A Critical Assessment of Indoor Air Pollution and Its Effect on Human Health

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ABSTRACT

Indoor air pollution occurs when harmful gases and/or particles are released into the air of a house, apartment or any other building. This type of pollution can cause a number of serious health problems among the occupants of an affected building, especially since indoor areas receive relatively little air circulation. Indoor air pollution is seen as real threat to human existence on the planet earth since people spend as much as 90% of their time indoor, and much of that time is in their homes. This makes it easy for man to have immediate or long-term reaction to poor indoor air quality. Since the quality of air in homes/office can impact one's health or the health of those we live with, care should be taken to prevent the emission of pollutant from sources like tobacco smoking, burning of forest, local lantern (boiboi), use of insecticide/chemicals and other offensive air/chemical that may trigger health effect like asthma, cancer, difficulty in breathing etc not to occur. Since human health solely depends on its environment, care should be taken to clean, protect in the use of natural air surrounding us. Besides using good legislation on consumption of some toxin substance, our home should be architecturally designed to include good ventilation, routine inspection of homes/offices by Environmental Health Officers, NGO's for better discovery of potential health hazards is also needful.

Key Words: Air pollution, Indoor- sources, Human health

Introduction

Indoor Air Pollution can be dated back to when human first moved to temperate climatic region which aggravated them to construct shelters and use fire place inside them for cooking, warmth and light. It may be considered as the addition of harmful chemicals to the atmosphere. Polluted air contains one or more chemicals or substances in concentration high enough to harm human, animals, plant or other materials. The most serious air pollution result from the burning of fossils or Biomass fuel, especially in internal combustion engines, dust, fumes and man-made products (Dekoning *et al.*, 1985).

Indoor air pollution is seen as real threat to human existence on the planet earth since people spend as much as 90% of their time indoor, and much of that time is in their homes. This makes it easy for man to have immediate or long-term reaction to poor indoor air quality. The quality of the air in our homes can impact our health or the health of those we live with, thus the need to study, control, and prevent/protect our indoor air from pollution because of human health (Chen, B.H 1990). Human health refers to the conditions of a person body or mind, not of animals, machine or goods. Therefore, indoor air pollution and human health can be seen as the act of introducing additional substances into the atmosphere as to break the freshness of the available air inside an enclosure or semi enclose building that alters the body, or state of mind of a person or persons staying there.

There is consistent evidence that indoor air pollution increases risk of chronic obstructive pulmonary disease and of acute respiratory infections in childhood. Indoor air pollution is estimated to cause approximately, 2 million premature deaths mostly in developing countries; almost half of these deaths are due to pneumonia in children under 5 years of age. Evidence also exists of associations of low birth weight, increased infant and perinated mortality, pulmonary tuberculosis, nasopharyngeal and laryngeal cancer, cataract and specifically in respect of the use of coal, with lung cancer. Conflicting evidence exists with regard to asthma. All studies are observational very few measured exposures directly, while a substantial proportion has not dealt with confounding. As a result, risk estimates are poorly quantified and may be biased. Exposure to indoor air pollution may be responsible for nearly 2 million excess deaths in developing countries and for some 4% of the global burden of disease. (Asthana *et al* 2003).

The United State Environmental Protection Agency's standards for 24hour average particulate matter (PM) PM10 and PM2.5 concentrations are 150ųg/m3 and65ųg/m3 respectively. The mean 24 hour levels of carbon monoxide in home using biomass fuels in developing countries are in the range 2-50 pm; during cooking, values of 10-500 PM have been reported. The United State Environmental protection Agency (EPA) 8-hour average carbon monoxide standard is 9ppm or 10mg/m3 (Bryner G.c.1995). Biomass fuel is any material derived from plants or animals which is deliberately burnt by humans. Wood is the most common example, but the use of animal dung and crop residues is also widespread.

Possible Sources of Indoor Air Pollution

Indoor air pollution occurs when harmful gases and/or particles are released into the air of a house, apartment or any other building. This type of pollution can cause a number of serious health problems among the occupants of an affected building, especially since indoor areas receive relatively little air circulation. In addition, many common chemicals can cause indoor air pollution.

Sources of indoor air pollution may be line with the activities and nature of that environment. The majority of households in developing countries burn biomass fuels in open fire places, consisting of such simple arrangements as three rocks, a u-shaped hole in block of clay, or a pit in the ground, or in poorly functioning earth or mental stores. Combustion is very incomplete in most of these stores, resulting in substantial emissions, which in the presence of poor ventilation; produce very high levels of indoor pollution. Indoor concentrations of particles usually exceed guideline levels by a large margin: 24 hours mean PM_{10}levels are typically in the range 300-3000ųg/m^3 and may reach 30,000ųg/m^3 or more during periods of cooking (Adinna. *et al*, 2003).

The principal source of pollution is Particulate Matter (PM), it affects more people than any other pollutant. The major components of PM are sulfate, nitrates, ammonia, sodium chloride, carbon, mineral dust and water. It consists of a complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air. The particles are identified according to their aerodynamic diameter, as either PM_{10} (particles with an aerodynamic diameter smaller than 10ųm). The diameters are more dangerous since, when inhaled, they may reach the peripheral regions of the bronchioles, and interfere with gas exchange inside the lungs (Achalu, O. E. *et al*).

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Possible source of poor indoor air quality includes the following:

- Tobacco smoking indoors, smoke drifting from outdoors, that is, from nearby houses, burning of forest, agricultural land and household waste, smoke being carried indoor on clothing.
- Other things that burn, like oil, gas, the use of kerosene lamp, charcoal briquettes, wood, candle, local lantern (boi boi) etc.
- Central heating, cooling or humidifying systems at homes.
- Use of new or recently installed building materials and furnishing, including carpets and certain wood pressed products.
- Cleaning and maintenance product used at homes. Some cleansing products contain chemicals that are carcinogenic in nature. The odors tend to be so offensive as to trigger asthma, cough or difficulty in breathing and vomiting.
- Some cosmetics and personal product, like hair spray and soaps. Most cosmetics especially bleaching creams, soap, detergent etc contains mercuric compounds. When stored in houses for use, the mercuric compound tends to sublime into the air which on inhalation through respiration may cause lung cancer. (Cunningham, w. p.et al 2003)
- Use of insecticide, pesticide and pollens, which traps on shoes and clothes. Some insecticides are pesticides especially those of organo-chlorine compounds with high persistency in the environment becomes a health hazard to man. It is observed that their fumes are toxic to man.
- Mold and mildew- mold is a form of fungi. It is in every moist indoor and outdoor environment all year round. It grows naturally indoors and can also enter the home on shoes, clothing, bags, animals, windows and ventilation systems. There is always a little mold in the air and on many surfaces. The mere presence of molds does not necessarily lead to symptoms. Mold may become a problem where there is excessive moisture, such as leakage in roofs, pipes, walls, plant pots, or where there has been flooding. Too much moisture can lead to mold and mildew. Although mold exposure does not always cause health problems, daily exposure has been known to cause respiratory problems, headaches, watery eyes, dizziness, lethargy rashes and other reactions. Mold and other biological contaminants can trigger asthma. (Cunningham, W. P. *et al* 2001)

Some Suggestions to Keep the Home Clear of Mold are:

- Flush the air two or three times a day (for three to four minutes, open all the doors and windows and let fresh air circulate through the house).
- Ventilate the bathroom and the kitchen with an exhaust fan.
- Keep shower curtain or bath tub sliding door open after bathing to increase air circulation.
- Assure that the dryer vents freely to the outside.
- Heat all the rooms in the home to keep moisture from forming on the walls and other surfaces of unheated areas.
- Use easy to clean paint and wallpaper, especially in bathrooms.

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- Install a timer switch on your bathroom fan, and leave the fan on for 15minutes after showering.
- When cooking, try to minimize simmering of liquid and foods.
- Keep furniture away from outside walls where mold might grow.
- Replacing carpet with wood or vinyl floor tiles will prevent some of the problems with carpeting.
- Clean up mold growing on surfaces by scrubbing it with regular soap and water.
- Next, apply a beach solution on the affected area (one part chlorine to four parts water).

However, the aforementioned sources can be group into:

- Tobacco smoking by both children and adult.
- Insecticides/mosquito coil etc.
- Smoke emanated from cooking appliances.
- Smoke produced from lighting appliances.
- Suspended particles matters.
- Radioactive sources.
- Vapor from building, home furniture and paint.
- Drying of food and fuel.
- Biological pollutants.
- Industrial and vehicle emissions.
- Mold and mildew.

The health or quality level of indoor air in a house is determined by how much and often pollutant is gathering into the air. Example can be seen in a properly adjusted gas, stove, it will emit significantly less carbon monoxide than one with poor adjustment. Indoor air quality can be improved by constructing good and quality ventilation spaces.

Solution to Indoor Air Pollution

(A) Managing Biological and Chemical factors

1. Good circulation of fresh, outdoor air through a home everyday to remove stale air and move possible pollutant out.
2. Smoking should be discouraged indoor.
3. Cleaning and wiping feet off before coming inside, and take shoe off in the house in order to keep out pesticide, chemical etc contamination.
4. Use of ventilating fans over the stove and in the bathroom and be sure they are vented to the outside of the house.

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5. Keeping ventilation fans clean always.

6. Replacement of cleaning of furnaces and air filters when they are dirty. Check them regularly at least every two months and use of a High Efficiency particulate Filters (HEPF).

7. Use of safe cleaning products, those without any of the signal words'' danger '' or '' caution.''

8. Vacuum carpets well and stuffed furniture well, wash lines weekly and dust regularly to keep the allergen ''dust mites'' to a minimum. Dust mites are microscopic but that lives in the dust and sloughed off skin.

9. Encourage the use of insect treated net in place of insecticide to kill mosquitoes.

(B) Managing Combustible Pollutant (Natural Gas)

- Stop Smoking indoors.
- Be sure to have good window or grapes etc for better ventilation in rooms with working fires, gas or wood stoves.
- Assures that gas flame in all appliances is blue, without much yellow. If there is gas leakage, open windows and doors and evacuate the room/ house.
- Care should be taken not to burn charcoal or kerosene heaters indoors.

Ways of Determining Indoor Air Quality Problems

- Do you or others sneeze and cough in your home?
- Do you or others in your home wake- up congested or with a headache?
- Do you or others in the home often have an irritated throat, nose or eyes?
- If you or others in your home have any of the above symptoms, are they more common in a certain part of the house/ home?
- Does anyone in your home/house have frequent asthma episode or respiratory infection?
- Do you notice that you feel better when you are away from home?

However, if you have answered, ''yes'' to any of those questions you may have an indoor air quality concern.

Signs of Possible Home Indoor Air Quality Problems

- Unusual and noticeable odours, stale or stuffy air.
- Noticeable lack of air movement.
- Dirty or faulty central heating or air conditioning equipment.
- Damaged flue pipes or chimneys.
- Unvented combustion air sources for fossil fuel appliances

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- Excessive humility
- Tightly constructed or remodeled home
- Presence of molds and mildew
- Health reaction after remodeling, weatherizing, using new furniture, use of household or hobby products, or moving into a new home.
- Feeling noticeably healthier outside the home.

Health Effect of Indoor Air Pollution

Health effect is determined not just by the pollution level but also, and more importantly, by the time people spend breathing polluted air that is, the exposure level. Exposure here refers to the concentration of pollution in the immediate breathing environment during a specified period of time. This can be measured directly-through personal monitoring or indirectly by combining information on pollutant concentrations in each micro environment where people spend time with information on activity patterns. Information on such patterns is very important for understanding the dynamic relationship between level of pollution and behavior. As pollution levels are reduced it is possible that people will spend more time indoors or nearer the sources of pollution. If this happens a reduction in ambient pollution will not necessarily result in a proportionate decrease in exposure, and there will be important implications for interventions. People in developing countries are commonly exposed to very high levels of pollution for 3-7hours daily over many years. During winter in cold and mountainous areas, exposure may occur over a substantial proportion of each 24- hour. Because of their customary involvement in cooking, women's exposure is much higher than men. Young children are often carried on their mother's backs while cooking is progress and therefore spend many hours breathing smoke. (Codlings, *et al* 1990)

Notwithstanding the significance of exposure to indoor air pollution and the risk of acute respiratory infections in childhood, chronic obstructive pulmonary disease and lung cancer, the health effects have been somewhat neglected by the research community, donors and makers. Many of the substances in biomass smoke can damage human health. The most important are particle, Carbon monoxide, nitrous oxides, sculpture oxide (principally from coal), formaldehyde, and polycyclic organic matters, including carcinogens such as benzo[a] Pyrenees. Particles with diameters below 10 microns (pm 10), and particularly those less than 2.5 microns in diameter (pm 2.5), can penetrate deeply into the lungs and appear to have the greater potential for damaging health.

- **Respiration illness**:

This include disease associated by difficulty in breathing, example can be seen in acute lower or upper respiratory infections. These are most important cause of mortality in children aged 5years.

Middle ear infection (otitis media) is rarely fatal but causes much morbidity, including deafness, and makes demand on the health system. It is known that exposure to environmental tobacco smoke cause middle ear disease.

Chronic pulmonary disease is due to smoking which is response for over 80% of causes of chronic bronchitis i.e. inflammation of the lining of the bronchial tube. Localized destruction

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and infection of the lung (local lung fibrosis and bronchiectasis disease) is also associated with indoor air pollution and repeated disease.

- **Asthma**: Indoor air pollution and environmental tobacco smoke trigger asthma in sensitized individual.

- **Cancer:** Tobacco smoke is the most important risk of lung cancer. However, smoke coal is known to be more carcinogen then coal and wood smoke. Exposure to biomass smoke is a potential risk factor for lung cancer.

Lighting appliance which emit great amount of smoke and dangerous chemicals compound such as carbon (iv) oxide, carbon monoxide etc. which health consequences causes irritation of the eyes, throat and nose, lung and heart cancer. Exposure to radioactive sources exposes man to health problems such as cancer and other like leukemia, bone tumours, dermatitis, burns, ulceration, illness, stillbirth, sterility and in some cases death. Suspended particulate matters like those form asbestos, metallic particles, oil, dust, smoke, volcanic eruptions, coal burning, road construction etc. this particles when inhale may cause lung cancer and other health problem like impairment of respiratory function, asbestos, headache, defect vision etc.

- **G I T Infection:** Vapour from other material like building materials, paint, furniture, ceiling etc. pollutant are injurious to lungs, irritation of the gastrointestinal tracts (G I T).

Pathogenic droplets, which arise when people laugh, sing, yawn, sneezes, cough etc. Some tiny droplets containing bacteria and other pathogenic organism are dislodged from nasal membrane, throat and upper respiratory passages. They are known to be responsible for airborne disease like tuberculosis, pneumonia, and measles diphtheria, common cold and other allied disease.

Prospects for Intervention and Control of Indoor Air Pollution

Indoor air pollution is best controlled when its source is known. The goal of intervention should be to reduce exposure to the pollutant itself, while meeting domestic energy and cultural needs and improving safety, fuel efficiency like the use of gas cooker and environmental protection.

Interventions should be affordable, perhaps requiring income generation and credit arrangements, and they should be sustainable. The evaluation of interventions should take into consideration all these criteria in addition to emphasizing the importance of reducing exposure to indoor air pollution. Exposure can be reduced by means of improved stoves, better housing, cleaner fuels and behavioural changes. Cleaner fuels, especially liquefied petroleum gas, probably offer the best long-term option in terms of reducing pollution and protecting the environment, but most poor communities using biomass are likely to be able to make the transition to such fuels for many years.

The use of improved biomass stoves has been varying results and has often been unsuccessful. In recent years, the main emphasis of stove programmers has been to reduce the use of wood, and consequently there has been relatively little evaluation of reduction in exposure. Although improved stoves are usually capable of reducing ambient pollution and personal exposure, the residual levels for stove in regular use are still high, mostly in the range500 to several thousands ųg/m^3TSP or (PM10).

Restriction on tobacco smoke should be place by government and strict enforcement of the time of exposure to radioactive sources, proper house sanitation, good ventilated room/

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house, screening of home with mosquitoes net in place of using insecticide and other chemicals dangerous to health.

Conclusion

This paper "Indoor Air Pollution and its Effect on Human Health" has in a way exposed the what, causes, effect and control of indoor air pollution in relation to human health.

Indoor air pollution is a major public health hazard for large numbers of the world's poorest, most vulnerable people and may be responsible for a similar proportion of the global burden of disease as risk factors such as tobacco. Since human health solely depends on its environment, care should be taken to clean and protect our surroundings. Use of most of our technological equipment, biological wares etc should be on specification.

Recommendations

In the course of this study some useful recommendation suggested can go a long way in reducing or eradicating indoor air pollution in our homes or work place.

1. Proper Health Education and enlightenment campaigns on the use of obnoxious gases, chemicals, radioactive materials and biological potential decomposing material should be encouraged.
2. There should be reduction of poverty level in order to encourage the use of improved source of fuel.
3. Government on their parts should make legislations on the control of tobacco consumptions.
4. Architectural designs of houses should consider good ventilation and the type of fuel consumption of that family.
5. There should be a routine inspection by Environmental Health Officers to Homes/workplace to ascertain health status of such premises.
6. Proper funding/staffing of health sector/research institutions by government and Non Government Organizations for better discovery of potential health hazard.

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