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AN OVERVIEW OF AIR POLLUTION AND ITS HEALTH EFFECTS ON URBAN SETTLEMENT: A NIGERIA'S PERSPECTIVES

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ABSTRACT

Air pollution is one of the major causes of health problems confronting humans today. Presently, there is certainly a high rate of atmospheric pollution in Nigeria especially in the densely populated urban cities. Besides, pollution levels may be rising as a result of increased motor vehicle traffic building on already congested roads. Consequently, accumulation of these pollutants in the atmosphere in large quantities and of longer duration poses harm to human health. Ultimately, people living in urban and industrial areas are particularly prone to varied types of diseases due to air pollution. Prevalent diseases resulting from exposure to these pollutants include pertussis, pulmonary tuberculosis, cerebral spinal meningitis (CSM), pneumonia, measles, chronic bronchitis, and upper respiratory tract infection (URTI). This review therefore focus on the effects of primary air pollutants on human health with the objective of examining their various sources, chemical composition and emission of these pollutants comprising of Nitrogen oxides (NOx), Carbon monoxide (CO), Particulate material (PM), Sulphur dioxide (SO_2), Volatile organic compounds (VOCs), and Lead (Pb). In view of these problems, control measures are likewise discussed. The human environment being the basis for any economic, social and cultural development needs to be maintained in a good state to ensure a high level of social performance. These can only be achieved through closer monitoring of the pollutants released by motor vehicles and industries, which can adequately help in reducing air pollution effects to the bearest minimum.

Keywords: Air pollution, health, pollutant, environment, Nigeria

INTRODUCTION

Air pollution is the world's largest single environmental health risk (WHO, 2013). Report by the World Health Organization (WHO) has estimated that urban air pollution is responsible for approximately 800,000 deaths and 4.6 million lost life-years each year around the globe (WHO, 2002). By definition, an air pollution is any substance which may harm humans, animals, vegetation or material (Kampas and Castanas, 2008). These polluted air is a growing concern for the inhabitants of urban areas because it spreads over long distances and can practically not be avoided. Therefore, considered as the major risk factor for several diseases, including cancers, lower respiratory infections, cardiovascular and cerebrovascular accounting for the greater share of the death (Ife, 2008). In recent years, urbanization,

coupled with increased industrialization, growing ownership of motor vehicles and continued use of solid fuels as domestic energy source have led to substantial worsening of air quality across the globe (Petcova *et al*., 2013).

Nigeria as a developing nation is increasingly experiencing a double burden of rapid urbanization and exposure to outdoor air pollution emissions from automobiles, industrial plant and high proliferation of power generation sets due to the unreliable power source (Ademola, and Ibem, 2010). Furthermore, these pollutants are emitted in the form of gas and particulate matter (Türk, and Kavraz, 2011). Furthermore, pollutants in the form of dust particulates are very prevalent in urban atmospheric environment due to the large-scale materials most especially motorbike (Okada) riders and their passengers, and those who live close to the traffic clogged areas (Nwachukwu and Ugwuanyi, 2010). Besides, cities are known to be places where money, services and wealth are centralised. Therefore, most polluting activities are related to energy consumption (Fisher *et al*., 2002). Moreover, apart from being the major problem in urban cities due to excessive use of fossil fuels, especially petroleum, diesel gas and solid fuels, air pollutants have been widely known to reduce visibility and disrupting traffic including air travels in extreme cases (Adeleke *et al*., 2011). Perhaps, particulate matters tend to form blankets that shield the land from the warming sunlight when excess UV radiation from the sun is screened from the earth surface Anderson *et al*., 2012; Ling, and Van, 2009).

In public health perspectives, the pollutants emitted have been associated with heart and lung diseases, with cancer of the lungs (AIM, 2011). Report by Antai, and Moradi, (2010), have indicated that urban populations are characterized by overcrowding with higher levels of air pollution and other hazardous substances that resulted in increased risks of infectious diseases and mortality. Therefore, exposure to these pollutants are associated with numerous effects on human health including pulmonary, cardiac, vascular and neurological impairments (Katsouyanni, 2003). In addition, children are more exposed to infection, because they are generally more active outdoors and their lungs are still developing (Kulshrestha, 2015). Furthermore, urban inhabitants are typically plagued by a series of complaints including eye irritations and respiratory problems (Hao *et al*., 2000). Hence, it is clearly obvious that the greater the concentration of people in one area, the greater the amount of pollution and the higher the risk of air pollution related illness (David, 2003). It is based on the above fact that this paper examines the sources of air pollutants and their characteristics in order to assess adverse effect on human health. Furthermore, some control measures were identified and recommendation to address these challenges was highlighted.

SOURCES OF AIR POLLUTION IN URBAN NIGERIAN CITIES

Nigerian cities have become '*isles*' of toxic air pollutants as a result of massive use of vehicles burning fossil fuels and industrial activities. The major sources of air pollution are therefore discussed in the following subheadings.

Particulate Matter (PM): These are particulate air pollutants with different combinations and sizes suspended in the atmosphere derived from natural and human processes (Ali and Haruna, 2015). Sources of particulate pollution are factories, power plants, refuse incinerators, motor vehicles, construction activity, fires, and natural windblown dust (Ali and Haruna, 2015). In urban cities, PM levels are generally higher due to dispersed heating with small-scale solid fuel use, uncontrolled industrial emissions and large numbers of old and poorly maintained vehicles which adds to traffic related air pollution (Kulshrestha et al., 2009).

Carbon Monoxide (CO): Carbon monoxide is mainly produced by incomplete combustion of carbonaceous fuels such as gasoline and natural gas. It is a colourless, odourless and non-irritating but a very poisonous. This pollutant is very much associated with emissions from petrol vehicles. Within urban areas where concentrations tend to be highest, motor traffic is responsible for about 98% of emissions of carbon monoxide Hao *et al*., 2000). The predominant sources of CO pollutants include; partial fuel combustion from generators emission, vehicle exhaust gas, industries activities and environmental tobacco smoke (Prockop, and Chichkova, 2003; Stanley *et al*., 2010)

Sulphur Dioxide (SO_2): is a water-soluble gas, colourless with a strong smell. Combustion of fossil fuels like coal, heavy oils, smelting of sulphur-containing ores and volcanoes are some of the sources of SO_2 (Kampas, and E. Castanas, 2008). In the atmosphere it is converted into Sulphuric acid which is a major component of acid deposition.

Nitrogen Oxides (NOx): These consist of nitrogen dioxide and nitric oxide which are usually considered as very reactive gases. Nitrogen oxides are odourless and colourless, but nitrogen dioxide (NO2) together with other particles form reddish-brown blanket. NOx is a precursor in the production of ground level ozone along with volatile organic compounds (Kampas, and E. Castanas, 2008; Ali and Haruna, 2015; Wichman *et al*., 2008). The major source of NOx, is the high temperature combination of atmospheric nitrogen and oxygen in combustion processes. Also found in a lesser contribution from combustion of nitrogen contained in the fuel.

Lead (Pb): is a poisonous metal derive from burning of lead-containing fuels and solid wastes (Wright, 2005). Other sources of lead include; emission from vehicle exhausts, from the manufacture of iron, steel, non-ferrous metals and cement (EEA, 2005).

Volatile Organic Compounds (VOCs): These are chemicals that readily evaporate into the air. Sources of VOCs includes; petroleum refineries, vehicle exhausts, natural gas fields, fuel stores, wastes, household products (deodorants, paints, and preservatives), pesticides, combustions and industrial activities and coniferous forests (Curtis *et al*., 2006; Godish, 2014)

EFFECT OF AIR POLLUTANTS ON HUMAN HEALTH

Human health can be adversely affected by air pollution depending on the pollutants,

quantity of pollutants and path of entry into body. Human receptors include the eyes, nose, skin, or respiratory system. Eye is more susceptible to damage as well as irritation compared to the skin. Children's health is adversely affected by air pollution due to incomplete metabolic systems (Stanley *et al*., 2010). Furthermore, on-going process of lung development and growth, high rates of infection by pathogens immature host defences, and activity specific to children can result in higher exposure to air pollution (WHO, 2005). The sources, health effects and vulnerable groups for major air pollutants are summarized in Table1.

Table 1: The sources, health effects and vulnerable groups for major air pollutants

Pollutants	Sources	Health effects	Population vulnerable	References
Particulate matter (PM)	Biomass and fossil fuel combustion in home heating, industrial and motor vehicle engines, cigarette smoke.	Upper respiratory tract irritation and infection, exacerbation of and increased mortality from cardiorespiratory diseases	Elderly people with respiratory and cardiovascular diseases; children with asthma	(Ebi and McGregor, 2008)
Sulphur dioxide (SO_2)	Fossil fuel combustion; metal smelting and petrol chemical industries; home heating and cooking with coal.	Throat irritation; exacerbation of cardiorespiratory diseases, including asthma	People with respiratory diseases (e.g. children with asthma)	(Pikhart *et al*., 2001)
Oxide of Nitrogen (NO_X)	Combustion at high temperature(e.g. from vehicle engines, gas cooking and heating)	Eye irritation; upper respiratory tract infection (especially in children); exacerbation of asthma; irritation of bronchi	People with respiratory diseases (e.g. children with asthma)	(Ezekwe *et al*., 2016)
Carbon monoxide (CO)	Biomass and fossil fuel combustion; cigarette smoke and vehicle exhaust	Headache, nausea, dizziness, breathlessness, fatigue, visual disturbance, confusion, low birth weight (after maternal exposure during pregnancy)	People with ischaemic heart diseases	(Levy, 2015)
Lead (Pb)	Smelting, lead petrol, battery manufacturers, Iron and steel producers	In children neuropsychological and cognitive effects. In children: hypertension, classic lead poisoning	Children, pregnant women	

Health Effects of Sulphur Dioxide

Sulphur dioxide is a potent bronchoconstriction at high levels, and patients with asthma are much more sensitive than normal individuals. Because levels of sulphur dioxide and particulate matter co-vary closely it has proved hard to demonstrate effects of sulphur dioxide that are independent from the effects of particulate matter in epidemiological studies. It is likely that sulphur dioxide contributes to respiratory symptoms, reduced lung function. Some effects of this pollutants include; respiratory irritation,

shortness of breath, impaired pulmonary function, increased susceptibility to infection, illnesses to lower respiratory tracts (particularly in children), chronic lung diseases, pulmonary fibrosis, increase toxicity in combination with other pollutants (Walji and Flegel, 2015). The most common acute exposure to SO_2 at concentration > = 0.4 ppm (parts per million) is induction of asthmatics after exposure lasting only 5 minutes (McCreanor *et al*., 2007). Increased prevalence of cough in children with intermittent exposure to SO_2 levels of 1.0 ppm is observed (Brunekreef, and Holgate, 2002). In addition, environmental effects of SO_2 includes; reduced visibility and acid deposition on trees, lakes, soils and monuments leading to their deterioration and adverse effect on aquatic life.

Health Effects of Nitrogen Dioxide

The rise in nitrogen dioxide emissions has led to concern about its health effects. Nitrogen dioxide is an oxidizing agent and can thus theoretically damage lung tissue (Kraft *et al*., 2005). At very high doses it acts as a potent initiator of inflammation within the lung, preferentially affecting the small airways close to the site of gas exchange in the lungs (Latza *et al*., 2009). High concentration of NO_2 may increase susceptibility to respiratory pathogens and also increases risk of acute respiratory diseases like bronchitis, chronic fibrosis, emphysema and bronchopneumonia. $N0_2$ exposure can cause decrement in lung function (Latza *et al*., 2009).

Health Effects of Carbon Monoxide

It is generally accepted that carbon monoxide exerts its toxic effect by binding very avidly to haemoglobin, thereby reducing the oxygen-carrying capacity of the blood. In very high doses it is fatal due to cerebral and cardiac hypoxia (Kuehni *et al*., 2006).In lower concentrations it may affect higher cerebral function, heart function, and exercise capacity, all of which are sensitive to lowered blood oxygen content (Prockop, and Chichkova, 2007).Carbon monoxide is present in very high concentrations in cigarette smoke, and cigarettes constitute by far the greatest source of exposure in smokers. Furthermore, Carbon monoxide causes a chemical asphyxiation since it impairs the oxygen transport in blood vessels as affinity of CO for haemoglobin is three hundred-fold more than oxygen (Beelen *et al*., 2008; Suglia, 2008). High dose exposure of CO may affect lung tissue and may lead to acute decrement in lung functions. CO level to about 5 per cent may cause cardiovascular effect in young healthy, non-smoking individuals leading to fatigue and reduced ability to work (Cohen *et al*., 2008; Kim *et al*., 2008)

Health Effects of Lead

Lead in air can cause severe health damage as it is toxic at very low exposure levels. Organo-lead compounds, like tetra-alkyl-lead and tri-alkyl-lead compounds, are more toxic compared to inorganic forms of lead. Lead has acute as well as chronic effects on health of humans as it is a multi-organ system toxicant (Toscano and Guilarte, 2005). It can cause neurological, gastrointestinal, haematological, cardiovascular, renal, and reproductive effects. The severity and type of effects depend on the duration, level, and timing of exposure (Liu *et al*., 2014). Lead is

pervasive environmental poison which affects virtually every system in the body. It can damage the kidneys, the nervous system, and the reproductive system and cause high blood pressure. Children are more prone to lead pollution because they absorb lead more readily than adults. It affects the development of brain in young children. Children exposed to lead show lack of intelligence, behavioural problems and decreased ability to concentrate (Nriagu *et al*., 1996). Chronic exposure with elevated blood lead levels is associated with hypertension, headache, confusion, irritability, focal motor dysfunction and insomnia.

Health Effects of Particulate Matter

Particulate matter (PM) consists of complex and varying mixtures of particles suspended in the air, with varying size and composition. They are produced by a wide variety of natural and anthropogenic activities (Cohen *et al*., 2005; Riediker *et al*., 2004). Exposure to PM was positively associated with acute myocardial infarction causing daily deaths in cities (Riediker *et al*., 2004). Furthermore, PM might also induce lung inflammation, which could cause cardiovascular stress. In addition, low levels of lower respiratory tract inflammation were observed in humans exposed to ambient PM (Ghio *et al*., 2000).

AIR POLLUTION CONTROL MEASURES

Control of air pollutants at their source level is a desirable and effective method through preventive or control technologies. Air pollution can be tackled by a mixture of technological solutions, laws and regulations. These include;

1. Vehicle inspection as an important preventive measure that will ensure drivers not only service their cars periodically but also old vehicles that emit to much smoke are taken off the roads (Adeleke *et al*., 2011). Other means of reducing emission includes; improvements in fuel quality, and the installation of pollution-reducing technologies in vehicles.
2. Improvement in electric power supply in Nigeria will drastically reduce the use of gasoline generators that are found at home, business premises, offices and industries. Nigeria has numerous sources of generating energy from renewable sources that could effectively harness to supply regular electricity to the people thereby reducing the use of gasoline generators. The use of fuel wood can be reduced by providing readily available alternative means of cooking and heating both for homes and small-scale industrial use.
3. Manufacturing industries operating in the urban cities should be compelled toad here strictly to the various pollution control legislations that are enacted by the government. Enforcement of air pollution legislations across the urban cities and industrial areas will help in improving the environment. Furthermore, there is the need to continuously enlighten and educate the public about the causes and effects of air pollution so that they realize the dangers and health hazards of living in polluted environment. Moreover, effective means of controlling air pollution is to identify their sources, then develop a new technology that will reduce emissions

from power plants, industries. Some of this equipment includes;

(i) Scrubbers which eliminate particulates, SO_2, hydrogen sulphide, and other pollutants from waste gases as they pass through a solution before leaving the smokestack of coal-firing and other plants.

(ii) Cyclones collect toxic gases and particulates by using centrifugal forces.

(iii) Electronic precipitators use static electricity to collect and remove unwanted substances that are suspended in very hot gases.

CONCLUSION

The Earth and its atmosphere suffer severe destruction due to human activities. Concentrations of the five major pollutants such as particulate matter, sulphur dioxide, nitrogen dioxide, carbon monoxide, and lead have led to air pollution problems over many urban cities of Nigeria. As such, pollution levels continue to rise due to unabated vehicle emissions and unsustainable industrial practices that mitigate efforts on controlling pollution at the urban cities level in Nigeria. Therefore, most activities necessary to reduce pollution levels require long term actions and commitments. However, for these to succeed more drastic solutions will be needed so that air quality can continue to improve. Some of the measures includes; expand the use of pollutant-reducing technologies and enforcement of pollutant emission restrictions law. Importantly, people need to make changes in their attitudes and everyone should gain knowledge of the science behind the problems of air pollution by making informed decisions regarding lifestyle choices.

FUTURE PERSPECTIVE

1. There should be regular environmental education provided on the need to do the following: keep car and other engines properly tuned and avoid using engines that smoke; avoid extended periods of engine idling; reduce or eliminate fireplaces and wood stoves; avoid burning leaves, trash and other materials – instead, mulch or compost leaves and yard waste.
2. There should be moral persuasion through publicity and social pressure, direct control, including regulations, market processes that affect the price of goods and services which include various kinds of subsidies and grants. This policy should also be applied to industries and all those that pollute the environment. Industries emitting significant ambient particulate pollution should set up chambers or collectors to control emissions of coarse particulates from power plants and industrial sites. This will provide a mechanism that causes particles in gas to settle out in a location where they may be collected for disposal in landfills.
3. The burning of refuse in market areas should be stopped. Environmental agency should engage in regular collection and processing of waste at approved government depots on the outskirts of the city, far away from residential areas. This could be done

through the reintroduction of monthly environmental sanitation collections.

4. It is recommended that an emissions standard for Nigerian cities should be introduced. Also, annual vehicle inspection should be made compulsory, in which the emissions and smoke emitted from each private or commercial vehicle is monitored and filters are checked. Furthermore, road pricing for automobiles (tollgates) in Nigerian major cities should be considered. This could be done by charging to enter a designated region of cities where congestion was noticed. Concurrently, improvements should also be made to public transport provisions such as the introduction of car sharing and the provision of park and ride facilities.
5. In order to ensure that emission levels are in compliance with international health and environmental standards, it is imperative that industrial sector in Nigerian urban centres need to be educated and sensitized. These standards should also be imposed with legal implications to ensure that control equipment/filters are installed at factories or industries to control the type and amount of pollutants that are released into the atmospheric environment.

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