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Original Research Article

Toxic air and respiratory indices among pregnant women in Bayelsa State, Nigeria

***[1]Solomon M. Uvoh, [1]Nwafor A. Chuemere, [2]Kiridi Emily Gabriel E. and [1]Charles Ngaikedi Nnandi**

[1]Department of Human Physiology, Faculty of Basic Medical Sciences, College of Health Sciences University of port Harcourt, Rivers State Nigeria.

[2]Department of Human Physiology, Faculty of Basic Medical Sciences, College of Health Sciences Niger Delta University Wilberforce islandAmossoma, Bayelsa state Nigeria.

***Corresponding Author Email: Solomonu31@gmail.com**

Abstract

This study was aimed at assessing the relationship between toxic air and respiratory indices among healthy pregnant women exposed to gas flares in Bayelsa State Nigeria. Out of the three hundred subject participants, two hundred were pregnant and one hundred non-pregnant subjects met the inclusion criteria. The respiratory indices were obtained from both subjects group and analysed using statistical packaging for social sciences version 20.0.Findings from the study indicate that the more the duration of exposure to toxic gas flares in years the lower the respiratory functions of the residents living in the gas flaring communities in Bayelsa state. The respiratory function parameters were lower in the pregnant test group compared with the non-pregnant group. Due to significant increase in the percentage difference between subjects in their third trimester with the rest trimesters a drastic decrease and a negative sign of above -60 was observed in figure 1. The prevalence of low and normal respiratory indices in non-pregnant was (69.75%) and (30.25%) while that of the pregnant was (76.25%) and (23.76%).The percentage ratio of the force expiratory volume in one second of the pregnant subjects decreases progressively in relation to trimesters.

Keywords: Forcevital capacity, Age, Pregnancy, Lung, gas flares, Trimesters, Duration, exposure.

INTRODUCTION

Pulmonary function test plays a key role in respiratory medicine during the three trimesters of pregnancy due to its reliance on the accuracy of appropriate data's. The ability to diagnose and interprets the extent of physiological impairment relating to respiratory parameters is of utmost importance to clinicians. The indiscriminate flaring of gases such as particulate matters, sulphur dioxide, carbon monoxide, heat and others into the environment have resulted in the degradation of air quality within the Niger Delta region and thus contribute immensely to an increase respiratory mortality rate world-wide (Feyrous et al., 2003; Eyong 2000; Mfon, 2016). No wondera famous professor in the Physiology of medicine (Arthur, 2013) once observed that life is under assault and there is nowhere to hide. The fishes in the river, animals in the forest, crops and even water that serves as the basis for all metabolic reactions in the body that the residents depend upon for survival are all affected and after absorption by plants they are usually ingested by animals with its concentration increasing as it move through the food chain to humans with resultant effect in respiratory disease and reduction in respiratory function indices among occupants of gas flaring communities and untimely death (Ovuakporaye et al., 2012). Exposure to outdoor toxic air have contributed to the death of over six million life including respiratory and cardiovascular diseases worldwide annually (WHO, 2016). Toxic air inhaled into the lungs escaped into the capillaries of the alveoli and permeates surrounding tissues as they cross the membranes into the blood stream resulting in an ill-health condition of the body system. The haphazard flaring of gases into the environment has contributed immensely to an increase respiratory mortality rate world-wide (Feyrous et al.,

2003; Eyong, 2000; Mfon, 2016).The indiscriminate flaring of gases such as particulate matters, sulphur dioxide, heat and others into the environment have resulted in the degradation of air quality within the Niger Delta region. A famous professor in the Physiology of medicine (Arthur 2013) once observed that life is under assault and there is nowhere to hide. The fishes in the river, animals in the forest, crops and even water that serves as the basis for all metabolic reactions in the body that the residents depend on for survival are all affected and after are taking up by plants they are usually ingested by animals with its concentration increasing as it move through the food chain to humans resulting in respiratory diseases, reduction in respiratory function indices among occupants of gas flaring communities and untimely death, (Ovuakporaye et al., 2012). Exposure to outdoor toxic air have contributed to the death of over six million life including respiratory and cardiovascular diseases worldwide annually (WHO, 2016). However alteration in maternal physiology during pregnancy have contributed to changes in airways and respiratory drive due to progesterone increase acting as a trigger of the primary respiratory centre by increasing the sensitivity of the respiratory centre to carbon dioxide. The enlargement of the uterus during pregnancy and hormonal changes posed a mechanical impact on respiratory function indices due to its effect on the *diaphragm* restricting the movement of the lungs especially during the third trimester (Yemisi and Sajja, 2014).

Several studies conducted in the Niger Delta have not emphasized much on the poor quality of air, water, crops and its relationship to pregnant women in Bayelsa State.

Substantial evidence from studies indicate that Flaring of gases contribute to the introduction of considerable number of hydrocarbons and environmental air pollution resulting in acid rainfall and several illnesses with its correlation between air pollutants in some communities in the Niger Delta with respiratory diseases (Adoki, 2012).

The quality of air fractions as contained in green data book (2015) indicates that Nigerian population are exposed to air pollution at PM 2.5 and recent studies have shown that exposure to these toxics are one of the most causes of death globally. Hence, the mortality rate associated with complications from pregnancy due to toxic air either prior to pregnancy or during pregnancy and other related effects is on the increase as they travel deep into the lungs and correlate with wheezing, asthma, couphing, low birth weight, premature delivery (Fabio et al., 2015; Shu et al., 2018; Devries et al., 2014). The lungs are somehow compressed due to the elevation of the diaphragm causing a decrease functional residual capacity together with increase tidal volume to allow for effective mixing of gases and increase alveoli ventilation by about 65% during pregnancy (Raph, 1983; Guyton and Hall, 1996). Gas flares is a global problem experienced by different nations all over the world since the discovery of oil with its negative impact on the region and its adverse effect on the health and livelihood of the citizens (Eremasi et al., 2021).Thus this study become necessary to ascertain if complications and death during pregnancy are linked to toxic air exposure in Bayelsa state.

MATERIALS AND METHODS

Research Design

This is a cross-sectional descriptive qualitative research study with semi structured questionnaires to obtain data's directly from pregnant women exposed to gas flares in their respective communities over a period of time compared with non- pregnant women in Bayelsa state Nigeria.

Location of Study

The pregnant and non-pregnant female participant subjects were interviewed in Government owned hospitals and health centers including some private hospitals / health centers located in gas flaring Communities Obuna, Polaku, Tombia, Immiringi and Amossomain Bayelsa State Nigeria.

Sample of Study Population

A total of two hundred pregnant and one hundred non-pregnant women were randomly selected from Tombia, Obuna, Polakau, Okolobiri, Immiringi, Olugbobiri, Olugboboro as research test groups and control subjects for the research study. The subjects must have lived in their respective communities consistently within Bayelsa State for at least five years.
Sources of Data; Primary.

Inclusion criteria

Residents of oil and gas flaring communities and consistently exposed to toxic air between five to ten years and above within Bayelsa state.

Exclusion criteria

Subjects with known chronic disease, newly residents and those who recently underwent thoracic/abdominal surgery were excluded from the study.

Ethical Consideration

The research was duly approved by the University of Port-Harcourt with approval number UPH/CEREMAD/ REC/MM62/009.

Table 1. Effect of duration with exposure and lung function indices in non-pregnant & pregnant subjects.

Parameters	non-pregnant			Pregnant			
	Short(≤10yrs.) (n=36)	Long(≥10yrs.) (n=64)	%diff	Short(≤10yrs.) (n=96)	Long(≥10 yrs.) (n=104)	%diff	Anova sig.
FVC (L)	1.83±0.49	1.71±0.57	6.6	1.75±0.34	1.67±0.57	4.5	0.02 #
FEV 1 (L)	1.58±0.49	1.45±0.53	2.5	1.43±0.46	1.32±0.40	7.6	0.02#
PER (L)	2.92±1.39	2.60±1.52	10.9	2.28±0.95	1.99±0.85	12.7	0.67 not sig
FEV 1%	86.33±12.23	84.79±12.42	1.7	83.90±12.58	79.04±14.56	5.7	0.08 not sig
FEV 25 (L)	2.64±1.43	2.41±1.51	8.7	2.02±0.89	1.74±0.84	13.8	0.70 not sig
FEV 75 (L)	1.22±0.67	1.05±0.54	13.9	1.07±0.46	1.02±0.45	4.6	0.00#
FEV 25-75 (L)	2.02±1.09	1.66±0.88	17.8	1.56±0.64	1.42±0.64	8.9	0.56 not sig

NB: Results are given as mean± standard deviation. #=significant

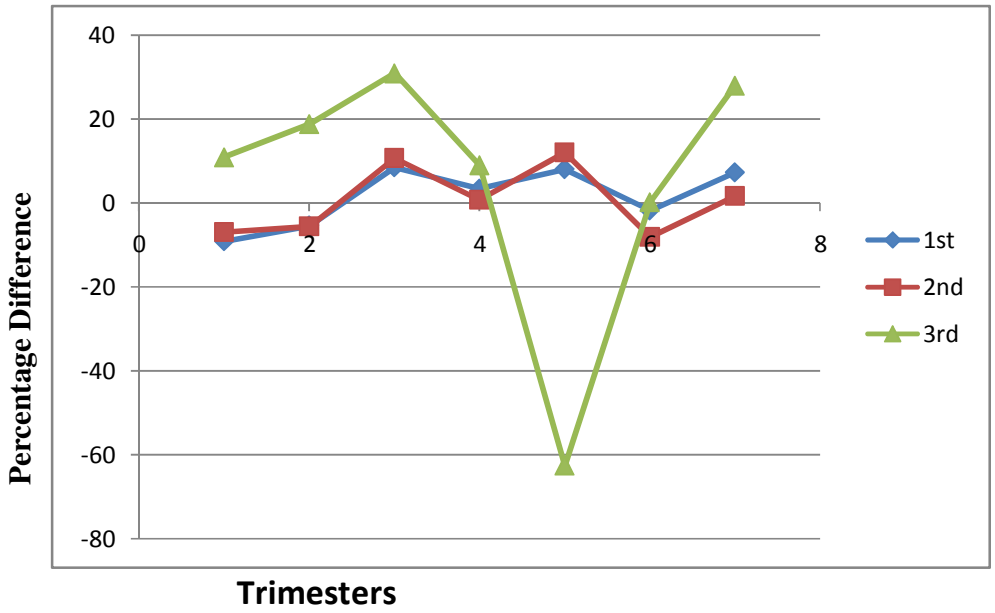

Figure 1. Respiratory indices in pregnancy.

Techniques

The subject noses were clip while on a sitting position and a mouth piece tightly fixed into the mouth to prevent escape of air. The subjects take a deep breath and then blow air as fast, hard and long as possible. The respiratory status of subject on spacious clothing only was determined.

The respiratory function test were performed for the pregnant women at different trimester in a sitting position with their nose closed using the electronic contec (China) Spirometer with different mouth piece for individual subjects. The pregnant women were all informed about the test to be performed before the actual test. The hand held contec spirometer measures 25% of the force vital capacity and average flow between 25%-75% of the force vital capacity, expired volume of air in one second and force vital capacity etc. The test was perform three times per subject and there upon the highest value was recorded. Other materials used includes latex gloves, hand sanitizers, facemask, methylated spirits among others.

RESULTS AND DISCUSSION

The results of the present study were carried out to assess some respiratory function test of pregnant women exposed to toxic air within their communities in Bayelsa State-Nigeria. The results were analyzed using statistical packaging for social sciences (SPSS) version 20.0 and presented in Tables 1 and 2) and Figures (1 and 2).

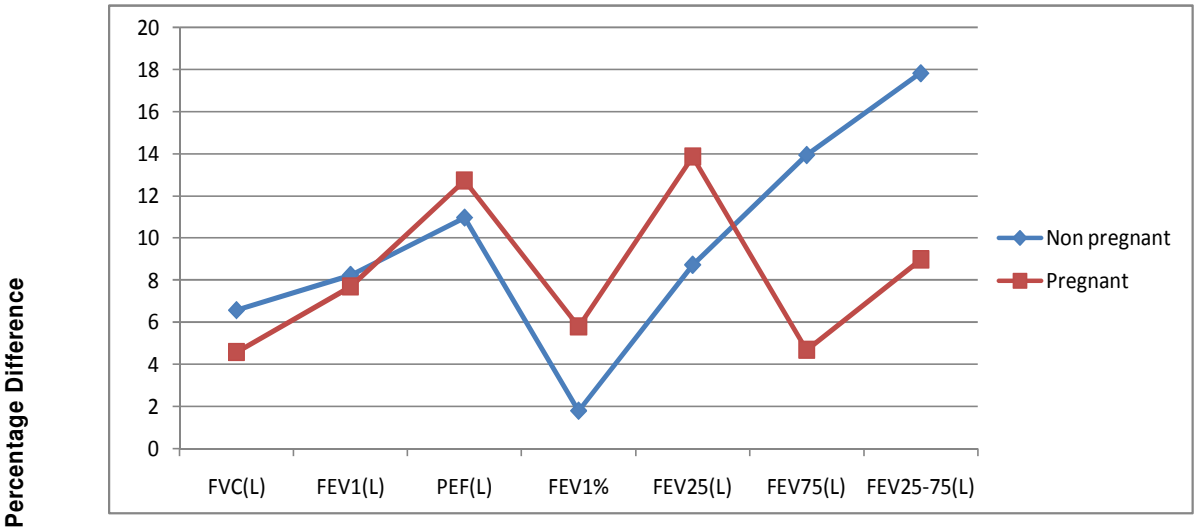

Figure 2. Effect of duration on respiratory indices of the participant.

Table 2. Lung function indices in non-pregnant and pregnant subjects.

Lung function (L)	FVC <2.94&>2.94		FEV1 <2.76&>2.76		FEV1% <80&>80		PEFR <3.57>3.57		Total Prevalence No (%)	
	low(%)	Normal (%)	low(%)	Normal (%)	low(%)	Normal (%)	low(%)	Normal (%)	low	normal
Pregnant	188	12	193	7	52	148	177	23	610	190
Prevalence no (%)	(62.66)	(4)	(64.33)	(2.33)	(17.33)	(49.32)	(59)	(7.66)	(76.25)	(23.75)
Non pregnant	97	3	94	6	33	67	55	45	279	121
Prevalenceno (%)	(32.3)	(1)	31.33)	(2)	(11)	(22.33)	(18.33)	(15)	(69.75)	(30.25)
	5(1.66)	14(4.6)	*6.98	#18.33						

DISCUSSION

The lung function test indicate a sharp decrease in the force vital capacity , force expiratory volume in one second, peak expiratory flow, the force expiratory volume ratio among the pregnant subjects. However, the force expiratory volume at seventy five (L) was higher among those in their first and second trimesters when compared with those in their third trimesters and the non-pregnant group. The highest percentage difference in relation to duration of exposure to toxic air was 17.8% at FEV_{25-75} and 13.8% at FEV_{25} among non-pregnant and pregnant subjects. However, the least percentage difference was observed in FEV1% (1.7%) and FVC (4.5%) from both groups respectively. The prevalence of low and normal respiratory indices in non-pregnant was (69.75%) and (30.25%) while that of the pregnant was (76.25%) and (23.76%).Other previous studies shown a significant increase in the force vital capacity and peak expiratory flow from fourteen to sixteen weeks of gestation (second trimester) and throughout in healthy pregnancies (Grindheim et al., 2011; David et al., 2018).

Lung capacity is a predictor of health and longitivity. Toxic air inhaled into the respiratory tract over a long duration period reduces the lungs ability to hold sufficient air and when less oxygen is taking into the cells, the body receive low oxygen which stimulate the heart muscles to increase its pump and in turn can lead to a heart failure. Similar findings has been observed by Dipok et al. (2012) in his study that confirmed a significant decrease in lung volume functions among pregnant women subjects in their third trimesters when compared with those in their first and second trimesters. This may be due to the dilatation of the capillaries within the respiratory tract that causes the trachea, larynx, bronchi engorgement in addition to the enlarged uterus and in turn result in breathing difficulties during pregnancy.

Further findings from the results this study also

indicate that the more the duration of exposure to gas flares in years the lower the respiratory functions of the residents living in the gas flaring communities in Bayelsa state. Ovuakporaye (2012) observe a similar significant decrease in the peak expiratory flow in his research study in respective of sex and age of residents exposed to gas flares over a prolonged period of time in the Niger Delta region. Health implication of prolonged exposure to gas flares emission also reveal a deteriorating haematological parameters among humans living in such areas (Adienbo and Nwafor, 2010). Prolonged exposure to gas flares thus definitely result in an increase rate of respiratory disorders such as asthma and pulmonary obstruction of the air ways with a higher risk of maternal and infant mortality rate (Onome et al., 2020). Due to significant increase in the percentage difference between subjects in their third trimester and the rest trimesters, a drastic decrease with a negative sign of above -60 was observed as seen in figure 1. The FVC, FEV_1, FEV_{75} and FEV_{25-75} percentage difference was higher among the non-pregnant compared with the pregnant. Though the FEV1%, PEFR and FEV_{25} percentage difference was higher in pregnancy than their non-pregnant counterpart. However, the study had some limitations such as the dreaded covid-19 virus pandemic that makes it difficult to assess the respiratory status of some subjects due to fear of infection and what their blood sample will be used for despite thorough explanations of the research benefit. The research requires grant due to its financial expensiveness but none was received. The actual health status of the participants may be difficult to define during the exercise as some may have asymptomatic chronic diseases of the lungs or kidney failure.

CONCLUSION

The study confirm that exposure to toxic air reduces lung function capabilities of pregnant women in Bayelsa State Nigeria. There was a considerable decrease in respiratory function indices among pregnant women in their third trimester compared with first and second trimesters. This study reveal a high prevalence rate of low respiratory function in non-pregnant (69.75%) and pregnant (76.25%) women exposed to hazardous air in Bayelsa State. The impact of pregnancy on maternal lungs function outcome in different trimesters of women exposed to toxic air will be of great importance to child clinician in the diagnosis of respiratory abnormalities during pregnancy.

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