A STUDY OF GAS FLARE ON CARDIOPULMONARY PARAMETERS OF RESIDENTS IN GAS FLARING COMMUNITIES IN SELECTED NIGER DELTA STATES

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A Thesis Submitted to the postgraduate School In partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy (Ph.D) in Physiology, of Delta State University, Abraka

DEPARTMENT OF PHYSIOLOGY

DELTA STATE UNIVERSITY

NOVEMBER, 2016.

DECLARATION

I declare that this is an original research work carried out by me in the Department of Human Physiology, Delta State University, Abraka.

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S.I OVUAKPORAYE   **Date**

Student

CERTIFICATION

I certify that this work was carried out by SIMON IRIKEFE OVUAKPORAYE in the department of human physiology, Delta State University, Abraka

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PROF. J.C IGWEH **Date**

Supervisor

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PROF. C.P ALOAMAKA **Date**

Supervisor

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Dr. A.O NAIHO **Date**

HOD

DEDICATION

I dedicate this project to God almighty who gave me life, strength and good health throughout the course of this project.

ACKNOWLEDGEMENTS

My special and sincere gratitude to God Almighty, for His grace and mercy, good health and journey mercies throughout the course of the project.

I owe the success of this work to my supervisors Prof. J.C Igweh and Prof. C.P Aloamaka who in spite of their numerous engagement exhibited patience, thoroughness in painstakingly going through this project work.

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ABSTRACT

The study is aimed at evaluating the impact of gas flare and its effect on cardiovascular and pulmonary parameters ofresidents in some states of the Niger Delta by specifically determining how gas flare impacted on blood pressure, pulse, peak expiratory flow and respiratory rate and associated changes of these parameters with time of exposure and possible gender variation induced by gas flare. Two locations (an experimental and a control) were used in five different states across the region under study– Edo (Oben and Ekiadolor), Rivers (Oshi and Ahoada), Akwa Ibom (Ibeno and Ikot Ekpene), Bayelsa (Immiringi and Ogbia) and Delta (Agbaro-otor and Eku).The two communities in each state are with similar socio economic and cultural characteristics and the residents are essentially artisans, traders, farmers, students and civil servants. The study adopted the direct administration of questionnaire, observation/recording and free medical check-up methods. The stratified random sampling method was used. The sample size was 1008 participants (504 in gas flared area and 504 in control area) this comprises of 686 adults and 322 children. The sample is made up of 564 males and 444 females. The electronic blood pressure kit assessed blood pressure and pulse rate of participants. Respiratory and peak expiratory flow rate of participants were observed and recorded by manual method and peak flow metre respectively. Questionnaire wasgiven physically to obtain personal details needed for analysis. Data obtained were subsequently subjected to statistical analysis. Significance difference between means was evaluated by student t-test and one-way analysis of variance (ANOVA). Findings show that gas flare increases mean pulse, respiratory and blood pressure of residents living in the gas flare areas. There was an associated reduction in average peak expiratory flow rate among inhabitants in the gas flared communities. A similar finding from the result is that gas flare impacted more on systolic component of blood pressure when compared to diastolic of residents. Findings also show that these cardiopulmonary parameters increases with prolonged exposure except peak expiratory flow rate that decreases with longer exposure time. Gender of residents affected the impact level of gas flare on some cardiopulmonary parameters. As contribution to knowledge, this study has offered valid information that unprotected exposure to gas flare can impact negatively on pulse, respiratory, peak expiratory flow rate and blood pressure of residents in the study area. This study has also shown that the level of impact of gas flare on these human cardiovascular and pulmonary parameters of people residing in this region is gender dependent. The study has also shown that the longer the time of exposure to gas flare the more the severity of changes in the cardiopulmonary parameters. The outcome of this study show that gas flare impacted more on systolic segment of blood pressure than diastolic blood pressure. This study has added to the existing literature on the evaluation of the health implication of flared gas on the socioeconomic environment in this region.

CHAPTER ONE

INTRODUCTION

1.1 Background Knowledge

Air pollution is a significant implicating factor associated with multiple health related conditions, including pulmonary infections, heart ailment with lung cancer (WHO, 2010).The health effects resulting from polluted airhave been documented to include several respiratory syndromes and worsening cardiopulmonary conditions.These effects have been shown to cause an increase in medications and hospital consultations. The human health implications of inadequate air quality are enormous, but majorly affect the body's cardiopulmonary system.(WHO, 2010).Health status, level of exposure, pollutant type has been observedin individual response to polluted air.(WHO, 2010).The usualsources of polluted air include particulates, ozone, nitrogen dioxide, and sulfur dioxide.Earlier report has shown that indoor as well as outdoor air pollution has caused approximately 3.3 million deaths worldwide. (WHO, 2010)

1.1.1 Gas Flaring

Cedigaz (2000) has reported that Nigeria ranked the highest in natural gas flaringworldwide, (19.79%) and is contributes to about 46 % of Africa's overall gas flared. Presently, there are so many flaring locations in the region;this led toNigeria topping the listof greenhouseemitter of gases in Africa (Uyigue and Agho, 2007).A lot of the natural gasobtained from oil wells in the region is flared into the open environment at approximately 70 million /m3 per day. This amounts to 40% of African total natural gasconsumption and occupies a major position globally with regard to greenhouse gas emissions (Friends of the earth, 2004 and World bank, 2008, Moffat and Linden, 1995). In a study that compared polluted air accumulation within the area under study, it was shown that pollutant concentrations were much higher in the Niger delta areas and that some greenhouse gasses emitted in these area contribute significantly to global warming. (Orubu, 2002b)

Fig 1.Picture of gas flaring in Immiringi town in Bayelsa state, Nigeria.

Gas flaring is associated with the burning away of harmful substances into the open air.In the mix are carbon dioxide along with methane that are major causes of global warming. Gas flaring has been reportedly linked to acid rain thatcauses acidity of the lakes and streams and devastates crops and vegetation.(Akpan, 2003).It causes low farm production and impacts on human health and by extension livelihoods of the residents. Gas flaring raises the risk of respiratory ailment and cancer. It often leads to dyspnea, chronic inflammation of the bronchioles, lower lung function, pruritus, blindness, impotency, miscarriages and premature deaths (Friends of the earth, 2008).

A flare is defined as toilet up-side-downfor removing waste gas, oil, and co-produced sea-water, cheaply by burning the organic material in an open, uncontrolled manner, at an elevation off the ground varying from 15 to 75 metre or more. The elevation is to remove waste products and get them off from the work environment (Argo, 2002).It has been observed that people who lived and work close to the industry from 0.2km up to 35+km are prone to multiple flaring discharges (Argo, 2002).

1.2 Statement of the Problem

Poisonous chemicals from gas flares have often been connected with dangerous health conditions and the well- being of the neighbourhood. Among the products from combustions include sulphur dioxide, benzene, xyleneand particulate matter and carcinogens. Expose residents to these by-products are at risk a variety of cardiopulmonary diseases, which have been observed among most inhabitants of these oil rich regions but have apparently gone uninvestigated. These chemicals canworsenasthma and other disease conditions in the respiratory spectrum (Environmental Right Action*et al.*, 2005).Environmental and health disordershave been associated with polluted air in the study region. Poor visibility and acid rain formation is a recurrent feature in the region.On air quality impairment, Oluwoleet al. (1996) in a report on the Niger Delta observed that the extent of volatile oxides of carbon, sulphur, phosphorous, nitrogen where above the knownFederalEnvironmental Protection Agency's (FEPA, 1991) standards. Also,raised lead levelconcentrations of 0.56 mg/l in the atmosphere were observed, Olobaniyi and Efe (2007).

1.3 Aim/Objective of the Study

General objective

To assess the impact of gas flare on some cardiopulmonary parameters of residents in gas flaring communities in Niger Delta area of Nigeria.

The specific objectives are to determine the effect of gas flare on:

i. Blood pressure of residents
ii. Resting heart rate(heart rate) of residents
iii. Resting respiratory rate
iv. Peak expiratory flow rate of residents
v. Duration of exposure on blood pressure, pulse, respiratory and peak expiratory flow rate and
vi. Possible gender variation induced by gas flare on blood pressure, pulse rate, respiratory rate as well as peak expiratory flow rate

1.4 Significance of the Study

This study has expanded the knowledge about the impact of flared gas beyond its environmental effect. It hasbrought to fore the cardiopulmonary effect and the related health implication of harmful flaring of gas on the residents of the region. It will further arouse the interest of scientific and medical researchers towards the health implications of continuous gas and oil exploration in the already deteriorated oil rich region of Nigeria.

This study will, however, add to the existing literature on evaluating the impact of gas flare on the socioeconomic environment in Nigeria.

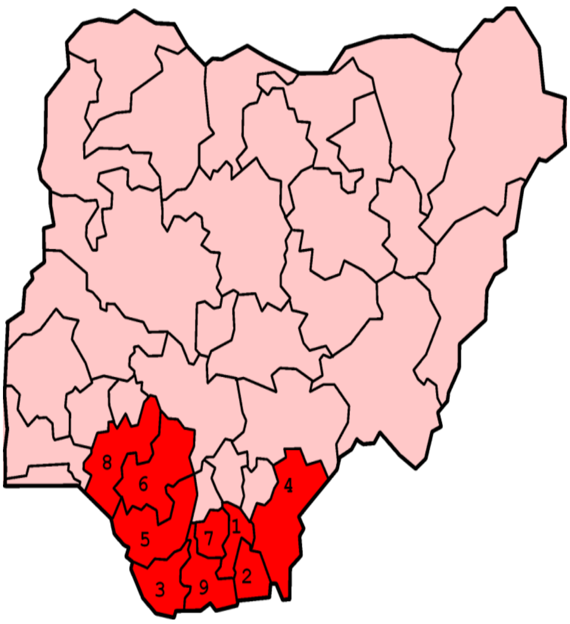
1.5 Justification for the Study

Air pollution is one of the major environmental problems confronting the Niger Delta Area(NDA) yet information regarding this is very scanty. Aside from data collected by a fewpeople and corporate organizations at scattered locations, there is dearth of database on the extent of devastation and magnitude of the challenges in the area.

Gasflaring has caused extreme damage to the environment as well as severe consequences on health. More so, the people tend to be more anxious about the environmental hazard of the flared gas as it relates to their farm lands, vegetation, aquatic habitants and their sourceof living with little knowledge about the health implications. While it is a common knowledge that gas flaring poisons communities across the region, there is dearth of comprehensive study on the health impacts of flared gas on communities in this region, including the extent of impact on cardiopulmonary indices. This study also intends to bridge the gap in awareness about the health impacts of flared gas on the people with specific reference to cardiopulmonary parameters

1.6 Scope of the Study

Fig 1.1



1	2	3	4	5	6	7	8	9
Abia	Akwa Ibom	Bayelsa	Cross River	Delta	E d o	Imo	Ondo	Rivers

FIG 1.1: MAPS SHOWING AN OVERVIEW OF NIGER DELTA

The research coverstwo communities each in five of the Niger Delta states. One, a gas flare location (experimental area) and the other a non-gas flaring location (control) will be at least 35km from the gas flaring location.

State	Experimental Area	Control
Akwa Ibom	Ibeno	Ikot Ekpene
Bayelsa	Immiringi	Ogbia
Delta	Agbarho-otor/Ughelli	Eku
Edo	Oben	Ekiadolor
Rivers	Oshi	Ahoada

A total number of one thousand and eight (1008) participantswere used for this research. This comprise of five hundred and four in the gas flaring communities and five hundred and four in the non-gas flaring communities.The electronic blood pressurekitwas used to record blood pressure value and resting heart rate of the residents. The Peak flow meter as a spirometric device was used to assess peak flow rates of the residents and the respiratory rate was taken manually with stop watches.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Air Pollution

World Health Organization recorded 2.4 million deaths annually from causes expressly linked to polluted air, of which 1.5 million of these are related to indoor air pollution. (WHO, 2010)"Epidemiological study opine that over 500,000 Americans die yearly from cardiopulmonary disorders linked to breathing fine particle air pollution. A strong correlation was between death from pneumonia and polluted air originating from vehicles has been proven at the University of Birmingham(The Guardian, 2008).Globally,increased deaths per annum were associated with air pollution when paired against automobile accidents (Collins, 2012). A 2005 research carried out by the European Commission pointed out that polluted air has a capacity for decreasing life expectancy by nearly nine months within the European Union (BBC, 2005).

Morbidity from cardiovascular abnormalities has been demonstrated to occur following exposure to polluted air (Miller *et al.,* 2007).Air pollution is considered anemergingpredisposition for stroke, especially in developing nations where polluted air levels are seems high(Farrah *et al.,* 2011). A 2007 study discovered that among women polluted air is linked with ischemic type of stroke instead of the hemorrhagic type(Miller *et al.,* 2007). Polluted air was also related with raised incidence and death from coronary cerebrovascular as recorded by a cohort study in 2011(Andersen, 2011).

2.2 Gas Flaring in Nigeria

At the beginning of oil exploration, gas flaring was institutionalized and natural gas was considered as waste product that resulted from the act of exploring crude oil and the practice became institutionalized all over the industry (Atoyebi and Akinde; 2012).Gas and oil development associated with a dreadful cost to human health. The cost affects the workers on site minimally. It is also a cost to women and children, the aged and infants, the teachers and health workers and rural dwellers who live around, but in nearness to a flare location. They reside at home (Argo, 2002). They are unprotected by Labour-code statutes about exposure because they live at home, but are exposed where they sleep and eat as wind carries the plume of combustion products from the source to their residence (Argo, 2002)

Fig.2.1 Gas flare site Agbarho-otor

The flared gases are often mixed with crude oil and must be separated; the cheapest way for oil companies to process the gas unfortunately appears to be environmentally unfriendly: that is burning it. This practice costs Nigeria 5 billion dollars annually, above 66% of the populace living in abject poverty.Eventhough data linked with gas flaring activities in Nigeria is disputable, the AG wasted at the time of flaring is estimated to cost Nigeria 2.5 billion dollar annually (Friends of the earth, 2008).The possible factors attributed this practice, which is globally considered wasteful economically and environmentally, is to maximize production of crude oil.

Gas flaring is often discouraged and condemned globally as it contributes significantly to climate change, which show its most damaging effects in developing nations, and particularly in the third world countries like Nigeria. The Niger Delta's low-lying plains are quite vulnerable as they lie only a few meters above sea-level. There is a synergy of efforts among all groups concerned with gas and oilindustry of the need to stop flaring of gas and reduce its negative impact, however, there is a challenge at the level of implementation.The flares in the region under study are at sea level, so the environmentally exposed groups live with gas flares that roar continuously, turning night into day, and polluting the air and ground thereby creating extremes of temperature, climate change and global warming with concurrent exacerbation of environmental associated increases in disease and cancer (Nwafor,2013).

2.3 Gas Flare Components

Among the associated processed species are hydrogen sulphide and carbon disulphidewhich are considered are strong toxic chemicals. Inhalation of H_2S above its optimal concentrations has been linked with spontaneous abortion. CS_2 is known to be a powerful peripheral neurotoxin (Argo, 2002).Among these gas flares are volatile organic compounds (VOCs) which includes the following:

Benzene

Benzene is a systemic toxicant in humans at any concentration and a risk factor for aplastic anaemia (deficient red blood cell production). The most harmful effect of benzene on human body is depression of bone marrow leading to pancytopenia, (a general depression of red blood cells, white blood cells and platelets. A widespread reduction in erythrocytes in a population will lead to a general increase in morbidity. Benzene is a known human carcinogen, causing leukaemia; it is non-mutagenic (Siemiatycki*et al.*, 1998).

Toluene

Toluene is a chemical with one methyl group in the benzene ring. Toluene is known to be a powerful central nervous system toxicant leading to narcosis, incoordination, emotional liability, and subjective symptoms like headache and fatigue. Known neurotoxic responses to acute toluene exposure include narcosis, hilarity, lassitude, drowsiness, mental productivity decrease, reaction time change, impaired balance, vertigo, disturbed vision, paresthesias. Neurotoxic responses to chronic exposure include emotional liability, bizarre behaviour, tremor, unsteadiness, rhythmic limb movements, ataxia, cerebellar ataxia, optic atrophy learning decrease, circling, excitement, delirium confusion, hallucinations, ringing in the ears. Emotional liability that is tearing for no identifiable reason is symptomatic (Ruth, 1986).

Xylene,

Xylene molecules have two methyl groups substituted into the benzene ring, either adjacent (= ortho), demacarted by one ring carbon (= meta) or separated by two ring carbon atoms (= para), Xylenes are unequivocal developmental toxins, leading to delayed development, reduced foetal body weights and altered enzyme activities.There is evidence ofbehavioural neurotoxicity in individuals occupationally exposed to short term levels of xylene. It appears to have the capacity of depressing central nervous system and other minor effects in the liver and kidney. In human studies 200 ppm are irritating to the nose, eyes as well as throat. Xylene(s) are fetotoxicincluding delayed development, reducedfoetal body weights and altered enzyme activities; which may lead to depression of the central nervous system in acute exposures resulting in dizziness, staggering, drowsiness and unconsciousness (Argo, 2002).

Styrene/ Hydrogen Sulphide

Styrene (vinyl benzene, ethenyl-benzene) is an irritant of the skin, eyes, and mucous membranes and a central nervous system depressant. Upper respiratory tract and eye-irritation have been observed at 50 ppm (Argo, 2002).**Hydrogen Sulphide** Aggravates respiratory conditions, and affects neurological system, cardiovascular system and can result in central nervous system problems (Pope and Dockery, 1996).

Particulates

The word "Particulates" as used here refers to both solid and colloidal micron sized particulates that are produced in open, uncontrolled burning. Availability of sulfur dioxide (SO_2) and with any organic material present great amount of aerosols are preferentially formed initially in the sub-micron size range. These quickly coalesce and form much of the fraction called $PM_{2.5}$. Aerosols are very stable and capable of long range transport for many hundreds of km. The $PM_{2.5}$ particulates include a size range lower than 2.5 microns that can be taken into the deepest recesses of the lung, the alveoli, and are strongly involved with highdisease and deathrates from all-cause, lung cancer, heart disease as well as respiratory disease (Pope and Dockery,1996). The next largest fraction, called PM_{10} because it includes a size range lower than 10 microns that can be inhaled in all but the smallest regions of the lungs, has long been identified with high morbidity (Pope and Dockery, 1996).

Nitrogen Oxides

It reacts with volcanic organic compounds forming ground-level ozone and smog thatcan trigger respiratory disorders. It has been found to react with other chemicals forming particulate pollution damaging lungs and causing cardiopulmonary disorders with premature death. Also it reacts with common organic chemicals forming toxics that may cause biological mutations (Ruth, 1986).

Sulphur Dioxide

This with other chemicals forming particulate pollutants, which has the propensity of damaginglungs and causingheart conditions, respiratory abnormalities and premature death (Ruth, 1986).From the aforementioned component of gas flaring, toluene, xylene, styrene have no known respiratory effect. Subsequently this review concentrates on those components of the gas flare like hydrogen sulphide (H_2S), sulphur dioxide (SO_2), particulate matter as well as benzene that have defined effect on the respiratory/pulmonary function.

2.4 Impacts of Gas Flaring

Fig. 2.2a Serene Environment being polluted by gas flares

Fig 2.2b Polluted environment at night by gas flares

2.5 Cardiovascular System

This system functionsin transporting nutrient to the body tissues and removing waste products, and conducting hormones from one segment of the human body to another. It generally sustains necessary environment in all tissue fluids for proper functioning of the body (Barrett *et al.*, 2010). The rate of blood flow across tissues is controlled in response to the tissue need for nutrients (Sembuligam and Sembuligam, 2013).The vital parameters of assessing cardiovascular function include: blood pressure, heart rate, pulse rate, venous return and electrocardiogram.

2.5.1 Blood Pressure

The pressure produced by left ventricular contraction is the movement of blood along the systemic circulation, from the aorta all of the way back to the right atrium. (Niiranen*et al.*, 2006) The average pressure within the aorta and large arteries is very high (90 to 100 mmHg) due to the continual addition of blood to the system by the pumping action of the heart. However, this pressure is *pulsatile* ; in other words, it fluctuates as a result of alternating contraction and relaxation phases of the cardiac cycle.(Brickman *et al.*, 2010)

In a healthy resting adult, *systolic pressure* is roughly 120 mmHg and *diastolic pressure* is approximately 80 mmHg. Blood pressure (BP), is also referred to as arterial blood pressure (ABP), Normal resting blood pressure for an adult is roughly 120/80 mm Hg (Klabunde, 2007).

2.5.2 Classification of Blood pressure

It is classified in terms of age development. The adult classification is shown below

Category	**Systolic, (mm/Hg)**	**Diastolic (mm/Hg)**
Hypotension	< 90	< 60
Desired	**90–119**	**60–79**
Prehypertension	120–139	80–89
Stage 1 hypertension	140–159	90–99
Stage 2 hypertension	160–179	100–109
Hypertensive emergency	≥ 180	≥ 110

(American Heart Association,2015)

It was reported by Pesola et al 2001 that human subjects with no history of hypertensionhave a mean blood pressure of 120/80 mm Hg that are presently categorised as desirable or "normal" values. Normal ranges hovers around the 24-hour cycle, with highest readings in the afternoons and lowest readings at night. (Berge-Landry *et al.*, 2008)

2.5.3 Factors Affecting Blood Pressure

A lot of physical variables that influence arterial pressure.Some of these may in be changed by physiological factors, such as: diet, height, drugs, alcohol, age,stress and obesity. The normal range for children is lower than that of adults. Also, a person's blood pressure changes with sleep pattern, digestion, emotional state, exercise, ciracadian rhythm and time of day. (Chiolero, 2014)

Resistance in the Circulatory System.

The more the resistance, the greater the arterial pressure upstream from the resistance to blood flow. Substances likevasoconstrictors has the capacity of reducing blood vessels size and increase resistance thereby raising blood pressure (Deakin and Low,2000). Viscosity of the fluid also affects BP. When the blood gets thickens, it subsequently leads to an increase in arterial pressure.

Blood pressure = cardiac output X peripheral resistance.

Thus, knowing the patient's blood pressure is critical to assess any pathology related to output and resistance

2.5.4 Properties ofBlood Pressure

The mean arterial pressure (MAP)

MAP can be approximately determined from measurements of the systolic pressure P_{sys} and the diastolic pressure (Eguchi*et al.,* 2007) $\text{MAP} \approx P_{\text{dias}} + \frac{1}{3}(P_{\text{sys}} - P_{\text{dias}}).$

2.5.5 Measurement of Blood Pressure

It is measured with the aid of a sphygmomanometer putting the height of mercury into consideration (Booth, 1977). Blood pressure ismeasured in millimetres of mercury (mm Hg).

2.6 Pulse Rate

Arterial pulse was defined to be the pressure changes transmitted in the form of waves through arterial wall and blood column from heart to periphery (Barrett *et al.,* 2011). Unit is in beats per minute (BPM). Pulse (or the count of arterial pulse per minute) is equivalent to measuring the heart rate.

New born (0-3months)	Infants 3- (6-6months)	Infants (1-12months)	Children 10 years)	Children over 10 years
100-150	90-120	80-120	70-130	60-100

2.6.1 Importance of Pulse

Moreso, in a study onElderly people that are subjected to heavily polluted air particleshad decreased heart rate variability (Devlin *et al.*, (2003). Also, Donald et al. (2009) reported that when exposed to heavy coarse polluted air particles result to mild cardiovascular and respiratory changes in apparently healthy young adults specifically decreasing heart rate after exposure. In a similar research, Gong et al.(2004),Altered Heart-Rate pattern amongAsthmatic and Healthy people that volunteered to be subjected to Concentrated Ambient Coarse Particles.Exposures were investigated in a Los Angeles suburb with a high degree of motor vehicle pollution and they posited, acute exposure to high concentrations of coarse particles triggered no obvious respiratory effects but appeared to change the autonomic nervous system of adult volunteers.

In another related study by Yeattset al. (2007),twelve adult who were known asthmatics, that are residing within an area of 30-mile radius of an atmospheric assessment location in North Carolina specifically Chapel Hill, were monitored over a 3 month period. Daily concentration of $PM_{2.5–10}$ and $PM_{2.5}$ were assessed and recorded differentlyfor each one day duration and reported that Heart Rate Variability was affected by coarse particulate matter ($PM_{2.5–10}$) Heart Rate Variability. However, it was observed from a study among solid waste workers in Port Harcourt south - south Nigeria that chemicals and affluent from solid waste substantially increases pulse rate (an index for heart rate)(Adienbo*et al.*,2012).

2.7 Cardiopulmonary System

Cardiopulmonary is relating to the heart and the lungs. Cardiopulmonary functions are carried out by a pump-oxygenator pending when the natural circulation is resolved. The cardiovascular system is an organ system which allows blood and lymph transportation of nutrients (like amino acids as well as electrolytes), hormones, oxygen, blood cells, carbon dioxide, etc. to fight disease, to maintain body temperature, pH and homeostasis.

The cardiovascular system is more oftenconsidered mainly as a blood network distributing blood, while some other people see it to be a circulatory system made up collectively of the cardiovascular system as well as lymphatic systemthat circulates lymph (Guyton and Hall, 2011). The cardiovascular system constitutes one of the major coordinating and integrating system of the body (Sembulingam and Sembulingam, 2010).

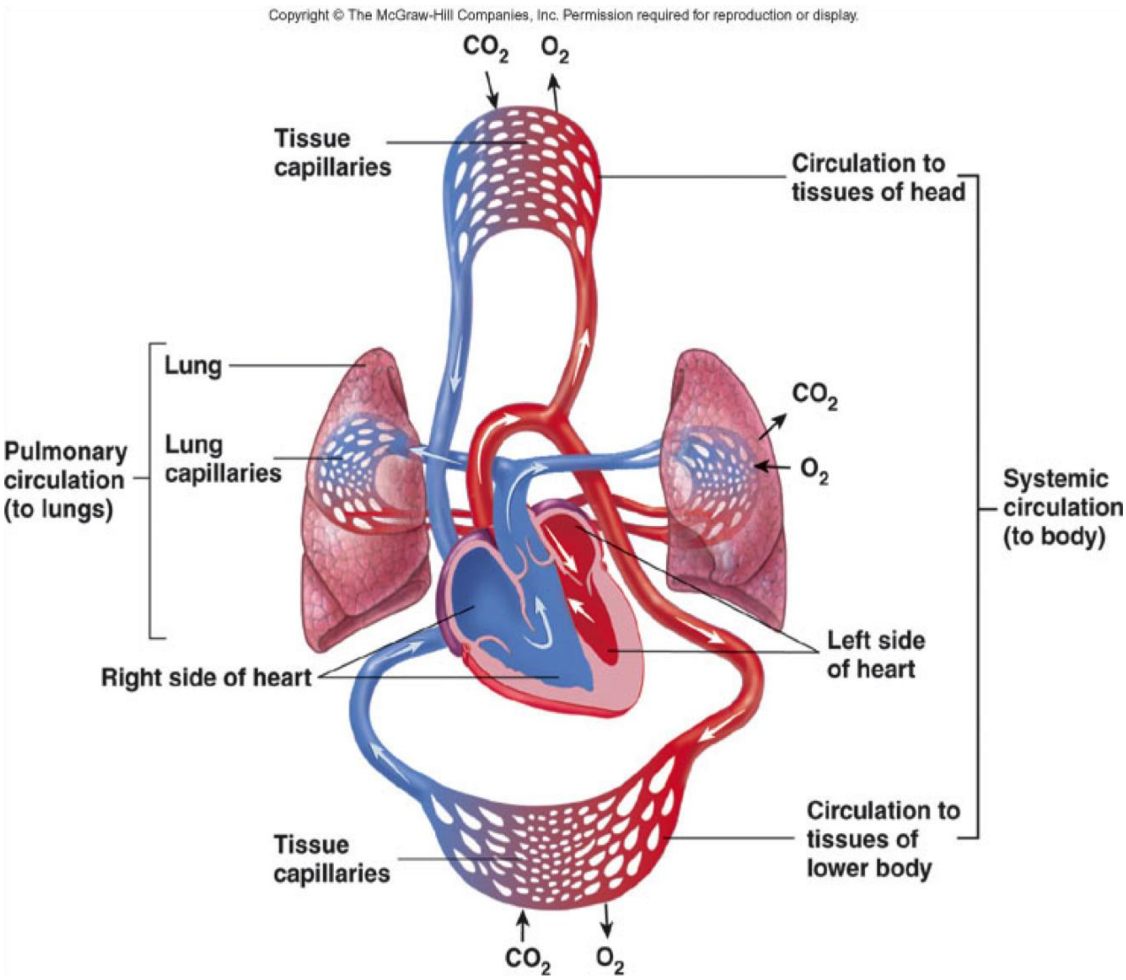


Figure 2.3 showing a diagram of the cardiopulmonary system

2.8 Respiratory System

This system comprises of the upper as well as lower tracts, the former contains the respiratory organs sited outside the chest cavity; the pharynx, larynx, upper trachea, as well as the nose and is related nasal cavities. The latter tract is made up of organs situated in the chest region: the distal trachea, bronchi, bronchioles, alveoli, lungs and muscles forming the chest cavity. The inferior part of the bronchi, the bronchioles and alveoli, are al located in the lungs. The alveoli are the point of gaseous exchange. The pleura are the outer lung covering. The respiratory area in the brain, which is located in the medulla oblongata, regulates breathing. This system is involved in transporting oxygen to tissues and removal of carbon dioxide from cell.Oxygenishoweverneeded by cells to generate energy and heat. (Sorrentino, 1997).

Respiration is the process by which oxygen is taken in and carbon dioxide is given out (Sembulingam and Sembulingam, 2010).

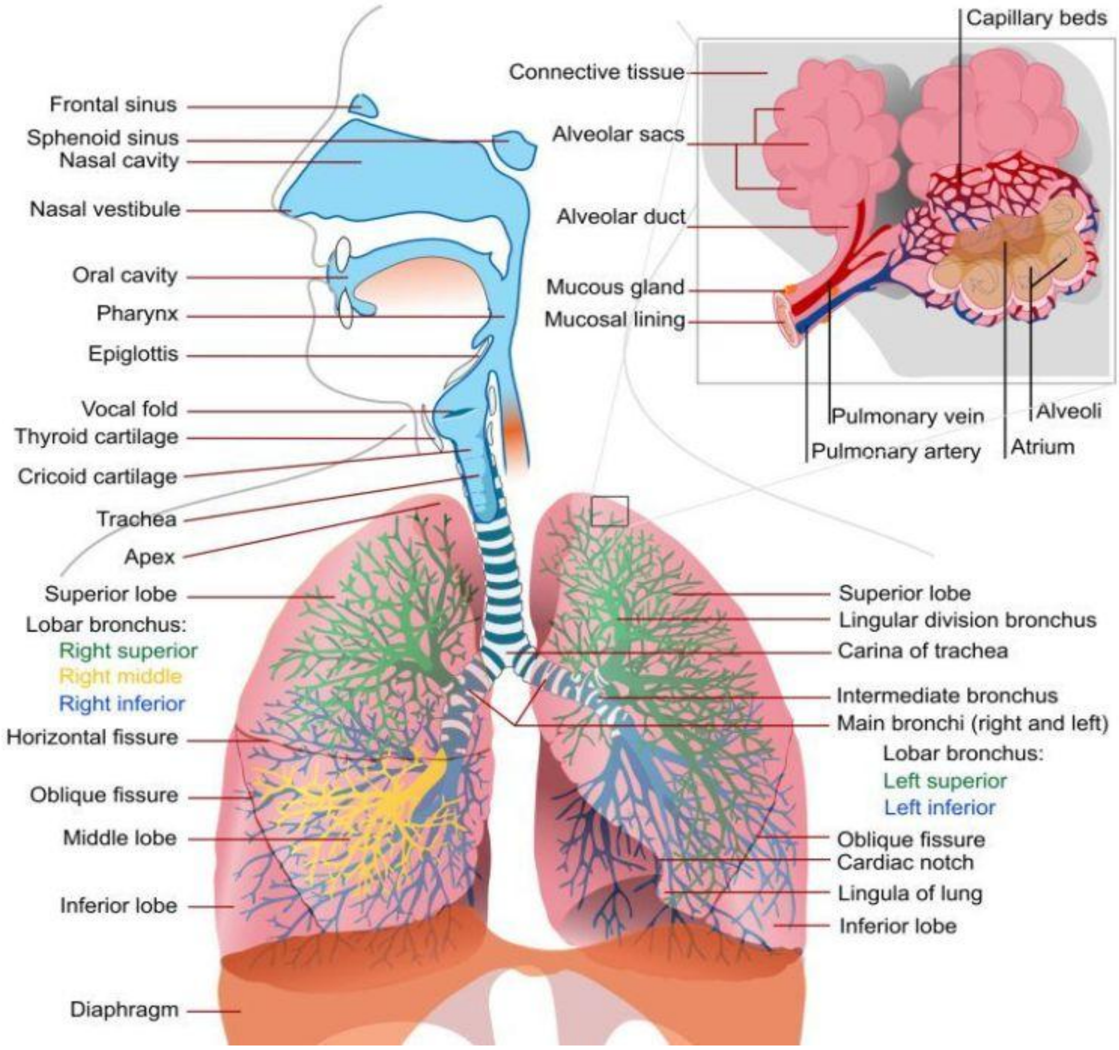


Figure 2.4.Showing a diagram of the human respiratory system.

2.8.1 Respiratory Rate

The respiratory rate (RR) is also known as the ventilation rate, pulmonary ventilator rate, or breathing frequency, is the rate (frequency) of ventilation, which is, the number of breaths (inhalation-exhalation cycles) taken within a set time (typically 60 seconds).

2.8.2 Measurement of Human Respiratory Rate

Some medical conditions like fever, ailment may result to increase in respiratory rate. In the process of assessing respiration, it is necessary to know whether the individual is laboured breathing.Thetypical respiratory pattern for an apparently healthy adult when at rest is 12-20 breaths per minute (kim*et al.*, 2010). Average resting breathing rates for the following ages are (Scott and Deboer, 2004)(Wilburta*et al.*, 2009);Birth to 6 weeks: 30-60 breaths per minute, 6 months: 25-40 breaths per minute, 3 years: 20-30 breaths per minute, 6 years: 18-25 breaths per minute, 10 years: 12-15 breaths per minute.

2.8.3 Peak Expiratory Flow Rate (PEFR): This is the speed of the air moving out of one's lungs at the beginning of the expiration, assessed in liters per minute in combination with FEV_1 is considered one of the primary indicators of lung function. It is measured with the peak flow meter (Miller *et al.,* 2005).

2.9 Empirical Studies

2.9.1 Health Impacts of Flaring Gas

The health challenges associated with polluted air spreads across a large area, and those who depends on locally made food - whether from their own production or even bought at market - risk contamination.15 At the global scale, the emissions of carbon dioxide and methane from Nigeria's flares make a substantial contributing substantially to climate change and the costs will mainly fall heavily on the poor. Gas flaring is a major barrier against the human capital development efforts of the area under study through disease and related impacts. (Nnimo, 2008)

Life expectancy in this region is markedly lower than what obtains elsewhere in the country. It remains firm at close to 40 years on the average. This is not surprisingdue to the toxic components (including benzene) being put out regularly into the aura. Diseases linked with gas flaring include asthma, cancers, blood abnormalities and dermatological disorders.

2.9.2 Effects on Cardiovascular Health

Concerning cardiovascular diseases, research have focussed on harmful effects of pollutants on inflammatory blood markers and on autonomic component of the nervous system control (Seaton *et al.,* 1995, Stone *et al.,* 1999). Heart rate, its variability, and blood pressure have been indicated to be susceptible to the effects of air contamination.(Godleski, 2000).Previous report suggests that potential mechanisms of particulate matter toxicity affecting cardiovascular health include the revision of the autonomic aspect of the nervous system (Dockery, 2001), systemic as well as local inflammatory events (Liao et al., 1999; Seaton et al., 1995), and changes in blood coagulability (Peters et al., 2000b; Pekkanen et al., 2000).
In another cohort study in Augsburg by Annette *et al.,* 1999 heart rate increases among adults ages 25-64 during an air pollution episode monitoring of trends and factors determining in cardiovascular disorders. In another panel study by Ubiratanet al.(2005) of

vehicular traffic controllers, air pollution increases blood pressure as well as heart rate in the metropolis of Sao Paulo, Brazil.Likewise, in another population based study, on the air pollution effects on blood pressure, they noted an increase in systolic blood pressure linked with ambient air pollution (Angela et al., 2001).

Written reports on the daily variation of particulate air contamination and heart rate variability, a marker of autonomic function of the nerve, in elderly residents showed a decrease in heart rate variability connected with particulate air pollution (Creason et al., 2001; Gold et al., 2000; Liao et al., 1999; Pope et al., 1999a). Blood pressure as well as heart rate areknown physiologic determinants that are often used to assess variations in the autonomic regulation of the heart and vascular tone (Grassi*et al.,* 1998; Noll *et al*., 1998). Raised blood pressure is a well-established predisposing factor regarding heart morbidity and mortality (Welin et al., 1993).

Through the usage of standard electrocardiograms (ECGs), exercise ECG testing, and long-term ambulatory ECG monitoring, modern electrocardiology make a valuable contribution to understanding the different mechanistic factors involved in the increase in adverse cardiovascular events due to air contamination.Heart rate variability analysis could offer quantitative insight regarding the autonomic output of the cardiovascular system to polluted air. Analysis of ventricular repolarization in an ECG (both time lag and morphology) provides useful information on the status and dynamic behavior of the heart muscles, reflecting myocardial substrate and vulnerability. ST-section analysis of ECGs is used routinely to monitor the magnitude of ischemia and could be utilized to monitor subtle changes in the myocardium in residents exposed to air contamination.Comprehensive analysis of ECG parameters explaining the roleplayed by the autonomic component of the nervous system, the function of myocardial substrate, and the contribution of myocardial vulnerability could and should be used in air pollution studies, particularly as those mechanical components have been shown to lead to increased cardiovascular morbidity and fatality rate in general (Wojciech et al., 2001).

Similarly, Electrocardiographic (ECG) analysis of the heart show high incidence of left ventricular hypertrophy (LVH) - an independent cardiovascular (CV) risk factor, and several related cardiovascular disorders on ECG among hypertensive and non-hypertensive among residents in the oil rich region. (Nwafor*et al.,* 2011; Nworah*et al.,* 2011). On gas flaring and lipid profile, a survey to assess the potential harmful effects on the lipid panel of some residents exposed to extended gas flares. In Imo East Senatorial zone of Nigeria it was found that the serum levels of the various lipids were substantially increased in subjects that were chronically exposed to flared gas when compared with control.(Egwurugwu*et al.,* 2013).

2.9.3 Effect on Respiratory Health

There is strong evidence that people in the Niger Delta region are exposed to harmful dangerous chemicals in their environment. The increments in such pollutants as nitrogen oxides, sulfur dioxide, and ozone exposures along with other air pollutants from petroleum and gas exploration activities are important contributors to chronic obstructive pulmonary diseases (Nwafor, 2013)

Previous studies on residents with respiratory disorders showed effects of ultrafine particles (UFP) on peak expiratory flow, symptoms, as well as medication use (Klot*et al.,* 2002; Pekkanen*et al.,* 1997; Peters *et al*., 1997b). Results from other literature strengthen the hypothesis that the reduction in some indices of lung function such as FVC, FEV1 and PEFR found in the general population residingin urban areas, or in areas that has high pollution, could be as a result of exposure to urban pollutants and show a framework of obstructive sign and symptoms (Chattopadhyay*et al.,* 2007).

A decrease of respiratory capacity (FVC and FEV1) has also been observed in a survey of Pope III et al., (1993): especially a decrease of 2% of FEV_1 for rise of PM10 of 100 g/m3 in the residents examined resulted statistically significant, all the residents were smokers with mild or lesser chronic obstructive lung disease (Devereux*et al.,* 1996). Among the statistically significant results linked to lung function the indices FVC, FEV1 and PEFR are all decreased, showing an obstructive deficit as chronic effect in the exposed population (Angela *et al.,* 2011).

The recurrent and prolonged exposure to low-levels of the environmentally unrelated chemicals led to a diminution in respiratory parameters - lung volumes and peak expiratory flow rates (lung cancer risk – irrespective of the individual smoking status etc). The average peak expiratory flow rate value the caliber of the airways which serves as valuable tool for diagnosis and treatment of lung functions for Nigerians cohort in this region are less than the international and national values. This shows that people living closer to and downwind of the site of the oil and gas extraction environments are at increased risk of having respiratory and pulmonary disorders related to exposure to "petroleum diseases" or "oil and gas flared problems"(Borestein*et al.*, 2009, Boezen*et al.*, 1998,Chatthopadhyay *et al.*, 2007).

In another survey on health variations in fishermen 2 years post clean-up of the Prestige oil spill**.** Participation in clean-up of a well-known oil spill was linked with persistent respiratory symptoms, increased determinants regarding airway insult in breath condensate, and chromosomal damage. Their findings revealed that 2 years after taking part in clean-up efforts of the *Prestige* oil spill, exposed fishermen had elevated prevalence rates of pulmonary symptoms and biomarkers of respiratory oxidative stress including growth factor activity, suggesting persistent airway injury. In addition, they had more structural chromosomal disorders in circulating lymphocytes. Their report indicate that exposure to oil sediments, even for short periods, may have harmful health effects. (Rodríguez-Trigo*et al.*, 2010).

In a panel study among participants prone to particulate matter during the Beijing Olympic,Linaet al.(2014) reported that breathing rate is an indicator of lung function status decreases significantly during the Olympics and that fast breath rate is a determinant of poor airway status and also peak expiratory flow rate changes significantly more during the games with a decrease in among female participants.In a related study onrespiratory hazard affecting the general population exposed to urban pollution, the results confirm the existence of statistically significant effects of urban pollution on respiratory syndrome (Angela *et al.*, 2011).

2.9.4 Effect on Cardiopulmonary System

Observational studies have consistently showed a link between polluted air and disease and death resulting from cardiopulmonary disorders.(Dockery *et al.*, 1993, Saldiva*et al.*, 1995, Peters *et al.*, 2000, Lin *et al.*, 2003, Godleski*et al.*, 2000 andSaldiva*et al.*, 2002).It has been estimated that 800 000 people globally die annually because of the far reaching health implications of air pollution. (Ezzati*et al.*, 2002)

In a cohort study, Pope et al., (2002)monitored 500 000 adults and discovered a 9% increase in cardiopulmonary death linked with a 10 mg/m3 increase in long-term particulate matter smaller than 2.5 mm (PM2.5) exposure and smaller death increases due to sulfate and sulfur dioxide (SO2) increases.

Particulate air pollution hasbeen implicated to be a cause of increased morbidity and death. A lot of have summarized and evaluatedhealth hazards of particulate air pollution have been reported (ATS 1996; Pope 2000; Pope *et al*., 1995). Adverse health implication of polluted air include an increase in cardiopulmonary deaths among older people as well as increased clinic consultations for cardiopulmonary diseases (Borja-Aburtoet al., 1998; Burnett *et al.,* 1999; Dab *et al.,* 1996; Delfino*et al.,* 1994; Prescott *et al*., 1998; Schwartz 1994, 1999; Sheppard *et al*., 1999; Spix and Wichmann 1996; Thurston 1996; Zanobetti*et al.,* 2000; Zmirou*et al*., 1998).

2.9.5 Other Health Impacts of Gas Flaring

In a survey on the health impact of gas flares on Igwurutu/Umuechem communities in Rivers State, the Research findings demonstrate that there is indeed a correlation between environmental factors emanating from gas flaring and the growth of some constituent found in individuals living in such area.Although the survey was unable to discover the character of private compounds in disease distribution, it recorded spikes in the absorption of some variables, particularly PM7, PM10, and TSP in the dry season. While the experiences gained through the clinic session and research findings indicates that fluctuations in environmental pollutants may be could be the reason for the anomalies seen, the researcher recognises that other damaging activities such as smoking, improper sanitary conditions and other variables may worsen it.(Gobo *et al.,* 2009).

In a linked study, investigation of the heat of using gas flare to dry tapioca (kpo-kpoGarri) at the Gana Flow station in Agbarho Delta State, Nigeria. It exposes the health effects of using gas flare in processing food. The chemical benzene is particularly hazardous, causing leukemia and other blood-related disorder. Women approaching the flare and people eating the processed food are particularly at risk.(Emumejaye, 2012)

2.9.6 Effect on Haematological Indices

The environmental effect, though frightening, is that prolonged exposure (involuntary) to gas and oil flared pathogens adversely affects the haematological parameters which are more marked in females when compared with males.Chronic exposure leads to a drastic decrease in the following blood parameters - packed cell volume (PCV), haemoglobin concentration [Hb], and red blood cell count (RBC) compared to none residents of the gas flaring environment (Intergovernmental Panel on Climate Change, (2007), Adienobo and Nwafor, 2013). Haematological abnormalities-including humeral and cell mediated immunity, altered levels of immunoglobulin, abnormal blood cell parameters.

Similarly, in another study on the effect of longer exposure to gas flare on some haematological parameters of humans in this region of Nigeria, findings showed that the concentrated environmentally associated pollutants occasioned by from prolonged exposure to oil and gas activities in the environment (Nwafor and Maduako,2001) led to pronounced elevation in the abnormality of red blood cell morphology as well as WBC count with a corresponding reduction in Packed Cell Volume, Haemoglobin and Red Blood Cell when compared to control.(Adienobo and Nwafor, 2010)

2.9.7 Risk to endocrine-reproductive systems - The endocrine disrupter chemicals present in the area of blood affect hormone concentrations and reproduction – the function of oestrogen and progesterone and /or the hypothalamic-hypophysial – high predisposition spontaneous abortion in women; spermatozoa may have molecular or biochemical disorders resulting in an inability for fertilization though their mobility and morphology may be normal.(Nwafor, 2013).

2.9.8 Metabolic syndrome and Dermatological toxicity -reduced antioxidant capacity, increase oxidative stress, pancreatic dysfunction (diabetes) in youth and adolescents also occurs (Nwafor, 2013).Potential cancer patients and malformations compromised immune system and several cases of unknown causes has been reported (Nwafor, 2013).**Dermatological toxicity-** Including occupational contact dermatitis and renal dysfunction has also been reported (Nwafor, 2013).

2.10 Gas Flaring effect on Cardiovascular Parameters

There are over than 123 gas flaring station in Niger Delta, thus making Nigeria to top the list of countries emitting greenhouse gases in Sub Sahara Africa (Uyigue and Agho, 2007). Air pollution resulting from gas flaring hasoften been implicated in endothelial impairment and vasoconstriction, elevated blood pressure, prothrombotic and coagulant changes, systemic inflammatory as well as oxidative reactions, autonomic imbalance with arrhythmias including the progression of atherosclerosis (Pope and Dockery, 2006; Brook, 2008; Simkohovich*et al.*, 2008). Everyday subjection to particulate matter has been closely associated with intense increase in systemic arterial blood pressure (Chuang et al., 2005; Choi et al., 2007; Auchincloss et al., 2008).

According to Chaung (2005), Choi (2007) and Auchineloss (2008), daily exposure to particulate matter has been linked to acute increases in systemic arterial blood pressure.More so, surface as well as underground waters in gas flared environments seems to have more concentration of hard metals like, selenium, manganese, magnesium etc.and appear more than control (Egwurugwu et al., 2003, Idodo-Umeh and Ogbeibe, 2010).The inhabitants of the oil rich region are therefore exposed not only to the various soil pollutants and air but also to other water contaminants especially heavy metals present in oil and gas flares, can also cause raised blood pressure and pulse pressure (Saturg*et al.*, 2006).

Exposure to petroleum and gas flare among residents of gas flaring communities causes an increase in hypertension may also touch on the kidney and causing chronic dehydration, causing chronic renal disease which is the most usual kind of secondary high blood pressure, and it is also an independent predisposing factor to cardiovascular morbidity and mortality (Anavekar et al., 2004: Go, 2004: Rosner, 2006: and Tedia et al., 2011). Moreso, according to Goines, 2007 and Heinonen- Guzejev et al., 2007), Gas flaring has been link with noise pollution from blazing fire and vehicular with human traffic as well as trend of heavy duty machineries, which add to the pool linking hypertension and increase coronary heart disease.Similarly,MacMathonet al.(1990) and Stanleret al. (1993), gas flared among residents of gas flaring communities has higher number of hypertensive and increase in blood pressure and pulse rate is a known predisposing factor for heart disorders. Modesti et al.(2013) reported that paradoxical, sleep deprivation lower plasma angiotension II concentrations, raised renal sympathetic nerve activity and probably increase in blood pressure.

In a standardized study of extended exposure to petroleum and gas flares ups the risks of hypertension to evaluate the impacts of prolonged exposure to oil/gas flares on blood pressure measures in people in two communities in the Imo east senatorial zone south eastern Nigeria.Their findings reveal that prolonged exposure to oil/gas flares increased the incidence of elevated blood pressure and this may increase the risks for cardiovascular diseases.(Egwurugwu*et al.*, 2013)

2.11 Gas Flaring Effect on Respiratory Parameters

Gas flares have negative effects on the health and livelihood of the communities in their environment as they emit a variety of poisonous chemicals. These chemicals can worsen asthma, cause breathing difficulty and chest pain and associated chronic bronchitis

(Environmental, 2005).Nitrogen monoxide (NO) is a known oxide of nitrogen gotten from natural gas combustion; a dangerous pollutant causing direct injuries to the respiratory system (Winter *et al.*, 1999).

Piller et al. (2007) reported that flares from nearby oil plants have contributed to an outbreak of bronchitis among adults, asthma as well as blurred vision in children, soots from flares containing harmful by-products like benzene, mercury and chromium, which add to reducing the immunity of community members, particularly children making them more susceptible to diseases like poliomyelitis and measles.).The tenacity and the extended exposure to low- levels of the environmentally unrelated chemicals led to a diminution in respiratory indices- lung volumes and peak expiratory flow rates (lung cancer risk-irrespective of smoking status etc.). The calliber of the airways which serve as a reliable tool for diagnosis and treatment of lung functions for Nigerians cohort in the region under study are reduced than the international and national values.This is evidence that residents closer to the site in the oil and gas extraction environment are at higher risk of having cardiopulmonary disorders related to "petroleum diseases" or oil and gas flared problem. (Argo, 2002; Nwafor, 2004; Joffa*et al.,* 2012).Average peak expiratory flow rate adapted by Clement Clarke (1989) for females of mean height 166. 40 cm (66 in) is 420L/min and males of average height 175.00cm (69 in) is 520L/min. The respiratory rate according to Yash (2010) has a trend of lowering with age. Few findings has shown that gas flaring impacts negatively on the lung function value of children and adults in gas flaring environment by decreasing their mean peak flow rates and this has worsen the severity of impact in peak flow rate with prolonged exposure to gas flare, hence marked reduction in peak expiratory flow rate but there is dearth of information regarding Respiratory or breathing rate.

A research, on the "Effects of gas flaring on blood parameters and respiratory system of laboratory mice, "*Musmusculus*" was carried out by Adebayo and Jemima in 2010.This work was held out by exposing the mice to gas flares for eight weeks under the laboratory. It was discovered that eosinophils level increased (in association with inflammation in respiratory systems) in the blood of mice exposed to gas flares which shows degenerative disease condition and documented it as a useful marker for pollution monitoring and detecting adverse effects of gas flares. Histopathological involving the lungs of exposed mice indicates distortions in the segmental bronchus and alveoli of the respiratory organ, with interspersed brown pigment and polymorph nuclear cells which were not present in the controls.

According to Adenibo et al. (2013), the respiratory rates (RR) show no major difference within the test groups when compared to control group of residents with different exposure duration.

Day-to-day variation in the lung function and particularly Peak Expiratory Flow (PEF) as measures of airflow limitation are usually utilized as an effect in panel studies (Ward et al., 1999). There is paucity of information regarding lung function of residents in communities known to be exposed to gas flares. Earlier studies have implicated occupational exposure to various environmental pollutants on the incidence of respiratory and cardiovascular disorder (Jinadu and Malomo, 1986;Okwari*et al.,* 2005; Ige and Onadeko, 2000; Okojie*et al.,* 2003;Alakija*et al.,* 1990). According to Samet*et al.,* (1996) that decrease in lung function was observed more in residents with longer duration in environment highly polluted with particulate matter.

CHAPTER THREE

RESEARCH METHODS

3.1 Area under study

This present study covered two different communities each in at five of the Niger Delta states. The first, a gas flaring station (experimental area) while the second a non-gas flaring area (control) was at least 35km from the gas station. Both locations in a particular state possess similar socio economic and cultural characteristics. The residents in both communities are essentially artisans, traders, farmers, students and civil servants.

State	Study Area	Control
Delta	Agbaro-otor/Ughelli	Eku
Edo	Oben	Ekiadolor
Bayelsa	Immiringi	Ogbia
Rivers	Oshi	Ahoada
Akwa Ibom	Ibeno	Ikot Ekpene

Agbaro-otor one of the rural locations situated in Ughelli north local council while Eku another rural area located in Ethiope east local council in Delta state south south Nigeria. Oben is another a rural setting in Orhionwon local council and Ekiadolor sited in Ovia local council also a rural environment both in Edo state. Immiringi and Ogbiaaretwo semi urban locations situated in Ogbia local council of Bayelsa state.Oshi and Ahoada are also semi urban towns both are in Ahoada west local council of Rivers state. WhileIbenoas well as Ikot Ekpene are both in Ikot Ekpene local council Akwa Ibom state.

3.2 Study Population

The study population of 51,379 is made up of 7955 residents in Edo state (Oben 3,752, Ekiadolor 4,203). Delta state, 10151 (Agbarho-otor 5,553, Eku 4604).Akwa Ibom state, 11956 (Ibeno 4,252, Ikot ekpene 7704).Bayelsa state, 6853 (Immriringi 3253, Ogbia 3600) and Rivers state, 14458 (Oshi 6600, Ahoada 7858).

3.3 Study Design

It is an ex post facto study that compared selected residents exposed to gas flaring with non-exposed person from other communities (Kellinger, 1970). Direct administration of questionnaire, observation and recording method were used.

3.4 Sample and Sampling Technique

This research was done using stratified random sampling technique resulting in a total of 1008 participants. This is made up of five hundred and four (504) in the gas flaring communities and five hundred (504) in the non - gas flaring communities.

Selection of subjects

Apparently healthy residents between the ages of 12 to 70years who verbally consented to take part in the study were randomly selected after detailed explanation. Close ended questionnaires, covering bio-data and other relevant information were directly administered to sampled participants. These were completed anonymously with reference to age, sex and exposure duration of residents. Theselection of male and female children was done considering the relative proportion of the various age and sex distribution of the sample population and at the different communities subject were randomly selected.

Sample Size

The research involved 504 participants in the study areas. The formula for sample size determination is:

$$n = \frac{Z^2 \times p(1 - p)}{e^2}$$

n = required Sample Size

z = confidence level at 95% (Standard value of 1.96)

p = estimated prevalence in project area (assumed = 0.3)

q = 1 – p

e = margin of error at 4% (0.04)

$$n = \frac{Z^2 \times p(1 - p)}{e^2}$$

(Cochran, 1977)

$$n = \frac{1.96^2 \times 0.11\ (1 - 0.11)}{(0.02)^2}$$

$$= \frac{3.84 \times 0.11\ (0.89)}{0.0004}$$

$$= \frac{3.84 \times 0.0979}{0.0004}$$

$$= \frac{0.3756}{0.0004}$$

n = 940

The sample size for this research is 1008 which is adequate for the study. This comprises of 686 adults and 322 children. The sample is made up of 564 males and 444 females which is further divided into 387 adult males and 299 adult females, while the children are further divided into 177 males and 145 females.

Method of Data collection

Data collection in this study was done with the aid of closed ended questionnaire, an electronic blood pressure kit for recording blood pressure as well as pulse rate simultaneously, while a spirometric device known as the peak flow metre was used for peak flow rate. Also used is a timing device (stop watch), a weighing scale for weight of the participants, while the respiratory rate was taken manually.

3.5 Subjects Selection Criteria

Inclusion/Exclusion Criteria

Children (male and female) within 12 – 17 years age bracket and adults male and female of ages 18 - 70 that participated in the study were randomly selected.

Exclusion Criteria

Questionnaires were directlyused to exclude Children below 12 years, participants that smoke tobacco, those who have not stayed up to one (1) year in the various communities, residents with established respiratory and cardiovascular diseases and those with high body mass index (BMI), residents with positive family history and all known cases of hypertension, diabetes mellitus, dyslipidemia, renal disease, atherosclerosis and contraceptive users.

3.6 Materials/methods

Materials

Electronic blood pressure kit, Stop watch, Weighing scale, Laboratory coat, Hand gloves, Face masks, Peak flow metre, questionnaire

Methods/procedures

Measurement of Blood Pressure /Pulse rate

A device which measures Blood pressure and record in mmHg along with pulse rate (heart rate) in beat/minutes of the participants.The cuff inflates by itself, it detects blood pressure as the cuff deflates and displays a digital reading of blood pressure and heart rate simultaneously. (Geetha*et al.*, 2012)

Figure 3.1 Electronic Blood Pressure kit

Measurement of Respiratory Rate

Participants' respiratory rate was measured while at rest. They were made not to be aware (as much as possible) to obtain a reliable count by observing the rise and fall of the participant's chest and count the number of respirations for thirty seconds or one full minute.

Weighing scale

Laboratory coat: A protective clothing worn when practical and procedure are been carried out

Hand gloves

Face masks: any of various devices to shield the face, sometimes attached to or forming part of a helmet, as that worn in a hazardous activity or a sport.

Measurement of Peak Flow Rate

Figure 3.2 Wright Peak flow meter

Wright peak flow meter device was used to check peak expiratory flow rate in litre/minute for all participants.

The marker was moved towards the bottom of the numbered scale, the participants were asked to stand up straight and take a deep breath to fill your lungs. Held their breath while they placed the mouthpiece in their mouth, between theirteeth. They closed their lips around it. And were asked not put their tongue against or inside the hole. They blew out as hard and fast as they can in a single blow. Participants were told to repeat the steps if not properly done. Three successive readings are usually taken and thereafter the highest value of these three was recorded as the peak expiratory flow rate of the participants. (NAEPP,NAEPPEPR 2014)

3.7 Ethical Consideration

Approval was sought from school heads, parents and community heads where applicable with a view to obtaining informed and valid consent from residents. Accordingly the ethical approval of the Research and Ethical committee constituted by the College of Health Sciences, of the Delta State University was obtained before the commencement of the research, registration number RBC/FBMS/DELSU/14/05.

3.8 Statistical Analysis

Data generated were expressed as mean ± SD. Significance difference between means was determined by student t-test and one-way analysis of variance (ANOVA). SPSS 20 software was used for statistical analysis. A level of $p \leq 0.05$ was accepted as significant

CHAPTER FOUR

RESULTS

4.1 Effect of flared gas on Systolic Blood Pressure of children residents in Edo State

The study shows the changes in systolic blood pressure of children residents in Edo State. The residents were the children living in Oben, a gas flaring community and Ekiadolor, a non-gas flaring community. Fig 4.1 shows that the flared gaselevatedthe systolic component of blood pressure of the male and female children with increase in the years of exposure.Comparing the systolic component of the blood pressure of those living in gas flaring and non-gas flaring communities, data show that the increase in systolic blood pressure of the female children living in gas flaring community for 6 – 10 years and above 10 years was statistically significant when compared to the systolic pressure of children living in non-gas flaring community.

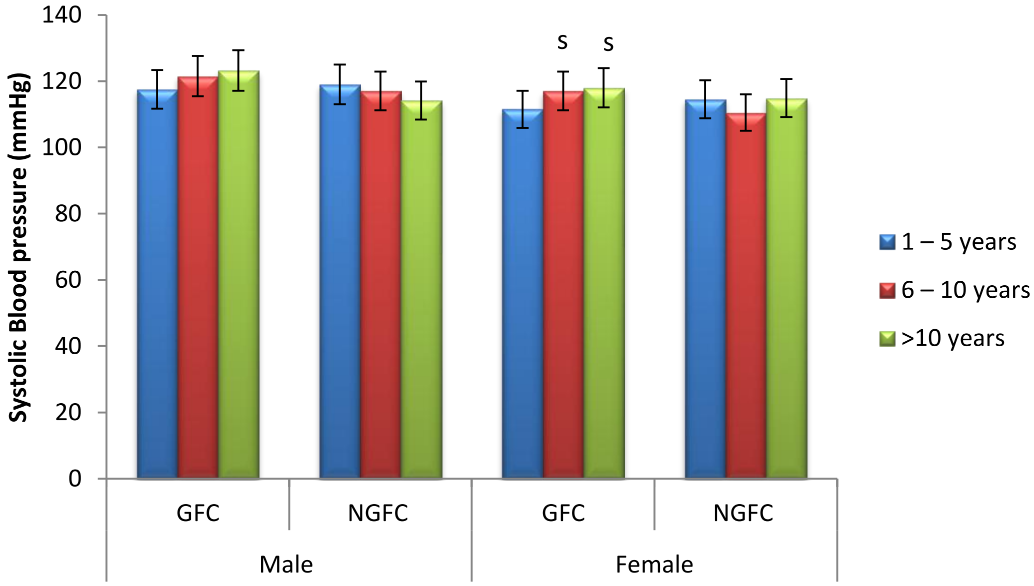


Fig 4.1: Effect of flared gas on Systolic component of Blood Pressure of children residents in Edo State

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.2 Effect of flared gas on Systolic component of Blood Pressure of adult residing in Edo State

This study assessed the effect of flared gas on the systolic component of blood pressure of adult residing in Edo State. When compared with the systolic component of blood pressure of adult living in non-gas flaring area, it was shown that flared gas elevated the systolic component of blood pressure with the highest value noted in those living in gas flaring community for greater than 10 years (>10years). Significance ($p<0.05$) was observed in male and female residents who lived in gas faring communities for 1 – 5 years and >10 years when compared to their counterparts in non-gas flaring areas.

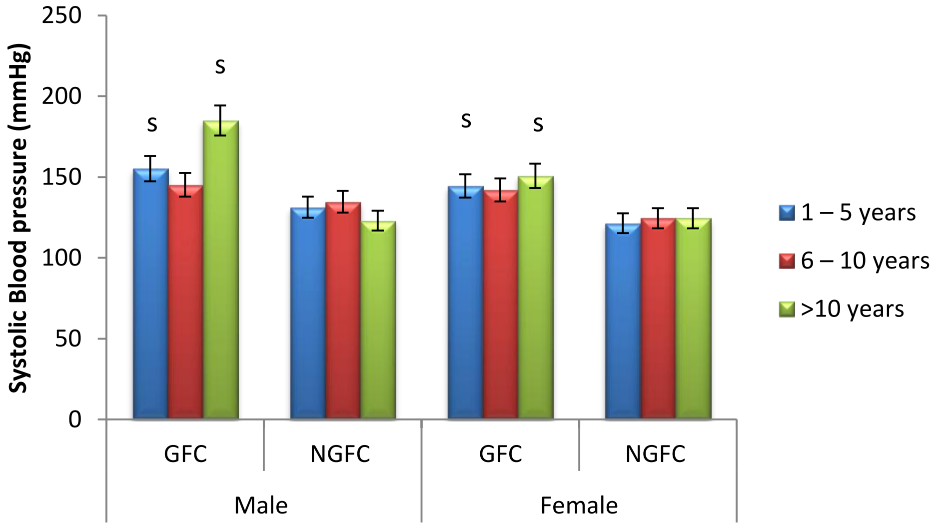


Fig 4.2: Effect of flared gas on Systolic component of Blood Pressure of adult residents in Edo State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.3 Effect of Gas Flare on Diastolic Blood pressure of children residents in Edo State

Data from the study show the changes in diastolic blood pressure of children living in flared gas community of Edo State. It was shown that gas flaring increased the diastolic component of blood pressure in the male children compared to those not exposed to gas flare, with significance ($p<0.05$) observed in male children exposed to gas flare for 1 – 5 years and >10 years. An opposite effect was observed in female children as gas flare decreased the diastolic blood pressure with increase in period of exposure. Despite the changes significant difference was not noted between the diastolic pressure of female children in both gas flaring and non-gas flaring communities.

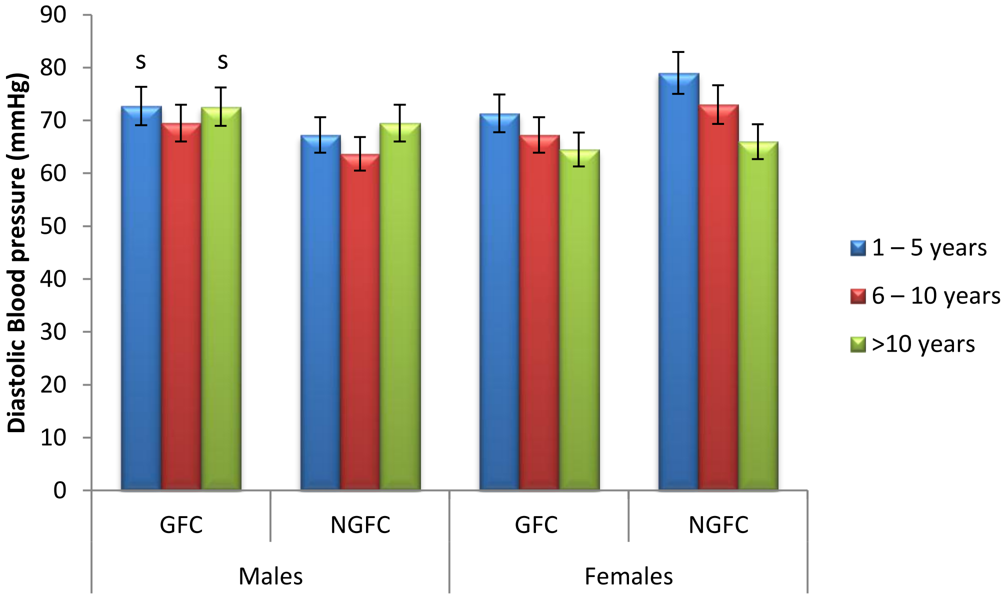


Fig 4.3: Effect of Gas Flare on Diastolic Blood pressure of children residents in Edo State

Values were presented as mean Standard error of mean,

s: $p<0.05$ when compared with NGFC

4.4 Effect of Gas Flare on Diastolic Blood pressure among Adults Residing in Edo State

Data from the study show the changes in diastolic component of blood pressure among adult residing in Edo State exposed to gas flare. It was observed that the diastolic blood pressure was increased for adult male and female exposed gas flare when compared to the diastolic component of blood pressure of residents living in non-gas flaring community. These changes were significant ($p<0.05$) when adult male exposed to gas flare for 1 – 5 years and above 10 years were compared to those in non-gas flaring areas. The increase in adult female diastolic arterial blood pressure was also significant ($p<0.05$).

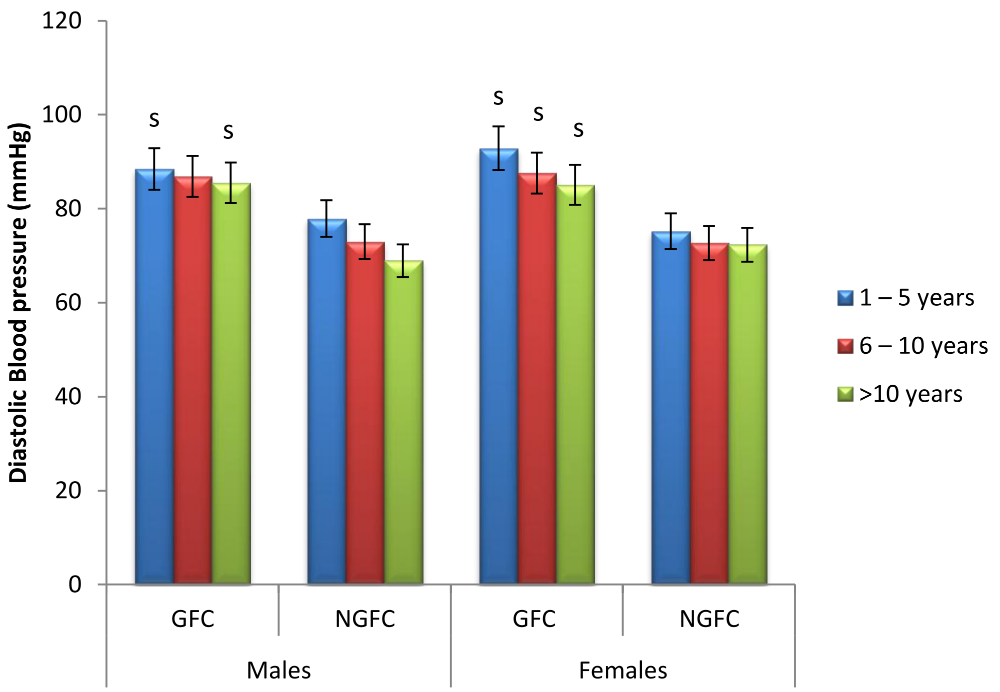


Fig 4.4: Effect of Gas Flare on Diastolic Blood pressure among Adult Residing in Edo State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.5 Gas Flare effect on the pulse rate of children residents in Edo State

In this section of the study, the pulse rate of children living in gas flaring community was compared with the pulse rate of those in non-gas flaring community. Data show that the gas flare increased the pulse rate with higher impact on the female children. Gas flare increased the pulse rate of the female children in duration of exposure dependent manner. There was statistical significance ($p<0.05$) when the mean pulse rate of female children exposed to gas flare for >10 years were compared to the female residents in non-gas flaring community.

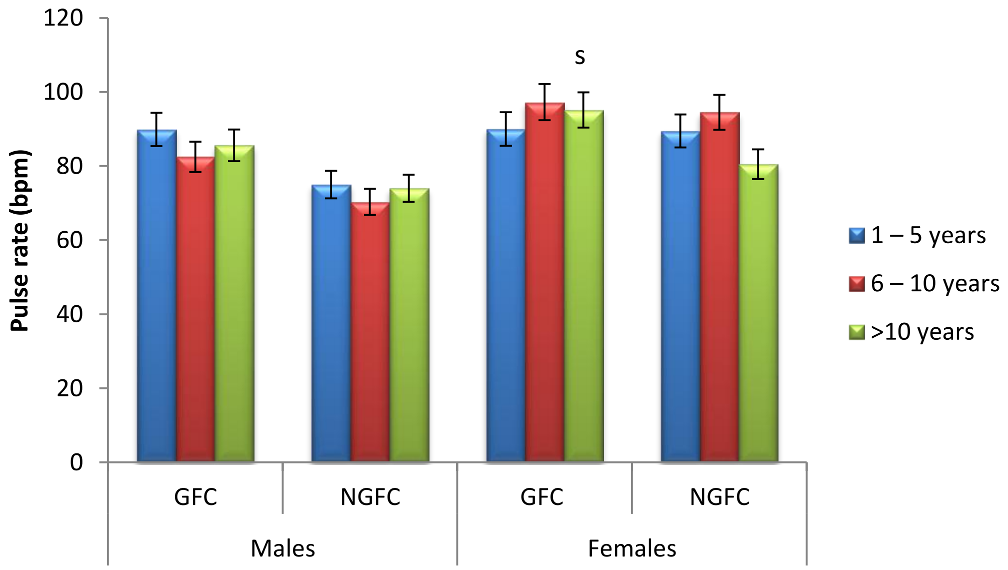


Fig 4.5: Gas Flare effect on the pulse rate of children residents in Edo State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.6 Gas Flare effect on the pulse rate of adult residing in Edo State

This part of the study showed the effect of the gas flare on pulse rate of adult residents. Data show that the gas flare increased the pulse rate in adult residents of both sex. Significance ($p<0.05$) was observed when male adults exposed to gas flare between 1 – 5 years, and female adults exposed to gas flare between 6 – 10 years were compared to individuals living in non-gas flaring regions.

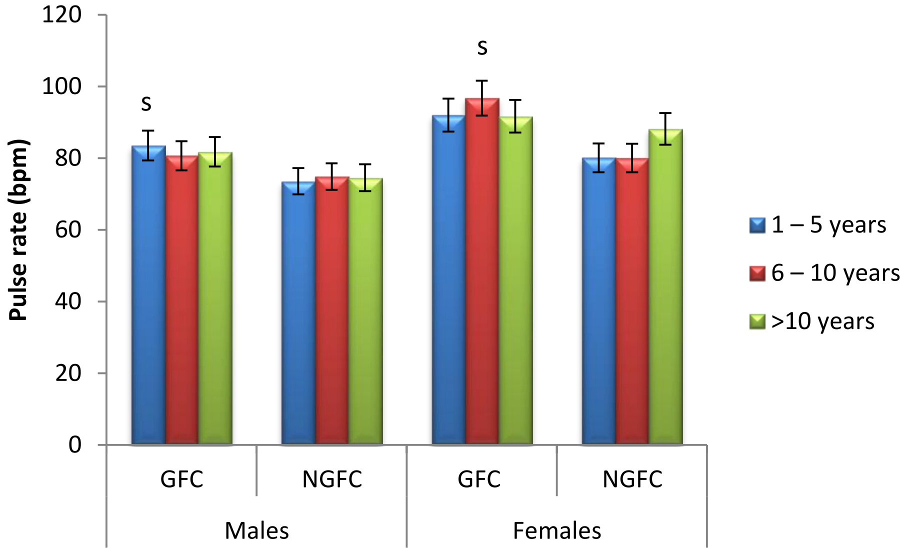


Fig 4.6 Gas Flare effect on the pulse rate of adult residents in Edo State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.7 Gas Flare effect on the respiratory rate of children residents in Edo State

Fig 4.7 show changes in the respiratory rate of children residents exposed to gas flare. Result show that the respiratory rate increased asexposure duration to flared gas increases. Despite these changes, significant difference were not noted in male residents, the female residents mean respiratory rate for 1 – 5 years and 6 – 10 years were significant ($p<0.05$) when compared to female counterparts of non-gas flaring community. There was also significance when the mean respiratory rate of female children exposed to gas flare for >10 years was compared to the mean respiratory rate of female residents exposed to gas flare for 1 – 5 years.

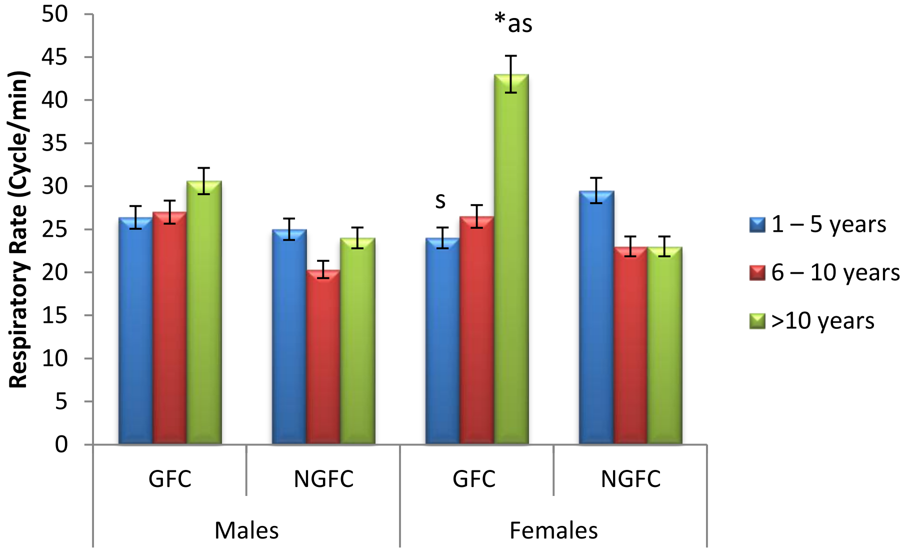


Fig. 4.7: Gas Flare effect on the respiratory rate of children residents in Edo State

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.8 Gas Flare effect on the respiratory rate of adult residing in Edo State

Data from this study show the changes in the respiratory rate of adult residents exposed to gas flare. Record show that male residents in gas flaring communities had significant ($p<0.05$) and lower mean respiratory rate when compared to the male residing in non-gas flaring area. Gas flare increased the respiratory rate of the female residents but the effect was not dependent on the duration of exposure. There was statistical significance ($p<0.05$) in the mean respiratory rate of female residents residing in gas flaring areas for 1 – 5 years and >10 years.

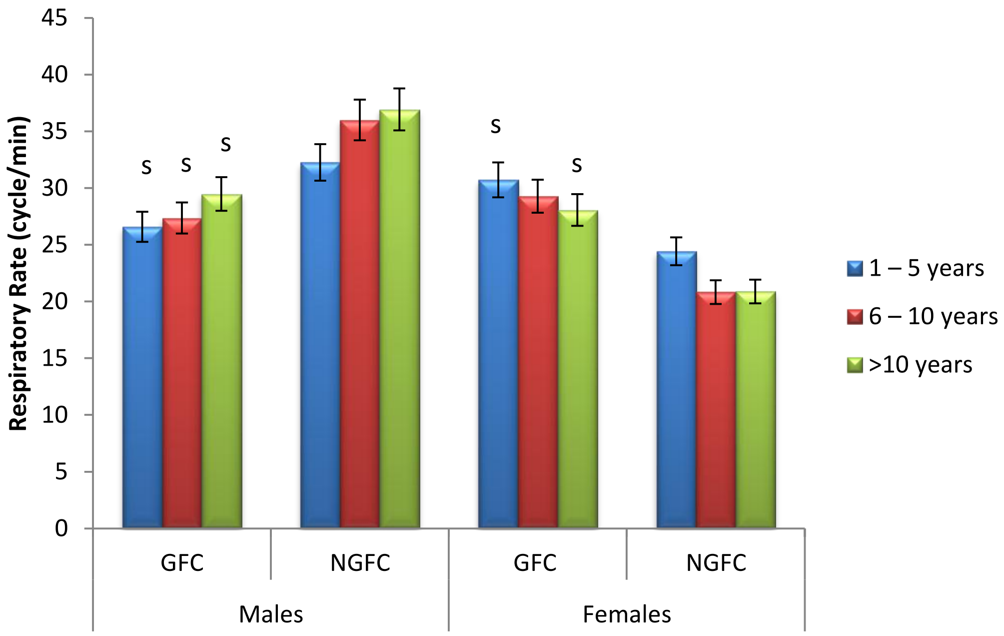


Fig 4.8 Gas Flare effect on the respiratory rate of adult residing in Edo State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.9 Effect of gas flaring on Peak Expiratory Flow Rate (PEFR) of children residents in Edo State

This study show the effect of gas flare on the PEFR) of children living in gas flaring and non-gas flaring communities of Edo State. Data in the table below show that changes in the PEFR for male and female children in gas flaring community (Oben) was inconsistent, though significance (p<0.05) was observed when the PEFR of male children living for more than 10 years in gas flaring community when compared to those who have lived there for 6 – 10 years.

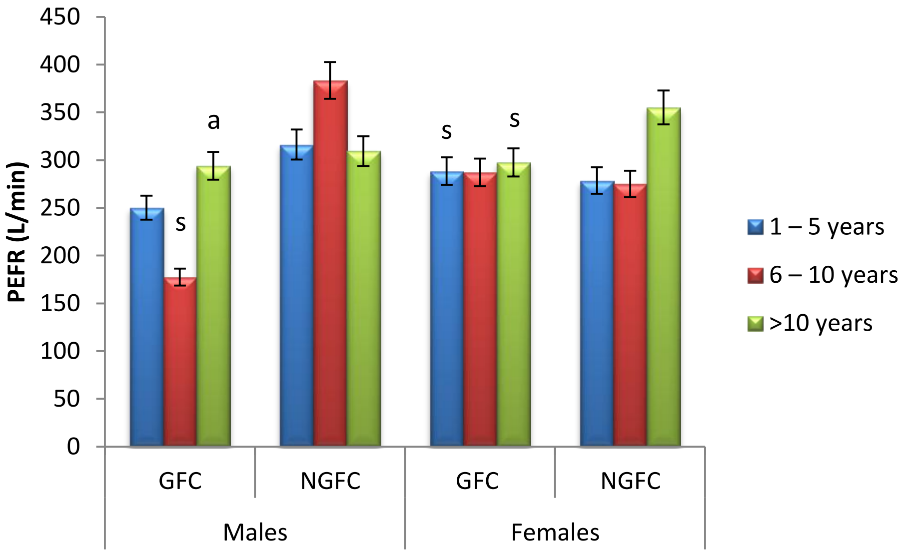


Fig 4.9 Effect of gas flare on Peak Expiratory Flow Rate of children residents in Edo State

Values were presented as mean Standard error of mean, *: p<0.05 when compared to 1 – 5 years a: p<0.05 when compared to 6 – 10 years s: p<0.05 when compared with NGFC

4.10 Effect of gas flare on Peak Expiratory Flow Rate (PEFR) of adult residing in Edo State

This study shows the effect of gas flare on the PEFR of male residing in gas flaring and non-gas flaring areas of Edo State. Gas flaring decreased the PEFR for male adult while increasing the PEFR of the female adult. The increase PEFR observed in female adult was significant ($p<0.05$) when the PEFR of women exposed to gas flare for more than 10 years was compared to the PEFR of women who lived in the gas flaring community for 1 – 5 years and 6 – 10 years.

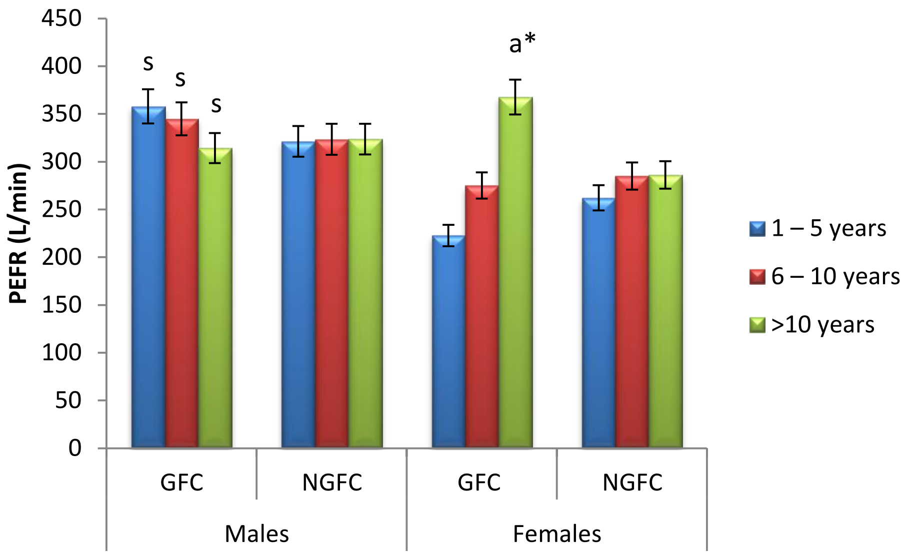


Fig 4.10 Effect of gas flaring on Peak Expiratory Flow Rate of adult residents in Edo State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.11 Effect of flared gas on Systolic Component of Blood Pressure(SBP)of children residents in Rivers State

In this study, the changes in SBPof children living in gas flaring areas of River State was determined. Gas flaring caused minimal increase in the(SBP). Similar findings was observed in female residents' systolic blood pressure with significance was observed when residents were exposed to gas flare for 6 – 10 years and >10 years.

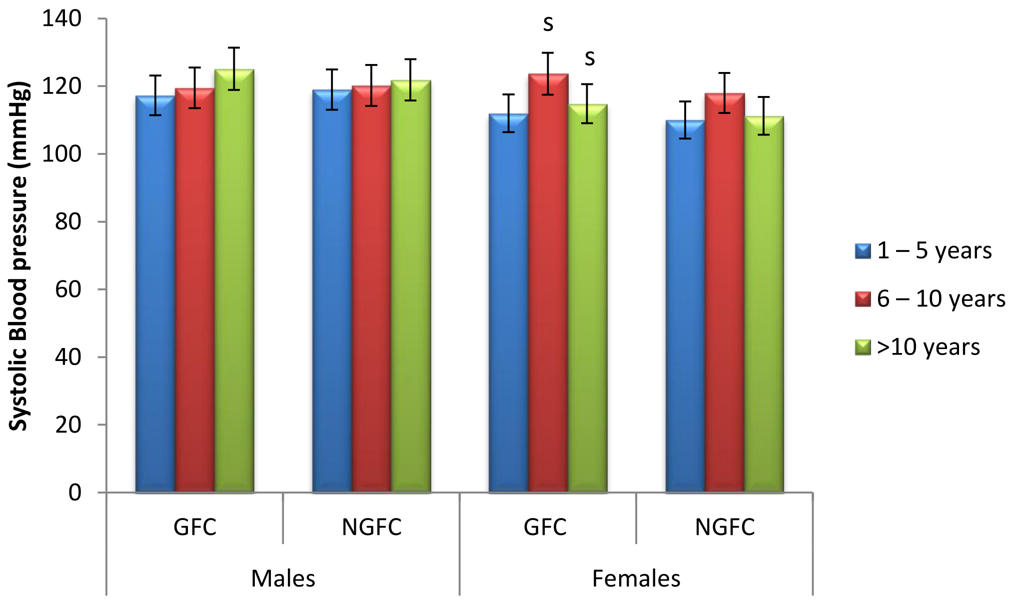


Fig 4.11 Effect of flared gas on Systolic Blood Pressure of children residing in Rivers State

Values are represented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.12 Effect of flared gas on Systolic component of blood pressure of adult residing in Rivers State

Fig 4.12 shows that the effects of gas flare on systolic blood pressure of adult residents in Rivers State. Data show that systolic blood pressure of both male and female residents increased after exposure to gas flare. The effect of gas flare on the female residents was duration of exposure dependent. Despite the elevation in SBPin male residents there was no significance. There was significant ($p<0.05$) increase of female residents exposed to gas flare for 6 – 10 years when compared to the female residents residing in non-gas flaring community.

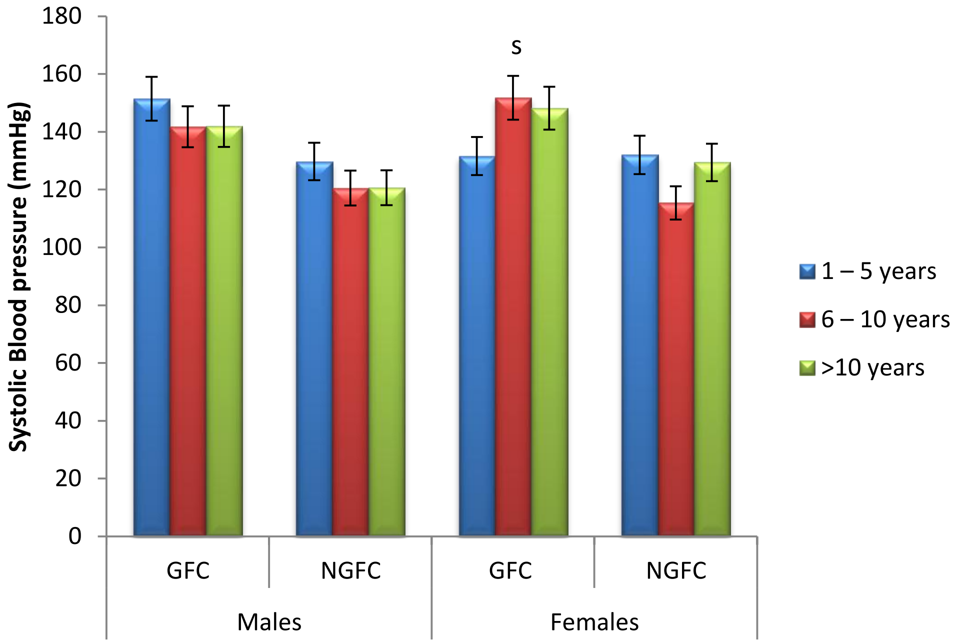


Fig 4.12 Effect of flared gas on Systolic blood pressure of adult residing in Rivers State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.13 Effect of flared gas on Diastolic blood pressure of children residents in Rivers State

This aspect of the study shows the changes in diastolic blood pressure of children residing in gas flaring area in Rivers State.

Comparing the diastolic blood pressure of those residing in gas flaring and non-gas flaring communities, data shows that gas flare did not significantly (p>0.05) affect diastolic blood pressure of the male and female children with different exposure durations (except female children with exposure duration of 6-10years) when compared to non-gas flaring communities in Rivers State.

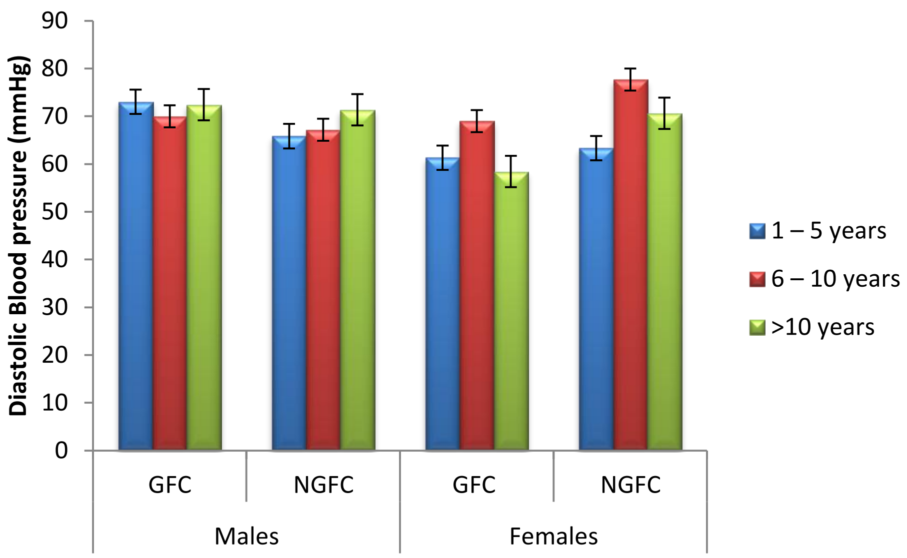


Fig 4.13 Effect of flared gas on Diastolic blood pressure of children residents in Rivers State

Values are represented as mean Standard error of mean,

4.14 Effect of flared gas on Diastolic component of blood pressure(DBP) of adult residing in Rivers State

This section of the study shows the effect of flared gas on DBPof adult residing in Rivers State. From this result, gas flare did not significantly (p>0.05) affect the diastolic blood pressure of the male and female adult based on duration of exposure in Rivers State.

Diastolic blood pressure of adult male and females with exposure duration above 10years were significantly (p<0.05) increased when compared to gas flaring communities. However, diastolic blood pressure of adult male and females in gas flaring communities with exposure duration above 1-5years and 6-10years were reduced but were not statistically significant (p>0.05).

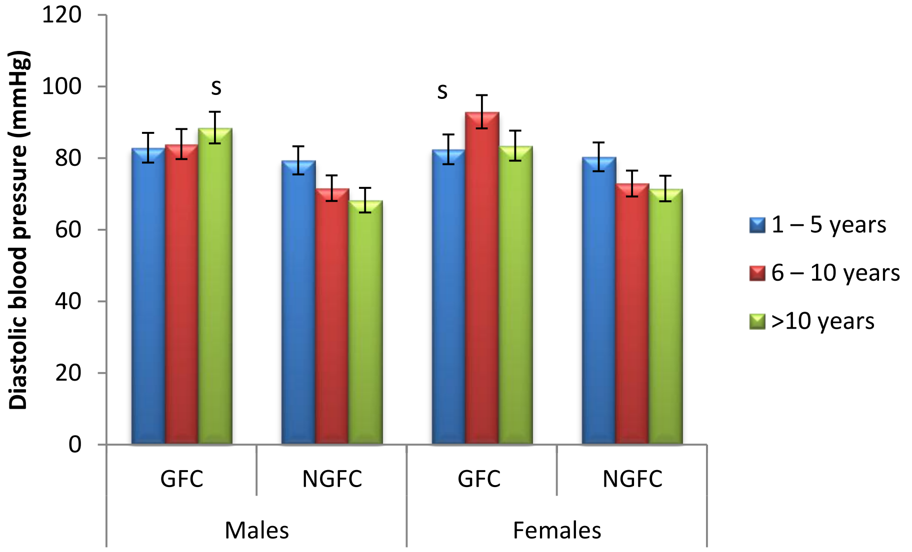


Fig 4.14 Effect of gas flaring on Diastolic blood pressure of adult residents in Rivers State

Values were presented as mean Standard error of mean, *: p<0.05 when compared to 1 – 5 years a: p<0.05 when compared to 6 – 10 years s: p<0.05 when compared with NGFC

4.15 Effect of flared gas on Pulse Rate of children residents in Rivers State

The effect of gas flare on pulse rate of children in Rivers State was examined in this study. The figure on this section shows that the gas flare did not affect the pulse rate of the male children and female children with different based on duration of exposure in Rivers State, and thus there was no significance when compared with the pulse rate of children in non gas flaring community of Rivers State.

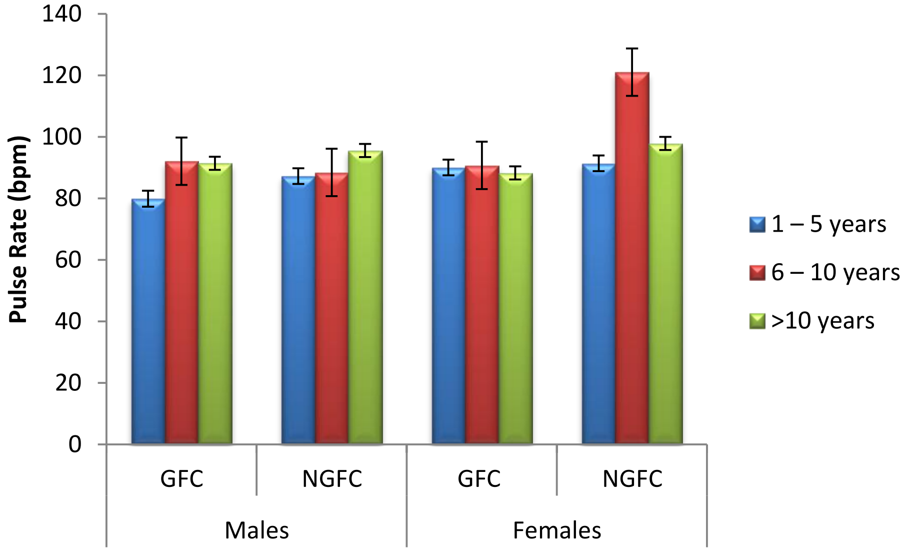


Fig 4.15 Effect of flared gas on Pulse Rate of children residents in Rivers State
Values are represented as mean Standard error of mean,

4.16 Effect of gas flaring on Pulse Rate of adult residents in Rivers State

This study shows the changes in pulse rate of adult residents in Rivers State due to gas flare. Comparing the pulse rate of those residing in gas flaring and non-gas flaring communities, there was significant ($p<0.05$) increase in pulse rate of adult females in gas flaring communities with exposure duration of 6-10 years and 10years (except 1-5years) when compared to non-gas flaring communities. However, There was significant ($p<0.05$) increase in pulse rate of adult males in gas flaring communities with exposure duration of 1-5years and above 10years (except 6-10years) when compared to non-gas flaring communities.

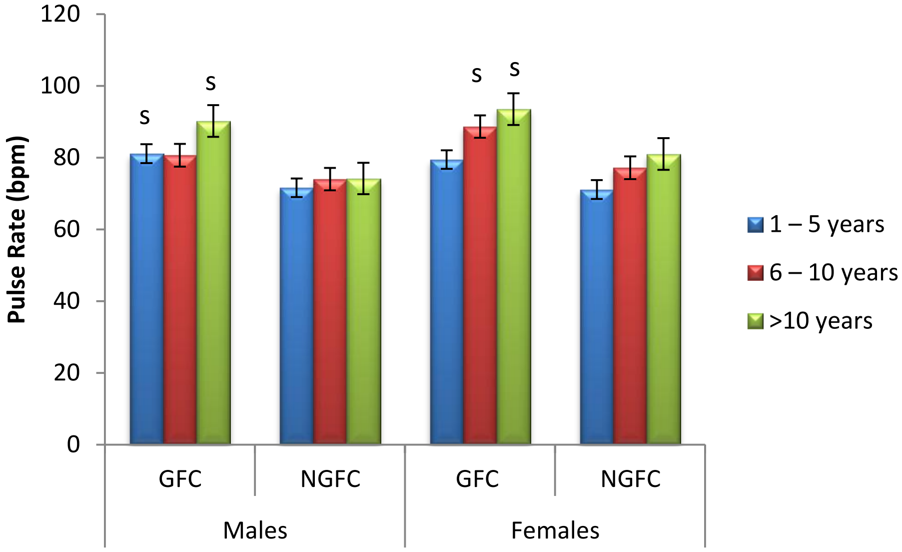


Fig 4.16 Effect of flared gas on Pulse Rate of adult residents in Rivers State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.17 Effect of flared gas on Respiratory Rate of children residents in Rivers State

The changes in respiratory rate of children residents in Rivers State exposed to gas flare was ascertain in this study. Data show that the gas flare did not significantly (p>0.05) affect the respiratory rate of the male children based on duration of exposure in Rivers State. However gas flare significantly (p<0.05) increase the respiratory rate of the female children with duration of exposure of 10years above when compared to 1-5years. Comparing the respiratory rate of those residing in gas flaring and non-gas flaring areas, significant difference (p>0.05) was not noted in respiratory rate male children and female children in gas flaring communities with exposure duration of 1-5years and 6-10 years when compared to non-gas flaring communities. However, There was significant (p<0.05) increase in respiratory rate of female children with exposure duration above 10years when compared to non-gas flaring communities.

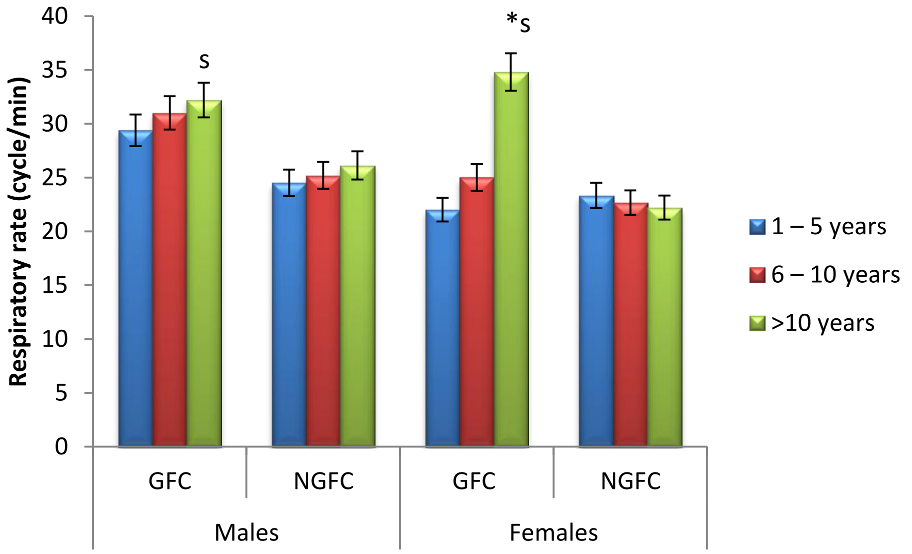


Fig 4.17 Effect of flaredgas on Respiratory Rate of children residents in Rivers State

Values were presented as mean Standard error of mean, *: p<0.05 when compared to 1 – 5 years s: p<0.05 when compared with NGFC

4.18 Effect of flared gas on Respiratory Rate of adult residents in Rivers State

This study shows the effect of flared on respiratory rate of adult residents in Rivers State. Gas flare significantly ($p<0.05$) reduced the respiratory rate of the adult males with duration of exposure of 6-10years when compared to 1-5years. Gas flare significantly ($p<0.05$) increase the respiratory rate of the adult females with duration of exposure of above10years when compared to 6-10years. Comparing the respiratory rate of those residing in gas flaring and non-gas flaring communities, no significant difference ($p>0.05$) difference was noted in respiratory rate adult females in gas flaring communities with exposure duration of 1-5years and 6-10 years when compared to non-gas flaring communities. However, There was significant ($p<0.05$) increase in respiratory rate of adult males in gas flaring communities with exposure duration of 1-5years, 6-10years and above 10years when compared to non-gas flaring communities. However, There was significant ($p<0.05$) increase in pulse rate of adult females in gas flaring communities with exposure duration of 6-10years and above 10years (except 1-5years) when compared to non-gas flaring communities.

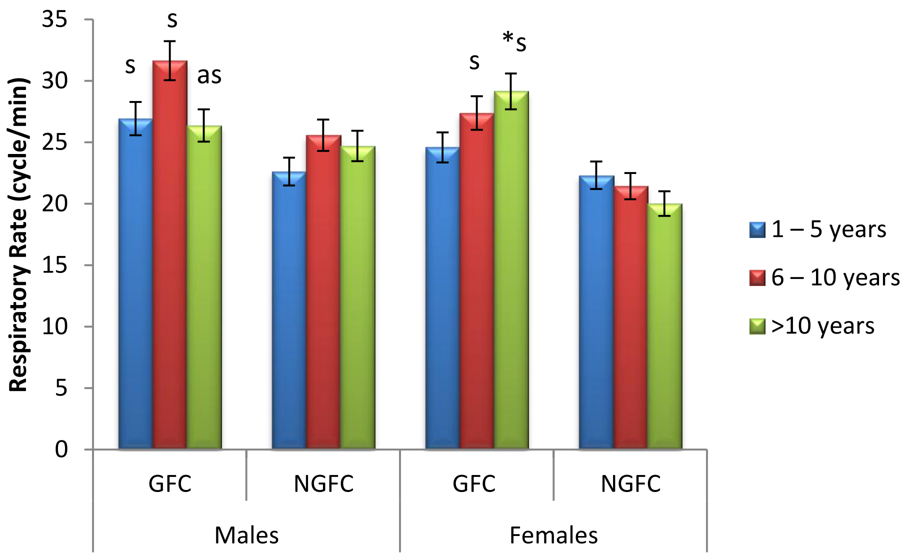


Fig 4.18 Effect of flared gas on Respiratory Rate of adult residents in Rivers State

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.19 Effect of flared gas on Peak Expiratory Flow(PEFR) Rate of children residents in Rivers State

Data show the effect of flared gas on PEFR of children residents in Rivers State. Fig 4.19 shows that the gas flare did not significantly ($p>0.05$) affect the peak expiratory flow rate of male children and female children based on duration of exposure in Rivers State.

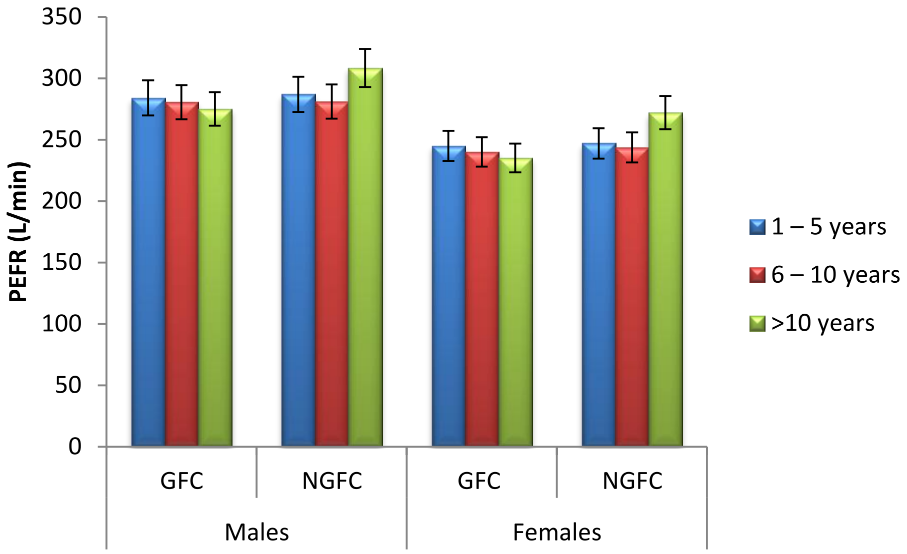


Fig 4.19 Effect of flared gas on Peak Expiratory Flow Rate of children residents in Rivers State

Values were presented as mean Standard error of mean

4.20 Effect of flared gas on Peak Expiratory Flow Rate(PEFR) of adult residents in Rivers State

This part of the study shows the effect of flared gas on (PEFR)of adult residents in Rivers State. Comparing the PEFR of those residing in gas flaring and non-gas flaring communities, there was significant difference (p>0.05) in PEFR of male and female adults in gas flaring communities with exposure duration of 6-10 years and above 10 years when compared to non-gas flaring communities.

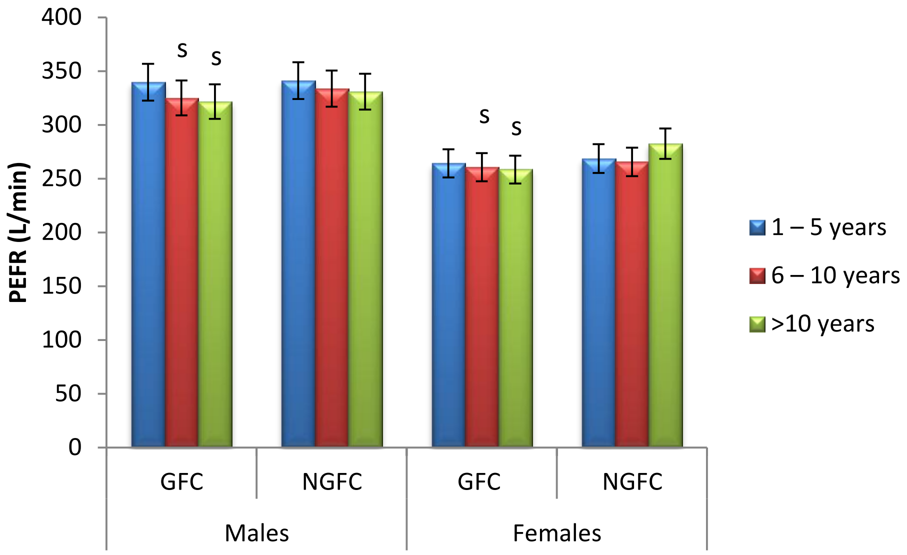


Fig. 4.20: Effect of flared gas on Peak Expiratory Flow Rate of adult residents in Rivers State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.21 Effect of flared gas on Systolic component of Blood Pressure(SBP) of children residents in Akwa Ibom State

This study highlighted the effect of flared gas on SBPof children residents in Akwa Ibom State. It was observed that the gas flare did not significantly ($p>0.05$) affect the SBPof the male children based on duration of exposure in Akwa Ibom State. The SBPof the female children with duration of exposure of above 10years was significantly reduced when compared to those with duration of exposure of 1-5years and 6-10years.

Comparing the SBPof those residing in gas flaring and non-gas flaring communities, no significant difference ($p>0.05$) was noted in systolic blood pressure of male children in gas flaring communities with exposure duration of 1-5years, 6-10years and above 10years when compared to non-gas flaring communities. There was significant ($p<0.05$) elevation in SBPof female children in gas flaring communities with exposure duration of 1-5years and 6-10years when compared to those in non-gas flaring communities.

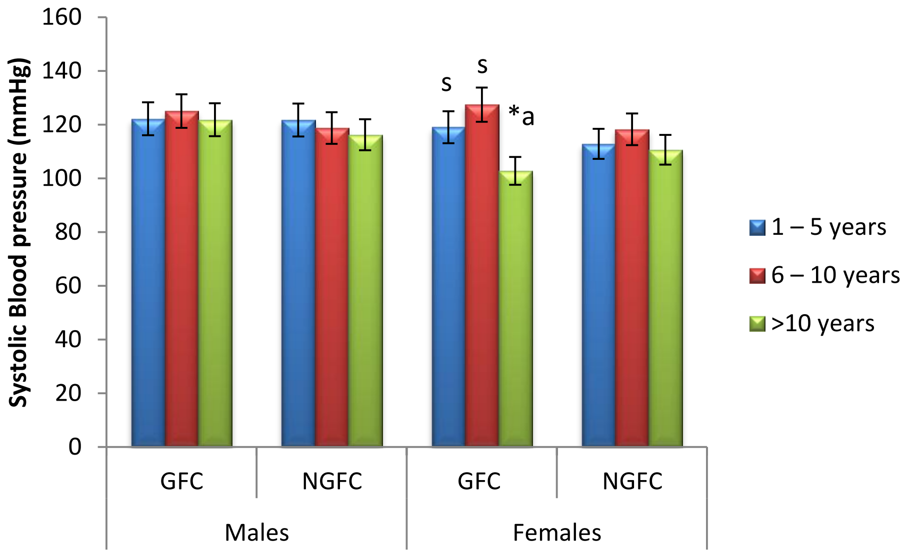


Fig 4.21 Effect of flared gas on Systolic Blood Pressure of children residents in Akwa Ibom State

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.22 Effect of flared gas on Systolic Blood Pressure(SBP) of Adult Residing in Akwa Ibom State

Fig 4.22 shows the study that determines the effect of flared gas on SBPof adult residing in Akwa Ibom State. Data show that the SBPof the adult males with duration of exposure of above 10years was significantly ($p<0.05$) increased when compared to those with duration of exposure of 1-5years. The SBPof the adult females with duration of exposure of 6-10years was significantly ($p<0.05$) reduced when compared to those with duration of exposure of 1-5years. There was significant ($p<0.05$) elevation in SBPof adult males in gas flaring communities with exposure duration of above 10years when compared to those in non-gas flaring communities. There was also significant ($p<0.05$) increase in systolic blood pressure of adult females in gas flaring communities with exposure duration of 6-10years when compared to those in non-gas flaring communities.

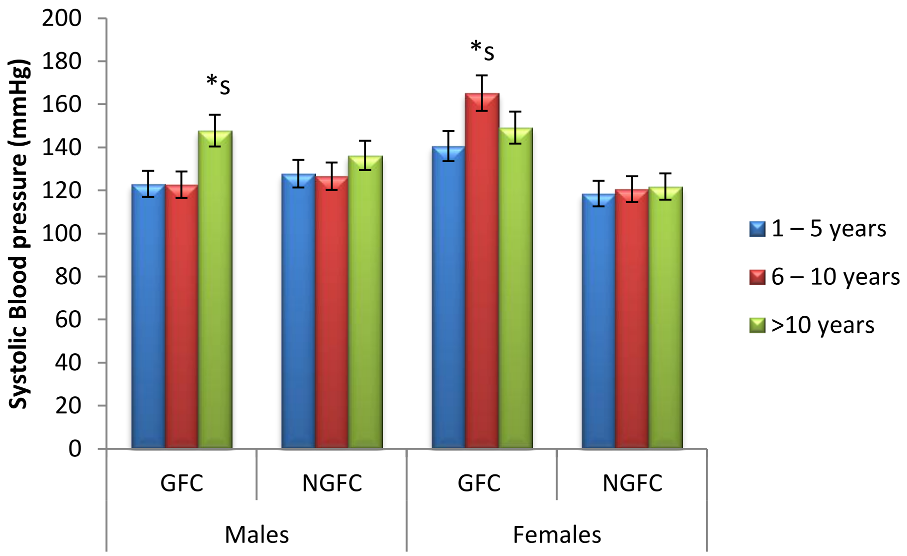


Fig. 4.22: Effect of flared gas on Systolic Blood Pressure of Adult Residents in Akwa Ibom State

Values were presented as mean Standard error of mean,
*: $p<0.05$ when compared to 1 – 5 years s: $p<0.05$ when compared with NGFC

4.23 Effect of flared gas on Diastolic Blood pressure of Children residents in Akwa Ibom State

Result from this study show the effect of flared gas on diastolic blood pressure of children residents in Akwa Ibom. Fig 4.23 there was no observable significant difference (p>0.05)in diastolic blood pressure of the male children in gas flaring communities based on duration of exposure in Akwa Ibom State.The diastolic blood pressure of the female children with duration of exposure above 10years was significantly reduced when compared to those with duration of exposure of 1-5years.

Comparing the diastolic blood pressure of those residing in gas flaring and non-gas flaring communities, there was no significant difference (p>0.05) in diastolic blood pressure of children male as well as female in gas flaring communities with exposure duration of 1-5years, 6-10years and above 10years when compared to non-gas flaring communities.

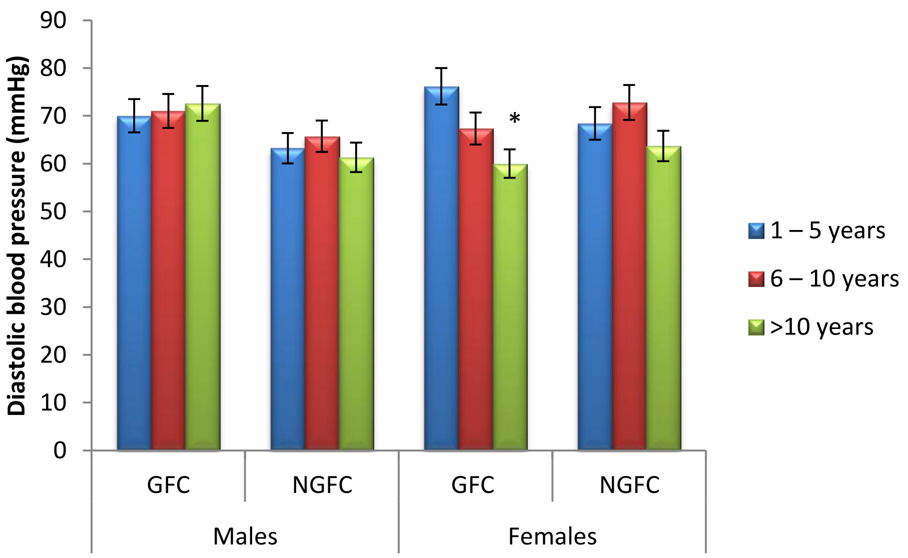


Fig 4.23 Effect of flared gas on Diastolic Blood pressure of Children residents in Akwa Ibom State

Values were presented as mean Standard error of mean,
*: p<0.05 when compared to 1 – 5 years

4.24 Effect of flared gas on Diastolic Blood pressure (DBP) of Adult residents in Akwa Ibom State

This study shows the effect of gas flaring on the DBP of adult residing in Akwa Ibom State. Findings show that no observable significant difference (p>0.05) in DBP of the adult males in gas flaring communities based on duration of exposure. The DBP of the adult females in gas flaring communities with duration of exposure of 10years above was significantly reduced when compared to those with duration of exposure of 6-10years.

Also, there was significant (p<0.05) increase in DBP of adult males in gas flaring communities with exposure duration of 1-5years and 10years above when compared to those in non-gas flaring communities. There was significant (p<0.05) increase in diastolic blood pressure of adult females in gas flaring communities with exposure duration of 6-10years and 10 years above when compared to those in non-gas flaring communities.

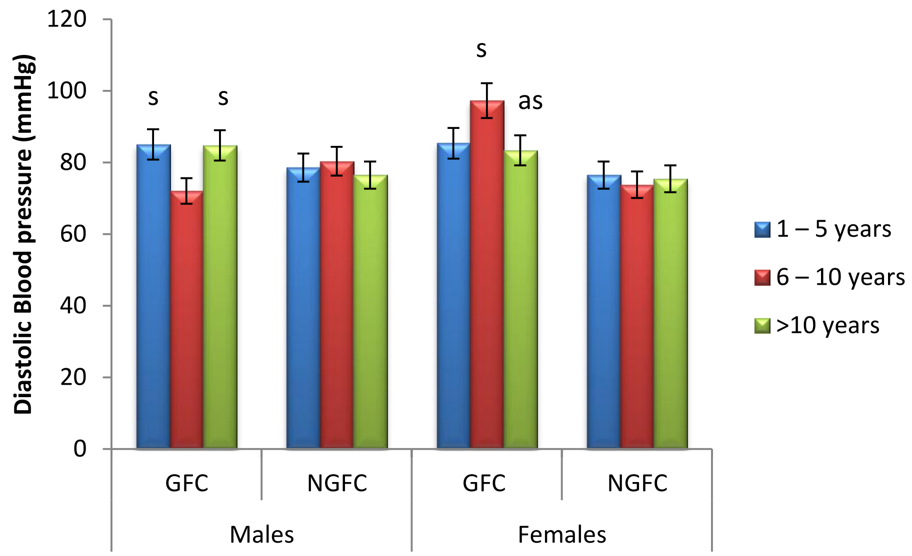


Fig 4.24 Effect of flared gas on Diastolic Component of Blood pressure inAdultresiding in Akwa Ibom State

Values are represented as mean Standard error of mean,
a: p<0.05 when compared to 6 – 10 years s: p<0.05 when compared with NGFC

4.25 Effect of flared gas on Pulse Rate of children residents in Akwa Ibom State

Effect of flared gas on pulse rate of children residents was determined in this study. The results showedno observable significant difference ($p>0.05$) in pulse rate of the male children and female children in gas flaring communities based on duration of exposure in Akwa Ibom State. Comparing the pulse rate of those residing in gas flaring and non-gas flaring communities, no significant difference ($p>0.05$) was observed in pulse rate of the male children and female children in gas flaring communities with different duration of exposure when compared to non-gas flaring communities.

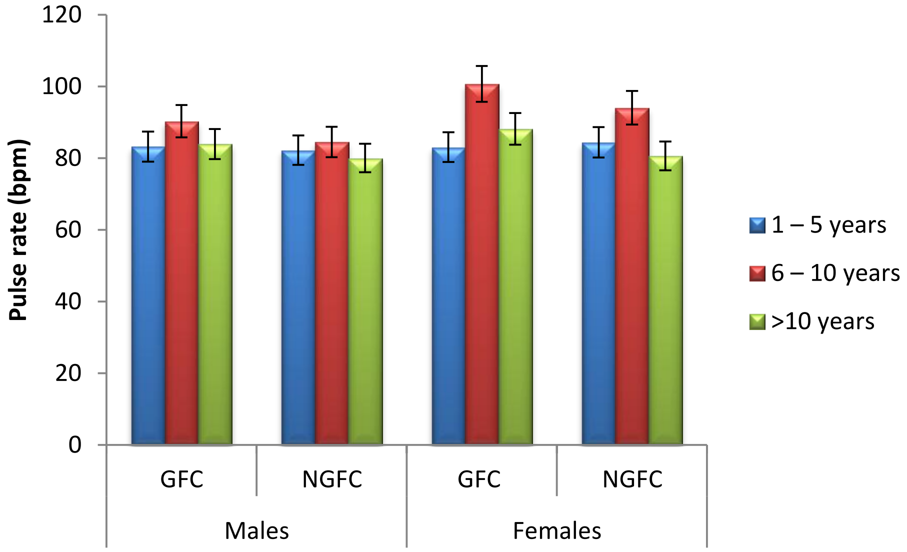


Fig 4.25 Effect of flared gas on Pulse Rate of children residents in Akwa Ibom State

Values were presented as mean Standard error of mean

4.26 Effect of flared gas on Pulse Rate of Adult residents in Akwa Ibom State

This section of the study show the changes in pulse rate of adult residents exposed to gas flare in Akwa Ibom State. Fig 4.26 showednoobservable significant difference ($p>0.05$)in pulse rate of male adults in gas flaring communities based on duration of exposure in Akwa Ibom State. However, there was significant ($p<0.05$) increase in pulse rate of female adults with exposure duration above 10 years when compared to those with exposure duration of 1-5years and 6-10years respectively.

Comparing the pulse rate of those residing in gas flaring and non-gas flaring communities, no significant difference ($p>0.05$) was observed in male adults in gas flaring communities with different duration of exposure when compared to non-gas flaring communities. However, there was significant ($p<0.05$) increase in pulse rate of adult females in gas flaring communities with exposure duration above 10years when compared to those in non-gas flaring communities.

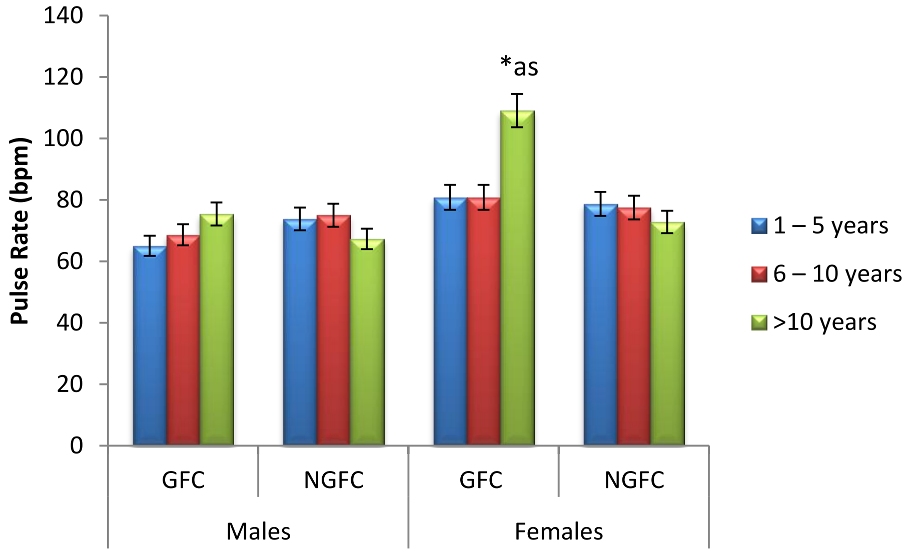


Fig 4.26 Effect of flared gas on Pulse Rate of Adult residents in Akwa Ibom State

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.27 Effect of flared gas on Respiratory Rate of children residents in Akwa Ibom State

The study shows the effect of flared gas on respiratory rate of children residents in Akwa Ibom State. Fig 4.27 indicated no observable significant difference (p>0.05) in respiratory rate of the male children and female children in gas flaring communities based on duration of exposure in Akwa Ibom State.

Comparing the respiratory rate of those residing in gas flaring and non-gas flaring communities, no significant difference (p>0.05) was observed in respiratory rate of the male children and female children in gas flaring communities with different duration of exposure when compared to non-gas flaring communities.

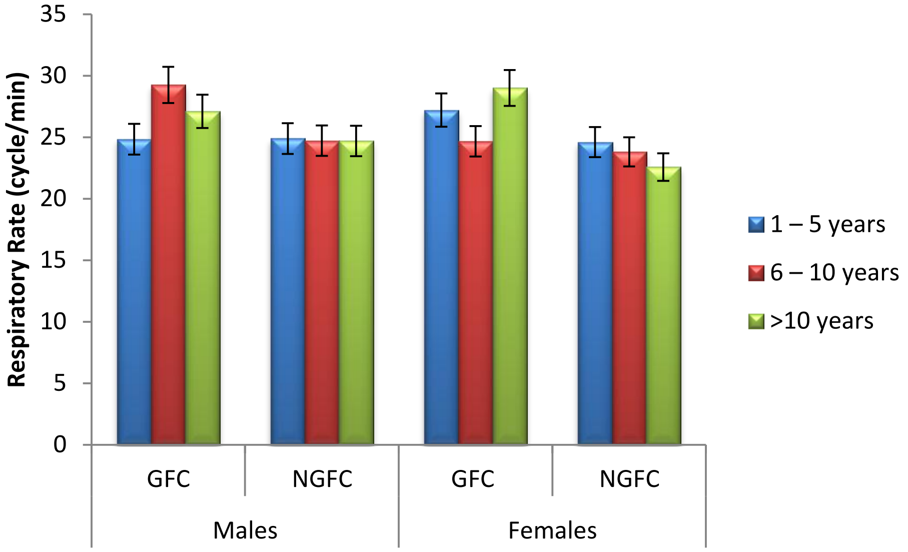


Fig 4.27 Effect of flared gas on Respiratory Rate of children residents in Akwa Ibom State

Values were presented as mean Standard error of mean, *: p<0.05 when compared to 1 – 5 years a: p<0.05 when compared to 6 – 10 years s: p<0.05 when compared with NGFC

4.28 Effect of flared gas on Respiratory Rate of Adult residents in Akwa Ibom State

This aspect of the study shows the effect of gas flaring of respiratory rate of adult residents in Akwa Ibom State. The study revealed no observable significant difference ($p>0.05$) in respiratory rate of male adults in gas flaring communities based on duration of exposure in Akwa Ibom State. However, there was significant ($p<0.05$) increase in respiratory rate of female adults with exposure duration above 10 years when compared to those with exposure duration of 1-5years and 6-10years respectively.

Comparing the respiratory rate of those residing in gas flaring and non-gas flaring communities, significant difference ($p>0.05$) was not observed in respiratory rate of the male adults in gas flaring communities with different duration of exposure when compared to non-gas flaring communities. However, there was significant ($p<0.05$) increase in respiratory rate of adult females in gas flaring communities with exposure duration above 10years when compared to those in non-gas flaring communities.

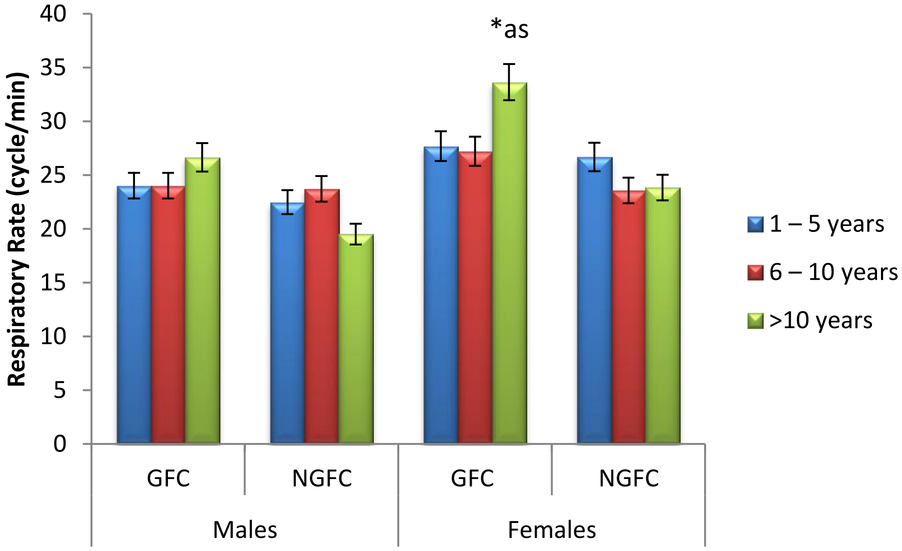


Fig 4.28: Effect of flared gas on Respiratory Rate of Adult residents in Akwa Ibom State

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.29 Effect of flared gas on Peak Expiratory Flow Rate (PEFR) of Children residents in Akwa Ibom State

This study shows changes in gas flaring on PEFR of children residents in Akwa Ibom. The findings of thisstudy showed no observable significant difference (p>0.05) in peak expiratory flow rate of the male children and female children in gas flaring communities based on duration of exposure in Akwa Ibom State. Comparing the peak expiratory flow rate of residents in gas flaring and non-gas flaring communities, was no significant difference (p>0.05) in peak expiratory flow rate of the male children and female children in gas flaring communities with different duration of exposure when compared to non-gas flaring communities.

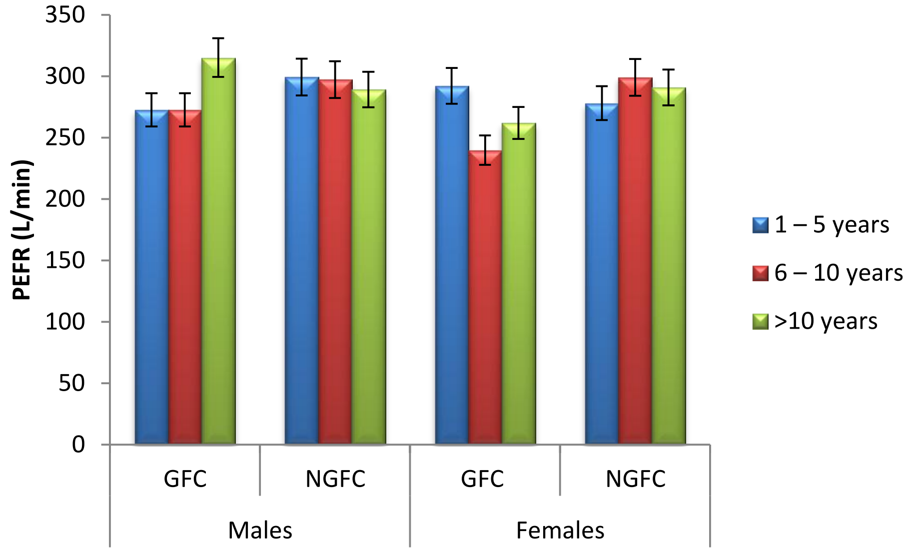


Fig 4.29 Effect of flared gas on Peak Expiratory Flow Rate of Children residents in Akwa Ibom State

Values were presented as mean Standard error of mean,

4.30 Effect of flared gas on Peak Expiratory Flow Rate (PEFR) of Adult residents in Akwa Ibom State

The findings of thisstudy showPEFR of adult residents exposed to gas flaring in Akwa Ibom State. There was no observable significant difference (p>0.05) in PEFR of the male adults in gas flaring communities based on duration of exposure in Akwa Ibom State. However, there was significant (p<0.05) increase PEFR of female adults with exposure duration above 10 years when compared to those with exposure duration of 1-5years.

There was no observable significant difference (p>0.05) in PEFR of the female adults in gas flaring communities with different duration of exposure when compared to non-gas flaring communities. However, there was significant (p<0.05) decrease PEFR of adult males in gas flaring communities with exposure duration of 6-10years when compared to those in non-gas flaring communities.

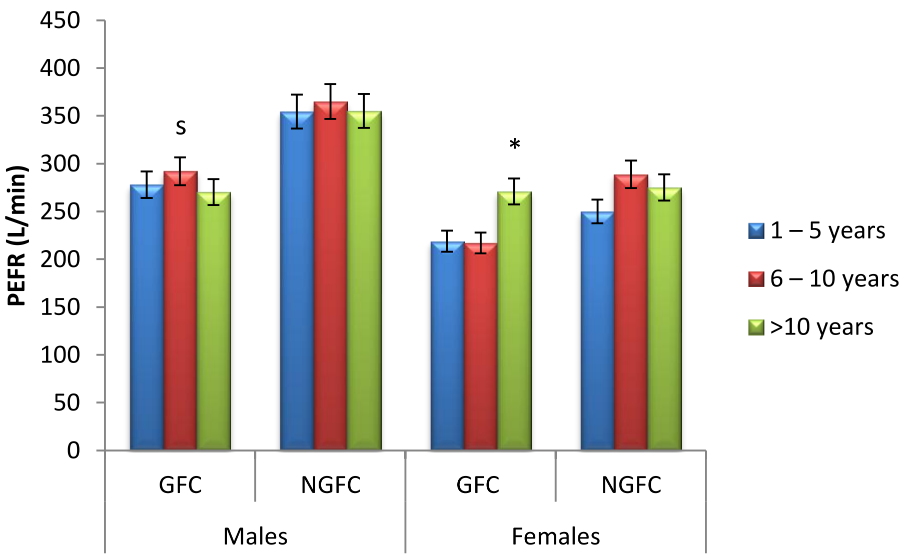


Fig 4.30 Effect of flared gas on Peak Expiratory Flow Rate of Adult residents in Akwa Ibom State

Values were presented as mean Standard error of mean, *: p<0.05 when compared to 1 – 5 years a: p<0.05 when compared to 6 – 10 years s: p<0.05 when compared with NGFC

4.31 Effect of flared gas on Systolic Blood Pressure (SBP) of children residents in Bayelsa State.

Table 4.4.1 shows no observable significant difference (p>0.05) in SBP of male children, female children and male adults in gas flaring communities based on duration of exposure in Bayelsa State. However, there was significant (p<0.05) increase in SBP of female adults with exposure duration above 10 years when compared to those with exposure duration of 1-5years. Furthermore, there was significant (p<0.05) increase in SBP of adult males in gas flaring communities with exposure duration of 1-5, 6-10 and above 10years when compared to those in non-gas flaring communities.

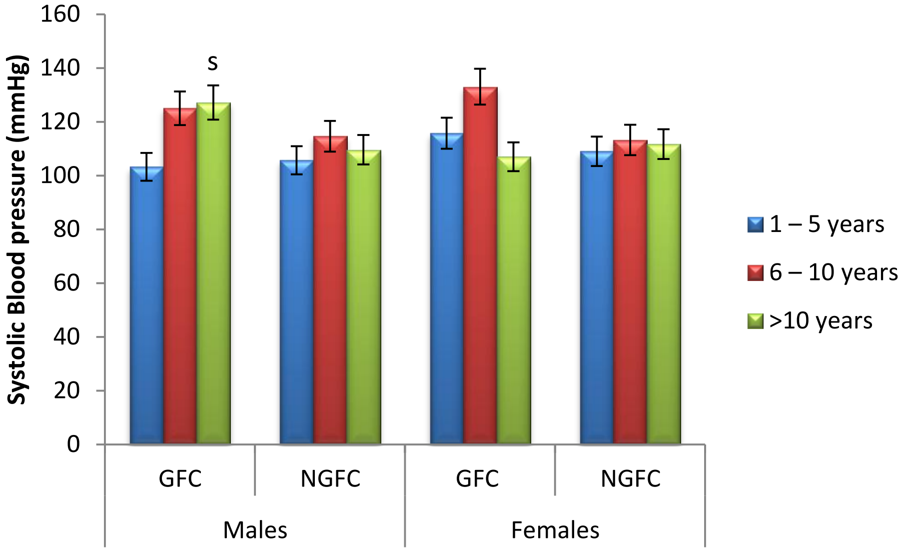


Fig 4.31 Effect of flared gas on Systolic Blood Pressure of children residents in Bayelsa State.

Values were presented as mean Standard error of mean,
s: p<0.05 when compared with NGFC

4.32 Effect of flaredgas on Systolic Blood Pressure (SBP) of adult residents in Bayelsa State.

Fig 4.32 shows the effect of gas flaring in SBP of adult residing in Bayelsa State. Findings from this study shows no observable significant difference ($p>0.05$) in systolic blood pressure of male adults in gas flaring communities based on duration of exposure in Bayelsa State. However, there was significant ($p<0.05$) increase in SBP of female adults with exposure duration above 10 years when compared to those with exposure duration of 1-5years. There was significant ($p<0.05$) increase in SBP of adult males in gas flaring communities with exposure duration of 1-5, 6-10 and above 10years when compared to those in non-gas flaring communities.

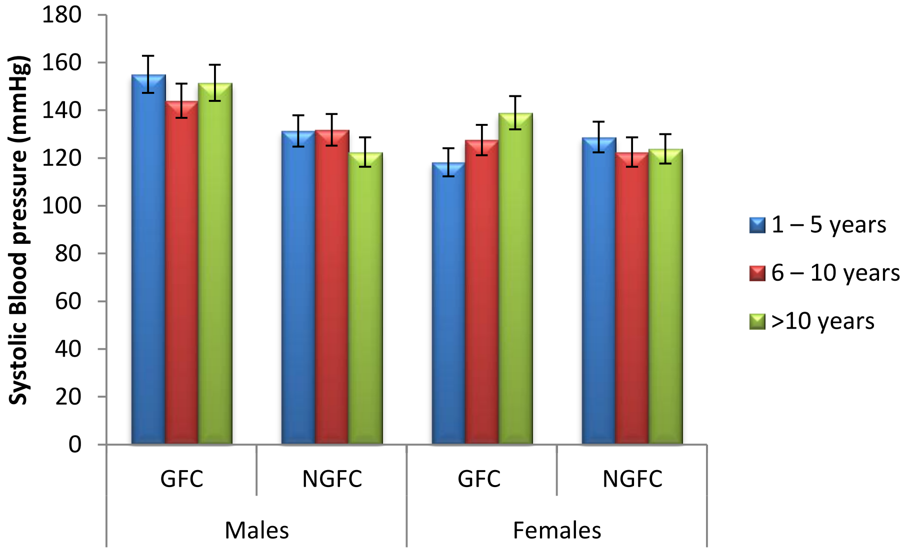


Fig 4.32 Effect of flaredgas on Systolic Blood Pressure of adult residents in Bayelsa State.

Values are represented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.33 Effect of gas flaring on Diastolic Blood Pressure of children residents in Bayelsa State.

This section of the study shows the effect of gas flaring on diastolic blood pressure of children residents in Bayelsa State. Data show that there was no significant difference ($p>0.05$) in diastolic blood pressure of male children and female children in gas flaring communities based on duration of exposure in Bayelsa State.

Comparing the diastolic blood pressure of residents in gas flaring and non-gas flaring communities, there was significant ($p<0.05$) increase in diastolic blood pressure of the male children in gas flaring communities with exposure duration above 10years when compared to non-gas flaring communities. There was no significant difference ($p>0.05$) in diastolic blood pressure of the female children in gas flaring communities with different exposure duration when compared to non-gas flaring communities.

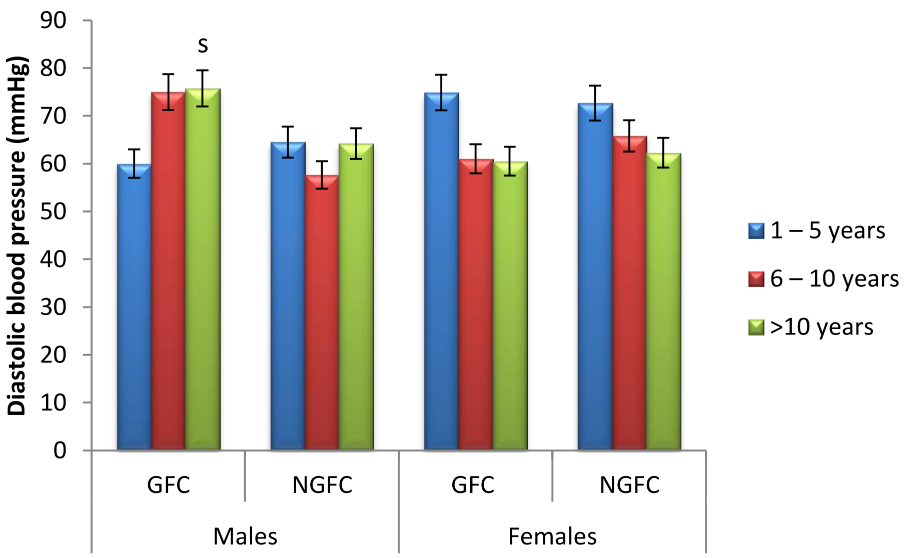


Fig. 4.33 Effect of gas flaring on Diastolic Blood Pressure of children residents in Bayelsa State.

Values are represented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.34 Effect of gas flaring on Diastolic Blood Pressure of Adult residents in Bayelsa State.

This part of the study shows the effect of gas flaring on diastolic blood pressure of adult residents in Bayelsa State. Fig 4.34 show that there was no significant difference (p>0.05) in diastolic blood pressure of female adult in gas flaring community.However, there was significant (p<0.05) increase in diastolic blood pressure of male adults with exposure duration above 10 years when compared to those with exposure duration of 1-5years.

Also, there was significant (p<0.05) increase in diastolic blood pressure of adult males in gas flaring communities with exposure duration of 6-10 and above 10years when compared to those in non-gas flaring communities. However, there was no significant difference (p>0.05) in diastolic blood pressure of the female adults in gas flaring communities with different exposure duration when compared to non-gas flaring communities.

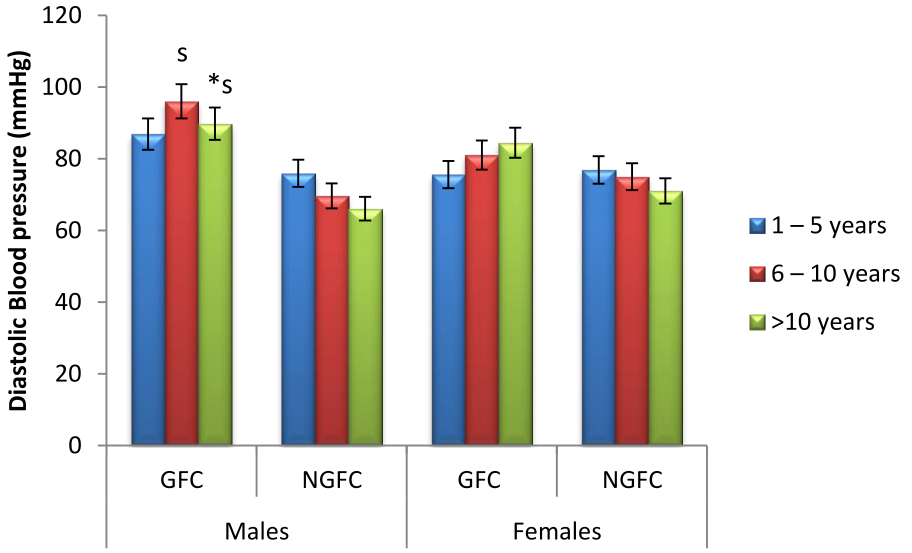


Fig 4.34 Effect of gas flaring on Diastolic Blood Pressure of Adult residents in Bayelsa State.

Values are represented as mean Standard error of mean, *: p<0.05 when compared to 1 – 5 years a: p<0.05 when compared to 6 – 10 years s: p<0.05 when compared with NGFC

4.35 Effect of flared gas on Pulse Rate of Children residents in Bayelsa State.

This study shows the effect of flared gas on pulse rate of children residents in Bayelsa State. The figure on this section shows no observable significant difference (p>0.05) in pulse rate of male children and female children in gas flaring communities based on duration of exposure in Bayelsa State.

Comparing the pulse rate of those living in gas flaring and non-gas flaring communities, there was significant (p<0.05) increase in pulse rate of the male children in gas flaring communities with exposure duration above 10years when compared to non-gas flaring communities. There was no observable significant difference (p>0.05) in pulse rate of the female children in gas flaring communities with different exposure duration when compared to non-gas flaring communities.

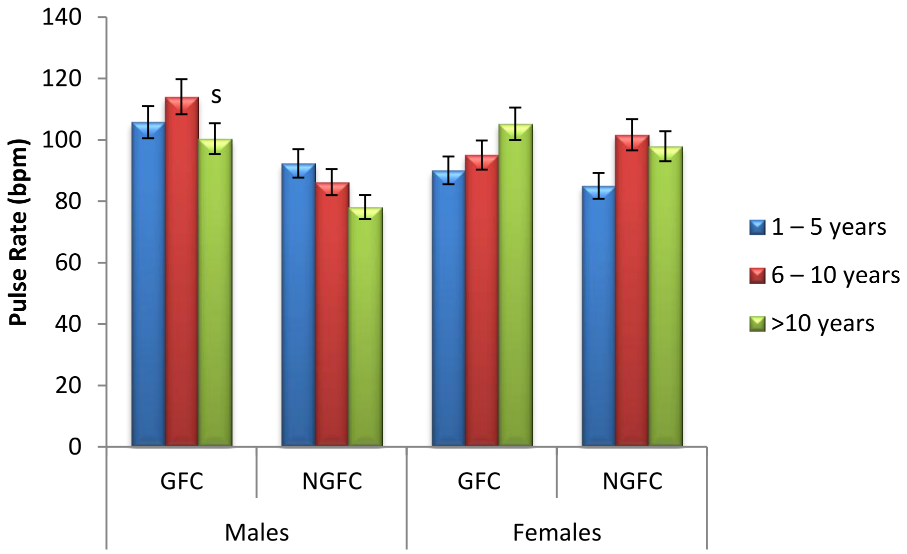


Fig 4.35 Effect of flared gas on Pulse Rate of Children residents in Bayelsa State.

Values were presented as mean Standard error of mean,
s: p<0.05 when compared with NGFC

4.36 Effect of flared gas on Pulse Rate of Adult residents in Bayelsa State.

Data from this section of the study show the effect of flared gas on pulse rate of adult residents in Bayelsa State. It was shown that there was no observable significant difference ($p>0.05$) in pulse rate of male adults and female adults in gas flaring communities based on duration of exposure in Bayelsa State. Furthermore, there was significant ($p<0.05$) increase in pulse rate of adult males in gas flaring communities with exposure duration above 10years when compared to those in non-gas flaring communities. However, there was no observable significant difference ($p>0.05$) pulse rateof female adults in gas flaring communities with different exposure duration when compared to non-gas flaring communities.

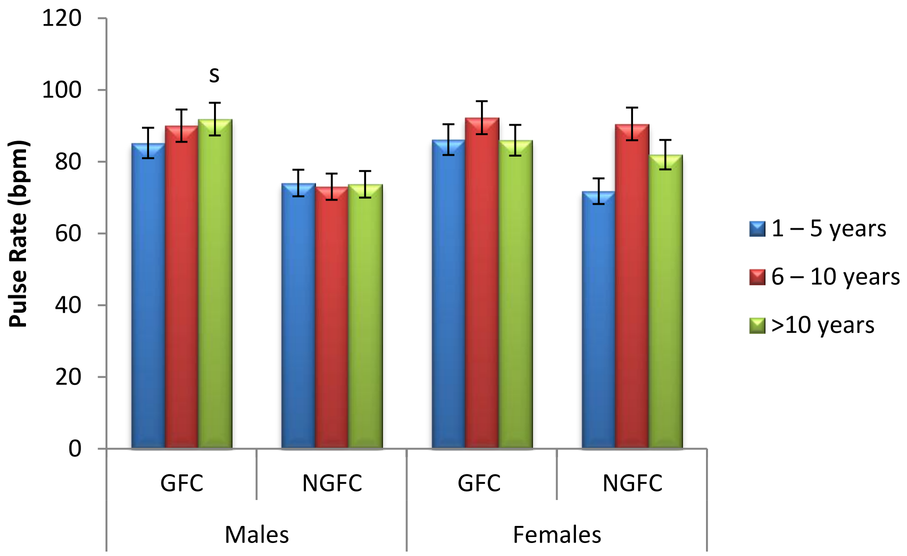


Fig 4.36 Effect of flared gas on Pulse Rate of Adult residents in Bayelsa State.

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.37 Effect of flared gas on Respiratory Rate of children residents in Bayelsa State.

This part of the study shows the changes in respiratory rate of children residents in Bayelsa State. It was shown that there was no observable significant difference ($p>0.05$) in respiratory rate of male children and female children, in gas flaring communities based on duration of exposure in Bayelsa State.

Comparing the respiratory rate of those living in gas flaring and non-gas flaring communities, there was significant ($p<0.05$) increase in respiratory rate of the male children in gas flaring communities with exposure duration above 10years when compared to non-gas flaring communities. There was no observable significant difference ($p>0.05$) in respiratory rate of the female children in gas flaring communities with different exposure duration when compared to non-gas flaring communities.

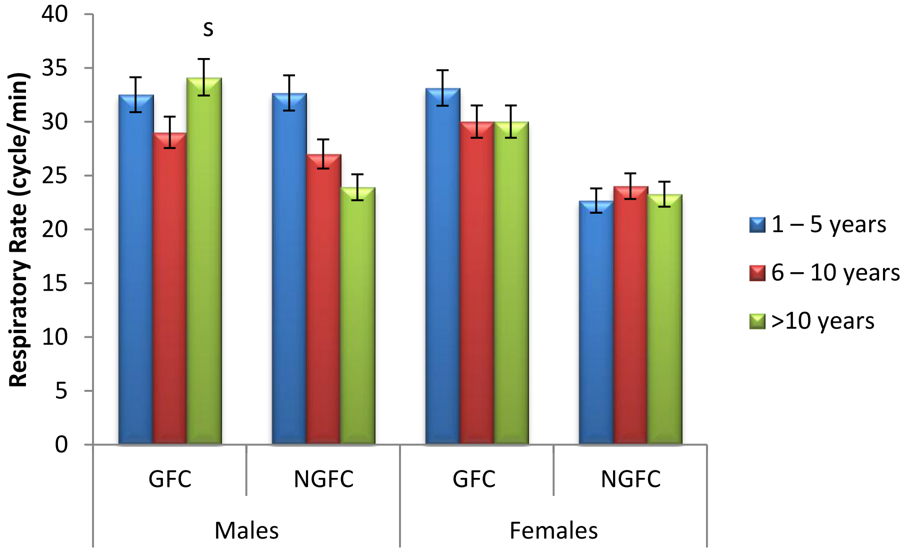


Fig 4.37 Effect of flared gas on Respiratory Rate of children residents in Bayelsa State.

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.38 Effect of flared gas on Respiratory Rate of Adult residents in Bayelsa State

The effect of flared gas on respiratory rate of adult residents in Bayelsa State was ascertained in this study. Result showedno observable significant difference (p>0.05) in respiratory rate of male adults and female adults in gas flaring communities based on duration of exposure in Bayelsa State. There was significant (p<0.05) increase in respiratory rate of adult males in gas flaring communities with exposure duration of 1-5years and above 10years when compared to those in non-gas flaring communities. Also, there was significant (p<0.05) increase in respiratory rate of adult females in gas flaring communities with exposure duration of 1-5years and above 10years when compared to those in non-gas flaring communities.

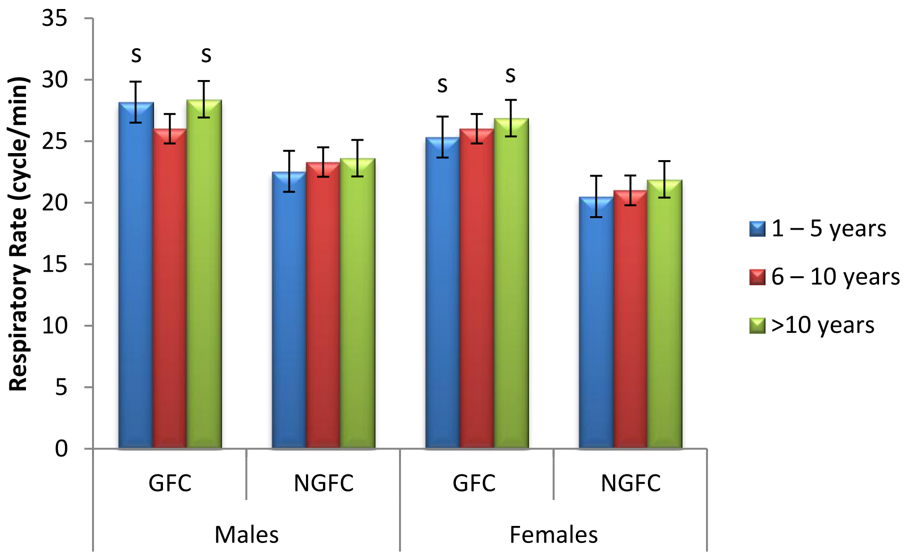


Fig 4.38 Effect of flared gas on Respiratory Rate of Adult residents in Bayelsa State.

Values were presented as mean Standard error of mean
s: p<0.05 when compared with NGFC

4.39 Effect of flared gas on Peak Expiratory Flow Rate (PEFR) of Children residents in Bayelsa State.

This study shows the effect of gas flaring on PEFR of Children residents in Bayelsa State. Data showedno observable significant difference (p>0.05) in peak expiratory flow rate of male children and female children in gas flaring communities based on duration of exposure in Bayelsa State.

Comparing the (PEFR) of those living in gas flaring and non-gas flaring communities, there was no observable significant difference (p>0.05) in peak expiratory flow rate of male children and female children in communities with different exposure duration when compared to non-gas flaring communities.

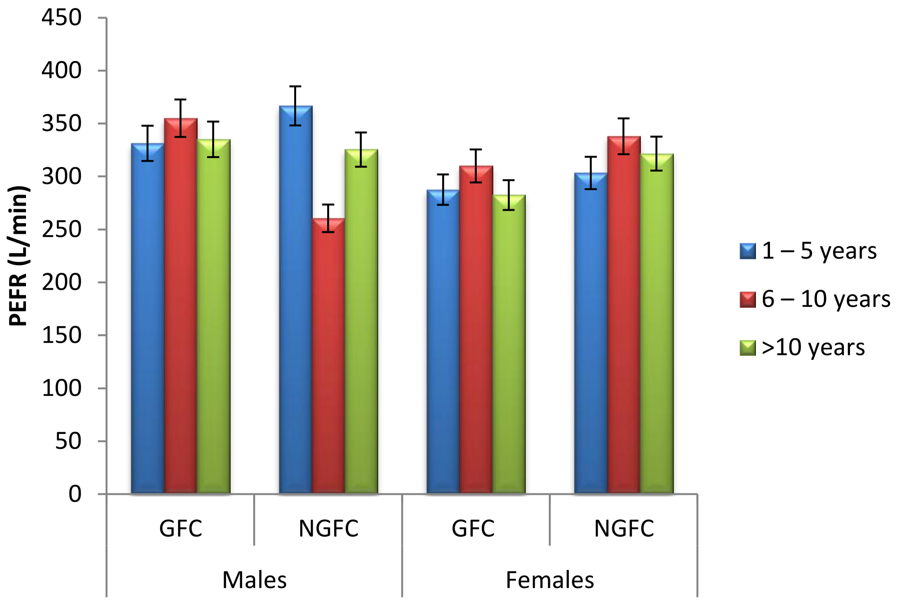


Fig 4.39 Effect of flared gas on Peak Expiratory Flow Rate of Children residents in Bayelsa State.

Values were presented as mean Standard error of mean, *: p<0.05 when compared to 1 – 5 years a: p<0.05 when compared to 6 – 10 years s: p<0.05 when compared with NGFC

4.40 Effect of flared gas on Peak Expiratory Flow Rate (PEFR) of Adult residents in Bayelsa State.

This section of the study showed no observable significant difference ($p>0.05$) in PEFR of male adults and female adults in gas flaring communities based on duration of exposure in Bayelsa State.

Comparing the PEFR of those living in gas flaring and non-gas flaring communities, there was no observable significant difference ($p>0.05$) in PEFR of male adults in communities with different exposure duration when compared to non-gas flaring communities. However, there was significant ($p<0.05$) increase in PEFR of adult females in gas flaring communities with exposure duration of 1-5years, 6-10 years and above 10years when compared to those in non-gas flaring communities.

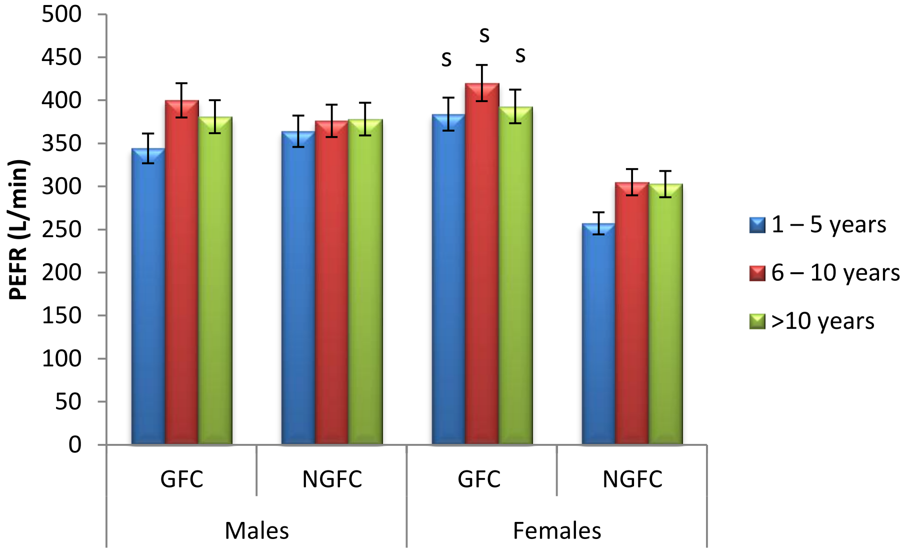


Fig 4.40 Effect of flared gas on Peak Expiratory Flow Rate of Adult residents in Bayelsa State.

Values are represented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.41 Effect of flared gas on Systolic Blood pressure (SBP) of children residents in Delta State

This study shows the effect of flared gas on SBP of children residents in Delta State. Findings from this study show that gas flaring increased the systolic blood pressure of the male children. It also shows that there was no significant difference ($p>0.05$) in SBP of male children and female children in gas flaring communities based on duration of exposure in Delta State.

Comparing the SBP of those living in gas flaring and non-gas flaring communities, there was significant ($p<0.05$) elevation in SBP of female children in gas flaring communities with duration of exposure duration of 1-5years and 10 years above when compared to non-gas flaring communities. There was no observable significant difference ($p>0.05$) in SBP of male children in gas flaring communities with different duration of exposure when compared to non-gas flaring communities.

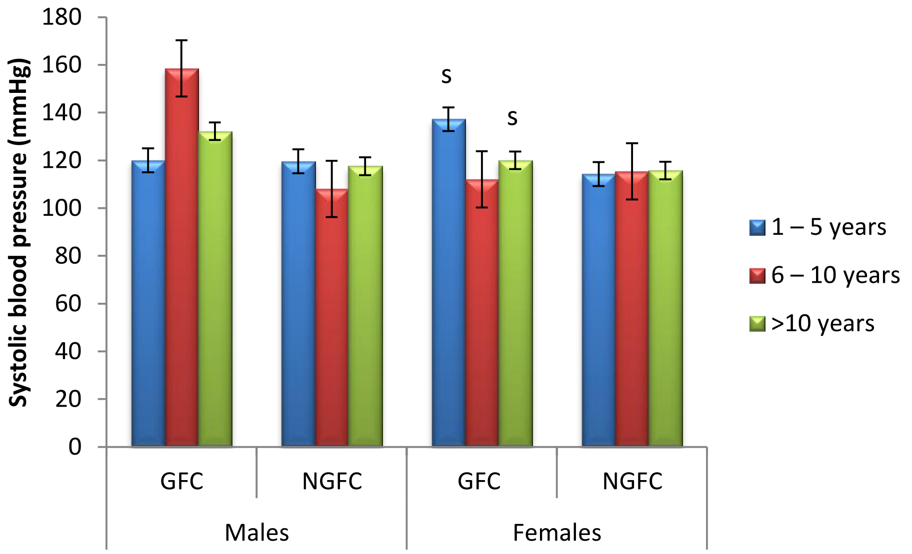


Fig 4.41 Effect of flared gas on Systolic Blood pressure of children residents in Delta State

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

4.42 Effect of flared gas on Systolic Blood pressure (SBP) of Adult residents in Delta State

This section of thestudy show the changes on SBP of adult subject exposed to gas flaring in Delta State. It was observed that there was no observable significant difference ($p>0.05$) in systolic blood pressure of male adults and female adults in gas flaring communities based on duration of exposure in Delta State.

Also, there was no observable significant difference ($p>0.05$) in SBP of male adults in gas flaring communities with different duration of exposure when compared to non-gas flaring communities. However, there was significant ($p<0.05$) increase in SBP of adult females in gas flaring communities with exposure duration above 10years when compared to those in non-gas flaring communities.

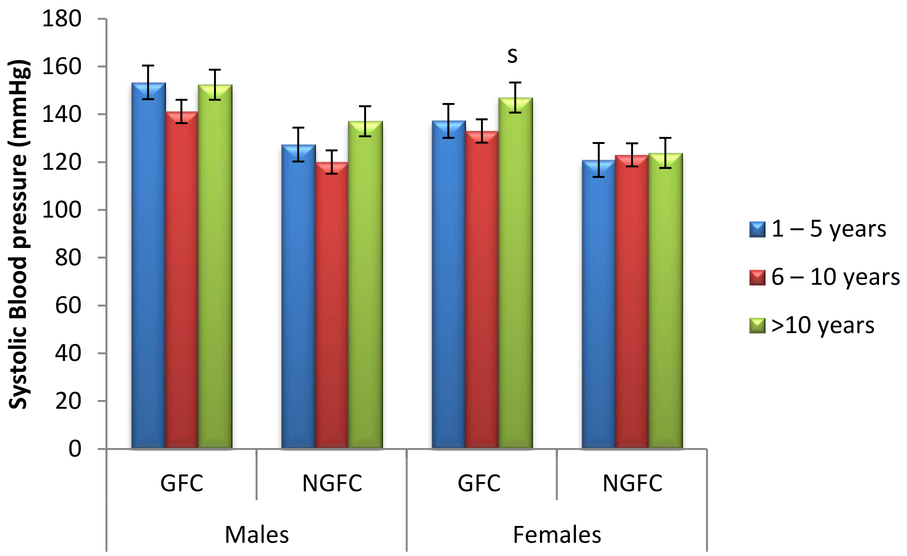


Fig 4.42Effect of flared gas on Systolic Blood pressure of Adult residents in Delta State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.43 Effect of flared gas on Diastolic Blood pressure (DBP) of Children residents in Delta State

The effect of flared gas on DBP of children residents in Delta State was assessed in this study. It was observed that there was no observable significant difference (p>0.05) in DBP of male children and female children in gas flaring communities based on duration of exposure in Delta State. Furthermore, comparing the DBP of those living in gas flaring and non-gas flaring communities, there was no observable significant difference (p>0.05) in DBP of male children and female children in gas flaring communities with different duration of exposure when compared to non-gas flaring communities.

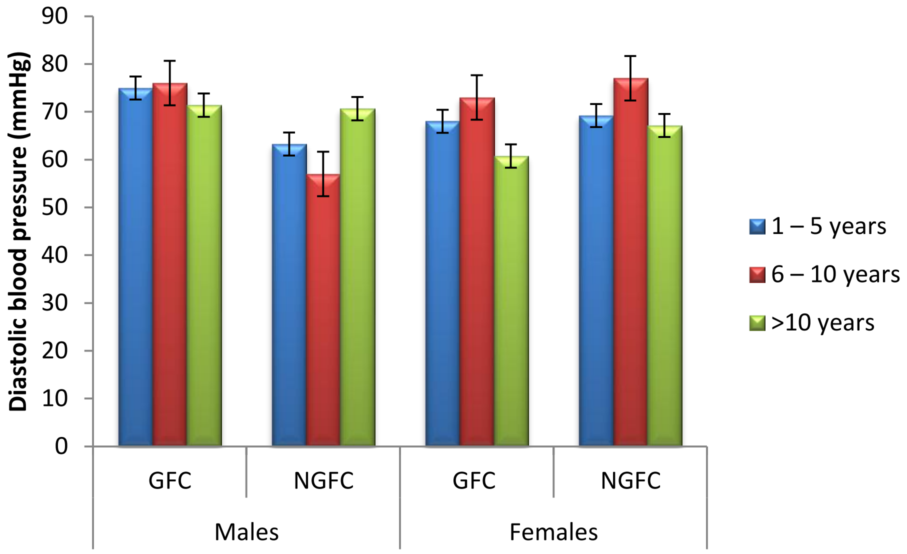


Fig 4.43 Effect of flared gas on Diastolic Blood pressure of Children residents in Delta State

Values were presented as mean Standard error of mean,

4.44 Effect of flared gas on Diastolic Blood pressure (DBP) of Adult residents in Delta State

In this section of the study, the effect of flared gas on DBP of adult living in Delta State was determined. Data show that there was no observable significant difference ($p>0.05$) in diastolic blood pressure of male adults and female adults in gas flaring communities based on duration of exposure in Delta State.

Comparing the DBP of those living in gas flaring and non-gas flaring communities, there was no observable significant difference ($p>0.05$) in DBP of male adults in gas flaring communities with different duration of exposure when compared to non-gas flaring communities. However, there was significant ($p<0.05$) increase in DBP of adult females in gas flaring communities with exposure duration of 1-5years and above 10years when compared to those in non-gas flaring communities.

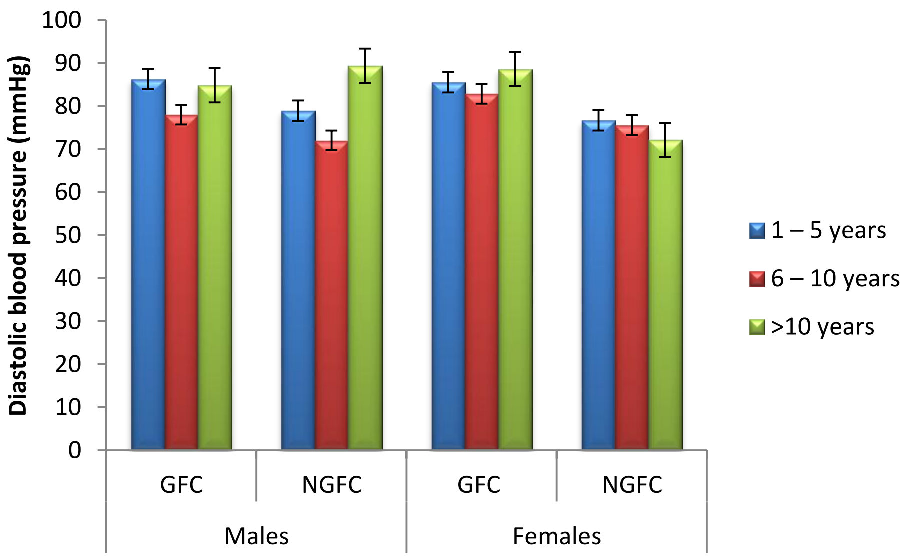


Fig 4.44 Effect of flared gas on Diastolic Blood pressure of Adult residents in Delta State

Values were presented as mean Standard error of mean,

4.45 Effect of flared gas on Pulse Rate of Children residents in Delta State

Changes in the pulse rate of children residents exposed to gas flaring in Delta State was determined in this study. Fig 4.45 show that there was no observable significant difference (p>0.05) in pulse rate of male children and female children in gas flaring communities based on duration of exposure in Delta State.

Comparing the pulse rate of those living in gas flaring and non-gas flaring communities, there was no significant difference (p>0.05) in pulse rate of male children and female children in gas flaring communities with different duration of exposure when compared to non-gas flaring communities.

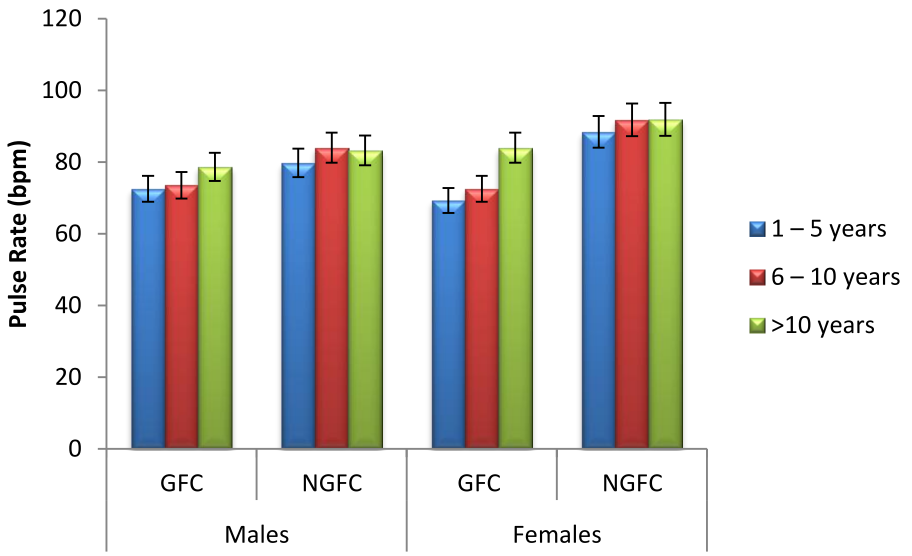


Fig 4.45 Effect of flared gas on Pulse Rate of Children residents in Delta State

Values were presented as mean Standard error of mean,

4.46 Effect of flared gas on Pulse Rate of Adult residents in Delta State

Fig 4.46 shows the effect of flared gas on pulse rate of adult residents in Delta State. Result from the study shows no observable significant difference ($p>0.05$) in pulse rate of male adults and female adults in gas flaring communities based on duration of exposure in Delta State. In comparing the pulse rate of those living in gas flaring and non-gas flaring communities, there was no observable significant difference ($p>0.05$) in pulse rate of female adults in gas flaring communities with different duration of exposure when compared to non-gas flaring communities. However, there was significant ($p<0.05$) increase in pulse rate of adult males in gas flaring communities with exposure duration of 1-5years when compared to those in non-gas flaring communities.

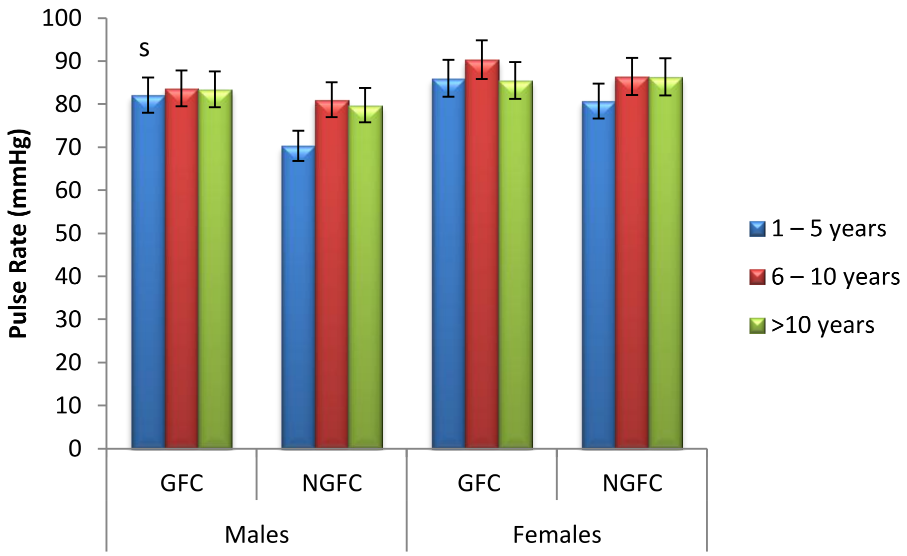


Fig 4.46 Effect of flared gas on Pulse Rate of Adult residents in Delta State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.47 Effect of flared gas on Respiratory Rate of Children residents in Delta State

Data from this study show the changes in respiratory rate of children exposed to gas flare in Delta State. It was observed that there was no observable significant difference ($p>0.05$) in respiratory rate of male as well as female children in gas flaring communities based on duration of exposure in Delta State.

Comparing the respiratory rate of residents in gas flaring and non-gas flaring communities, there was significant ($p<0.05$) increase in respiratory rate of male and female children in gas flaring communities with exposure duration above 10years when compared to non-gas flaring communities.

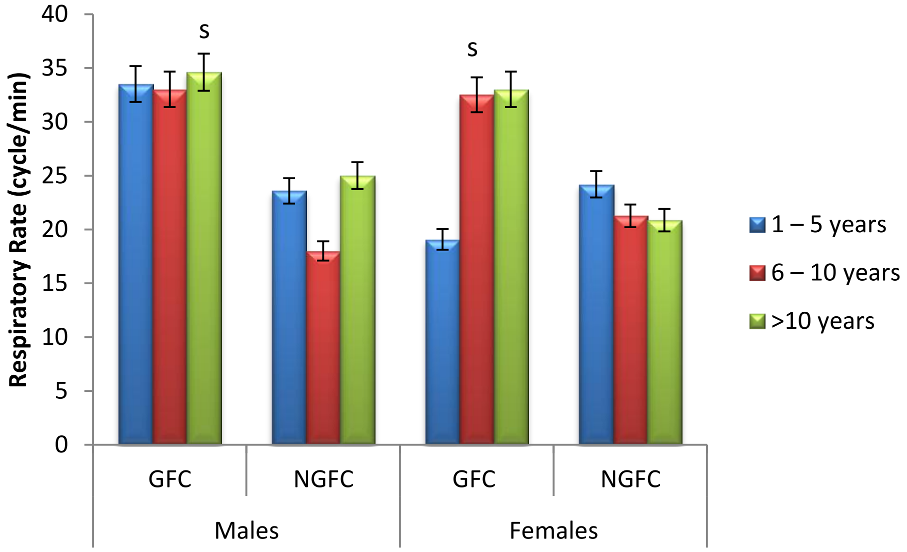


Fig 4.47 Effect of flared gas on Respiratory Rate of Children residents in Delta State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.48 Effect of gas flaring on Respiratory Rate of Adult residents in Delta State

In this study, the effect of flared gas on respiratory rate of adult residents in Delta State was examined. Data show that there was significant ($p<0.05$) reduction in respiratory rate of male adults in gas flaring communities with duration of exposure above 10 years. There was also significant ($p<0.05$) reduction in respiratory rate of male adults in gas flaring communities with duration of exposure above 10 years.

Furthermore, there was significant ($p<0.05$) increase in respiratory rate of male adults in gas flaring communities with different exposure duration when compared to non-gas flaring communities. There was significant ($p<0.05$) increase in respiratory rate of female adults in gas flaring communities with duration of exposure of 6-10years and 10years above when compared to non-gas flaring communities.

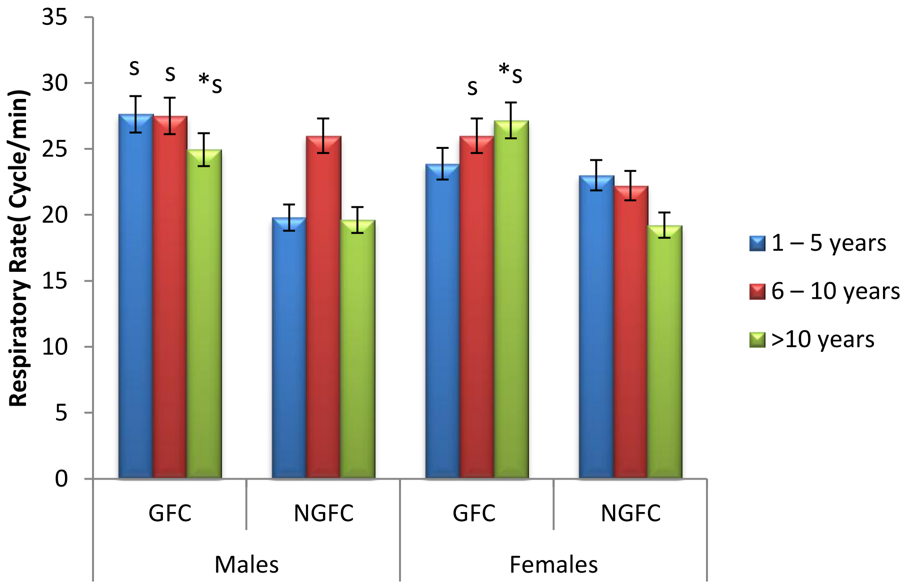


Fig 4.48 Effect of flared gas on Respiratory Rate of Adult residents in Delta State

Values were presented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years s: $p<0.05$ when compared with NGFC

4.49 Effect of flared gas on Peak Expiratory Flow Rate (PEFR) of Children residents in Delta State

This section of the study shows the effect of flared gas on PEFR of children in Delta State. Results show that there was significant difference ($p>0.05$) in PEFR of male as well as female children in gas flaring communities based on duration of exposure in Delta State.

In comparing the PEFR of those living in gas flaring and non-gas flaring communities, there was significant ($p<0.05$) decrease in PEFR of male as well as female children in gas flaring communities irrespective of duration to exposure.

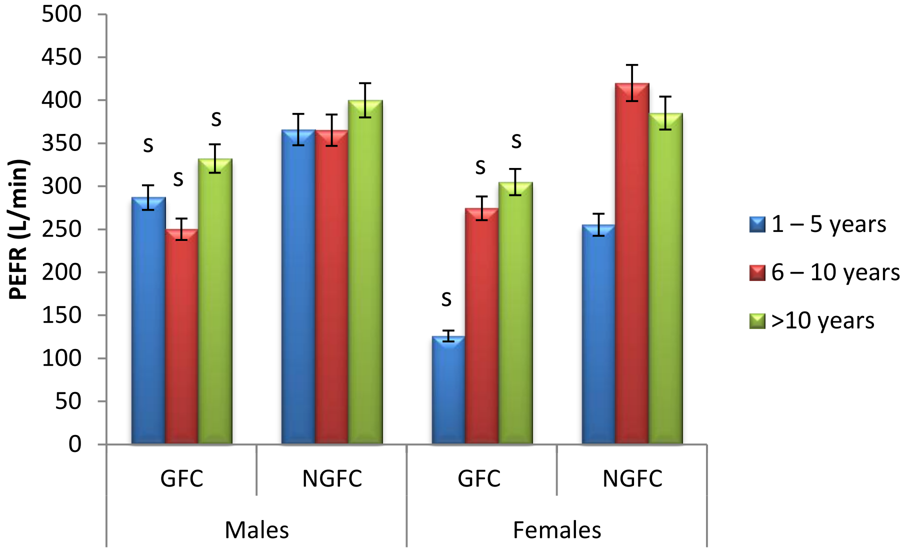


Fig 4.49Effect of flaredgas on Peak Expiratory Flow Rate of Children residents in Delta State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.50 Effect of flared gas on Peak Expiratory Flow Rate (PEFR) of Adult residents in Delta State

Fig 4.50 shows the effect of flared gas on PEFR of adult residents in Delta State. It was observed that there was significant difference ($p>0.05$) in PEFR of male adult and female adult in gas flaring communities based on duration of exposure in Delta State.

There was also significant ($p<0.05$) decrease in PEFR of male as well as female adults in gas flaring communities with different exposure duration when compared to non-gas flaring communities.

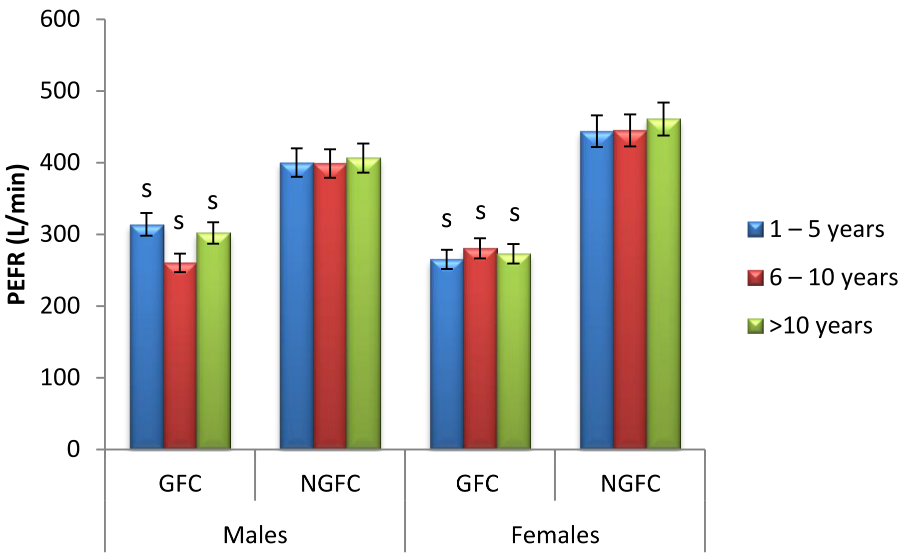


Fig 4.50 Effect of flared gas on Peak Expiratory Flow Rate of Adult residents in Delta State

Values were presented as mean Standard error of mean,
s: $p<0.05$ when compared with NGFC

4.6.0 Gender Variation on the Impact of Flared Gas on Cardiopulmonary parameters.

MALE				FEMALE		
PARAMETERS	GFC	NGFC	IMPACT	GFC	NGFC	IMPACT
SYSTOLIC (mmHg)	135.62 ± 7.58	126.50 ± 6.87	9.12 ± 1.25	129.86 ± 11.03	120.41 ± 15.03	9.45 ± 1.18
DIASTOLIC(mmHg)	78.55 ± 2.30	69.94 ± 5.88	8.61 ± 0.12	76.04 ± 9.56	72.20 ± 4.95	3.84 ± 5.32
PULSE RATE (beats/min)	84.87 ± 14.08	73.36 ± 8.04	11.51 ± 1.01	88.75 ± 7.36	86.74 ±12.01	2.01 ± 0.05
RESPIRATORY RATE (cycle/min)	28.67 ± 1.64	24.76 ± 1.55	3.91 ± 0.05	28.23 ± 1.78	22.76 ± 1.89	5.47 ± 0.05
PEFR (litres/min)	303.18 ± 23.56	340.88 ± 25.47	37.70 ± 1.02	278.09 ± 15.12	307.99 ± 18.03	29.90 ± 2.56

4.6.1 Gender VariationOn The Impact Of Flared Gas On Systolic Blood Pressure (SBP)

This study shows the gender variation on the impact of flared gas on SBP. Findings in this study show that the male and female impact factors were -8.5% and -6.7% respectively. There was no statistical significance when the mean SBP of male and female residents were compared.

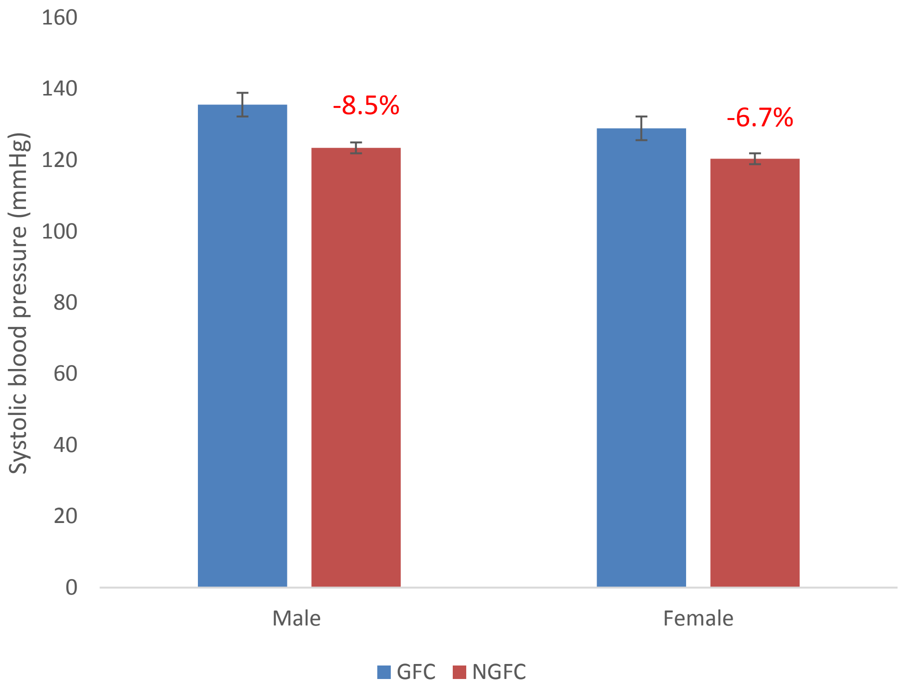


Fig. 4.6.1 Gender Variation On The Impact Of Flared Gas On Systolic Blood Pressure

4.6.2 Gender VariationOnThe Impact Of Gas Flaring On Diastolic Blood Pressure (DBP)

This section of thestudy shows the gender variation on the impact of flared gas on DBP. It was observed that male and female impact factors were -10.96% and -5.05% respectively. The mean DBP was higher in male residents, this was statistically significant ($p<0.05$).

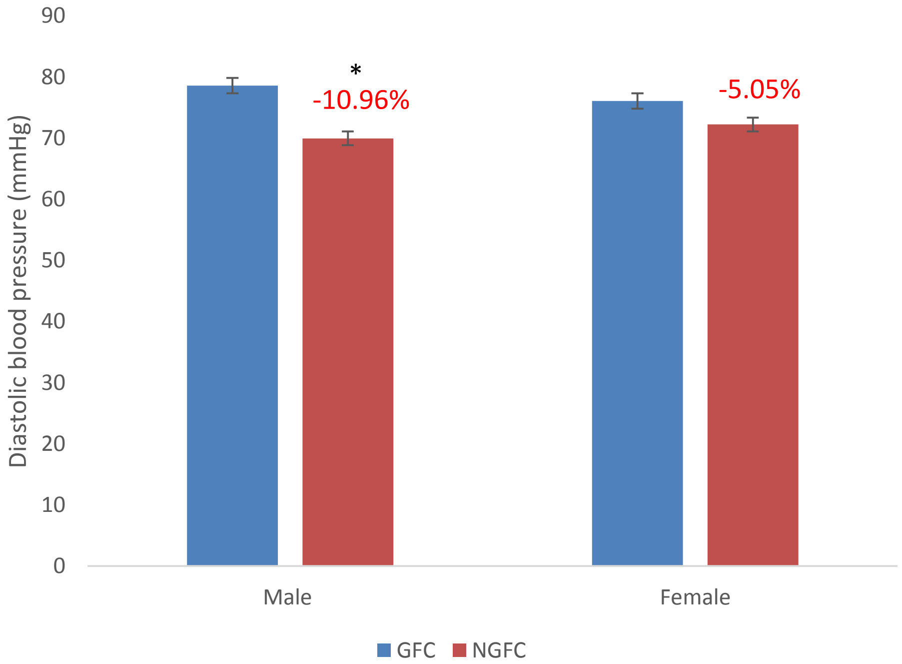


Fig.4.6.2 Gender Variation On The Impact Of Flared Gas On Diastolic Blood Pressure

4.6.3 Gender VariationOnThe Impact Of Flared Gas On Pulse Rate

This aspect of the study shows gender variation on the impact of flared gas on pulse rate. Report shows that male impact factor for pulse rate was 13.53% while the female impact factor was 36.07%. The pulse rate of the female residents was significantly ($p<0.05$) higher than the pulse rate of the male residents.

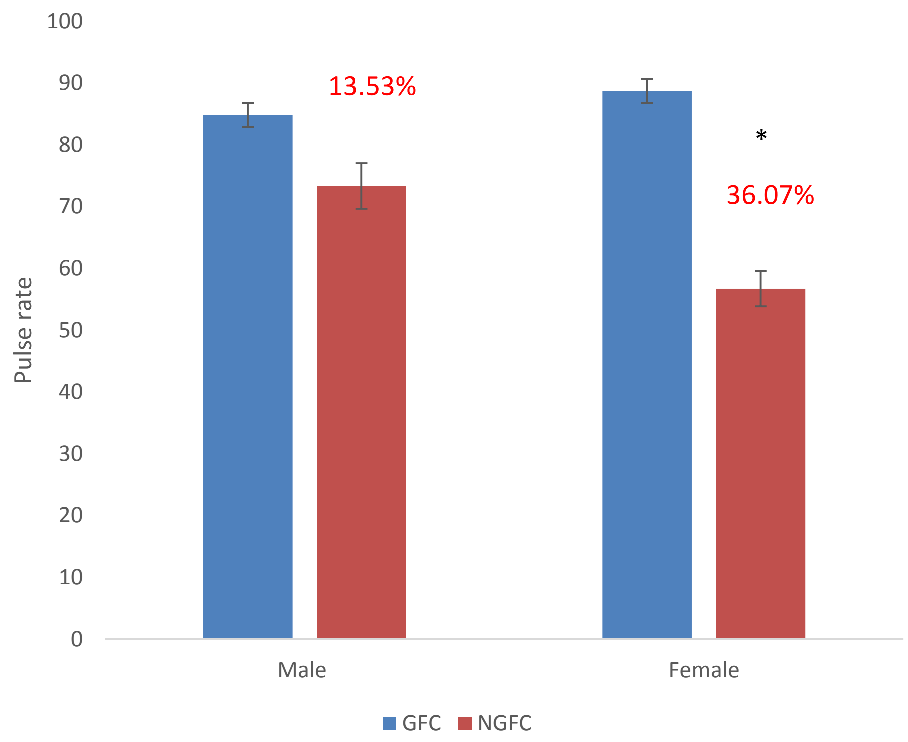


Fig. 4.6.3 Gender Variation On The Impact Of Flared Gas On Pulse Rate

4.6.4 Gender variation on the Impact of flared Gas on Respiratory Rate

This aspect of the study shows the gender variation on the impact of flared gas on respiratory rate. Report shows that male impact factor for respiratory rate was -13.64% while the female impact factor was -19.387%. The respiratory rate of the female residents was higher than that of the male residents, with the female subject more impacted though with no significant difference

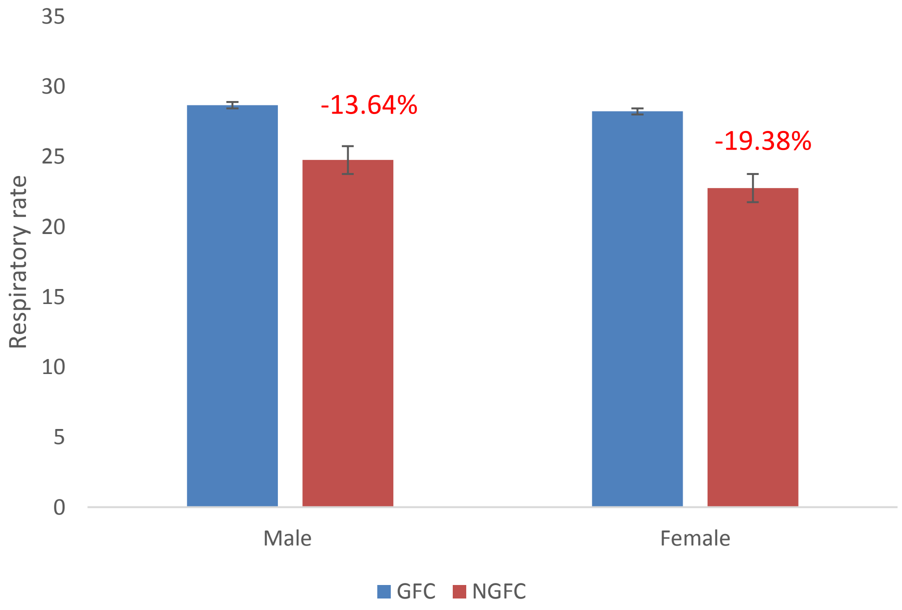


Fig. 4.6.4 Gender variation on the Impact of flared Gas on Respiratory Rate

4.6.5 Gender Variation on The Impact Of Flared Gas On Peak Expiratory Flow Rate (PEFR)

This section of the study show gender variation on the impact of flared gas on PEFR.It was observed that male and female impact factors were +11.06% and +9.715% respectively. The mean PEFR was higher in male residents, this wasstatistically significant (p<0.05).

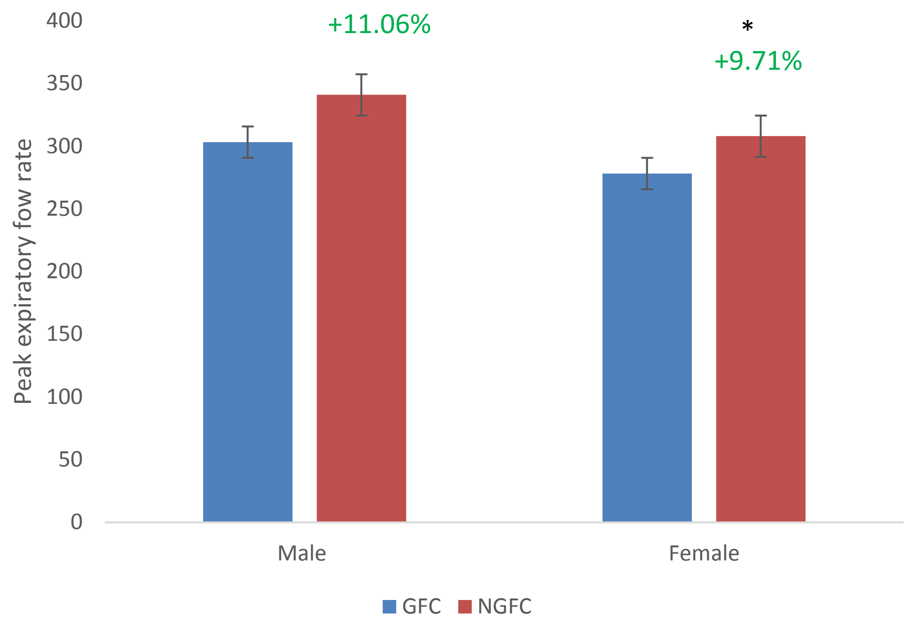


Fig. 4.6.5 Gender Variation on The Impact Of Flared Gas On Peak Expiratory Flow Rate (PEFR)

4.7 Summary of research findings

i. Gas flare increases the mean blood pressure of inhabitants residing in gas flaring area

ii. The result of this study shows that gas flare impacted more on systolic blood pressure than diastolic blood pressure.

iii. There was increase in mean pulse rate of inhabitants residing in gas flaring area

iv. Residents of gas flaring communities have increased mean respiratory rate

v. The mean PEFR of those residing in gas flaring communities reduce markedly

vi. Blood pressure, pulse rate, and respiratory rate of those residing in gas flaring area increases with prolonged time of exposure while the mean peak expiratory flow rate decreases markedly with longer duration of exposure.

vii. Gender of residents affected the impact level of gas flare on some cardiopulmonary parameters

CHAPTER FIVE

DISCUSSION, CONCLUSSION AND RECOMMENDATIONS

5.1 Discussion

The present study evaluated the impact of flared gas on some cardiopulmonary parameters of humans residing in gas flaring communities in some states of the Niger Delta. The cardiopulmonary parameters studied include Blood pressure, pulse, respiratory as well as peak expiratory flow rate.The above parameters of inhabitants residing in gas flaring area in Edo, Rivers, Akwa Ibom, Bayelsa and Delta states were compared with those in non-gas flaring communities.

Furthermore, the cardiopulmonary parameters of children in gas flaring communities were compared with other children in non-gas flaring communities. The study also determined the effect of gas flare on adult residing in gas flaring areas while comparing the cardiopulmonary parameters of children with those of adults studied in communities across the Niger Delta.

Likewise, the study also found the result of gas flare on duration of exposure of residents.This was indicated by a residency period of 1-5years, 6-10years and greater than 10years time of exposure in the gas flaring and non-gas flaring communities.All the residents, children and adults, males and females have different resident's duration of exposure to gas flare.The study also determined the effect of gas flare on males and females. This was carried out by comparing the cardiopulmonary parameters of male residing in gas flaring and non-gas flaring areas in the various states.

Gas flaring and blood pressure

It was observed that gas flare increased systolic Blood pressure (SBP) of male as well as female children with increase in the years of exposure as shown in Figures 4.1, 4.11, 4.2, 4.12, 4.21, 4.22, 4.31, 4.32, 4.41, and 4.42. Data also shows that the systolic blood pressure of both male and female adults increased after exposure to gas flare and this was duration dependent and similar trend were observed across the states as shown in figures 4.1, 4.2, 4.11, 4.12, 4.21, 4.22, 4.31, 4.32, 4.41, and 4.42

On diastolic blood pressure (DBP), it was shown that gas flaring increased the mean diastolic blood pressure of male and female residents compared to those not exposed to gas flare as shown in figures 4.3, 4.4, 4.13, 4.14, etc. The increase in diastolic blood pressure was significant in adult male and female with longer exposure duration as shown in fig. 4.4, 4.14, 4.24, 4.33 and 4.34.

Arising from the results, the study showed that gas flare impacted more on systolic blood pressure when compared with diastolic blood pressure. Although the mean of both parameters give rise to the final blood pressure reading. This observation could be attributed to apparently the physical acute and emotional stress induced by gas flare that maybe transient when compared to the more chronic and physiological episodic stress induced diastolic blood pressure (Juliet, 2015). Another possible reason for the observed higher impact of systolic blood pressure (isolated hypertension) in this study, could be as a result of the exclusion of residents with high body mass index, smokers and alcoholics which are major contributors to isolated diastolic pressure (Matthew, 2010).

From the results obtained there was statistically significant increase in systolic and diastolic blood pressure of the inhabitants residing in the gas flaring area when compared with the non- gas flaring communities (control) ($p<0.05$). This finding agrees with Egwurugwuet al. (2013) who reported a significant elevation in SBP and DBP among residents with prolonged exposure to gas flare in Imo state south eastern Nigeria. The finding also agrees with Adienboet al.(2013) who noted an elevation in SBP and DBP among workers in a solid waste industry in Port Harcourt south south Nigeria that were exposed to Carbon monoxide, particulate matter as well as other chemicals emitted from solid waste that are also components of gas flare. The finding from the study is also in consonant with earlier report by Gong et al.(2003) that healthy inhabitants that were exposed to particulate matter recordedelevated systolic blood pressure.

Earlier studies have noted association between ontogeny of cardiovascular diseases and environmental pollution (CVD)(Jennrich, 2013).The statistically significant elevation in SBP and DBP with hypertension among inhabitants of gas flaring areas in the area under study may be ascribed to the fact that flaring of gas impacts sleep-wake cycle (Perry et al., 2011).Sleep loss is linked with increase prevalence of Hypertension (Legramante and Galante, 2005).Sleep loss lead significant rise in serum norepinephrine and sympathetic activity, venous endothelial dysfunction and hypertension (Detton*et al.,* 2012). Sleep loss lowered plasma angiotensin II concentrations, raised renal sympathetic nerve activity and probably increase in blood pressure (Perry *et al.,*2011). Modesty and co-workers have shown that for every hour of extra daylight experienced, the mean night time systolic blood pressure rose by 0.63mm Hg (Modest *et al.*,2013). Gas flaring causes increase in temperature (Oseji, 2011).

Moreso, increase in temperature can lead persistent and chronic dehydration among inhabitants of gas flaring communities.Dehydrationoccasioned by the persistent heat causes reduced blood volume, increase in blood viscosity, and increase in blood pressure. And this is further aggravated by the poor water available in the Region (Egwurugwu*et al.*,2013). Also, it has been reported that subjection to particulate matter has a link with blood pressure and the underlying physiological mechanism for this linkage with air pollution led to increase cardiovascular risk could include distorted circadian rhythms of renal sodium handling and blood pressure (Tsai, 2012). Another possible reason for the increase in blood pressure is the heavy metal like Zn present in Nigerian crude oil and waters in gas flaring communities (Idodo-Umeh and Ogbeibu, 2010, Egwurugwu et al, 2013 and Satarug et al, 2010). High blood pressure can also raise serum uric acid (SUA) through elevated serum lactate levels. Hypertension initially produces renal microvascular disorders with local tissue hypoxia, as shown an increase in serum lactate. The lactate lowerstubularsecretion of uric acid, causing increased serum levels. Intra-renal ischaemia can also add to generation of uric acid through xanthine oxidase. It is also probable that metabolic changes (hyperinsulinemia) activity may produce changes in renal sodium handling, communating in increased arterial pressure, decreased renal blood flow and lower uric acid secretion. This will subsequently increase purine oxidation leading to elevatedreactive oxygen species (ROS) generation, subsequent vascular injury, and reduced nitric oxide (Bickel *et al.*,2002).The rise in hypertension of the exposed individuals could also be ascribed to the effect of gas flare on the kidneys. Chronic dehydration has also been linked with longer time of exposure to oil and gas flares because of its effect on the kidney.Renal perfusion and persistent dehydration has also been reported to cause elevated urea level.(Tedla*et al.*, 2011).

Furthermore, gas flaring has been linked with noise pollution from blazing fire, vehicular, human traffic as well as from movement of heavy duty machineries. Noise pollution could contribute significantly to cardiovascular disease and to hearing loss, sleep disturbance, low productivity, impaired teaching withlearning, absenteeism, high drug use, and accidents (Goines and Hagler, 2007). Noise sensitivity has correlation with hypertension and increased cardiopulmonary morbidity and mortality (Heinonen-Guzejev*et al.*, 2007).

Gas flaring and pulse rate

There was significant increase in pulse rate of children in gas flaring communities compared with non-gas flaring communities. The increase in pulse rate was significant in male as well as female children in gas flaring communities. Similarly, there was significant increase in pulse rate of both male and female adults in gas flaring communities when compared with children in non-gas flaring communities as shown in figures 4.5, 4.6, 4.16, 4.17, 4.26 and 4.35, 4.36, 4.46 males. The statistically significant increases in pulse rate as observed in this study has further strengthened earlier report by Adienoboet al. (2013) who observed a significant increase in pulse rate (index for heart rate) among solid waste workers. This may be attributed to a possible physiologic haemodynamic instability resulting from exposure to chemicals present in gas flare. The inhaled particulate matter decreases the blood oxygen tension (PO2) that the body responds by increasing the heart rate in other to sustain adequate oxygen delivery to tissues which was observed as an increase in pulse rate. This is similar with the findings of Devlin et al. (2003) who documented that exposure to sharp particulate matter has the potential of elevating Heart Rate.However, this result do not support earlier reports by Devlin et al.(2003), Donald et al.(2009), Gong et al.(2004) and Yeats et al.(2007) that noted decrease in heart rate variability associated with those exposed to concentrated air pollution, coarse polluted particles, as well as ambient coarse particles and coarse particulate matter respectively.

Gas flaring and respiratory rate

There was statistically significant increase in respiratory rate of children (male and female) including adults (male and female) residing in gas flaring locations when compared with those of non-gas flaring locations especially in those with longer time of exposure as shown in figures 4.8 (females), 4.17, 4.18, 4.28 (females), 4.37 (males), 4.38 and 4.48. Arising from the result, this observation agrees with the outcome of the panel study by Linaet al.(2014) who noted breath rate elevation among participants in the Beijing Olympics who were exposed to particulate matter and also recorded fast breath rate as an indicator of poor air quality. Findings from this present study however disagrees with that of Adienboet al.(2013) who reported no changes in respiratory rate ofinhabitants in the different exposure duration category.

Gas flaring and peak expiratory flow rate

There was significant decrease in *PEFR* of male as well as female children living in gas flaring communities when compared with those in non-gas flaring communities.There was also significant decrease in *PEFR* in adult male and female residing in gas flaring location when compared with those in non -gas flaring communities especially in those with longer duration of exposure. These observations were seen in figures 4.9, 4.10, 4.20, 4.30, 4.49 and 4.50. A common trend in this parameter is a decrease in *PEFR* for most residents irrespective of sex and age. This finding is in agreement with Argo, (2002), Nwafor, (2004), Joffaet al. (2012) and Ovuakporaye et al.(2012) that reported lower mean *PEFR* values among people living around oil and gas flaring environment when compared with national and international values.

The exposure dependent decrease in *PEFR* shown in the test groups when matched with control may be ascribe to the direct inhalation of a large and progressively accumulating volume of obnoxious gaseous chemicals and particulate matter deposits in the lungs relatedinflammatory changes, and physically impeding the normal lung function (Ihekwaba*et al.*,2009). There is reasonably strong evidence that people in Niger Delta area are exposed to potentially dangerous chemicals in the environment. The increase in such pollutants as nitrogen oxides, sulphur oxide and ozone exposures along with other air pollutants from oil and gas exploration activities are significant contributors to chronic obstructive pulmonary diseases (COPD).

Moreso, findings so far has shown that gas flaring impacts negatively on lung function of children and adults of gas flaring communities by reducing their mean peak flow rates and the severity of impact on peak flow rate. The degrees of impact on PEFR increase with prolong exposure time to gas flare hence the observed marked decline in PEFR impacted residents.

Duration of exposure to gas flare and cardiopulmonary parameters

It was observed that the changes in cardiopulmonary parameters were duration dependent. The blood pressure for children (males as well as females) SBP and DBP, adult (males and females) were statistically increased ($p<0.05$) for residents with prolonged duration of exposure to gas flare as shown in figures 4.1, 4.2, 4.3, 4.4, 4.11, 4.12, 4.14, 4.21, 4.22, 4.24, 4.31, 4.33, 4.34, 4.42. These observation is in consonant with Egwuguruet al. (2013) that prolonged exposure to gas oil and gas flare ups the risk for hypertension.

Data shows that gas flare increases pulse rate of male and female children and adult residents. These changes are statistically significant ($p<0.05$) especially in residents with prolonged duration of exposure as seen in figures 4.5, 4.6, 4.16, 4.26, 4.35, 4.36 and 4.46.

Concerning the pulmonary parameters respiratory rate as well as*PEFR*, data indicates increase in mean respiratory rate of residents and a decrease in mean *PEFR* of residents with increase in duration of exposure as shown in figures 4.7, 4.8, 4.9, 4.10, 4.16, 4.17, 4.18, 4.20, 4.28, 4.30, 4.37, 4.38, 4.40, 4.47, 4.48, 4.49 and 4.50.The statistically significant decrease in *PEFR* found among the residents with prolong exposure to gas flares agrees with earlier report by Sametet al.(1996) and Ovuakporaye et al.(2012) that noted reduction in lung function value among residents with longer duration in environment highly polluted with particulate matter and a decrease in lung function with inhabitants exposed to longer duration to gas flare in Delta state south - south Nigeria respectively.

Gender variation on the impact of gas flaring and cardiopulmonary parameters

Arising from the result of the study, there was no statistically significant difference when mean SBP of males and females were compared. However, there was statistically significant difference in the mean DBP of males (10.96%) when compared with that of the female (5.05%) residents showing more impact on male residents as shown in figures 4.61 and 4.62. This latter finding agrees with that of Egwuguruet al.(2013) who reported substantial increase in DBP among males exposed to gas flare and that this observation could be attributed to the possibility of men having more of the constituents of oil and gas flares than female residents. This observation agrees with previous report that men tend to have elevated BP than women in the general population (independence of race, culture and ethno - tribal consideration (Reckhekoff, 2001, Maric, 2005, Sanderg and Hong, 2012, Shin *et al.*, 2012)

On age, blood pressure and gas flares, the seemingly increase in SBP and DBP (hypertension) among adults (males and females) when compared to children (males and females) noted in this study agree with what obtained in the general population as hypertension increases with age (Yoon *et al.,* 2012) The increase in hypertension could have resulted from myriad of factors linked to extended duration to gas flares such as raised temperature, chronic and persistent dehydration, particulate matters, renal function related to age, renal disorders and other comorbidities. Elevated blood pressure with age among the residents in this study could be associated with increases in exposure level and duration.

On pulse rate, the mean PR of female residents were significantly higher ($p<0.05$) than that of the males (13.53%) showing more impact on the females (36.07%) as shown in figure 4.63.This observation may be due to the fact that the females are more exposed in their homes, farms and creeks engaging in domestic activities, fishing, fetching of fire woods for smoking fishes and drying their farm products like tapioca (kpo-kpogarri) from cassava with the heat from the gas flare.

On respiratory rate, the mean RR of female residents was higher than those of the male residents with female residents more impacted though with no significant difference. This observation contradicted earlier reports by Prasad et al.(2006), Ezeilo(2002) that lung function parameters are normally higher in males than females.

The observed elevated values in this study maybe due to the fact that the females are more exposed because they stay more at home or in their farms than their adventurous males (Adienbo and Nwafor, 2010). Also women maybe more exposed to chemical effects, either because alcohol dehydrogenase which detoxifies carbohydrate, alcohol and chemicals are reduced in females than in males (Grout, 2012). A compound Butylcholinesteraseswhich scavenges chemicals are said to be lower in females than in males (Cichoke, 1999)

With respect to *PEFR*, the mean *PEFR* was higher in male inhabitants when compared to female inhabitants in the gas flaring communities. The increase in mean*PEFR* for male residents were statistically significant as shown in figure 4.65 with more percentage increase in males (11.06%) than in females (9.71%). This observation agrees with earlier findings by Prasaadet al. (2006), Ezeilo, (2002) that the values recorded in lung function indices are often higher in males than in females. The observed reduction in the mean *PEFR* of female residents may attributed to the fact that the females were more domiciled either at home or in their farms than the more mobile men and as such were more exposed to the polluted environment than the males. Moreso, the observed reduction in females may be due to the presence of other chemicals present in make-up and exposed daily to toxic products even in their kitchen (Grout, 2013).

5.2 Conclusion

The study revealed that gas flare increase blood pressure, pulse rate (resting heart rate) and respiratory rate of children and adult residents in gas flaring locations in the Niger Delta area. Finding also revealed that gas flare reduces the mean peak expiratory flow rate of children and adult inhabitants in the gas flaring communities. Another finding from this study is that the change in cardiopulmonary parameters is duration dependent as prolonged duration of exposure affected the changes markedly. This study also shows that gender variation impacted on cardiopulmonary parameters of inhabitants in gas flaring areas.

5.3 Recommendations

Arising from the findings and conclusions of this study, the following recommendations are made for future directions:

i. Residents who had their ancestral home close to the gas flaring station should be adequately compensated and relocated far away outside the accepted radius in line with global best practices.

ii. Government should encourage gas flaring companies to device protective measures similar to those used by their workers for residents of nearby host communities.

iii. Government in collaboration with oil and gas companies should provide adequate, accessible and well equipped health facilities in oil and gas bearing communities.

iv. Since natural gas is a source of energy and can be used for power generation. The steam turbine has the capacity for generating electricity in the facility or the host community

v. There is a need to engage in renewable energy, clean energy and cleaner air initiatives.

vi. There is need to fast track the current gas-to-liquid plant project in the oil rich region and ensure appropriate utilization of natural gaswhich is useful in the domestic market.

vii. There is the need to accelerate the on-going gas-to- power projects across the region to address present and future demands from power generation plants.

viii. Various government agencies like the Niger Delta Development Commission (NDDC) should go into collaboration with major multinationals and stakeholders in air pollution management to faction out a comprehensive air quality management blue print for the region.

ix. Focus should be on reducing pollution levels from gas flaring, industry, vehicles as well as burning of timber domestically, to permissible levels as documented in national and international standards.

5.4 Suggestion for further studies

The study be replicated in other gas flaring communities across all the states in the Niger Delta to enable us know the extent of devastation and have a holistic view of the problem with a view to offering lasting solution.

Some other cardiopulmonary parameters like electrocardiogram (ECG), cardiac output (CO)and forced vital capacity (FVC) in relation to gas flare impact be studied to have an in-depth knowledge of the associated changes in these parameters.

The impact of polluted air associated with industrial and vehicular sources as it affects the health status of the communities within the region as well as its biodiversity needs to be researched into.

5.5 Contributions to knowledge

i. This study has provided useful information that unprotected exposure to gas flare can impact negatively on blood pressure, pulse rate, respiratory rate and peak expiratory flow rate of residents in the Niger Delta

ii. The outcome of this study shows that gas flare impacted more on systolic blood pressure than diastolic blood pressure.

iii. The study has also shown that the longer the duration of exposure to gas flare, the more the severity of changes in the cardiopulmonary parameters.

iv. This study has shown that the level of impact of gas flare on human blood pressure, pulse rate, peak expiratory flow rate and respiratory rate of residents in the Niger Delta is gender dependent.

v. This study has added to the existing literature on the evaluation of the health impact of flared gas on the socioeconomic environment in the Niger Delta

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APPENDIX I

Questionnaire/Cover Letter for Questionnaire

Dear Sir/Madam,

I am a postgraduate student of Department of Human Physiology, Faculty of Basic Medical Sciences, Delta State University Abraka.

I am carrying out a postgraduate research on Study of Gas Flare on Cardiopulmonary Parameters of Residents in Gas Flaring Communities in the Niger Delta Region of Nigeria. The purpose of the research is to determine the impact of gas flare on some cardiopulmonary parameters of residents in gas flaring communities in some Niger Delta region of Nigeria and to make appropriate recommendations/suggestions to the public or relevant agencies with a view to preventing/reducing any adverse health effects on the people without necessarily affecting the operation of the gas flaring station.

I am appealing to you to give accurate/correct information as this will enable me come out with reliable findings that will form the basis of my recommendation/suggestion to the public and relevant agencies. Information/data generated from this research will be treated with utmost confidentiality and so you may not need to indicate your name in the questionnaire.

QUESTIONNAIRE ONSTUDY OF GAS FLARE ON CARDIOPULMONARY PARAMETERS OF RESIDENTS IN GAS FLARING COMMUNITIES IN SOME NIGER DELTA STATES

Dear Sir/Madam

The questions below are to be answered without fear of any kind.

INSTRUCTIONS: Please tick as appropriate

1. Name of community GFC ☐ NGFC ☐

2. Age 12 – 17yrs ☐ 18 – 70yrs ☐

3. What is your occupation? Student ☐ Civil Servant ☐ Farmer ☐ Private Business ☐

4. Sex Male ☐ Female ☐

5. How long have you been staying in the community? ≥1-5yrs ☐ 6-10yrs ☐ 10yrs and above ☐

6. Do you smoke? Yes ☐ No ☐

7. How often do you smoke? Daily ☐ Weekly ☐ Occasionally ☐

8. How many packets do you smoke in a day?

9. Have you been treated for any respiratory ailment like Catarrh ☐ Cough ☐ Asthma ☐

10.(i) Have you had cough in the past 6months – 1yr ☐ - 3yrs ☐ 4yrs and above ☐

(ii). How often have you had it? Once ☐ Twice ☐ Three times and above ☐

(iii). How serious was it. Mild ☐ Moderate ☐ Severe ☐

11.(i). Have you been sneezing/ having catarrh in the past

0- 6months ☐ 7months- 1yr ☐ yrs and above ☐

(ii). How serious was it. Mild ☐ Moderate ☐ Severe ☐

12(i). Have you been having difficulty in breathing in the past

6months – 1yr ☐ 2yrs and above ☐

(ii) How serious is it. Mild ☐ Moderate ☐ Severe ☐

13. Do you drink alcohol? Yes ☐ No ☐

14. How often do you drink alcohol?

Daily ☐ Weekly ☐ Occasionally ☐

15. How many bottles of alcohol do you drink in a day?

Two ☐ Three Four ☐ Five ☐ ☐

16. Have you been treated in the past for any heart related diseases like hypertension, heart failure, stroke etc? Yes ☐ No ☐

17. Have you been treated or admitted for any metabolic ailment like diabetes mellitus

Yes ☐ No ☐

18. Are you on any contraceptive? Yes ☐ No ☐

19. How often have you had any of the above ailments?

Once ☐ Twice ☐ Three times and above ☐

20. Did any of your parents have any of the above named ailments in the past?

Yes ☐ No ☐

21. Were you born with the above ailments? Yes ☐ No ☐

22. Was the ailment acquired during your stay in this community?

Yes ☐ No ☐

23. If you had any of (9), (10), (11), (12), (16) above, were you treated in a hospital? Yes ☐ No ☐

24. Are you aware that environmental factors could be responsible? Yes ☐ No ☐

25. If you are aware, what preventive/protective measures are you taking against it? Use of Mouth mask ☐ Nose mask ☐ None ☐

26. Is there a health centre/hospital in this community? Yes ☐ No ☐

27. Are there medical personnel in the health centre/hospital? Yes ☐ No ☐

28(i). Who owns the health centre/hospital Private ☐ Government ☐ Community ☐

(ii). If it is government owned, is it Local Government ☐ State Government ☐ Federal Government ☐

NOTE: GFC –GAS FLARING COMMUNITY

NGFC – NON GAS FLARING COMMUNITY

THANK YOU.

APPENDIX II

ETHICAL APPROVAL

RESEARCH AND BIOETHICS COMMITTEE
FACULTY OF BASIC MEDICAL SCIENCES,
DELTA STATE UNIVERSITY, ABRAKA.

OUR REF: RBC/FBMS/DELSU/14/05 **DATE** 12/2/2014

Ovuakporaye Simon
Department of Physiology,
Delta State University,
Abraka.

Dear Sir,

RE: APPLICATION FOR PERMISSION FOR THE USE OF HUMAN SUBJECT IN CARRYING OUT A RESEARCH

This is to convey approval for the use of Human subject in the research study titled: *"A Study of Gas Flare on Cardiopulmonary Parameters of Residents in Gas Flaring Communities in some Niger Delta States"*. The committee granted the approval during their February meeting that held on the 10th of February, 2014.

Congrats.

Dr. I. Onyesom
(Chairman)

APPENDIX III

Statistical Analysis

EDO ADULT SEX COMPARISON

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	144.5714[a]	7	14.30451	5.40660
	Systolic1female	144.5714[a]	7	14.30451	5.40660
Pair 2	Systolic2male	142.0000[a]	7	8.75595	3.30944
	Systolic2female	142.0000[a]	7	8.75595	3.30944
Pair 3	Systolic3male	150.7333[a]	15	27.29853	7.04845
	Systolic3female	150.7333[a]	15	27.29853	7.04845
Pair 4	Diastolic1male	89.5714	7	9.21696	3.48368
	Diastolic1female	92.8571	7	12.29402	4.64670
Pair 5	Diastolic2male	86.0000	7	7.28011	2.75162
	Diastolic2female	87.5714	7	2.76026	1.04328
Pair 6	Diastolic3male	87.8000	15	9.90815	2.55827
	Diastolic3female	85.0667	15	9.93167	2.56435
Pair 7	PRATE1male	82.7143	7	23.53518	8.89546
	PRATE1female	92.0000	7	19.17464	7.24733
Pair 8	PRATE2male	79.8571	7	11.75342	4.44237
	PRATE2female	96.7143	7	13.82889	5.22683
Pair 9	PRATE3male	80.1333	15	17.71951	4.57516
	PRATE3female	91.6667	15	10.78800	2.78545
Pair 10	RRATE1male	23.8571	7	5.78586	2.18685
	RRATE1female	30.7143	7	1.70434	.64418
Pair 11	RRATE2male	28.7143	7	13.62246	5.14881
	RRATE2female	29.2857	7	3.59232	1.35777
Pair 12	RRATE3male	28.8000	15	11.39047	2.94101
	RRATE3female	28.0667	15	3.95450	1.02105
Pair 13	PEFR1male	323.0000	5	51.79286	23.16247
	PEFR1female	249.2000	5	37.79153	16.90089
Pair 14	PEFR2male	280.0000	2	98.99495	70.00000
	PEFRfemale	177.5000	2	10.60660	7.50000
Pair 15	PEFR3male	305.0000	5	38.07887	17.02939
	PEFR3female	294.0000	5	91.61059	40.96950

a. The correlation and t cannot be computed because the standard error of the difference is 0.

Paired Samples Test

		t	df	Sig. (2-tailed)
Pair 4	Diastolic1male - Diastolic1female	-.626	6	0.554
Pair 5	Diastolic2male - Diastolic2female	-.519	6	0.623
Pair 6	Diastolic3male - Diastolic3female	.633	14	0.537
Pair 7	PRATE1male - PRATE1female	-.779	6	0.466
Pair 8	PRATE2male - PRATE2female	-1.833	6	0.116
Pair 9	PRATE3male - PRATE3female	-2.189	14	0.046
Pair 10	RRATE1male - RRATE1female	-3.200	6	0.019
Pair 11	RRATE2male - RRATE2female	-.106	6	0.919
Pair 12	RRATE3male - RRATE3female	.261	14	0.798
Pair 13	PEFR1male - PEFR1female	2.580	4	0.061
Pair 14	PEFR2male - PEFRfemale	1.323	1	.412
Pair 15	PEFR3male - PEFR3female	.270	4	.801

EDO CHILDREN SEX COMPARISON

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	119.3333	6	8.33467	3.40261
	Systolic1female	111.5000	6	11.18481	4.56618
Pair 2	Systolic2male	121.5000	2	20.50610	14.50000
	Systolic2female	115.5000	2	21.92031	15.50000
Pair 3	Systolic3male	119.0000	2	18.38478	13.00000
	Systolic3female	116.0000	2	26.87006	19.00000
Pair 4	Diastolic1male	71.3333	6	6.40833	2.61619
	Diastolic1female	71.3333	6	11.99444	4.89671
Pair 5	Diastolic2male	69.5000	2	.70711	.50000
	Diastolic2female	71.0000	2	1.41421	1.00000
Pair 6	Diastolic3male	73.5000	2	7.77817	5.50000
	Diastolic3female	64.5000	2	12.02082	8.50000
Pair 7	PRATE1male	97.8333	6	19.88383	8.11754
	PRATE1female	90.0000	6	14.97999	6.11555
Pair 8	PRATE2male	82.5000	2	27.57716	19.50000
	PRATE2female	111.5000	2	4.94975	3.50000
Pair 9	PRATE3male	90.0000	2	2.82843	2.00000
	PRATE3female	80.5000	2	3.53553	2.50000
Pair 10	RRATE1male	26.6667	6	3.01109	1.22927
	RRATE1female	24.0000	6	6.78233	2.76887
Pair 11	RRATE2male	26.0000	2	.00000	.00000

	RRATE2female	20.0000	2	5.65685	4.00000
Pair 12	RRATE3male	27.5000	2	3.53553	2.50000
	RRATE3female	43.0000	2	9.89949	7.00000
Pair 13	PEFR1male	245.3333	6	35.10366	14.33101
	PEFR1female	288.3333	6	117.41664	47.93514
Pair 14	PEFR2male	177.5000	2	10.60660	7.50000
	PEFRfemale	199.5000	2	48.79037	34.50000
Pair 15	PEFR3male	227.5000	2	31.81981	22.50000
	PEFR3female	297.5000	2	74.24621	52.50000

Paired Samples Test

		t	df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	1.371	5	.229
Pair 2	Systolic2male - Systolic2female	6.000	1	.105
Pair 3	Systolic3male - Systolic3female	.500	1	.705
Pair 4	Diastolic1male - Diastolic1female	.000	5	1.000
Pair 5	Diastolic2male - Diastolic2female	-1.000	1	.500
Pair 6	Diastolic3male - Diastolic3female	3.000	1	.205
Pair 7	PRATE1male - PRATE1female	.861	5	.429
Pair 8	PRATE2male - PRATE2female	-1.813	1	.321
Pair 9	PRATE3male - PRATE3female	2.111	1	.282
Pair 10	RRATE1male - RRATE1female	.914	5	.403
Pair 11	RRATE2male - RRATE2female	1.500	1	.374
Pair 12	RRATE3male - RRATE3female	-1.632	1	.350
Pair 13	PEFR1male - PEFR1female	-.969	5	.377
Pair 14	PEFR2male - PEFRfemale	-.524	1	.693
Pair 15	PEFR3male - PEFR3female	-.933	1	.522

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	155.0000	6	30.05329	12.26920
	Systolic1female	118.1667	6	9.57949	3.91081
Pair 2	Systolic2male	144.0000	3	.00000	.00000
	Systolic2female	120.6667	3	12.34234	7.12585
Pair 3	Systolic3male	151.4400	25	25.35429	5.07086
	Systolic3female	136.1200	25	24.35385	4.87077
Pair 4	Diastolic1male	86.8333	6	11.66905	4.76387
	Diastolic1female	72.3333	6	6.62319	2.70391
Pair 5	Diastolic2male	96.0000	3	.00000	.00000
	Diastolic2female	78.3333	3	15.94783	9.20748
Pair 6	Diastolic3male	89.7200	25	8.99778	1.79956
	Diastolic3female	85.1600	25	25.16393	5.03279
Pair 7	PRATE1male	85.1667	6	12.59233	5.14080
	PRATE1female	88.0000	6	4.97996	2.03306
Pair 8	PRATE2male	90.0000	3	.00000	.00000
	PRATE2female	99.0000	3	16.46208	9.50438
Pair 9	PRATE3male	91.8400	25	8.85852	1.77170
	PRATE3female	85.5200	25	11.42410	2.28482
Pair 10	RRATE1male	28.1667	6	4.02078	1.64148
	RRATE1female	25.1667	6	4.26224	1.74005
Pair 11	RRATE2male	26.0000	3	.00000	.00000
	RRATE2female	25.0000	3	3.60555	2.08167
Pair 12	RRATE3male	28.4000	25	2.41523	.48305
	RRATE3female	26.9600	25	3.08869	.61774
Pair 13	PEFR1male	344.1667	6	76.51253	31.23611
	PEFR1female	419.3333	6	69.53177	28.38623
Pair 14	PEFR2male	400.0000	3	.00000	.00000
	PEFRfemale	426.6667	3	110.15141	63.59595
Pair 15	PEFR3male	381.0000	25	66.22248	13.24450
	PEFR3female	398.8800	25	66.55907	13.31181

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	5	.032
Pair 2	Systolic2male - Systolic2female	2	.082
Pair 3	Systolic3male - Systolic3female	24	.036
Pair 4	Diastolic1male - Diastolic1female	5	.061
Pair 5	Diastolic2male - Diastolic2female	2	.195
Pair 6	Diastolic3male - Diastolic3female	24	.400
Pair 7	PRATE1male - PRATE1female	5	.699
Pair 8	PRATE2male - PRATE2female	2	.444
Pair 9	PRATE3male - PRATE3female	24	.028
Pair 10	RRATE1male - RRATE1female	5	.091
Pair 11	RRATE2male - RRATE2female	2	.678
Pair 12	RRATE3male - RRATE3female	24	.091
Pair 13	PEFR1male - PEFR1female	5	.108
Pair 14	PEFR2male - PEFRfemale	2	.716
Pair 15	PEFR3male - PEFR3female	24	.334

BAYELSA CHILDREN SEX COMPARISON

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	103.2500	4	21.86893	10.93446
	Systolic1female	113.2500	4	11.72959	5.86480
Pair 2	Systolic2male	125.0000[a]	3	.00000	.00000
	Systolic2female	133.0000[a]	3	.00000	.00000
Pair 3	Systolic3male	129.0000	4	16.39105	8.19553
	Systolic3female	107.0000	4	11.16542	5.58271
Pair 4	Diastolic1male	60.0000	4	5.29150	2.64575
	Diastolic1female	74.5000	4	15.60983	7.80491
Pair 5	Diastolic2male	75.0000[a]	3	.00000	.00000
	Diastolic2female	61.0000[a]	3	.00000	.00000
Pair 6	Diastolic3male	80.7500	4	10.53170	5.26585
	Diastolic3female	60.5000	4	6.80686	3.40343
Pair 7	PRATE1male	105.7500	4	10.99621	5.49811
	PRATE1female	96.0000	4	12.56981	6.28490
Pair 8	PRATE2male	114.0000[a]	3	.00000	.00000
	PRATE2female	95.0000[a]	3	.00000	.00000
Pair 9	PRATE3male	100.5000	4	14.84363	7.42181
	PRATE3female	105.2500	4	6.13052	3.06526

Pair 10	RRATE1male	32.5000	4	2.64575	1.32288
	RRATE1female	31.7500	4	6.02080	3.01040
Pair 11	RRATE2male	29.0000[a]	3	.00000	.00000
	RRATE2female	30.0000[a]	3	.00000	.00000
Pair 12	RRATE3male	36.0000	4	2.82843	1.41421
	RRATE3female	30.0000	4	1.63299	.81650
Pair 13	PEFR1male	331.2500	4	90.21964	45.10982
	PEFR1female	278.7500	4	49.72843	24.86421
Pair 14	PEFR2male	355.0000[a]	3	.00000	.00000
	PEFRfemale	310.0000[a]	3	.00000	.00000
Pair 15	PEFR3male	323.7500	4	39.86958	19.93479
	PEFR3female	282.5000	4	140.32700	70.16350

a. The correlation and t cannot be computed because the standard error of the difference is 0.

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	3	.463
Pair 3	Systolic3male - Systolic3female	3	.175
Pair 4	Diastolic1male - Diastolic1female	3	.185
Pair 6	Diastolic3male - Diastolic3female	3	.064
Pair 7	PRATE1male - PRATE1female	3	.217
Pair 9	PRATE3male - PRATE3female	3	.645
Pair 10	RRATE1male - RRATE1female	3	.848
Pair 12	RRATE3male - RRATE3female	3	.035
Pair 13	PEFR1male - PEFR1female	3	.476
Pair 15	PEFR3male - PEFR3female	3	.630

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	151.8571	7	20.69967	7.82374
	Systolic1female	131.5714	7	19.78937	7.47968
Pair 2	Systolic2male	142.3333	6	12.04436	4.91709
	Systolic2female	152.8333	6	16.77399	6.84795
Pair 3	Systolic3male	142.0000	14	26.89009	7.18668
	Systolic3female	148.1429	14	30.85663	8.24678
Pair 4	Diastolic1male	84.7143	7	12.51285	4.72941
	Diastolic1female	82.4286	7	16.20553	6.12511
Pair 5	Diastolic2male	83.8750	8	9.40270	3.32436
	Diastolic2female	92.8750	8	10.37080	3.66663
Pair 6	Diastolic3male	87.5833	12	8.52225	2.46016
	Diastolic3female	83.0833	12	11.77407	3.39888
Pair 7	PRATE1male	80.8571	7	14.64501	5.53529
	PRATE1female	79.4286	7	10.09715	3.81636
Pair 8	PRATE2male	80.6250	8	11.05748	3.90941
	PRATE2female	88.6250	8	10.29476	3.63975
Pair 9	PRATE3male	93.7857	14	10.31189	2.75597
	PRATE3female	93.5000	14	11.32560	3.02689
Pair 10	RRATE1male	26.7143	7	2.42997	.91844
	RRATE1female	24.5714	7	4.39155	1.65985
Pair 11	RRATE2male	31.6250	8	12.02304	4.25079
	RRATE2female	27.3750	8	5.37022	1.89866
Pair 12	RRATE3male	26.8571	14	2.31574	.61891
	RRATE3female	29.1429	14	3.69734	.98816
Pair 13	PEFR1male	335.7143	7	62.61180	23.66504
	PEFR1female	357.1429	7	104.83547	39.62408
Pair 14	PEFR2male	355.0000	8	76.11082	26.90924
	PEFRfemale	320.6250	8	127.90726	45.22205
Pair 15	PEFR3male	357.8571	14	79.51087	21.25017
	PEFR3female	386.4286	14	103.80137	27.74208

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	6	.037
Pair 2	Systolic2male - Systolic2female	5	.121
Pair 3	Systolic3male - Systolic3female	13	.525
Pair 4	Diastolic1male - Diastolic1female	6	.688
Pair 5	Diastolic2male - Diastolic2female	7	.068
Pair 6	Diastolic3male - Diastolic3female	11	.168
Pair 7	PRATE1male - PRATE1female	6	.794
Pair 8	PRATE2male - PRATE2female	7	.118
Pair 9	PRATE3male - PRATE3female	13	.952
Pair 10	RRATE1male - RRATE1female	6	.369
Pair 11	RRATE2male - RRATE2female	7	.301
Pair 12	RRATE3male - RRATE3female	13	.093
Pair 13	PEFR1male - PEFR1female	6	.704
Pair 14	PEFR2male - PEFRfemale	7	.517
Pair 15	PEFR3male - PEFR3female	13	.348

RIVERS CHILDREN SEX COMPARISON

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	113.3333	3	13.31666	7.68838
	Systolic1female	112.0000	3	7.54983	4.35890
Pair 2	Systolic2male	119.5000	2	17.67767	12.50000
	Systolic2female	125.5000	2	7.77817	5.50000
Pair 3	Systolic3male	115.4000	5	30.17118	13.49296
	Systolic3female	114.8000	5	19.29249	8.62786
Pair 4	Diastolic1male	69.0000	3	9.84886	5.68624
	Diastolic1female	61.3333	3	8.62168	4.97773
Pair 5	Diastolic2male	70.0000	2	.00000	.00000
	Diastolic2female	76.0000	2	5.65685	4.00000
Pair 6	Diastolic3male	70.8000	5	11.75585	5.25738
	Diastolic3female	58.4000	5	13.12631	5.87026
Pair 7	PRATE1male	89.3333	3	28.02380	16.17955
	PRATE1female	90.0000	3	22.64950	13.07670
Pair 8	PRATE2male	92.0000	2	14.14214	10.00000
	PRATE2female	91.0000	2	24.04163	17.00000
Pair 9	PRATE3male	99.8000	5	9.03881	4.04228
	PRATE3female	88.2000	5	14.34225	6.41405
Pair 10	RRATE1male	28.0000	3	4.00000	2.30940

	RRATE1female	22.0000	3	3.46410	2.00000
Pair 11	RRATE2male	31.0000	2	7.07107	5.00000
	RRATE2female	26.5000	2	3.53553	2.50000
Pair 12	RRATE3male	31.8000	5	4.02492	1.80000
	RRATE3female	34.8000	5	9.23038	4.12795
Pair 13	PEFR1male	272.0000	3	27.51363	15.88500
	PEFR1female	245.0000	3	39.68627	22.91288
Pair 14	PEFR2male	282.5000	2	137.88582	97.50000
	PEFRfemale	317.0000	2	117.37973	83.00000
Pair 15	PEFR3male	324.0000	5	67.58328	30.22416
	PEFR3female	295.0000	5	118.90122	53.17424

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	2	.917
Pair 2	Systolic2male - Systolic2female	1	.795
Pair 3	Systolic3male - Systolic3female	4	.977
Pair 4	Diastolic1male - Diastolic1female	2	.318
Pair 5	Diastolic2male - Diastolic2female	1	.374
Pair 6	Diastolic3male - Diastolic3female	4	.068
Pair 7	PRATE1male - PRATE1female	2	.982
Pair 8	PRATE2male - PRATE2female	1	.910
Pair 9	PRATE3male - PRATE3female	4	.172
Pair 10	RRATE1male - RRATE1female	2	.188
Pair 11	RRATE2male - RRATE2female	1	.323
Pair 12	RRATE3male - RRATE3female	4	.479
Pair 13	PEFR1male - PEFR1female	2	.538
Pair 14	PEFR2male - PEFRfemale	1	.253
Pair 15	PEFR3male - PEFR3female	4	.654

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	123.0000	2	.00000	.00000
	Systolic1female	163.5000	2	9.19239	6.50000
Pair 2	Systolic2male	122.6000	5	16.75709	7.49400
	Systolic2female	165.2000	5	10.42593	4.66262
Pair 3	Systolic3male	146.0909	11	22.77040	6.86553
	Systolic3female	149.1818	11	16.56996	4.99603
Pair 4	Diastolic1male	85.0000	2	.00000	.00000
	Diastolic1female	103.5000	2	13.43503	9.50000
Pair 5	Diastolic2male	72.0000	5	13.43503	6.00833
	Diastolic2female	97.2000	5	13.77316	6.15955
Pair 6	Diastolic3male	86.0909	11	6.68513	2.01564
	Diastolic3female	83.3636	11	10.89287	3.28432
Pair 7	PRATE1male	65.0000	2	.00000	.00000
	PRATE1female	71.5000	2	14.84924	10.50000
Pair 8	PRATE2male	68.6000	5	26.80112	11.98582
	PRATE2female	80.4000	5	3.71484	1.66132
Pair 9	PRATE3male	71.8182	11	19.34331	5.83223
	PRATE3female	109.0000	11	6.87023	2.07145
Pair 10	RRATE1male	24.0000	2	.00000	.00000
	RRATE1female	23.5000	2	9.19239	6.50000
Pair 11	RRATE2male	24.0000	5	3.39116	1.51658
	RRATE2female	27.2000	5	6.68581	2.98998
Pair 12	RRATE3male	33.9091	11	23.23555	7.00578
	RRATE3female	33.6364	11	2.65604	.80083
Pair 13	PEFR1male	278.0000	2	.00000	.00000
	PEFR1female	217.5000	2	17.67767	12.50000
Pair 14	PEFR2male	292.0000	5	71.64147	32.03904
	PEFRfemale	217.0000	5	51.67204	23.10844
Pair 15	PEFR3male	311.3636	11	73.35158	22.11633
	PEFR3female	270.9091	11	46.19622	13.92868

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	1	.101
Pair 2	Systolic2male - Systolic2female	4	.015
Pair 3	Systolic3male - Systolic3female	10	.706
Pair 4	Diastolic1male - Diastolic1female	1	.302
Pair 5	Diastolic2male - Diastolic2female	4	.051
Pair 6	Diastolic3male - Diastolic3female	10	.527
Pair 7	PRATE1male - PRATE1female	1	.647
Pair 8	PRATE2male - PRATE2female	4	.408
Pair 9	PRATE3male - PRATE3female	10	.000
Pair 10	RRATE1male - RRATE1female	1	.951
Pair 11	RRATE2male - RRATE2female	4	.219
Pair 12	RRATE3male - RRATE3female	10	.971
Pair 13	PEFR1male - PEFR1female	1	.130
Pair 14	PEFR2male - PEFRfemale	4	.071
Pair 15	PEFR3male - PEFR3female	10	.089

AKWA IBOM CHILDREN SEX COMPARISON

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	123.0000	5	10.67708	4.77493
	Systolic1female	119.0000	5	12.51000	5.59464
Pair 2	Systolic2male	126.3333	3	9.07377	5.23874
	Systolic2female	127.3333	3	3.21455	1.85592
Pair 3	Systolic3male	120.8750	8	11.65501	4.12067
	Systolic3female	102.7500	8	10.68711	3.77846
Pair 4	Diastolic1male	69.0000	5	5.65685	2.52982
	Diastolic1female	76.2000	5	12.87245	5.75674
Pair 5	Diastolic2male	71.3333	3	3.21455	1.85592
	Diastolic2female	67.3333	3	5.03322	2.90593
Pair 6	Diastolic3male	69.2500	8	9.06721	3.20574
	Diastolic3female	60.0000	8	5.37188	1.89925
Pair 7	PRATE1male	77.8000	5	21.53369	9.63016
	PRATE1female	83.0000	5	10.36822	4.63681
Pair 8	PRATE2male	93.0000	3	26.66458	15.39480
	PRATE2female	100.6667	3	8.08290	4.66667
Pair 9	PRATE3male	80.8750	8	16.50487	5.83535
	PRATE3female	88.1250	8	12.04085	4.25708
Pair 10	RRATE1male	25.0000	5	6.16441	2.75681

	RRATE1female	27.2000	5	10.18332	4.55412
Pair 11	RRATE2male	27.0000	3	1.73205	1.00000
	RRATE2female	24.6667	3	3.05505	1.76383
Pair 12	RRATE3male	25.3750	8	7.89100	2.78989
	RRATE3female	29.0000	8	5.12696	1.81265
Pair 13	PEFR1male	272.0000	5	52.63079	23.53720
	PEFR1female	292.0000	5	118.61703	53.04715
Pair 14	PEFR2male	236.6667	3	102.75375	59.32491
	PEFRfemale	239.6667	3	57.70904	33.31833
Pair 15	PEFR3male	308.7500	8	76.14601	26.92168
	PEFR3female	261.8750	8	68.81328	24.32917

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	4	.621
Pair 2	Systolic2male - Systolic2female	2	.873
Pair 3	Systolic3male - Systolic3female	7	.005
Pair 4	Diastolic1male - Diastolic1female	4	.302
Pair 5	Diastolic2male - Diastolic2female	2	.314
Pair 6	Diastolic3male - Diastolic3female	7	.042
Pair 7	PRATE1male - PRATE1female	4	.397
Pair 8	PRATE2male - PRATE2female	2	.584
Pair 9	PRATE3male - PRATE3female	7	.322
Pair 10	RRATE1male - RRATE1female	4	.516
Pair 11	RRATE2male - RRATE2female	2	.118
Pair 12	RRATE3male - RRATE3female	7	.122
Pair 13	PEFR1male - PEFR1female	4	.747
Pair 14	PEFR2male - PEFRfemale	2	.931
Pair 15	PEFR3male - PEFR3female	7	.080

DELTA ADULT SEX COMPARISON

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	155.6667	9	20.68816	6.89605
	Systolic1female	137.2222	9	14.67803	4.89268
Pair 2	Systolic2male	141.1667	6	7.49444	3.05959
	Systolic2female	133.0000	6	16.54086	6.75278
Pair 3	Systolic3male	151.2667	15	18.61822	4.80720
	Systolic3female	144.0667	15	24.36469	6.29094
Pair 4	Diastolic1male	85.8889	9	19.36779	6.45593
	Diastolic1female	85.5556	9	10.78322	3.59441
Pair 5	Diastolic2male	78.0000	6	4.97996	2.03306
	Diastolic2female	82.8333	6	5.56477	2.27181
Pair 6	Diastolic3male	83.5556	18	10.69482	2.52079
	Diastolic3female	88.6111	18	11.42824	2.69366
Pair 7	PRATE1male	84.4444	9	6.93021	2.31007
	PRATE1female	86.0000	9	6.70820	2.23607
Pair 8	PRATE2male	83.6667	6	6.62319	2.70391
	PRATE2female	90.3333	6	13.70645	5.59563
Pair 9	PRATE3male	83.9444	18	9.01941	2.12589
	PRATE3female	85.5000	18	6.93881	1.63549
Pair 10	RRATE1male	27.4444	9	2.29734	.76578
	RRATE1female	23.8889	9	4.75511	1.58504
Pair 11	RRATE2male	27.5000	6	3.98748	1.62788
	RRATE2female	26.0000	6	2.52982	1.03280
Pair 12	RRATE3male	24.5556	18	2.25499	.53151
	RRATE3female	27.1667	18	4.50163	1.06105
Pair 13	PEFR1male	409.4444	9	55.53402	18.51134
	PEFR1female	443.8889	9	29.55691	9.85230
Pair 14	PEFR2male	398.8333	6	54.57258	22.27916
	PEFRfemale	445.0000	6	37.41657	15.27525
Pair 15	PEFR3male	445.0000	18	53.13689	12.52449
	PEFR3female	460.8333	18	27.71971	6.53360

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	8	.135
Pair 2	Systolic2male - Systolic2female	5	.370
Pair 3	Systolic3male - Systolic3female	14	.417
Pair 4	Diastolic1male - Diastolic1female	8	.967
Pair 5	Diastolic2male - Diastolic2female	5	.143
Pair 6	Diastolic3male - Diastolic3female	17	.173
Pair 7	PRATE1male - PRATE1female	8	.658
Pair 8	PRATE2male - PRATE2female	5	.221
Pair 9	PRATE3male - PRATE3female	17	.617
Pair 10	RRATE1male - RRATE1female	8	.143
Pair 11	RRATE2male - RRATE2female	5	.512
Pair 12	RRATE3male - RRATE3female	17	.041
Pair 13	PEFR1male - PEFR1female	8	.076
Pair 14	PEFR2male - PEFRfemale	5	.172
Pair 15	PEFR3male - PEFR3female	17	.269

DELTA CHILDREN SEX COMPARISON

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Systolic1male	120.0000	2	.00000	.00000
	Systolic1female	126.0000	2	1.41421	1.00000
Pair 2	Systolic2male	158.5000	2	37.47666	26.50000
	Systolic2female	112.0000	2	11.31371	8.00000
Pair 3	Systolic3male	137.5000	4	26.09598	13.04799
	Systolic3female	120.0000	4	17.77639	8.88819
Pair 4	Diastolic1male	75.0000	2	21.21320	15.00000
	Diastolic1female	76.5000	2	4.94975	3.50000
Pair 5	Diastolic2male	76.0000	2	8.48528	6.00000
	Diastolic2female	73.0000	2	9.89949	7.00000
Pair 6	Diastolic3male	71.0000	4	7.61577	3.80789
	Diastolic3female	60.7500	4	19.06786	9.53393
Pair 7	PRATE1male	72.5000	2	3.53553	2.50000
	PRATE1female	75.0000	2	4.24264	3.00000
Pair 8	PRATE2male	73.5000	2	12.02082	8.50000

	PRATE2female	72.5000	2	2.12132	1.50000
Pair 9	PRATE3male	79.0000	4	7.39369	3.69685
	PRATE3female	84.0000	4	14.69694	7.34847
Pair 10	RRATE1male	33.5000	2	7.77817	5.50000
	RRATE1female	31.5000	2	4.94975	3.50000
Pair 11	RRATE2male	33.0000	2	4.24264	3.00000
	RRATE2female	32.5000	2	4.94975	3.50000
Pair 12	RRATE3male	34.7500	4	2.50000	1.25000
	RRATE3female	33.0000	4	3.82971	1.91485
Pair 13	PEFR1male	365.0000	2	91.92388	65.00000
	PEFR1female	400.0000	2	70.71068	50.00000
Pair 14	PEFR2male	365.0000	2	21.21320	15.00000
	PEFRfemale	420.0000	2	28.28427	20.00000
Pair 15	PEFR3male	395.0000	4	34.15650	17.07825
	PEFR3female	385.0000	4	62.84903	31.42451

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	Systolic1male - Systolic1female	1	.105
Pair 2	Systolic2male - Systolic2female	1	.241
Pair 3	Systolic3male - Systolic3female	3	.146
Pair 4	Diastolic1male - Diastolic1female	1	.948
Pair 5	Diastolic2male - Diastolic2female	1	.205
Pair 6	Diastolic3male - Diastolic3female	3	.477
Pair 7	PRATE1male - PRATE1female	1	.728
Pair 8	PRATE2male - PRATE2female	1	.937
Pair 9	PRATE3male - PRATE3female	3	.529
Pair 10	RRATE1male - RRATE1female	1	.500
Pair 11	RRATE2male - RRATE2female	1	.500
Pair 12	RRATE3male - RRATE3female	3	.614
Pair 13	PEFR1male - PEFR1female	1	.258
Pair 14	PEFR2male - PEFRfemale	1	.058
Pair 15	PEFR3male - PEFR3female	3	.756

APPENDIX IV

Table of Statistical Mean Values

Table 4.1 Systolic Blood pressure recordings of residents of Edo State

		Males		Females	
Age	Duration of exposure	GFC (Oben)	NGFC (Ekiadolor)	GFC (Oben)	NGFC (Ekiadolor)
Children (12 – 17yrs)	1 – 5 years	117.50 ± 8.91	119 ± 3.11	111.5 ± 4.57	114.50 ± 0.50
	6 – 10 years	121.5 ± 20.50	117.00 ± 2.88	117.00 ± 7.41[s]	110.50 ± 4.94
	>10 years	123.20 ± 14.09	114.13 ± 4.44	118.00 ± 9.00[s]	114.87 ± 3.10
Adults (18 – 70 yrs)	1– 5 years	155.21 ± 13.78[s]	131.36 ± 3.83	144.57 ± 5.41[s]	121.42 ± 4.59
	6 – 10 years	145.21 ± 8.75	134.67 ± 3.61	142.00 ± 3.01	124.5 ± 3.84
	>10 years	184.96 ± 24.07[s]	123.00 ± 2.69	150.73 ± 7.04[s]	124.44 ± 4.05

Values are represented as mean Standard error of mean, *: $p<0.05$ when compared to 1 – 5 years a: $p<0.05$ when compared to 6 – 10 years s: $p<0.05$ when compared with NGFC

Table 4.2 Gas Flare effect on Diastolic Blood pressure of residents in Edo State

		Males		Females	
Age	Duration of exposure	GFC (Oben)	NGFC (Ekiadolor)	GFC (Oben)	NGFC (Ekiadolor)
Children (12 – 17yrs)	1 – 5 years	72.75 ±3.25[s]	67.25 ± 9.75	71.33 ±4.90	79.00 ± 5.00
	6 – 10 years	69.50 ± 0.50	63.67 ± 0.33	67.25 ± 2.42	73.00 ± 5.00
	>10 years	72.60 ± 1.80[s]	69.50 ± 4.91	64.50 ± 8.50	66.00 ± 3.52
Adults (18 – 70 yrs)	1 – 5 years	88.43 ± 2.60[s]	77.89 ± 2.57	92.86 ± 4.65[s]	75.21 ± 3.265
	6 – 10 years	86.88 ± 2.38	73.00 ± 3.42	87.57 ± 1.04[s]	72.67 ± 3.59
	>10 years	85.52 ± 2.31[s]	68.92 ± 1.54	85.07 ± 2.56[s]	72.33 ± 2.19

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.3 Values of Pulse Rate of residents in Edo State

		Males		Females	
Age	Duration of exposure	GFC (Oben)	NGFC (Ekiadolor)	GFC (Oben)	NGFC (Ekiadolor)
Children (12 – 17yrs)	1 – 5 years	89.87 ± 8.08	75.00 ± 1.47	90.00 ± 6.11	89.50 ± 8.50
	6 – 10 years	82.50 ± 19.50	70.33 ± 0.33	97.25 ± 9.68	94.50 ± 16.50
	>10 years	85.60 ± 4.92	74.00 ± 2.11	95.13 ± 2.50^{s}	80.50 ± 6.59
Adults (18 – 70 yrs)	1– 5 years	83.50±4.38^{s}	73.52 ± 1.57	92.00 ± 7.25	80.07 ± 2.89
	6 – 10 years	80.62 ±3.92	74.83 ± 3.91	96.71 ±5.23^{s}	80.00 ± 4.68
	>10 years	81.73±3.29	74.50 ± 2.00	91.66± 2.79	88.11 ± 5.75

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Table 4.4 Gas Flare effect on Respiratory Rate of residents in Edo State

		Males		Females	
Age	Duration of exposure	GFC (Oben)	NGFC (Ekiadolor)	GFC (Oben)	NGFC (Ekiadolor)
Children (12 – 17yrs)	1 – 5 years	26.37±2.06	25.00 ± 1.47	24.00±2.76^{s}	29.50 ± 2.50
	6 – 10 years	27.00± 0.02	20.33 ± 0.33	26.50±4.27	23.00 ± 1.00
	>10 years	30.60±2.44	24.00 ± 2.10	43.00±7.00^{*as}	23.00 ± 2.08
Adults (18 – 70 yrs)	1 – 5 years	26.57±1.40^{s}	32.26 ± 1.46	30.71± 0.64^{s}	24.42 ± 0.98
	6 – 10 years	27.37±4.51^{s}	36.00 ± 1.00	29.28 ± 1.36	20.83 ± 1.17
	>10 years	29.48±1.95^{s}	36.93 ±1.41	28.07±1.02^{s}	20.89 ± 1.29*

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.5 Gas flare effect on Peak Expiratory Flow Rate of residents in Edo State

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	250.25 ± 12.81	316.25 ± 32.14	288.33 ± 47.94[s]	278.50 ± 21.50
	6 – 10 years	177.50 ± 7.50[s]	383.33 ± 16.67	287.25 ± 58.90	275.00 ± 45.00
	>10 years	294.00 ± 40.97[a]	309.38 ± 27.62	297.50 ± 52.50[s]	355.00 ± 24.58
Adults (18 – 70 yrs)	1 – 5 years	357.86 ± 13.40[s]	321.36 ±10.73	222.71 ± 4.16	262.14 ± 14.66
	6 – 10 years	344.75 ± 24.04[s]	323.50 ± 17.04	275.00 ± 46.95	285.00 ±28.93
	>10 years	314.34 ± 19.55[s]	323.64 ± 18.27	367.67 ± 25.32[*a]	286.11 ± 23.42

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.6 Blood pressure recordings of residents (systolic) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	117.25 ± 3.81	119.00 ± 4.11	112.00 ± 4.35	110.00 ± 1.73
	6 – 10 years	119.50 ± 12.50	120.20 ± 5.65	123.67 ± 3.67^{s}	118.00 ±2.30
	>10 years	125.10 ± 7.47	121.88 ± 4.63	114.80 ± 8.63^{s}	111.20 ± 4.93
Adults (18 – 70 yrs)	1 – 5 years	151.42 ± 4.99^{s}	129.72 ± 3.56	131.57 ± 7.48	132.00 ± 5.57
	6 – 10 years	141.75 ± 3.70^{s}	120.55 ± 3.94	151.75 ±5.31^{s}	115.42 ± 3.35*
	>10 years	141.90 ± 5.78	120.69 ± 4.65	148.14 ± 8.24	129.44 ± 4.55

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.7 Blood pressure recordings of residents (diastolic) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	73.00 ± 3.61	65.83 ±4.62	61.33±4.97	63.33 ±5.84
	6 – 10 years	70.00 ±.02	67.20 ±1.39	69.00 ±7.37	77.67 ± 2.03*
	>10 years	72.40 ± 4.09	71.33 ±3.13	58.40 ±5.87	70.60 ±3.10
Adults (18 – 70 yrs)	1 – 5 years	82.83 ± 2.95	79.33 ±3.18	82.42 ± 6.13	80.31 ± 3.24
	6 – 10 years	83.87 ±3.32	71.55 ±3.99	92.87 ± 3.67	72.86 ± 2.76
	>10 years	88.45 ± 2.35[s]	68.23 ±1.68*	83.43 ±2.91[s]	71.44 ±2.79*

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Table 4.8 Blood pressure recordings of residents (PRate)

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	79.86 ±8.30	87.17 ± 0.91	90.00 ± 13.08	91.33 ± 2.19
	6 – 10 years	92.00 ±10.00	88.40 ± 3.96	90.67 ±9.82	121.00 ± 30.67
	>10 years	91.40 ±3.89	95.56 ±3.79	88.20 ±6.41	97.80 ±5.15
Adults (18 – 70 yrs)	1– 5 years	81.08 ±3.30[s]	71.55 ±2.24	79.42 ± 3.82	71.08 ±4.53
	6 – 10 years	80.62 ±3.90	74.00 ±4.17	88.62 ±3.63[s]	77.14 ±4.00
	>10 years	90.20 ±2.62[*s]	74.15 ± 1.32	93.50 ±3.03[*s]	81.00 ±4.69

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.9 Blood pressure recordings of residents (RRate)

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	29.38 ± 2.09	24.50 ± 1.59	22.00 ±2.00	23.33 ±1.67
	6 – 10 years	31.00 ±5.00	25.20 ±1.24	25.00 ±2.08	22.67 ±3.17
	>10 years	32.20 ±1.58[s]	26.11 ± 0.92	34.80 ±4.12[*]	22.20 ±1.56
Adults (18 – 70 yrs)	1 – 5 years	26.92 ± 0.73[s]	22.61 ±19.68	24.57 ± 1.66	22.30 ±1.30
	6 – 10 years	31.63 ±4.25[s]	25.56 ±23.97	27.37 ±1.90[s]	21.43 ± 0.57
	>10 years	26.35 ± 0.56[as]	24.69 ±10.07	29.14 ± 0.98[*s]	20.00 ± 0.93

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Table 4.9.1 Blood pressure recordings of residents (PEFR)

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	284.00 ± 14.85	286.83 ± 29.22	245.00 ± 22.91	247.00 ± 40.41
	6 – 10 years	280.50 ± 97.50	281.00 ± 40.54	240.00 ± 65.05	243.67 ± 14.81
	>10 years	275.00 ± 20.75	308.33 ± 21.34	235.00 ± 53.17	272.00 ± 36.39
Adults (18 – 70 yrs)	1 – 5 years	339.58 ± 22.78	341.11 ± .98	264.14 ± 39.62	268.62 ± 14.05
	6 – 10 years	325.00 ± 26.91 [s]	333.66 ± 1.39	260.62 ± 45.22 [s]	265.57 ± 17.39
	>10 years	321.50 ± 16.73 [as]	330.84 ± 0.95	258.43 ± 27.74 [s]	282.44 ± 24.60

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.3.1 Blood pressure recordings of residents (systolic) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	122.17 ± 3.99	121.67 ± 2.20	119.00±5.59^{s}	112.80 ± 2.18
	6 – 10 years	125.00 ±6.41	118.71 ± 4.36	127.33 ± 1.86^{s}	118.20 ±1.11
	>10 years	121.80 ±4.21	116.20 ±4.10	102.75 ± 3.78^{*a}	110.57 ±3.59
Adults (18 – 70 yrs)	1 – 5 years	123.00 ± 4.99	127.71 ± 3.89	140.55 ±5.27	118.56 ±3.65
	6 – 10 years	122.60 ± 7.49	126.57 ±4.59	165.20 ±4.66^{*s}	120.55 ±4.56
	>10 years	147.77 ± 3.67^{*s}	136.25 ± 8.62	149.18 ±4.99	121.83 ±2.77

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 01– 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Table 4.3.2 Blood pressure recordings of residents (diastolic) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1– 5 years	70.00 ±2.29	63.22 ± 4.39	76.20 ±5.75	68.40 ±4.50
	6 – 10 years	71.00 ±1.35	65.71 ±2.02	67.33 ± 2.91	72.80 ± 3.59
	>10 years	72.60 ±3.63	61.30 ± 2.87	60.00 ±1.89*	63.71 ± 3.56
Adults (18 – 70 yrs)	1 – 5 years	85.00 ± 3.89^{s}	78.52 ±3.19	85.33 ± 3.93	76.44 ±3.53
	6 – 10 years	72.00 ± 6.01	80.28 ±3.71	97.20 ± 6.16^{s}	73.78 ±2.41
	>10 years	84.72 ± 1.69^{s}	76.44 ± 3.53	83.36 ±3.28^{as}	75.42 ± 2.24

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Blood pressure recordings of residents (PRate)

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	83.17 ± 9.52	82.22 ± 3.24	83.00 ±4.63	84.40 ± 4.94
	6 – 10 years	90.25 ± 11.23	84.48 ±3.19	100.67 ±4.66	94.00 ±3.56
	>10 years	83.90 ±5.28	80.00 ±1.82	88.13 ±4.25	80.57 ± 4.81
Adults (18 – 70 yrs)	1 – 5 years	65.00 ±3.53	73.77 ±2.19	80.77 ±3.79	78.67 ±3.73
	6 – 10 years	68.60 ±11.98	75.00 ±5.87	80.78 ±3.79	77.44 ±3.28
	>10 years	75.35 ±2.52	67.25 ±3.49	109.00 ±2.07[*as]	72.75 ±1.99

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.3.4: Blood pressure recordings of residents(RRate)

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1– 5 years	24.83 ± 2.26	24.88 ±1.13	27.20 ±4.55	24.60 ± 1.21
	6 – 10 years	29.25 ± 2.36	24.71 ±1.30	24.67 ±1.76	23.80 ±1.85
	>10 years	27.10 ±2.50	24.70 ±1.01	29.00 ±1.81	22.57 ±2.09
Adults (18 – 70 yrs)	1 – 5 years	24.00 ±4.25	22.47 ± 0.74	27.67 ±2.08	26.67± 1.11
	6 – 10 years	24.00 ±1.51	23.71 ± 2.19	27.20 ±2.98	23.56 ± 0.78
	>10 years	26.64 ±2.08	19.50 ± 2.22	33.63 ± 0.80[*as]	23.83 ± 0.82

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1– 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Table 4.3.5 Blood pressure recordings of residents (PEFR)

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1– 5 years	272.50 ±19.22	299.33 ±426.65	292.00± 53.05	278.00 ± 23.54
	6 – 10 years	272.50 ±55.17	297.14 ±28.82	239.67 ± 33.32	299.00 ±29.68
	>10 years	315.00 ±23.41	289.00 ±18.28	261.88 ±24.32	290.71 ±20.77
Adults (18 – 70 yrs)	1 – 5 years	278.00±24.32	354.41 ±20.42	218.89 ± 19.98	250.00 ±17.05
	6 – 10 years	292.00 ± 32.04[s]	365.00 ±26.72	217.00 ± 23.11	288.78 ± 18.79
	>10 years	270.28 ±14.43	355.00 ±38.89	270.99 ±13.92*	275.00 ±13.51

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

4.4.1: Blood pressure recordings of residents (systolic) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	103.25 ±10.93	105.67 ± 2.40	115.75 ±4.53	109.00 ±2.00
	6 – 10 years	125.00 ±2.88	114.60 ±4.27[a]	133.00 ±0.93	113.20 ±1.77
	>10 years	127.13 ± 6.20[s]	109.54 ±1.09	107.00 ±5.58	111.67 ±3.00
Adults (18 – 70 yrs)	1 – 5 years	155.00 ± 12.27[s]	131.36 ±6.44	118.22 ±4.37	128.75 ±6.46
	6 – 10 years	144.00 ±5.58[s]	131.80 ±5.06	127.50 ±8.49	122.50 ±7.50
	>10 years	151.44 ±5.07[s]	122.46 ±3.25	138.93 ±5.17[*]	123.80 ±2.88

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.4.2: Blood pressure recordings of residents (Diastolic) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	60.00 ±2.64	64.50 ± 2.71	74.87 ± 4.96	72.66 ±8.45
	6 – 10 years	75.00 ±1.56	57.60 ±4.00	61.00 ±5.30	65.80 ±1.35
	>10 years	75.75 ±3.95^{s}	64.18 ±2.06	60.50 ±3.40	62.25 ±5.30
Adults (18 – 70 yrs)	1– 5 years	86.83 ±4.76	75.90 ±4.88	75.55 ±3.32	76.83 ±3.97
	6 – 10 years	96.00 ± 3.32^{s}	69.60 ±3.66	81.00 ±7.03	75.00 ±5.00
	>10 years	89.72 ±1.79^{*s}	66.00 ±1.56	84.44 ±4.41	71.00 ±2.42

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Blood pressure recordings of residents (PRate).

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	105.75 ± 5.49	92.33 ± 5.95	90.00 ±4.67	85.00 ±5.85
	6 – 10 years	114.00 ±9.52	86.20 ±5.28	95.00 ± 3.79	101.60 ±9.45
	>10 years	100.37 ± 3.79^{s}	78.09 ±4.68	105.25 ±3.06	97.83 ±3.05
Adults (18 – 70 yrs)	1 – 5 years	85.16 ±5.14	74.00 ±2.86	86.11 ±1.66	71.75 ±4.62
	6 – 10 years	90.00 ±3.90	73.00 ±3.42	92.25 ±9.52	90.50 ± 0.50
	>10 years	91.84 ±1.77^{s}	73.69 ±2.52	85.96 ±2.04	81.90 ±3.90

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Table 4.4.4: Blood pressure recordings of residents (RRate)

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	32.50 ±1.32	32.67 ±10.22	33.12 ±1.71	22.67 ±2.33
	6 – 10 years	29.00 ±1.00	27.00 ±89.50	30.00 ±2.45	24.00 ±1.41
	>10 years	34.12 ±1.07[s]	23.90 ±1.28	30.00 ± 0.81	23.25 ±1.58
Adults (18 – 70 yrs)	1 – 5 years	28.17 ±1.64[s]	22.54 ±1.30	25.33 ±1.31[s]	20.50 ± 0.59
	6 – 10 years	26.00 ±1.32	23.30 ±1.49	26.00 ± 1.78	21.00 ±1.00
	>10 years	28.40 ± 0.48[s]	23.61 ±1.17	26.86 ± 0.54[s]	21.90 ±1.13

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.4.5: Blood pressure recordings of residents (PEFR)

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	331.25 ±45.10	366.67 ±31.48	287.50 ±5.86	303.33 ±23.33
	6 – 10 years	355.00 ±12.42	260.60 ±58.88	310.00 ±16.23	338.00 ± 39.55
	>10 years	335.00 ±15.89	325.45 ±25.13	282.50 ± 70.16	321.67 ± 21.81
Adults (18 – 70 yrs)	1 – 5 years	344.17 ±31.23	364.09 ± 22.33	384.00 ±25.52[s]	257.08 ±12.14
	6 – 10 years	400.00 ±15.00	376.00 ± 22.49	420.00 ±15.89[s]	305.00 ±15.00
	>10 years	381.00 ±13.24	378.07 ±20.30	392.82 ±12.42[s]	302.70 ± 24.28

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.5.1: Blood pressure recordings of residents (systolic) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	120.00 ± 0.03	119.57 ± 2.64	137.22 ± 4.89[s]	114.27 ± 1.56
	6 – 10 years	158.50 ± 26.50	108.00 ± 2.21	112.00 ± 8.00	115.37 ± 3.11
	>10 years	132.20 ± 11.41	117.56 ± 3.06	120.00 ± 8.88[s]	115.71 ± 2.05
Adults (18 – 70 yrs)	1 – 5 years	153.36 ± 3.89	127.33 ± 2.57	137.22 ± 4.89	120.91 ± 3.79
	6 – 10 years	141.16 ± 3.05	120.00 ± 3.35	133.00 ± 6.75	123.00 ± 4.73
	>10 years	152.37 ± 3.19	137.13 ± 5.16	147.00 ± 5.98[s]	123.77 ± 3.50

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Table 4.5.2: Blood pressure recordings of residents (diastolic) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	75.00 ± 15.00	63.28 ± 4.71	68.00 ± 5.88	69.18 ± 2.90
	6 – 10 years	76.00 ± 6.00	57.00 ± 2.18*	73.00 ± 7.00	77.00 ± 2.07
	>10 years	71.40 ± 2.97	70.67 ± 4.46[a]	60.75 ± 9.53	67.14 ± 1.98
Adults (18 – 70 yrs)	1 – 5 years	86.26 ± 3.55	78.93 ± 2.22	85.55 ± 3.59	76.66 ± 3.20
	6 – 10 years	78.00 ± 2.03	72.00 ± 2.37	82.83 ± 2.27[s]	75.56 ± 3.84
	>10 years	84.83 ± 2.18	89.37 ± 6.75	88.61 ± 2.69[s]	72.11 ± 2.37

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table 4.5.3: Blood pressure recordings of residents (PRate) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	72.50 ± 2.50	79.71 ± 4.39	69.24 ± 2.68	88.36 ± 4.73
	6 – 10 years	73.50 ± 8.50	84.00 ± 2.33	72.50 ± 1.50	91.75 ± 5.13
	>10 years	78.60 ± 2.89	83.22 ± 4.06	84.00 ± 7.34	91.85 ± 6.18
Adults (18 – 70 yrs)	1 – 5 years	82.10 ± 1.48[s]	70.33 ± 2.00	86.00 ± 2.23	80.75 ± 2.86
	6 – 10 years	83.67 ± 2.70	81.00 ± 1.55	90.33 ± 5.59	86.44 ± 3.76
	>10 years	83.45 ± 1.75	79.75 ± 4.45	85.50 ± 1.64	86.33 ± 6.27

Values are represented as mean Standard error of mean; *: $p<0.05$ when compared to 1 – 5 years
a: $p<0.05$ when compared to 6 – 10 years; s: $p<0.05$ when compared with NGFC

Table4.5.4: Blood pressure recordings of residents(RRate) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	33.50 ± 5.50	23.57 ± 1.34	19.07 ± 1.43	24.18 ± 1.55
	6 – 10 years	33.00 ± 3.00	18.00 ± 1.55	32.50 ± 3.50	21.25 ± 1.42
	>10 years	34.60 ± 0.97^{s}	25.00 ± 1.50	33.00 ± 1.91^{s}	20.85 ± 0.93
Adults (18 – 70 yrs)	1 – 5 years	27.63 ± 0.58^{s}	19.80 ± 0.34	23.88 ± 1.58	23.00 ± 1.16
	6 – 10 years	27.50 ± 1.63^{s}	26.00 ± 3.00	26.00 ± 1.03^{s}	22.22 ± 1.62
	>10 years	24.95 ± 0.56^{*s}	19.62 ± 0.99*	27.17 ± 1.06^{*s}	19.22 ± 0.95

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

Table 4.5.5: Blood pressure recordings of residents (PEFR) mmHg

		Males		Females	
Age	Duration of exposure	GFC	NGFC	GFC	NGFC
Children (12 – 17yrs)	1 – 5 years	287.00 ± 35.92^{s}	365.86 ± 65.00	126.00 ± 2.08 ^{s}	255.27 ± 17.42
	6 – 10 years	250.00 ± 16.79 ^{s}	365.00 ± 15.00	274.37 ± 19.89 ^{s}	420.00 ± 20.00
	>10 years	332.22 ± 44.02 ^{s}	400.00 ± 14.14	305.00 ± 29.44 ^{s}	385.00 ± 31.42
Adults (18 – 70 yrs)	1– 5 years	313.87 ± 35.64^{s}	400.05 ± 18.94	265.00 ± 15.74^{s}	443.88 ± 9.85
	6 – 10 years	260.00 ± 14.14^{s}	398.83 ± 22.27	280.56 ± 21.83^{s}	445.00 ± 15.27
	>10 years	301.88 ±18.44^{s}	406.45 ± 18.00	272.78 ± 16.79^{s}	460.83 ± 6.53

Values are represented as mean Standard error of mean; *: p<0.05 when compared to 1 – 5 years
a: p<0.05 when compared to 6 – 10 years; s: p<0.05 when compared with NGFC

5.6.0 GENDER EFFECT ON THE IMPACT OF GAS FLARING ON CARDIOPULMONARY PARAMETERS.

MALE				FEMALE		
PARAMETERS	GFC	NGFC	IMPACT	GFC	NGFC	IMPACT
SYSTOLIC (mmHg)	135.62 ± 7.58	126.50 ± 6.87	9.12 ± 1.25	129.86 ± 11.03	120.41 ± 15.03	9.45 ± 1.18
DIASTOLIC(mmHg)	78.55 ± 2.30	69.94 ± 5.88	8.61 ± 0.12	76.04 ± 9.56	72.20 ± 4.95	3.84 ± 5.32
PULSE RATE (beats/min)	84.87 ± 14.08	73.36 ± 8.04	11.51 ± 1.01	88.75 ± 7.36	86.74 ±12.01	2.01 ± 0.05
RESPIRATORY RATE (cycle/min)	28.67 ± 1.64	24.76 ± 1.55	3.91 ± 0.05	28.23 ± 1.78	22.76 ± 1.89	5.47 ± 0.05
PEFR (litres/min)	303.18 ± 23.56	340.88 ± 25.47	37.70 ± 1.02	278.09 ± 15.12	307.99 ± 18.03	29.90 ± 2.56

On DBP, PR, PEFR males were more impacted, (8.61, 11.51, 37.70) while on RR females were more impacted (5.47) and the impact SBP seems negligible (9.45) for females and 9.12 for males.

Appendix v

Sample Size Determination

The research involved 504 participants in the study areas. The formula for sample size determination is:

$$n = \frac{Z^2 \times p(1-p)}{e^2}$$

n = required Sample Size

z = confidence level at 95% (Standard value of 1.96)

p = estimated prevalence in project area (assumed = 0.3)

q = 1 – p

e = margin of error at 4% (0.04)

$$n = \frac{Z^2 \times p(1-p)}{e^2}$$ (Cochran, 1977)

$$n = \frac{1.96^2 \times 0.11\,(1-0.11)}{(0.02)^2}$$

$$= \frac{3.84 \times 0.11\,(0.89)}{0.0004}$$

$$= \frac{3.84 \times 0.0979}{0.0004}$$

$$= \frac{0.3756}{0.0004}$$

n = 940