Sub-Sahara African Academic Research Publications
June, 2021, Editions

JPAS
Journal of Pure and Applied Science
Vol..20, No.9, ISSN 2318-9315

DETERMINATION OF NIGHT AMBIENT AIR QUALITY IN ADO-EKITI, NIGERIA

AWOPETU, M. S., BAYERO, M., AKANBI, T. Y., WASIRI, J. A. AND AHMED A. A.
Department of Civil and Environmental Engineering, Faculty of Ground and Communication Engineering, Air Force Institute of Technology, Kaduna, Nigeria

Abstract
This study investigated the level of night ambient air pollution in Ado Ekiti. The pollutant of interest investigated is carbon monoxide (CO). The air quality samples were taken in January 2020, during the dry season for a period of one week (7 days). Seven (7) sampling points across the two (2) major environmental zones in the study area namely; commercial and residential (high income and low income areas) were considered, three (3) times daily totaling one hundred and forty-seven (147) samples. All sampling locations were sampled at different times of the night, early night (9pm-11pm), midnight (1am-3am) and early morning (4am-6am). It was discovered that most of the air pollutants sampled at night were low except for carbon monoxide (CO) which is disgustingly higher than the World health organization (WHO) and Federal Environmental Protection Agency of Nigeria (FEPA) standard thereby posing great risk to the public health in particular and the environment in general. Cleaner energy such as solar energy should be adopted in place of power generating machine in order to reduce carbon monoxide generation.

Keywords: *Ambient, air pollution, night, Ado-Ekiti, environmental zones*

Introduction
Undoubtedly, air pollution has become a source of rising menace or hazard in the past few years, with an increasing number of acute air pollution episodes in

many cities worldwide and worst scenarios recorded in Africa (Awopetu and Aribisala, 2019). Both ambient and household air pollution can be referred to as the biggest environmental risk to human health, specifically responsible for about one in every nine deaths annually. Ambient air pollution alone kills around 3 million people each year, mainly from non-communicable diseases. Only one person in ten lives in a city that complies with the WHO air quality guidelines. Air pollution continues to rise at an alarming rate, and affects economies and people's quality of life, thus, air pollution is a public health emergency (WHO, 2016).

It is established in the literature that numerous outdoor and indoor air pollutants affect human health as well as the environment and pose significant dangers to individuals worldwide, such as cardiovascular or respiratory disorders, asthma and lung cancer, which can be fatal (Awopetu and Aribisala, 2018;WHO, 2002, 2003a, 2006, 2009). Given that an individual inhales more than 14, 000 litres of air per day, it becomes evident that air pollutants pose significant dangers to human health. According to the World Health Organization (WHO, 2006, 2009), more than two million premature deaths each year can be attributed to the effects of urban outdoor and indoor air pollution. In particular, every year indoor air pollution is responsible for the death of 1.6 million people while 800, 000 deaths from lung cancer, cardiovascular and respiratory diseases worldwide are attributed to outdoor air pollution (Valent *et al.,* 2004; WHO, 2005). It is estimated that air pollution reduces average life expectancy of Europeans by 9 to 24 months (CEC, 2006).

Carbon monoxide (CO) is a colorless, odorless gas created when a fuel is burned or from incomplete combustion of hydrocarbons in gasoline-powered engines such as generator, motor vehicle exhaust industries, solid wastes and forest water (USEPA, 2016). Common fuels include natural gas, propane, gasoline and wood. It is practically impossible to detect the presence of CO through senses in an environment since CO has no smell or taste. Dangerous concentrations of CO can easily build up indoors and results to illness before someone realizes he or she is being poisoned. Symptoms of CO poisoning are very similar to the flu and this may cause you to ignore the early signs of poisoning. It is worthy of note that there are reported cases of breathlessness, restlessness and unconsciousness following inhalation of fumes produced by an electric generator that was put in a confined area [Seleye-Fubura *et at.* (2011);

Afolayan *et al.* (2014),]. As reported by Aliyu and Ibrahim, (2014) was a case of CO poisoning which resulted in loss of consciousness as seen in a family of six children who slept in an overcrowded room, polluted with burning charcoal which was meant to generate heat for warmth.

According to Nordqvist (2017), hemoglobin is the molecule in red blood cells that carries oxygen from the lungs to tissues all over the body, and it brings carbon dioxide (CO_2) back from the tissues. CO binds to hemoglobin over 200 times more easily than oxygen does, so if CO is present, oxygen will not be able to find space to get into the hemoglobin. This is because the space is occupied by CO. As a result, parts of the body will be starved of oxygen, and the affected parts will die. The human body needs oxygen, but it has no use for CO. If human being breathes in CO, it provides no benefit, but it deprives the blood of oxygen. Levels of CO over 70 ppm may cause noticeable symptoms, and if they reach above 150 to 200 ppm, they may cause disorientation, unconsciousness, and death. CO is referred to as a silent killer.

This study seek to investigate the level of CO pollution in the study areas so as to provide information on air pollutants in the commercial and residential areas at night during rainy season

The study area

The study area lies approximately between the latitude 7^{o} 33^{1} and 7^{o} 42^{1} North of the equator and the longitude $5^{o}11^{1}$ and $5^{o}20^{1}$ East on a low-land surrounded by several isolated hills and inselbergs (Oyedele and Olayinka, 2012). Geographically, this region is bounded by Kogi and Kwara state in the North, by Osun State in the West and by Ondo State in the South with the projected 2019 population of 443, 591. The temperature of this area is almost uniform throughout the year, with little deviation from the mean annual temperature of 27^{o}C. February and March are the hottest 28^{o}C and 29^{o}C respectively, while June with temperature of 25^{o}C is the coolest (Adebayo, 1993). The mean annual rainfall is 1,367mm with a low co-efficient variation of about 10%. Rainfall is highly seasonal with well-marked wet and dry seasons. The wet season lasts from April to October, with a break in August. The town also boasts of the highest number of registered motor vehicles in Ekiti. Consequently, this has resulted into increase in vehicle fuel consumption. Major pollutants emitted

from vehicles are CO, NOx, particulate matter and hydrocarbons. Ado Ekiti is the largest municipal solid waste producer in Ekiti State.

Research method

Hand held portable ambient air quality sampling equipment (AS8900 multi-gas monitor) was used to measure ambient CO pollutant. The air quality sample was taken for a period of one week (Monday to Sunday. All sampling locations were sampled at different times at night (early night, mid-night and morning). Early night readings were taken between 9pm-11pm, mid-night readings between 1am-3am and morning readings were taken between 4am-6am.

Seven sampling points across two environmental zones in the study area namely; commercial and residential (high income and low income areas) were considered, resulting in 147 samples. Fourteen sampling per day was carried out in seven core sites which are as follows:

i. ***Old Garage:*** this area is characterized by retail shops, market, high vehicle and pedestrian traffic, it also serves as transfer point for mini buses and taxi linking other towns, urban, pre-urban and rural destinations;
ii. ***Ajilosun:*** represented medium economic status residential area where majority of the residents either use kerosene or cooking gas for cooking;
iii. ***Dalimore Junction:*** this serves as an important commuter route within ado Ekiti which represented heavy-traffic sites;
iv. ***Government Reserved Area (GRA)***: represented high economic status residential area with low vehicular and pedestrian traffic volume;
v. ***Odo Ado:*** Odo Ado-Ekiti represent rural background area;
vi. ***Fajuyi Park:*** represented civil engineering construction activity area; and
vii. ***Ilokun:*** represented low economic status residential area where the houses are built of mud bricks without plastering and the floors were not paved or cemented. A lots of fire wood burning activities were taking place.

Results and discussion

Most of the results (Table 1) showed that CO pollution level at night is higher than the Federal Environmental protection Agency of Nigeria (FEPA) and

United States Environmental Protection Agency (USEPA) standard which are 10ppm and 9ppm respectively. It is also pertinent to note that most of the 8 – hour average CO pollutant is lower than the World Health Organization (WHO) standard of 25ppm. Only four days CO pollution level in Ilokun (Monday, Tuesday, Saturday and Sunday) and one day in Odo – Ado (Monday) are lower than FEPA and USEPA standards.

Table 1: 8 – Hour Average Daily CO Sample Reading

	Ilokun	Dalimore	Fajuyi	GRA	Ajilosun	Odo Ado	Old Garage
Mon	8	10	58	11	20	8	15
Tue	9	21	22	10	25	15	25
Wed	12	20	21	12	20	12	21
Thu	14	22	35	15	25	13	20
Fri	10	18	20	15	27	12	12
Sat	9	15	16	12	15	11	19
Sun	8	16	22	10	20	13	21

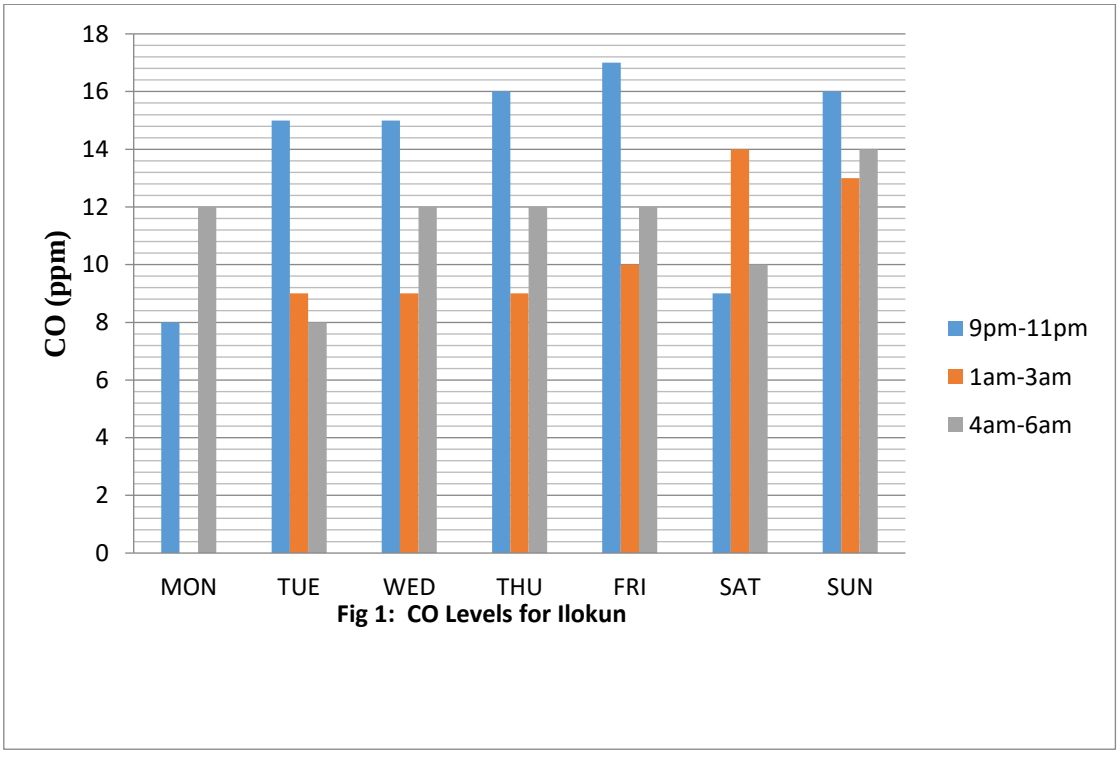

Fig 1: CO Levels for Ilokun

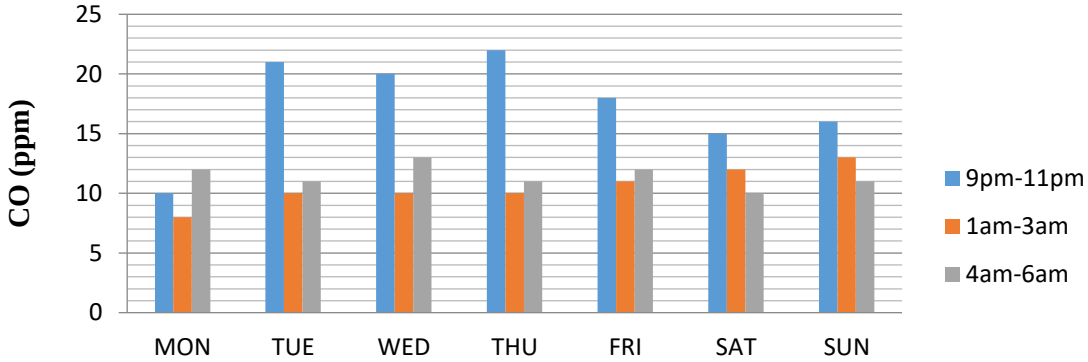

Fig 2: CO Levels for Dallimore

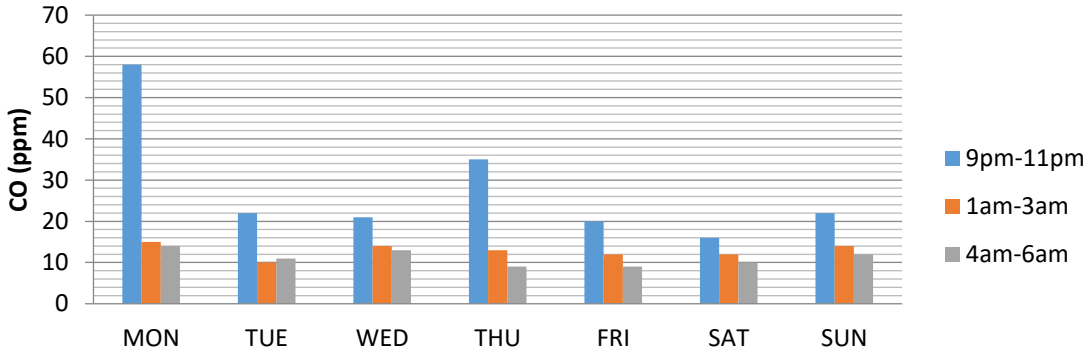

Fig 3: CO Levels for Fajuyi

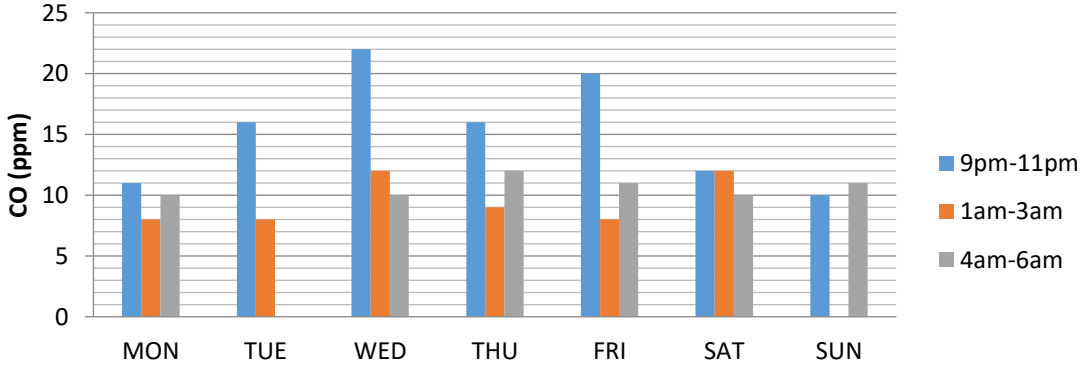

Fig 4: CO Levels for GRA

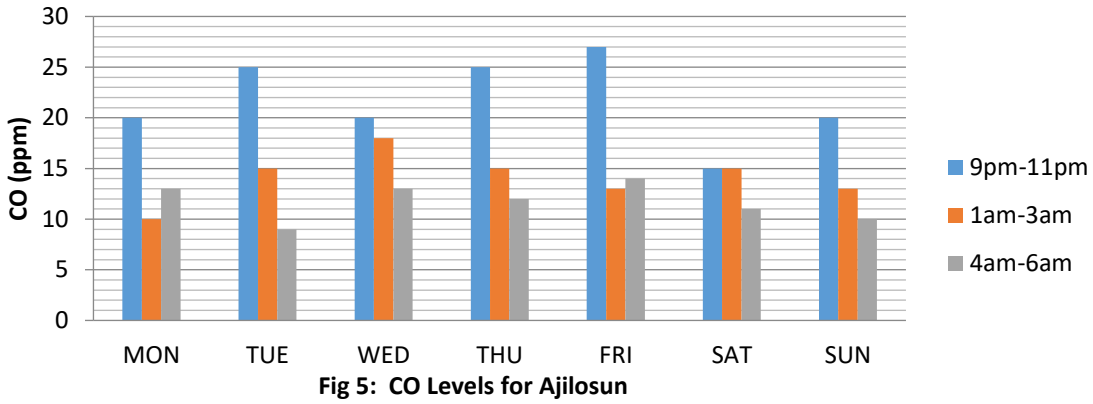

Fig 5: CO Levels for Ajilosun

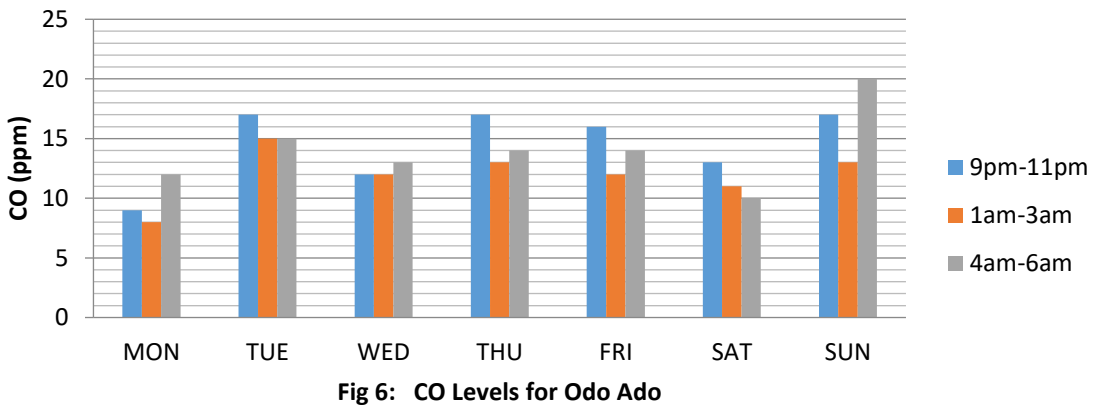

Fig 6: CO Levels for Odo Ado

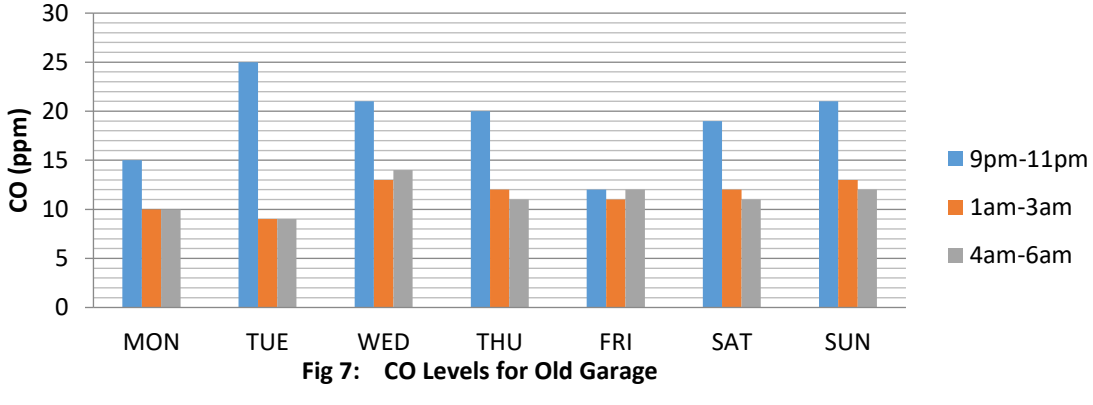

Fig 7: CO Levels for Old Garage

The figures 1 – 7 showed that carbon monoxide pollutants vary during night hours from 9 to 11pm, 1 to 3am and 4 to 6am throughout a week period

(Monday, Tuesday, Wednesday, Thursday, Friday, Saturday & Sunday). Generally, CO pollution level is higher from 9 – 11pm and lowest in between 4 and 6am. This can be linked to the higher anthropogenic activities between 9 and 11pm. The highest range of CO pollutant was found in Fajuyi Park while the least range of pollutants was found in Ilokun. The entire CO measured at night in Fajuyi fell between 9 and 58ppm (Figure 3) which is far higher than the FEPA, USEPA and WHO standards. The high value of CO pollutant observed at Fajuyi could be due to high or heavy vehicular movement coupled with the use of generator in and around the area. In a similar study carried out by Awopetu and Aribisala, (2018) in Fajuyi Ado-Ekiti during the day, the CO concentration ranged between 7.25-16.45ppm which is higher than the Nigerian standard but generally low than night CO concentration.

GRA and Ilokun were observed to be the areas with less CO pollution level than other locations. GRA represented high economic status residential area with low vehicular and pedestrian traffic volume but characterized with many hotels and restaurants. It was also observed that CO pollution level were relatively higher than the FEPA and USEPA standard between 9 and 11pm throughout the period under investigation. This can be linked to the fact that all the hotels, restaurants and almost every household put on generator in the evening. The night ambient CO concentration recorded ranged between 0 – 15ppm. Awopetu and Aribisala, (2018) also recorded CO concentration ranged between 0.8-9.5ppm during the day which is almost at par with FEPA and USEPA standard.

Conclusion

This study established that ambient CO air pollution is higher in the night compared to the day in Ado-Ekiti. At night, it has been reviewed that the early night (9-11pm) is the most polluted hour of the day. Air pollution is relatively low early in the morning (4am-6am).Collectively, air pollution is something we cannot overlook at this time and age. The deleterious adverse effect of air pollution is already evidently here with us. Man's continual passiveness and remaining aloof to air pollution mitigation will unquestionably spell doom for human, plant, animal and the environment. This study showed that Ado Ekiti is grossly polluted as revealed by the results. It is disheartening to note that the state and local government had no air quality maintenance scheme. There is a need to develop monitoring mechanisms, regulations and enforcement

measures. The current internal generation revenue (IGR), driven motor vehicles annual testing and other regulations such as electrical generators should be reoriented and tailored towards being driven by environmental sustainability. Ecofriendly alternatives like solar powered generator and cleaner cooking fuels should be encouraged. Mass transit options can also be put in place to reduce the amount of individual vehicles plying the roads.

Reference

Adebayo, W. O. (1993) Weather and climate. Ado-Ekiti region. *A Geographical Analysis and Master Plan*, ed. F.S. Ebisemiju, Alpha Prints: Lagos, pp. 11–14.

Afolayan, J. M., Edomwonyi, N.P. & Esangbedo, S.E., Carbon monoxide poisoning in a Nigerian home: case reports. *Nigerian Postgraduate Medical Journal*, **21**(2), pp. 199–202, 2014.

Aliyu, I. & Ibrahim, Z. F., Accidental carbon monoxide poisoning in a family of six: Diagnosis and treatment challenges in a resource limited setting. *Journal of Medical Investigation and Practice*, 9, 130–131, 2014.

Awopetu, M. S. and Aribisala, J. O. (2018). Analysis of Air Pollution in Ado Ekiti Residential and Commercial Areas. Global Journal of Researches in Engineering: Civil and Structural Engineering. Volume 18 Issue 2 Version 1.0 Year 2018 Online ISSN: 2249-4596& Print ISSN: 0975-5861. https://engineeringresearch.org/index.php/GJRE/article/view/1847/1778

Awopetu, M. S. and Aribisala, J. O. (2019). Air Quality Index as a Tool for Environmental Degradation Campaign. Wessex Institute of Technology UK 27th International Conference on Modeling, Monitoring and Management of Air Pollution. 26 – 28 June, 2019. Aveiro, Portugal.

Nordqvist, C., Carbon monoxide (CO), the silent killer. *Medical News Today*, 11 November 2017.

Oyedele, E.A.A. & Olayinka, A.I. (2012) Statistical evaluation of groundwater potential of Ado-Ekiti, South West Nigeria. *Transnational Journal of Science & Technology*, **2**(6), pp. 110–127.

Seleye-Fubara, D., Etebu, E.N. & Athanasius, B. (2011) Pathology of deaths from carbon monoxide poisoning in Port Harcourt: an autopsy study of 75 cases. *Nigerian Journal of Medicine*, **20**(3), pp. 337–340, 2011.

USEPA (2014) National Ambient Air Quality Standards (NAAQS). Retrieved from https://www.epa.gov/sites/production/files/2015-02/documents/criteria.pdf on 15/06/2021 FEPA

Valent, F., Little, D., Tamburlini, G. & Barbone, F. (2004). Burden of disease attributable to selected environmental factors and injuries among Europe's children and adolescents. Retrieved from https://www.semanticscholar.org/paper/Burden-of-disease-attributable-to-selected-factors-Valent-Little/4a9b97a211571ff4250a1bd784c7d78deb83ac33 on 16/11/2019

WHO (2005). Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide Global update. Retrieved from

http://apps.who.int/iris/bitstream/handle/10665/69477/WHO_SDE_PHE_OEH_06.02_eng.pdf?sequence=1 on 15/06/2021

WHO (2005*). Indoor air pollution and health. Fact sheet N°292,10.03.2011*, 12.11.07, Available fromhttp://www.who.int/mediacentre/factsheets/fs29

WHO (2016). Ambient Air pollution: A Global Assessment of Burden of Disease https://apps.who.int/iris/bitstream/handle/10665/250141/9789241511353-eng.pdf?sequence=1Accessed on 27/03/2021

WHO (2009). Global Health Risks: Mortality and burden of disease attributable to selected major risks, World Health Organization, Geneva. https://www.cabdirect.org/cabdirect/abstract/20093343418