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Environmental Health Implications Of Increase In Levels Of Carbon Monoxide In Onitsha, Nigeria

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***Abstract*—The world is presently confronted with the twin cries of environmental degradation and fossil fuel depletion. Also, all over the globe, there is an increasing awareness on environmental pollution and its resultant impacts. Fossil fuel powered engine are currently noted to account for over 60% of the carbon monoxide pollution in the environment. This could be said to have serious environmental and health implications especially in our urban areas. The conditions in Onitsha metropolis cannot be said to be different. This paper, therefore reviewed the increasing levels of carbon monoxide in Onitsha metropolis and the health implications in the area. A review of the various sources of carbon monoxide worldwide with particular reference to Onitsha metropolis was carried out. The various areas in the metropolis prone to increase in levels of carbon monoxide were identified with peculiar sources associated in each location. Health implications of the increasing levels of carbon monoxide in the metropolis were ascertained, which entails cardiovascular diseases and others which may eventually lead to death. Recommendations were made towards ameliorating the situation, and they include speedy completion of second Niger Bridge, the use of carbon foot print, carbon off setting, as well as enacting and implementing enabling laws to curb the problem.**

***Keywords*—Health, Implications, Carbon Monoxide, Onitsha**

INTRODUCTION

Concerning the effect of carbon monoxide on the environment, a lot has been advanced. Carbon monoxide produced from the partial oxidation of carbon containing compounds; is formed when there is not enough oxygen to produce carbon dioxide. Peter (2014)(1) observed that in the presence of oxygen, including atmospheric concentrations, carbon monoxide, burns with a blue flame producing carbon dioxide. According to him, coal gas used widely before the 1960s for domestic lighting, cooking and heating had carbon monoxide as an important fuel constituent.

Baker, (2016)(2) noted that the chemical composition of ambient air is very complex and depends on many different factors, traffic generated air pollution being a major source in large cities. This is especially true in the developing world, mainly due to the high proportion of the old, poorly maintained vehicles, the abundance of two stroke vehicles and this poor fuel quality.

Following three initial report that carbon monoxide is a normal neurotransmitter in 1993, as well as one of the three gases that naturally modulate inflammatory response in the body, carbon monoxide has received a great deal of clinical attention, as a biological regulator. However, Schwartz (2013)(3), advanced that clinical trials of small amount of carbon monoxide as a drug are ongoing, pointing out that too much of carbon monoxide brings about carbon monoxide poisoning.

This paper therefore reviews the environmental health implications of high level of carbon monoxide particularly as at affects Onitsha, in Anambra state of Nigeria.

Mechanism of Carbon Monoxide Toxicity

The principal mechanism of toxic effects at low level carbon monoxide exposure is the decreased oxygen carrying capacity of blood and subsequent interference, with oxygen release in the tissue caused by the binding of carbon with Hb, producing CHOb. This induces tissue hypoxia in diverse organ systems, especially organs with the highest oxygen requirement such as heart and brain. Allred (2016)(4), emphasized that carbon monoxide is absorbed through the lungs and diffuse across the alveolar capillary membrane. The exchange of carbon monoxide between the inhaled air and the blood is controlled by both physical and physiological mechanism. As it is absorbed, the carbon monoxide diffuses through the plasma, going through the red blood cell membrane and eventually is moving to the red blood cell stoma where carbon monoxide binds hemoglobin to form carboxyhemonglotin. This inevitably reduces the oxygen carrying capacity of blood and interferes with oxygen release at the tissues. Consequently delivering of oxygen is impaired and this can interfere with cellular respiration and bring about tissue hypoxia.

Dissociation of oxygen from other hemoglobin sites could also take place as a result of the presence of

carbon monoxide, and this is likely to compromise the delivery of oxygen to the tissues.

In his recent work, Anderson (2013)(5), affirmed that the most likely protein to be inhibited at relevant levels of COHb is myoglobin, which abounds in skeletal muscle and the myocardium. By impairing the oxygen carrying capacity and the transportation of oxygen from the blood to the mitochondrial, lower myoglobin levels cause dysfunction. Carbon monoxide also binds with cytochrome oxidase, the terminal enzyme in the mitochondrial electron transport chain that catalyzes the reduction of molecular oxygen to water. This inhibits cellular respiration and resulting in anaerobic metabolism and lactic acidosis.

Determining the factors responsible for the final levels of COHb in blood, Adams (2012)(6) outlines; the amount of inspired carbon monoxide, the minute alveolar ventilation at rest and during exercises, blood volum, barometric pressure, diffusion capability of the lungs and endogenous , carbon monoxide supply. Endogenous carbon monoxide is produced from metabolism of the alpha –methane carbon atom in the protoporphyrin ring by hemoxygenase during Hb catabolism. Carbon monoxide production results in a basal COHB level of 0.4-0.966% in a healthy unexposed person at rest.

Kleinman (2017)(7), however asserted that carbon monoxide is not a cumulative poison because COHb is fully dissociable and once exposure has ceased, the Hb will revert to **oxy** hemoglobin and carbon monoxide is eliminated through the lungs. According to Kleinman, the biological half life of carbon monoxide in the blood of sedentary adult is 2-5 hours (h) and the elimination becomes slower as the concentration decreases, hence only a small amount of carbon monoxide is metabolized to carbon dioxide. The signs and symptoms of carbon monoxide poisoning appear when COHb concentration exceeds 10%.

Sources, levels and distribution of carbon monoxide in the environment

Motor vehicles have been identified as a major source of air pollution with significant impact on exposures in the ambient environment (United Nations, 2005)(8). Carbon monoxide as a major constituent of air pollution has been categorized into on road light duty vehicles, trucks, and motor cycles and of road vehicles, equipment and engines used off road in situation such as construction and agriculture (Hovarth, 2015)(9). Air pollution mixture is dependent on among other characteristic the traffic system, fleet composition, the proximity of vehicles to the roads and the availability of other pollution sources (Hexter, 2011)(10). Exposure of the population is influenced by the concentration of air pollution and the activities of the population (WHO, 2005)(11). National Security Agency (2001) remarked that emissions from the urban environment are exacerbated by both adverse meteorological conditions and topographic constraints.

Saldivia (2015)(12) noted that carbon monoxide is a trace constituent of the troposphere produced by both natural process and human activities. Because plants can both metabolise and produce carbon monoxide, trace levels are considered a normal constituent of the natural environment. Although ambient concentrations of carbon monoxide in the vicinity of urban and industrial areas can substantially exceed global background levels there are no reports of these currently measured levels of carbon monoxide producing any adverse effects on plants or micro organisms. Trends in air quality data from fixed site, stations show a general decline in carbon monoxide concentration, which reflect the efficiency of emission control system on newer vehicles. This could be boldly said of developed countries. However, highway vehicles emission in USA accounts for about 50% of total emission, non highway transportation sources contribute 13%. The other categories of carbon monoxide emission are other fuel combustion source such as steam boilers (12%), industrial processes (8%), and solid waste disposal (3%) and miscellaneous other sources (14%).

Indoor concentrations of carbon monoxide are a function of outdoor concentrations, indoor sources, infiltrations, ventilation and mixing between and within rooms. In residence without sources, average carbon monoxide concentrations are approximately equal to average outdoor levels. The highest indoor carbon monoxide concentrations are associated with combustion sources and are found in enclosed parking garages, service stations, restaurants and the likes. The lowest indoor carbon monoxide concentrations are found in homes, churches and healthcare facilities. Exposure studies show that passive cigarette smoke is associated with increasing a non smokers exposure by an average of about 1.7mg/m^3 (1.5ppm) and that use of a gas cooking range at home is associated with an increase of about 22.9mg/m^3 (22.5ppm). Other sources that could contribute to carbon monoxide in the home include combustion space and water heaters and coal or wood burning stoves (Varon, 2013)(13).

National security Agency (2001) observed that family high levels of secondary pollutants can be formed from molecular emissions in the urban environments. The emission of pollutants from motor vehicles is influenced by the vehicle type,(light or heavy duty vehicles, age, operating and maintenance conditions) exhaust treatment and engine lubricants used. Cold-start operation emits high-levels of pollutants such as hydrocarbons, carbon monoxide and nitrogen oxide USA High energy Ignition, (2010)(14). Exposure occurs in three scales of distance namely near field (0-02km), the urban scale (0.22-220km) and regional scale (20-22,000km) (Siger, 1999)(15) Elevated exposures occur in the near field environment and the people mostly affected are pedestrians, people in nearby buildings, cyclist,

and vehicle passengers. Studies have shown that the highest exposures normally occur at a distance ranging from 50 to 100 metres from road ways (world Health organization, 2005)(16).

In his work, Kuller (2015)(17) added that recent data on global trends in tropospheric carbon monoxide concentrations indicated a decrease over the last decade. Global background concentration fell in the range of 60-140g/m^3(50-1220ppm). Levels were higher in the northern hemisphere than in Southern hemispheres. Average background concentration also fluctuated seasonally. Higher levels occurred in the winter months and lower levels occurred in the summer months. About 60% of the carbon monoxide found in the non urban troposphere was attributed to human activities both directly from combustion processes and indirectly through the oxidation of hydrocarbons and methane that in turn, arose from agricultural activities, landfills and other similar sources.

Considering the population at increased risk of adverse effect of carbon monoxide, Anderson (2013) outlined the exposure as;

i. In individuals with cardiovascular diseases, COOHb levels of 2.6% may impaire the delivery of oxygen in the myocardium causing hypoxia and increasing coronary blood flow demand by nearly 30%. When myocardial oxygen demands are increased, as in exercise, the hypoxic effects of carbon monoxide may exceed the limited coronary reserve producing adverse health effects, including earlier onset of myocardial ischemia, reduce exercise tolerance in persons with stable angina pectoris, increased number and complexity of arrhythmias, and increased hospital admission for congestive heart failure.

ii. Fetuses and young infants are more susceptible to carbon exposure for different reasons; carbon crosses the placenta, fetal Hb has greater affinity for carbon monoxide than maternal Hb, the half life of COHb in fetal blood is three times longer than that of material blood and the fetus has high rates of oxygen consumption and lower oxygen tension in the blood than adult. Also, material smoking during pregnancy exposes the fetus to greater than normal concentration of carbon monoxide leading to a decrease in birth weight.

iii. Children are at risk because they spend a great deal of time outdoor, and their pulmonary ventilation is greater, than in adult.

iv. Pregnant women have increased alveolar ventilation, increasing the rate of carbon monoxide uptake from inspired air.

v. Individual with chronic obstructive pulmonary disease such as bronchitis and emphysemas are more suscetible to carbon monoxide effects since their lungs are less efficient at oxygenating the blood

vi. Individuals with low hemoglobin levels are more sensitive to low level carbon monoxide exposure due to their reduced ability to transfer oxygen.

vii. Smokers can generate COHb levels as high as 15% because cigarette smoke contains high carbon dioxide level.

ix. Certain occupation group is at great risk from ambient carbon monoxide exposure including those who work on the city streets (street repairmen, sheet cleaners, street vendors, deliverymen, garage attendant, and taxi and bus drivers) individuals who work in industrial processes are also at great risk.

x. Young healthy individuals who spend a lot of time on the streets doing exercise or heavy work have increased COHb levels and may experience decreased maximal exercise duration and impaired psychomotor task performance. During exercise, after the anaerobic threshold is reached, booth lactate levels and the lactate /private ratio increase as an index of anaerobic metabolism.

xi. Concentration of COHb between 2% and 6% decrease the anaerobic threshold and anaerobic metabolism appears earlier causing early fatigue of skeletal muscle and decreased maximal effort capability.

Health effects of carbon monoxide

In his view, Morris (2015)(18) opined that adverse effects associated with exposure to ambient and indoor concentration of carbon monoxide are related to concentration of COHb in the blood. Health effects observed may include; early onset of cardiovascular disease, behavioral impairment, decreased exercise performance of young health men, reduced birth weight, sudden infant, death syndrome and increased daily mortality rate.

Individuals with cardiovascular disease are more susceptible to exposure to outdoor and indoor levels of carbon monoxide. Exposure to concentration of carbon monoxide levels from 50ppm to 100ppm can have direct adverse effect on the heart. In these individuals, exposures to 50ppm carbon monoxide for 2-4hrs (producing COHb blood concentration of 2%-5%), can decrease exercise tolerance, cause the appearance of typical angina pain after exercises, increase the frequency of arrhythmias. Such exposures also decrease the time to exercise induced angina and ST Segment depression among subjects with diagnosed coronary artery disease and increased hospital admission for congestive heart failure. In 2014, Allred observed relationship between doses of carbon monoxide producing 2-4% of COOHb and effects on cardiac function, during exercise in subject, with coronary artery disease. There was a decrease of 5.1% (P=0.01) in the time of development of ischema (manifested by St-segment changes in the EKG) and a decrease of 4.2% (P=0.027) in the time to onset of angina at mean COHb levels of 22.0% as a result of exposure to 117ppm carbon monoxide, a concentration commonly found in heavy traffic.

Aronow and Ibell (2004)(19) carried out a study in which they found that exposure to 50ppm carton monoxide for 2hrs produced COHb levels of 22.7%, and reduced significantly the time to onset of exercise induced angina pectoris from 3.74min observed after

subjects breathed clean air) to 3.13min (observed after carbon monoxide exposure. Adams (2016) conducted a study focused on the cardiovascular effects of subject exposed to 100 or 200ppm carbon monoxide reaching COHb levels of 6%.

Morris (2018) in a study of seven US cities found an association between ambient carbon monoxide levels and hospital admission for congestive heart failure among elderly people. The relative risk of hospital admission associated with exposure to 10ppm of carbon monoxide ranged from 1.1 in New York to 1.37 in Los Angeles. Lim (2012)(20) investigated the association between air pollution and daily hospital admission in Los Angeles. Carbon monoxide and NO_2 showed the strongest relationship ($P<0.5$) with cardiovascular hospital admissions in the winter when the range of carbon monoxide concentrations was 1.1 to 2.2ppm and the increase in cardiovascular admission was 4.0%. Also Morris (2017) showed that the effect of carbon monoxide on hospital admission for heart failure may be temperature dependent, which can be attributed to cold air exposure which may increase heart rate, systolic and diastolic blood pressure and cardiac output. Beard and Werthein (2014)(21) demonstrated that exposure to 50ppm carbon monoxide for 90minutes caused a progressive deterioration in subject's abilities to estimate the passage of time. Baker (2016) correlated flu-like symptoms with COHb levels between 2% and 5% in children and found out that increased metabolic demands on oxygen delivery may make infants more susceptible than adults to carbon monoxide poisoning.

Zinn (2010) asserted that risk increase with the number of cigarettes smoked. According to him levels of COHb at 2% -5% due to smoking or environmental exposure may aggravate the course of an acute mycarclial infraction in patients with coronary artery disease.

According to Horvath (2017), exposures to carbon monoxide sufficient to reach blood COHb concentration of 26% decreased exercise performance in young non smoking healthy individuals. He reported a reduction of 5% and 7% in work time to exhaustion at 3.3 and 4.3% COHb level respectively, a 38% reduction in work time being reported previously. Adir noted a significant decrease in exercise duration and maximal effort capability at blood COHb concentrations of 4% -6% in young health men.

Recently, (2016)(22) evaluated the effects of carbon monoxide exposure during the last trimester of pregnancy on the frequency of IBW among neonates born 1989-1999 to women living in the Los Angeles, California area. He found exposure to be more than 5.5ppm carbon monoxide during the last trimester of pregnancy, and it was associated with a 22% increase in LBN.

Sudden infant death syndrome has been linked to exposure to ambient carbon monoxide. Hoppenbrouwers (2010)(23) reported a statistical association between the daily incidence of sudden infant death syndrome and levels of carbon monoxide in Loss Angeles country. Besides, certain studies also demonstrated association between daily mortality and outdoor and indoor concentrations of carbon monoxide. Hexter and Goldsmith (2009)(24) reported an association between daily death rate and exposure to ambient carbon monoxide in Los Angeles country. They found that a carbon dioxide concentration of 20.2ppm (the highest daily concentration recorded during 4 years) contributed II out of 159 death. Cohen (2012)(25) studied case fatality rates for patients admitted with myocardial infarction in Loss Angeles. According to him, they demonsyrated that high carbon monoxide pollution areas (7-12ppm) had greater admission case fatality rate than low carbon monoxide pollution areas. Evaluating the association between air pollution and mortality in phoenix, Mar (2013)(26) found out that cardiovascular mortality was strongly associated with carbon monoxide and NO_2 ($P <0.5$)

Carbon monoxide emission in Onitsha metropolis

Onitsha commercial city of great importance in Nigerian and the sub region of West Africa at large - is currently being bedeviled by the endemic environmental challenges facing most growing cities in developing countries.

Mba and Umeakuka (1999)(27), reported that these environmental degradation have led to the deterioration of the environmental quality of the area, which manifests in various area of the environment. Air pollution and precisely, carbon monoxide emission tends to pose serious environmental problem plaguing Onitsha metropolis. The metropolis which hitherto used to be in stable condition as nature tended to balance and replenish anomalies, is no longer so. Under undisturbed vegetation, plants around the metropolis generated a lot of oxygen needed by residents and absorbed excess carbon products from the areas. This brings a balance in temperature in an area. But as the vegetative parts of the metropolis is fast diminishing, the excess carbon products in the areas finds it difficult to be absorbed, and no additional sources of oxygen could be observed to be available in the area. Hence, there is noticeable imbalance in temperature, which tends to contribute a great deal to the warming of the environment within the metropolis. However, in recent time, it has been observed that the area is filled with carbon monoxide as some studies have indicated.

This is a major air pollutant that may not be conducive to residents of any environment, particularly if found beyond a limiting level. The questions to be asked include; what are the sources of carbon monoxide in the areas; what areas are prone to excessive emission of carbon monoxide in the metropolis; and what are the health implication of high level of carbon monoxide present in the metropolis. Answers to these questions will tend to

give an insight as to the environmental health implication of increase in level of carbon monoxide among residents of Onitsha metropolis in Anambra state of Nigeria.

In line with the findings of Saldivia (2015), that ambient concentration of carbon monoxide in the vicinity of urban and industrial areas can substantially exceed global background levels, the case of Onitsha is indeed not different. Because of the Nigerian civil war of 1967-1970 and the obnoxious national policy then which confiscated most of the landed properties owned all over the nation by the easterners the easterners have learnt their bitter lesion of brining home some of their business investments. Onitsha, being a commercial centre of great importance, these business men find it conducive to site their industrial outfits in this city. The state government is not left out in this endeavour.

Some of these industries include the premier industry the enamel ware and the likes, owned by the government as well as individuals (even though some of them are moribund.) These industrial outfits emit carbon monoxide into atmosphere in unguided and unguarded manner. No appropriate measures have been put in place to check the pollution of the environmental. Hence, carbon monoxide produced in these industrial outfits tend to infiltrate the environment impairing the environmental quality of the area.

Godin (2012)(28) pointed out that tobacco smoke is a source of carbon monoxide for both smokers as well as non smokers. Tobacco smoke is also a source of other chemicals with which environmental carbon monoxide could interact. In Onitsha, there is no law prohibiting smoking in public places. A lot of people smoke both in private and public places without considering the effects on others, not to talk of themselves. However, the United Nation (2005) declared that motor vehicles are major sources of air pollution with significant impact on exposures in the ambient environment. This declaration tends to explain what is playing out in Onitsha. As a result of economic hardship in Nigeria, exacerbated by the effects of COVID -19 pandemic, a lot of Nigerians tend to be down in their purchasing powers. Many people cannot afford to purchase new motor vehicles, hence they go for fairly used one imported into the country. Even those who have motor vehicles already find it difficult to maintain them. Thus, emission from these vehicles tend to infuse carbon monoxide into the environment.

Niger Bridge is a prominent areas noted for proliferation of carbon monoxide. Niger bridge at Onitsha is a connecting link between many states in western part of Nigeria with many other states in the eastern part of the country. States like Lagos, Ogun, Oyo, Ondo, Osun and even, Edo and Delta are conveniently connected through Niger bridge to some other states like Anamora, Imo, Enugu, Abia, Ebonyi and equally Benue states. Hence, Niger Bridge is almost carrying beyond its carrying capacity. There is always traffic congestion at the head bridge part of the metropolis and around the vicinity, particularly in the peak period of morning and evening. The traffic congestion here makes movement very difficult, and vehicles often held in this delima- most of which are second hand vehicles imported from abroad tend to emit a lot of carbon monoxide, thereby polluting the air and the environment. Also moving from Nkpor Junction areas into Onitsha metropolis is always a heculian task particularly during the peak periods. There is always the presence of traffic congestion as one move from linca road through Boronmeo joining Enugu Onitsha expressway. The road from upper Iweka through Enamelware and to Owerri is always bedeviled with traffic congestion. This is always so in the later part of the day when vehicles traveling to Lagos and other parts of Western Nigeria get to pass through Onitsha. Furthermore, it is always hectic for travelers moving in or out of Onitsha through G.R.A and down to Nkwere Ezunaka road because of traffic congestion. Commuters always find it difficult to enter or exit the metropolis through these areas. Even within the core areas of the metropolis traffic congestion is equally experienced. There is always traffic congestion along old market road down to Ose market, and through main market to new market road. This would partly be because of the presence of the one of the biggest market s in West Africa (Onitsha Main Market). There is often traffic congestion in these areas from morning till evening. Oguta road from DMGS round about to upper Iweka is not an exception. It is not always easy for commuters to go through upper Iweka down to Ochanja market without experiencing heavy traffic congestion along the road. So it is also moving from upper Iweka through Port-Harcourt road to head bridge. Heavy traffic congestion is always experienced at Borromeo round about down to Awka road at Savoy. This happens often during morning and evening hours when commuters are either going to their business stations or coming back from such. It is therefore clear that a result of heavy traffic congestion being experienced in different parts of the metropolis, there is a lot of carbon monoxide emission into the environment.

Health implications of high level of carbon monoxide on residents in Onitsha metropolis

A number of specific populations stand out increased risk of the adverse effects from carbon monoxide exposures than others. In accordance with the assertion of Anderson (2013) in individual living in Onitsha metropolis where there is high level of carbon monoxide and who have cardiovascular disease, COHb levels of 2.6% may impair the delivery of oxygen to the myocardium causing hypexica and increasing coronary blood flow demand by about 30%. Pregnant women who face the odeal of constant exposure to carbon monoxide may run the risk of exposing their fetuses to health hazard. This is because fetuses and young infants are more susceptible to carbon monoxide exposure than adults.

Furthermore, pregnant women who engage in smoking during pregnancy will expose the fetus to greater than normal concentration of carbon monoxide bringing about a decrease in birth weight. Because pregnant women have increased alveolar ventilation, the chance of increase in the rate of carbon monoxide intake is always there. Since children spend their time mostly outdoors, and their pulmonary ventilation being greater than that of the adult, they are at risk being exposed to the areas of high level of carbon monoxide. Individuals in the metropolis with low hemoglobin levels are more likely to be affected as a result of their reduced ability to transfer oxygen. Also residents or people playing in areas infested with carbon monoxide in the metropolis and are having chronic obstructive pulmonary disease like brondutis are more susceptible to the effects of carbon monoxide than others. Some occupation groups like those who load vehicles in motor parks are at great risk from ambient carbon monoxide exposure. Such could be said of the vehicle loaders and tauts at upper Iweka Park. Also, those who work in industrial outfits stand the risk of facing the hazard. It has also been ascertained that young people who spend a lot of time doing heavy work have increased COHb levels and are likely to experience impaired psychomotor task performance. Thus, younger ones in the metropolis who are largely engaged in heavy work like auto mechanics for several hours most of the day tend to be at the risk of impaired psychomotor task performance.

Besides, according to Morris (2018), people with cardiovascular disease are more susceptible to exposure to outdoor and indoor levels of carbon monoxide. Exposure ro concentration of carbon monoxide from heavy traffic and /or breathing carbon monoxide levels for 50ppm to 100ppm can have direct adverse effect on the heart. Hence, individuals with cardiovascular disease who are engaged in one business or the other like hawking, touting etc in high prone areas of upper Iweka, Limca Road, Old /New market road and other areas may be susceptible to direct adverse heart effect. Also ambient carbon dioxide levels could lead to congestive heart failure among elderly people. This is in a agreement with the study of Morris(2018) which established a relationship between ambient carbon monoxide level and hospital admission for congestive heart failure among elderly people. Smoking or environmental exposure may aggravate the course of an acute myocardial infarction in patients with coronary artery disease. This is in line with the views of Lim (2010), who noted that risk increases with the number of cigarettes smoked, and levels of COHb at 2%-5% due to smoking or exposure exacerbates myocardial infarction.

Meanwhile, it could be asserted that individuals who constantly engaged in activity or the other in carbon monoxide prone areas one in Onitsha metropolis run the risk of early death. Certain studies have established relationship between daily mortality and outdoor and indoor concentrations of carbon monoxide. Hexter and Goldsmith (2009), reported an association between daily death rate and exposure to ambient carbon monoxide in loss Angeles county. Cohen (2012) demonstrated that high carbon monoxide pollution areas had greater admission case fatality rate than low carbon monoxide pollution areas. In his study of the association between air pollution and mortality in phoenix Mars (2013) noted that cardiovascular mortality was strongly associated with carbon monoxide. Also Hoppenbrouwers investigated and reported a statistical association between the daily incidence of sudden infant death syndrome and levels of carbon monoxide in loss Angeles county

Conclusion

Levels of carbon monoxide in Onitsha metropolis have been found to be increasing over the years. This is as a result of the influx of fairly used vehicles into the area. The state of Nigerian economy, particularly during this COVID19 pandemic era has adversely affected the purchasing power of many Nigerians. Hence, a lot of Nigerians and Onitsha residence in particular find it difficult to afford the cost of new vehicles. Consequently, they go for fairly used ones imported from abroad. The fairly used vehicles have been identified as the major sources through which carbon monoxide is emitted into the metropolis.

Major areas identified as prone areas in the metropolis include; upper Iweka –Owerri road towards enableware industry, upper Iweka-head-bridge axis, upper Iweka-Ochanja are, Old market road through Ose market, main market and to New market road, GRA towards Nkwelle Ezunaka, as well as borrome round about through Limca road and towards Nkpor Junction. These areas are often bedeviled with heavy traffic congestion particularly during the peak periods.

The implication entails manifestation of various health challenges like cardiovascular disease among other health problems. Sometimes such can lead to death it is therefore ideal that proper measures by taken to ameliorate the situation, as the effects may linger around the victims and may take sometime to physically manifest.

Recommendations

The following measures, if adopted could go a long way towards proffering solutions to the problem.

- The federal Government should hasten the completion of second Niger Bridge. This bridge, when completed will divert traffic from the Western part of the country through Ozubulu to other eastern states like Imo, Abia states. This will ease traffic at upper Iweka and indeed, reduce traffic congestion in that area, which indeed, emit a lot of carbon monoxide.

- For industrial outfits, by assessing how much pollution an organizations action generate, one can begin to see how changing a few policies can significantly reduce the overall carbon foot print. A carbon footprint could be measured by undertaking a green house gas emissions assessment. Then a

strategy can be devised through technological development or better process and product management to reduce it.

- Encouraging employers and businessmen to switch to public transportation, telecommuting and other innovative ways to save energy and reduce greenhouse gas emission on the way to and from work and business places can add up and have tremendous effects. Employers can offer commuter benefits that address limited or expensive parking, reduce traffic congestion, and minimize the environmental impacts associated with drive alone commuting

- Carbon offsetting is being advocated, this may entail the mitigation of carbon footprints through the development of alternative projects such as wind energy. This represents a way of reducing a carbon footprint, leaving the environment devoid of high level of carbon monoxide. Other forms of renewable energy like solar energy can equally be adopted.

- Large companies or industries who are large scale emitter will be limited to the amount of greenhouse gas that they can emit. The industrials must have emission permit for every ton of carbon monoxide released into the atmosphere. The permits will set an enforceable limit on the amount of green house gas pollution each industry is allowed to emit.

- Laws banning cigarette smoking in public places should be fully and strictly enforced. This will discourage public pollution of the environment and reduce the susceptibility of non smokers as they are not indeed exposed to inhale such smoke.

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