HEALTH EFFECTS OF AIR POLLUTION ON PREGNANCY

BY

HAUWA UMAR USMAN [1] & ABUBAKAR IBRAHIM HASSAN (PH.D) [2]

Abstract

An Addition of harmful substances to the atmosphere resulting in damage to the environment, human health and quality of lifeis termed air pollution. Air pollution affects pregnancy in totality, it affect the mother and child. This paper addresses the health effects of air pollution on pregnancy, human activities that result to air pollution, major sources of air pollution and tips on how to prevent/control air pollution when pregnant.It is recommended among others that pregnant women need to be constantly enlightened about the effects polluted air as on them and their fetus, through antenatal and postnatal visits to the hospital.

Introduction

The time between conception and birth is perhaps one of the most vulnerable life stages, during which the environment may have tremendous immediate and lasting effects on health, The fetus undergoes rapid growth and organ development and the maternal environment helps direct these processes, for better or for worse because living in an industrial society has its advantages, including abundant food, endless consumer goods and speedy transportation options;but while some risks can be minimized, it is much harder to escape the environmental pollution that results from activities such as automobile use, and even seemingly innocuous products can be rife with industrial additives(Salam, Millstein & Li, 2005). Exactly what compounds in the ambient air most affect reproductive and children's health, and

[1,2] Department of Physical and Health Education Bayero University, Kano.

how these exposures result in restricted fetal growth, early parturition, and development of respiratory diseases remains largely unknown (John, 2009). The study of air pollution's impact on reproductive outcomes is still a developing area of science with many important questions unanswered, but more evidence is emerging that air pollution exposures in pregnancy and early childhood put children at higher risk of adverse health outcomes. (Sram, Binkova&Dejmek, 2005).

Pregnancy is the development of one or more offspring, known as an embryo or fetus, in a woman's uterus. It is the common name for gestation in humans. Conception can be achieved through sexual intercourse or assisted reproductive technology(John, 2010).

Air pollution occurs when gases, dust particles, fumes (or smoke) or odour are introduced into the atmosphere in a way that makes it harmful to humans, animals and plants. This is because the air becomes unclean (contaminated). The Earth is surrounded by a blanket of air (made up of various gases) called the atmosphere. The atmosphere helps protect the Earth and allow life to exist. Without it, we would be burned by the intense heat of the sun during the day or frozen by the very low temperatures at night. Any additional gas, particles or odoursthat are introduced into the air(either by nature or human activity), distort this natural balance and cause harm to living things. These pollutants include nitrogen oxides, carbon monoxides, hydrocarbons, sulphur oxides (usually from factories), sand or dust particles and organic compounds that can evaporate and enter the atmosphere. (United State Environmental Protection Agency 2012)There are two types of pollutants: Primary pollutants are those gases or particles that are pumped into the air to make it unclean. They include carbon monoxide from automobile (cars) exhausts and sulfur dioxide from the combustion of coal. Secondary pollutant, occurswhen pollutant in the air mix up in a chemical reaction, forming even more dangerous chemical. Photochemical smog is an example of this.Air pollution can result from both human and natural actions. Natural events that pollute the air include forest fires, volcanic eruptions, wind erosion,

pollen dispersal, evaporation of organic compounds and natural radioactivity. Pollution from natural occurrences is not very often (Ayodele, Adekiya & Yakubu, 2007).

Human Activities That Result in Air Pollution

Many of us experience some kind of air pollution related symptoms such as watery eyes, coughing, or wheezing. Even for healthy people, polluted air can cause respiratory irritation or breathing difficulties during exercise or outdoor activities. The actual risk depends on one's current health status, the pollutant type and concentration, and the length of exposure to the polluted air. This is mostly caused by:-

1. Emissions from industries and manufacturing activities Pollution by industries Consider a typical manufacturing plant: You will notice that there are long tubes (called chimneys) erected high into the air, with lots of smoke and fumes coming out of it. Waste incinerators, manufacturing industries and power plants emit high levels of carbon monoxide, organic compounds, and chemicals into the air. This happens almost everywhere that people live. Petroleum refineries also release lots of hydrocarbons into the air (Miller, Garfinkel, & Horton, 2004).

2. Burning of Fossil Fuels: After the industrial age, transportation has become a key part of our lives. Cars and heavy duty trucks, trains, shipping vessels and airplanes all burn lots of fossil fuels to work. Emissions from automobile engines contain both primary and secondary pollutants. This is a major cause of pollution and one that is very difficult to manage. This is because humans rely heavily on vehicles and engines for transporting people, good and services. Fumes from car exhaust contain dangerous gases such as carbon monoxide, oxides of nitrogen, hydrocarbons and particulates. On their own, they cause great harm to people who breathe them. Additionally, they react with environmental gases to create further toxic gases (Salam, Millstein, & Li, 2005).

3. Household and Farming Chemicals Crop dusting, fumigating homes,

household cleaning products or painting supplies, over the counter insect/pest killers and fertilizer dust, emit harmful chemicals into the air and cause pollution (Pedersen, 2010).

Major Sources of Air Pollution during Pregnancy

The timing of exposure and the specific components of air pollution that possibly impact fetal development and birth outcomes are critical to understand but there are major pollutant which affects pregnancy and it includes:-

Tobacco Smoke

It is well documented that maternal smoking during pregnancy is associated with poor fetal development.However, exposure to secondhand smoke duringpregnancy might also result in a higher risk of poor fetal development (i.e., reduced birth weight and birth length), reduced lung function, respiratory illnesses (e.g., asthma), and cognitive deficits (e.g. impaired speech, language skills, and intelligence) (Jaakkola, Kosheleva, and Katsnelson, 2006)

Carbon Monoxide

Carbon Monoxide (CO) is often referred to as a silent killer. Carbon Monoxide (CO) is a toxic gas that is difficult to detect because it is colorless, odorless, tasteless, and does not irritate the skin, malfunctioning or improperly used fuel-burning appliances and idling automobiles in enclosed spaces are responsible for hundreds of unintentional CO-related deaths every year and Indoor sources of CO include back-drafting from woodstoves and gas water heaters, gas stoves, the improper use of generators in enclosed spaces such as homes, cigarette smoke, and unvented gas and kerosene space heaters.CO reduces the capacity of a mother's blood to carry oxygen (O_2), complicating delivery of O_2 to the developing fetus. The severity of CO poisoning for the fetus depends on the amount and length of exposure, as well as gestational age at the time of exposure (USEPA 2009).

Particle pollution

According toRoberts, Lyall, Hart, Laden, Allan, Bobb, Koenen, Alberto & Weisskopf, (2013), particle

pollution, also known as particulate matter or PM, is the generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. Particles originate from a variety of anthropogenic stationary and mobile sources as well as from natural sources. Particles may be emitted directly, or formed in the atmosphere by transformations of gaseous emissions such as Sulfur Oxides (SOX), Nitrogen Oxides (NOX), and Volatile Organic Compounds (VOCs).

Ozone

Ozone is a gas composed of three oxygen atoms (O3). "Good" ozone is a naturally formed layer in the stratosphere that helps protect life on Earth from the sun's rays. "Bad" ozone exists at ground level and can be harmful to health. Ground-level ozone is created by chemical reactions of tailpipe exhaust, gasoline vapors, industrial emissions, chemical solvents, and natural sources. Joined with particulate matter and acted on by sunlight and heat, ozone creates "smog." (Wang, 2013)

Paint Fumes

According to Richard, (2006), stated that when preparing the house for the new baby, we must be aware that exposure to paint fumes can be hazardous to the health of the mother and developing fetus. There are two general types of household paints; oil-based and water-based. Oil-based (alkyd) paint is often used on the exterior of houses because it dries very hard and withstands harsh weather for a long time. Water-based (latex) paint generally emits fewer chemical.

Cleaning Products

Exposure to fumes from some cleaning products during pregnancy can pose risks when used in the home and in the workplace. Common cleaning products contain a range of ingredients including solvents, strong acids and bases, and fragrances. Some of these ingredients pose health concerns; others can be bad for the environment and some of them can release toxic fumes either individually, or if mixed together. Phthalates can be carriers for fragrance in glass cleaners, deodorizers, laundry detergents, and fabric softeners. Some

phthalate compounds can be associated with potential adverse effects in male children, reduced sperm count in adult men, and increased allergic symptoms and asthma in children.(Hauser & Calafat, 2005).

Health Effects of Air Pollution on Pregnancy:

The effects of air pollution aren't limited to those who actually breathe it in directly. Rather, it shows these pollutants can find their way into a developing fetus, with measurable consequences such as:-

Fetal growth retardation

Fetal growth retardation is an abnormality of fetal growth inside thewomb that causes a tenfold increase in mortality.According to Gliksman & Geronimo, (2004), when carbon monoxide enters the body, it interferes with the blood's ability to bring oxygen to all body parts and organs. Without oxygen, the body soon shuts down. In the fetus, carbon monoxide crosses theplacenta and reduces the amount of oxygen that is delivered and circulated. This can cause a condition called fetal growth retardation.

To Di Cera & Miller (1989), in Epidemiological and animal toxicological studies suggest that long-term exposure to ambient CO, especially during the first trimester, may increase risk for preterm birth, reduced fetal growth, and certain birth defects such as cardiac birth defects and otoacoustic deficits.

Secondhand smoke, also known as environmental tobacco smoke (ETS), contains more than 4,000 compounds, of which at least 250 have been found to be toxic to human health. Some of these chemicals can cross the placenta to the developing fetus and increase the risk of adverse birth outcomes and children exposed to secondhand smoke after birth are more likely to suffer serious health problems such as asthma, lower respiratory tract infections, ear infections or Sudden Infant Death Syndrome (SIDS) (USEPA. 2008).

Preeclampsia in pregnant women

Pereira, Haggar, Shand, Bower, Cook & Nassar (2012), studied the

association between pre-eclampsia and locally derived traffic-related air pollution, in which the researchers looked at the association between preeclampsia in pregnant women and exposure to traffic-related air pollution, as measured by the estimated levels of nitrogen dioxide near the women's homes.They found a higher levels of traffic-related air pollution near the women's homes over the entire pregnancy resulted in a 12 percent greater risk of the women developing preeclampsia by trimester. This means pregnant women with the highest exposures to traffic related air pollution during their whole pregnancy had an increased risk for preeclampsia.

To Pereira, et al. (2012), one of the most interesting aspects of their study was that the link between air pollution and preeclampsia appears to be greatest during the third trimester – although the third trimester is also when most preeclampsia cases develop and are diagnosed. One explanation for this increased importance of third trimester exposure may be that among pregnant women who are predisposed to develop preeclampsia such as women with diabetes, the exposure to the elevated levels of traffic-related air pollution may trigger overt disease.

High Blood Pressure

Heavy intake of air pollutants from car exhausts could lead to an increased risk of developing high blood pressure disorders during pregnancy. According to astudy byScientists at the University of Florida, the worst offending pollutants include two specific types of particulate matter; carbon monoxide and sulphur dioxide. Sulphur dioxide is emitted from power plants and industries, while most carbon monoxide is produced by car exhaust.Xiaohui (2014) in a study on hypertension, among a sample of pregnant women, 4.7 percent developed hypertension during pregnancy. Exposure to air pollutants throughout the first two trimesters of pregnancy increased women's risk of developing one of these conditions, this was determined after controlling for other factors that could affect a woman's risk for developing hypertension, such as socioeconomic status, exposure to co-pollutants and

smoking during pregnancy. They could nothowever determine conclusively whether exposure early in the pregnancy or late in the pregnancy was more likely to increase a woman's risk for hypertension.

Autism in children

According to Roberts (2013), women in the U.S. exposed to high levels of air pollution while pregnant were up to twice as likely, to have a child with autism as women who lived in areas with low pollution;This finding raises concerns since, depending on the pollutant, 20% to 60% of the women in the study lived in areas where risk of autism was elevated. Exposure to diesel particulates, lead, manganese, mercury, methylene chloride and other pollutants are known to affect brain function and to affect the developing baby.

Two previous studies also found associations between exposure to air pollution during pregnancy and autism in children, but those studies looked at data in just three locations in the United State. The researchers examined data from Nurses' Health Study II, a long-term study based at Brigham and Women's Hospital involving 116,430 nurses that began in 1989. Among that group, the authors studied 325 women who had a child with autism and 22,000 women who had a child without the disorder. They looked at association between autism and levels of pollutants at the time and place of birth. They used air pollution data from the U.S. Environmental Protection Agency to estimate women's exposure to pollutants while pregnant. They also adjusted for the influence of factors such as income, education, and smoking during pregnancy.

The results showed that women who lived in the 20% of locations with the highest levels of diesel particulates or mercury in the air were twice as likely to have a child with autism as those who lived in the 20% of areas with the lowest levels (Roberts et al 2013).

Asthma in children

According to Dallas, (2014), babies born to women exposed to fine particle air pollution during the second trimester of pregnancy may be at

greater risk for developing asthma in early childhood, according to a new study, fine particle air pollution, which can be inhaled deeply, is linked to the greatest health risks. These particles can be found in smoke and haze. The researchers followed over 400 children to age 7 years and their mothers daily exposure to air pollution from traffic, power plants and other sources in the prenatal period was estimated based on where the mothers lived. It revealed exposure to higher levels of fine particles in the second trimester of pregnancy had the strongest association with greater prevalence of asthma.

Low Birth Weight

Pregnant women exposed to even very low levels of air pollution risk having babies of low birth weight, which results in a higher risk of health problems and death, Most survive, but are more likely to suffer from conditions such as diabetes and heart disease as adults. Scientists measured traffic on the nearest road and on all major roads within 100 meters of each pregnant woman's home. They found that for every increase of five micrograms per cubic meter in exposure to fine particulate matter - emitted by vehicles and coal-fired power stations - the risk of low birth weight at term jumped by 18% (Paneth, 1995).

According to Ayodele, et al (2007). Health effects of carbon monoxide are not only determined by its pollution level, but the time spent breathing polluted air. Samples of carbon monoxide gas in three different residential districts within the Kano Metropolis; the high (the main old Kano city), medium (Sabongari area) and low (Nassarawa GRA) density residential districts were assessed. The frequency distribution pattern for the gas is skewed towards high frequency of low concentration. Evidence linking high level of indoor carbon monoxide to low birth weight and increase in prenatal deaths necessitates the need to periodically check the levels of the gas within each house hold in the metropolis.

How to prevent/control air pollution when pregnant.

USEPA (2012), developed various tips on how to prevent/ control the six common air pollutant these are:-

Tips for Preventing Exposure to Tobacco Smoke

* Pregnant women should not smoke.
* Pregnant women should avoid public places where smoking is allowed.
* Pregnant women should make their homes and cars smoke-free.

Tips for Preventing CO Exposure

* Install carbon monoxide alarms that are Nationally Recognized Testing Laboratory (NRTL) approved (such as Underwriters Laboratories Inc.) outside all sleeping rooms.
* Have fuel-burning appliances, furnace flues, and chimneys checked at the beginning of every heating season by a trained professional to ensure proper working order.
* Do not use gas ovens or burners to heat a home, not even for a short time.
* Donot use charcoal grills indoors, even in a fireplace.
* Do not use any gasoline - powered engines (mowers, weed trimmers, snow blowers, chain saws, small engines, or generators) in enclosed spaces.
* Donot idle cars in the garage.
* Donot ignore symptoms (nausea, vomiting, and tiredness) when around a CO source, especially if more than one person is feeling them. You could lose consciousness and even die if you do nothing.
* Go to the emergency room if CO poisoning is suspected.

Tips for Reducing Exposure to Particle Pollution and Ozone

* Check local news media for air quality forecasts and plan outdoor activities for days when particle and ozone levels are lower. EPA's Air Quality Index (AQI) is a tool that state and local agencies use to issue public reports of actual levels

of particles, ground-level ozone, and other common air pollutants.

* When the AQI indicates poor air quality, reduce activity time or substitute another activity that requires less energy. For example, walk rather than jog.
* Don't exercise near high-traffic roads, where particle levels are generally higher.
* Protect yourself from exposure to particulate matter in wood smoke. (Burn only clean, seasoned wood, not trash or plastics.

Tips for Preventing Exposure to Paint Fumes

* Pregnant women and children should avoid exposure to paint fumes and limit their time in freshly painted rooms.
* Creating a nursery can involve exposure to hazardous substances. Before using any product, always read the label first for instructions and safety information.
* Open the windows and doors fully in any room that is being painted or has recently been painted. Put a box fan in the window directing the air and fumes outdoors. Keep the fan on while painting and for about 48 hours afterward.If the room does not have a window, use a fan to circulate and exhaust air away from the work area. Keep doors open.
* Do not paint indoors with paint labelled "for exterior use only."

Tips for Reducing Exposure to Cleaning Products

* Never mix cleaning products, as the fumes can be hazardous or deadly! For example, mixing chlorine bleach and ammonia can generate very harmful chloramines gas.
* Pregnant women should only use cleaning products in well-ventilated areas, wearing protective gloves.
* Consider using alternative cleaners. Baking soda can be used to scrub greasy pots, pans and ovens; and vinegar and water to clean countertops and other surfaces.

* Look for the Design for the Environment (DfE) logo on safer cleaning products.

Conclusion

In conclusion for our children and mothers to be safe from most environmental induced problems, especially air pollution that causes most maternal mortality today,air quality needs to be check since atmospheric pollution during pregnancy can affect the pulmonary development of the fetus and cause respiratory problems, therefore the control of the two worst offending pollutants carbon monoxide and sulphur dioxide is necessary since sulphur dioxide is emitted from power plants and industries, while most carbon monoxide is produced by car exhaust.

Recommendations

* Pregnant women need to be constantly enlightened about the effects polluted air has on them and their fetus. Through antenatal and postnatal visit to the hospital or through the media.
* The general public should be educated on measures of preventing and controlling air pollution.
* The Government, among others, should also enact laws to guide and ensure the proper construction of industrial chimney, control the emitting of leads from vehicles to the atmosphere by insisting on owners to service them frequently, so as to help control air pollution.

References

Ayodele, J., Adekiya. A & Yakubu, I., (2007).Carbon Monoxide as Indoor Pollutant in Kano Metropolis.*Journal of Applied Science Environmental Management.Vol.11(3) 27-30 JASEM* www.bioline.org.br/ja (Retrieved 29th August 2014).

Dallas,M., (2014). Children's Asthma & Air Pollution in 2nd Trimester Preliminary research finds timing of exposure an

important element. htt:// www.webmd.com/asthma (Retrieved 12th September 2014).

Di Cera, E &Miller, D., (1989).Carbon monoxide and oxygen binding to humanhemoglobin F0. *Biochemistry, 28(6): 2631-2638.* (Retrieved 29th August 2014).

Gliksman, I& Foy DiGeronimo, T., (2004). The Complete Idiot's Guide to Pregnancy and Childbirth. Penguin USA inc publisherhttps://www.over drive.com (Retrieved 12th September 2014).

Hauser, R & Calafat, A (2005). Phthalates and Human Health. *Occupational and Environmental Medicine, 62: 806-818* (retrieved 1st September 2014).

John, U., (2009). Healthy Pregnancy. http://www.womenhealth.gov/ pregnancy (Retrieved 1st September 2014).

John, W., (2010).Healthy Pregnancy. http://www.womenshealth.gov/ pregnancy (Retrieved 29th August 2014).

Jaakkola, J., Kosheleva, A & Katsnelson, B., (2006). Prenatal and postnatal tobacco smoke exposure and respiratory health in Russian children. *Respiratory Research,7(1):48.* (Retrieved 1st September 2014).

Miller, R., Garfinkel, R & Horton, M., (2004). Polycyclic aromatic hydrocarbons, environmental tobacco smoke, and respiratory symptoms in an inner-city birth cohort. *Chest, 126:1071-1078.*http://www.chestjournal .org/content/126/4/1071 (Retrieved 12th September 2014).

Paneth, N., (2008). The problem of low birth weight.*Future Child, 5(1): 19 34*http://future of children.org/futureofchildren/ publications/journals/ article(Retrieved1stSeptember 2014).

Pedersen, M., (2010).Air pollution during pregnancy. Centre for Research in Environment Epidemiology, Barcelona, Spain. http://www.mirror.co.uk/lifestyle/health/air-pollution during pregnancy. (Retrieved 29th August 2014).

Pereira, G.,Haggar,A., Shand, C., Cook, A & Nassar, N., (2012). Association between pre eclampsia and locally derived traffic-related air pollution a retrospective cohort study. *Journal of Epidemiology and Community Health 10.1136 jech* (Retrieved 12th September 2014).

Richard, H., (2006). 6 HiddenHome Hazards during Pregnancy published in American Baby magazine http://www.parents.com /pregnancy (Retrieved 12th September 2014).

Roberts, A., (2013). Exposure to high pollution levels during pregnancy mayincrease risk of having child with autism. Harvard School of Public Health, HSPH Department of Social and Behavioral Sciences. (Retrieved 12th September 2014).

Roberts, A, Lyall K, Hart J, Laden F, Allan C, Bobb J, Koenen K, Alberto A&Weisskopf, M., (2013). Prenatal air pollutant exposures and autism spectrum disorder in the children of Nurses' Health Study II participants," Environmental Health Perspectives, (Retrieved 29th August 2014).

Salam, M., Millstein, J & Li,Y., (2005). Birth outcomes and prenatal exposure to ozone, carbon monoxide, and particulate matter: results from the children's health study. *Environmental Health Perspectives,113(11):1638-1644*www.epa.gov/iaq/co(Retrieved 12th September 2014).

Sram, R., Binkova, B&Dejmek, J., (2005). Ambient air pollution and pregnancy outcomes: a review of literature. *Environmental*

Health Perspectives, 113 (4): 378-382.www.ehponline.org (Retrieved 29th August 2014).

USEPA.National Center for Environmental Assessment-RTP Division (2008).Integrated Science Assessment for Particulate Matter (Retrieved 12th September 2014).

USEPA,(2009). Integrated Science Assessment for Carbon Monoxide http://oaspub.epa.gov (Retrieved 12th September 2014).

USEPA,(2012).Six common air pollutants. United States Environmental Protection Agency, Washington, DC, USA.http://www.epa.gov/air quality/urbanair (Retrieved 29thAugust 2014).

Wang, S., (2013) Ozone, Pregnancy Ills Linked.The wall street journal http://online.wsj.com/ news/articles (Retrieved 1st September 204).

Xiaohui, X., (2014).Air pollution increases risk for hypertension in pregnantwomen Category: Environment, Health, Research http://news.ufl.edu(Retrieved 12th September 2014).