of heavy metals, which led to impairments in their reproductive hormones; and consequently could impair their reproductive functions and reproductive capacities.

Keywords: Gas flaring, reproductive Hormones, Niger Delta, infertility

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INTRODUCTION

Gas flaring can be defined as the process by which excess natural associated gas released from an oilfield is burnt. In Nigeria, it started in 1956, when oil was first discovered in commercial quantity in Oloibiri-Ogbia, in Ogbia Local Government Area, Bayelsa State, Niger Delta Region. Since then, so many oil wells were discovered in the region with associated flow stations, including the Kolo Creek flow station, Imiringi - Ogbia. Accordingly, gas flaring has correspondingly been on the increase[1] (Obinna et al., 2014). Reports show that the Kolo Creek flow station produces about 600,000m^3/day of flared gases[2] (Sunday and Ubi, 2008). These associated flared gases also contain particulate matter and some heavy metals such as vanadium, cadmium, mercury, arsenic and nickel which are released into the environment[3] (Strosher et al., 2000), are absorbed into the human body through the respiratory system by inhalation and or through the food chain[4] (Fierrens et al., 2003). Components of gas flares have been associated with disorders in the haematological, respiratory and digestive systems; brain, bones as well as hepatorenal and reproductive toxicity[5-7] (Adienbo and Nwafor, 2010; Okilo et al., 2008; Dockery et al., 1993). This study was therefore aimed at evaluating and relating the effects of prolong exposure to gas flaring on the serum level of these heavy metals and the reproductive hormones among residents of these gas flaring communities.

MATERIALS AND METHOD

Study Area/ Study Population:

This study was carried out in rural, unindustrialized, gas flaring communities in Ogbia Local Government Area of Bayelsa State, Niger Delta Region of Nigeria. They include Imiringi and Ewoi communities whose residential homes are about 100m and 5km respectively, from the gas flaring points. The control subjects were from Ihiala, a non-gas flaring, unindustrialized rural community about 200km from gas flares. Ethical clearance was sought for and approval given by the Institutional ethical committee of the College of Health Sciences, University of Port Harcourt. An informed consent was willingly obtained from all interested participants of this study, after explaining the study protocols, and those who fulfilled the inclusion criteria were included for the study. The study population include (a) apparently healthy male and female subjects of age range 20 - 50 years, resident in the gas flaring communities for at least 10 years, and not on any hormonal or mineral supplement for at least six months preceding the study; (b) apparently healthy male and female subjects of age range 20 – 50 years, resident in a non-gas flaring community (Ihiala) for at least 10 years, and not on any hormonal or mineral supplement for the last six months. Both the exposed and unexposed populations were of similar socio-demographic and economic status with similar diet habits.

Study Design:

This is a cross sectional analytical study. A total of 200 subjects were randomly selected from the study populations. They include 100 exposed subjects (test group) comprising 50 males and 50 females; while the control group had 100 unexposed subjects comprising 50 males and 50 females. 4ml of blood samples was obtained from each subject, by venipuncture, into plain bottles between 8am – 10am. These were placed in ice-pack and transported to the laboratory. The sera was used for the following analyses: (a) to determine the concentrations of heavy metals using atomic adsorption spectrophotometer, following digestion with analytical grade nitric and hydrochloric acids. (b) The concentrations of Follicle Stimulating hormone, Leuteinising hormone, Prolactin and Testosterone (for male subjects); and Follicle Stimulating hormone, Leuteinising hormone, Prolactin, Progesterone and Oestrogen (for female subjects) were determined with enzyme linked immunoassay methods.

RESULTS AND DISCUSSION

The results from this study shows that among the male subjects (table 1) resident in the gas flaring communities, there was a significant ($p<0.01$) decrease in the serum levels of Leuteinising hormone, Follicle Stimulating hormone, Prolactin, and Testosterone respectively, when compared with the control group subjects. The female test subjects (table 2) similarly have significant ($p<0.01$) reductions in their serum Leuteinising hormone, Follicle Stimulating hormone, Progesterone and Oestradiol respectively, while prolactin was insignificantly ($p>0.05$) reduced, when compared with their respective control group subjects. Further, the male test subjects (table3) from the gas flaring communities all have significant ($p<0.01$) increase in the serum concentrations of copper, cadmium, nickel, zinc, mercury, arsenic and vanadium, when compared with subjects in the control group. Similar results were observed among the female test subjects (table 4) where the serum levels of copper, cadmium, nickel, zinc, mercury, arsenic and vanadium were significantly ($p<0.01$ increased, when compared with the control subjects.

Table 1: Serum levels of reproductive hormones among resident male subjects in the study populations

Hormone	**Control subjects**	**Test Subjects**	
	Ihiala	Imiringi	Ewoi
LH (miu/l)	17.36±0.15	10.00±0.50**	12.86±0.75**
FSH (miu/l)	18.43±0.18	10.50±0.62**	14.01±1.25*
PROL (µg/l)	16.73±0.26	9.06±0.47**	11.60±0.74**
TESTOSTERONE (µg/l)	11.04±0.07	5.38±0.46*	6.00±1.98*

*p<0.01; **P<0.001

Table 2: Serum levels of reproductive hormones among resident female subjects in the study populations

Hormone	Control subjects	Test Subjects	
	Ihiala	Imiringi	Ewoi
LH (miu/l)	18.64±0.14	10.44±0.52*	14.02±1.43***
FSH (miu/l)	19.01±0.17	11.18±0.52*	15.18±1.66***
PROL (µg/l)	19.96±0.15	16.30±2.92	19.65±4.16
PROGESTERONE (µg/l)	15.18±0.37	10.25±0.89**	12.79±0.56***
OESTRADIOL (µg/l)	84.47±0.49	54.14±5.51***	72.82±3.88*

*p≤0.05; **p<0.01; ***P<0.001

Table 3: Serum levels of heavy metals among resident male subjects in the study populations

Heavy metal (mg/m^3)	Control subjects	Test Subjects	
	Ihiala	Imiringi	Ewoi
Copper	0.010±0.001	3.02±0.10**	0.02±0.00
Cadmium	0.001±0.00	0.100±0.00**	0.002±0.01**
Nickel	0.009±0.001	0.500±0.01**	0.06±0.02**
Zinc	0.057±0.003	11.45±1.07**	7.84±0.47**
Mercury	0.0001±0.00	0.100±0.00**	0.0002±0.00**
Arsenic	0.0001±0.00	0.100±0.01**	0.0001±0.00
Vanadium	0.010±0.001	1.00±0.01**	0.20±0.01**

*p<0.01; **P<0.001

Table 4: Serum levels of heavy metals among resident female subjects in the study populations

Heavy metal (mg/m^3)	Control subjects	Test Subjects	
	Ihiala	Imiring	Ewoi
Copper	0.02±0.001	3.15±0.04**	1.02±0.001**
Cadmium	0.001±0.00	0.100±0.00**	0.002±0.00**
Nickel	0.011±0.00	0.50±0,01**	0.10±0.001**
Zinc	0.052±0.00	12.15±3.16*	8.16±0.18**
Mercury	0.0001±0.00	0.100±0.00**	0.0002±0.00**
Arsenic	0.0001±0.00	0.50±0.00**	0.0001±0.00
Vanadium	0.04±0.00	1.00±0.03**	0.20±0.01**

*p<0.01; **P<0.001

The findings from this study showed that the concentrations of heavy metals in the serum of both male and female subjects residents in the gas flaring communities (Imiringi and Ewo) were significantly (p<0.05) increased, with an associated significant (p<0.05) decrease in the reproductive hormones. The increase in the serum level of heavy metals among the test subjects may have resulted from the prolong exposure to the heavy metal-containing gas flares released into the environment[3] (Strosher et al., 2000), which are absorbed into the body systems by inhalation and or through the food chain[4] (Fierrens et al., 2003). Reports from previous studies indicate that these heavy metals could induce damaging effects on endocrine and reproductive organs[8] (Buzcu-Guven and Harriss, 2012) as well as on the hypothalamo-

pituitary-gonadal axis[9-11] (Akinoloye et al., 2006; Umeyama et al.,1986; Makada and Amith, 2005). Leuteinising hormone, Follicle stimulating hormone and Prolactin are synthesized and secreted by the pituitary gland, while testosterone, oestradiol, and progesterone are produced by the gonads. Therefore, the observed reductions in the serum levels of these reproductive hormones suggests that the associated increase observed in the serum levels of heavy metals among the test subjects could have caused an impairment in the neurochemical secretory mechanisms along the hypothalamo-pituitary-gonadal axis responsible for the synthesis and secretion of these hormones. An inverse relationship is therefore established between the serum levels of flared heavy metals, and the reproductive hormones in such human subjects. The impairment in reproductive hormones could consequently impair the reproductive functions and reproductive capacities of residents in these communities. .

The decrease in the reproductive hormones among test subjects resident in Imiringi community (the gas flaring site) was observed to be higher compared to those resident in Ewoi community. This may be due to differences in the distances of both communities to the gas flaring points: Imiringi is about 100m and Ewoi is about 5km away from the flaring point. This suggests that residents of Imiringi are more likely to experience a greater impact of the gas flaring than Ewoi.

CONCLUSION

In conclusion, this study has shown that the prolong exposure of residents of Ogbia communities in Niger delta region, to gas flaring results in an abnormal increase in the serum concentrations of heavy metals as well as impairments in their reproductive hormones. The severity of the impact varies with the distance of the gas flaring point from the communities. An association between gas flaring, serum heavy metals and impairment in reproductive hormones is thereby established.

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