

7. Impacts of Environment Pollutants on Pregnancy & Preventive Measures

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7.1 Introduction:

Health hazards associated with environment pollutants is well recognised around the world¹. According to the World Health Organization, death due to toxic health impacts of environment pollutants is more than the total number of death occurring around the world due to various diseases like malaria, HIV, tuberculosis etc./, taken together². WHO reports approximately 7 million deaths around the world due to pollution². Most badly affected by health ailments due to pollution are the developing countries of the world. Studies show that more than 95% of pollution related death primarily due to air pollution occur in the low and middle income countries³. Toxic pollutants are added to the environment either naturally or due to human activities. Human activities are known to influence the environment and alter its natural constituents. These toxic substances are termed as pollutants as they pollute the environment⁴. Exposure to these toxic pollutants are harmful for human, animals and plants on the planet earth. Exposure of pregnant women directly affects the maternal and fetal health. Increased morbidity and mortality with exposure to toxic pollutants is reported⁵ [Fig.1].

Exposure to toxic pollutants at early stages of development in embryonic stage may cause maximum possible damages in the foetus⁶. These damages are mostly irreversible and the impacts may prevail in the infant, teen, adult and even for the rest of the life of the individual^{7,8}. Studies show that exposure to toxic pollutants at early stages of fetal life causes remarkable developmental defects and damages. Damages caused at the developmental

stages in fetus may cause behavioural, anatomical and metabolic disorders in the embryo and those may persist in the adulthood⁸. Neurobehavioral alterations are reported to occur due to impacts of toxic exposures during fetal developmental stages⁷. Other health ailments like asthma in childhood and adult days, diabetes, obesity, hypertension, cardiovascular disorders may occur due to the adverse impacts of toxic pollutants in the early days of development during fetal stage in mother's womb⁶⁻⁸. Maternal hypertension and associated disorders as well as preterm birth are also reported with exposure to environmental pollutant exposure of pregnant women⁹ [Fig.1].

7.2 Impact of Air Pollution on Pregnancy:

Air pollutants enter a pregnant mothers' body mainly through the respiratory system¹⁰. (Particulate Matter) PM 2.5, PM 10 or 2.5 and ultrafine particles may be fatal to maternal health and may cross the various membrane barriers and also the placenta¹¹. Studies show that gestational exposure to Particulate Matter 2.5 (PM2.5) causes spatial memory dysfunction and impairment of neurodevelopment in Hippocampus of offspring of mice¹¹. Gestational exposure to oxides of sulfur, nitrogen, ozone, PAH or oxides of carbon may not only affect maternal health, metabolism but also is reported to affect the fetal health. Scientific reports suggest that gestational exposure to toxic pollutants as mentioned may affect fetal birth weight. Low birth weight, abnormal fetal growth, reduced head circumference, are quite common¹². Mothers exposed to air pollutants may suffer from stress, diabetes, anemia, polyhydramnios, oligohydramnios, intrahepatic cholestasis, hypohepatia, respiratory distress, hypertension and preeclampsia, preterm birth of low birth weight baby and stillbirths^{13,14}. Exposure of pregnant mothers to air pollution is known to be associated with risk of development of congenital heart defect in those pre-pregnancy overweighted women¹⁵. Babies born to mothers exposed to toxic air pollutants are victim of low vitamin D, coronary heart disease, hypertension and even non-insulin dependent diabetes melitus¹⁶. During pregnancy maternal exposure to repairable toxic gasses and dusts may affect the immune system of the female. Innate immune cells, t-lymphocytes and Nk cells may show altered immune responses and IgE levels may show hypersensitive responses¹⁶ [Fig.1].

Once entering the maternal circulation, air pollutants may generate oxidative stress that may cause damages to placental barrier, blood brain barrier and vascular endothelium damage which may be reflected as systematic and pulmonary hypertension, placental abruption, placenta Previa and accrete. Indeed, normal fetal demand for nutrients, gas transport and excretory functions as well may be at a stake in such case¹⁷. Exposure to particulates has been reported in expression of hippocampal proinflammatory cytokines resulting in altered hippocampal neural morphology leading to neural stress¹⁸. Fetal neural development may be at a distress and the child may be a victim of neurodevelopmental disorder, attention deficit hyperactivity disorder, altered cognitive function and addictive behaviour due to maternal exposure to air pollutants¹⁹.

Moreover, oxides and sulfides of ambient gasses, fly aces and PAH easily caused oxidative damage to fetal tissues, DNA damage, P450 enzyme activation²⁰. These altogether may cause teratogenic effects in the fetus, birth malformations, limb defects, and carcinogenic insults. Maternal endocrine disruption may also be reflected in fetal genital function, thyroidal tissue, leptin, adiponectin function and fetus may suffer from obesity [Fig 1]²⁰.

7.3 Impact of Water Pollution on Pregnancy:

Studies show that consumption of contaminated drinking water during pregnancy leads to adverse maternal and fetal health effects. During treatment of water with chlorine leads to formation of Trihalomethanes (THMs) which when enters the maternal body, causes cardiac ailments, preterm delivery, low birth weight, neural tube defects, oral clefts and spontaneous abortion²¹. Contamination of drinking water with pollutants like chemical pollutants and radioactive substances may impose serious health hazards for pregnant women. Contamination of water with certain microorganisms including virus, bacteria, and parasites may also lead to serious troubles in pregnant women which include miscarriage, preterm delivery and still birth²².

Prenatal exposure to contamination of drinking water with chemicals like Tetrachloroethylene (PCE), is reported to cause serious health effects in pregnant women and the fetus. Among these, worth mentioning are increased risks of abruption of placental, delayed time-to-pregnancy, and stillbirths because of placental dysfunction, and certain birth defects. Anyways, no associations of prenatal exposure to PCE with pregnancy loss, birth weight, and gestational duration are reported²³.

An increased risk of pregnancy loss during the first trimester due to exposure of pregnant mothers to nitrate is observed. The risk is reported to be highest due to exposure to water with nitrate concentration in between 1 and 10 mg/L²⁴. Exposure of pregnant mother to contaminated water with certain pollutants like lead, pesticides as well as the byproducts of processes used for disinfection of water supplies can harm the baby and may result in retarded mental development, improper and retarded growth and may lead to various birth defects²⁵.

Heavy metals like lead, mercury, cadmium, etc., are known to have adverse effects on the vital organs like heart, liver, kidneys and other organs and lead to toxic effects on the health of the exposed individuals²⁶⁻²⁸. Contamination of drinking water with heavy metals causes serious toxic impacts on the health of the pregnant mother and the fetus²⁵. Significant effects on birth weights and gestation of infants due to exposure of pregnant mothers to contaminated and polluted water is reported [Fig.1]²⁹.

Lead, nitrate, atrazine, manganese and chlorine are recognised as the five most toxic contaminants of water³⁰. Exposure of pregnant women to manganese contaminated water is known to cause adverse health effects on the mother and the fetus³¹. Another study reveals that no significant association between low birth weight and maternal exposure to chlorinated water is noted³².

Studies also show that maternal exposure to the by-products of water disinfection may lead to an enhanced risk of birth defects which include anencephalus which is actually a fatal condition in which major portion of the upper part of the brain and the skull does not develop. The other birth defects due to exposure to contaminants which are the by-products of water purification are defects of the wall separating the ventricles of the heart. Cleft palate is also reported in the new born who have been exposed to the by-products of water purification in fetal stage due to maternal exposure to such drinking water [Fig.1]³³.

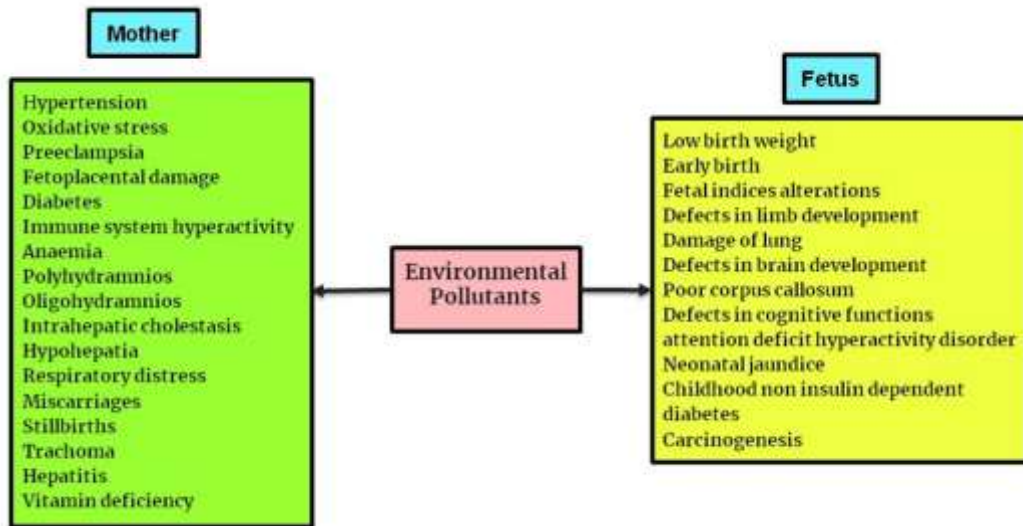


Figure 7.1: Impacts of toxic environment pollutants on pregnant mother's health and fetal health.

7.4 Impact of Soil Pollution on Pregnancy:

Concentration of certain toxic pollutants especially heavy metals in soil around the home or residence of pregnant women is known to enter the body of those women through water and other resources and is reported to cause low birth weight of the babies of those mothers. Studies show that there exists a statistically significant relationship between the concentrations of arsenic in the soil around the home of pregnant women and an enhanced risk of low birth weight for her infant³⁴.

Low birth weight is a very significant parameter for determining good health of the new born. Low birth is known to be associated with increased risk of morbidity and mortality of the new borns³⁵.Epideniological studies show that the soil pollutants enter the body of the residents of a place from hand to mouth route and also through the food chain through consumption of the vegetation's grown in the soil contaminated with toxic pollutants³⁶.In pregnant mothers, certain toxic pollutants which enters the body through hand to mouth route or through the food chain are simply passed on to the growing fetus in her womb through the placenta^{35,37}. There have been several studies on the impact of low dose exposure of pregnant women to toxic heavy metal contaminants of the soil. The studies report that exposure of pregnant mothers to low level of heavy metals in the soil leads to low birth weight in the new born babies³⁸. A study conducted using experimental rats show that the offspring of the rats exposed to polluted and contaminated soil of urban region during pre-pregnancy caused significant alterations in growth pattern, weight gain,

development length and a reduction in the count of platelets compared to those in the control group of experimental rats. The same study also reveals that exposure of pregnant mothers to contaminated urban soil during pregnancy results in low birth weight, weight gain during the growth incisor eruption, development length, and also caused opening of the ears.

The pups born to those mothers exposed to contaminated soil during pregnancy also are found to have reduced physical performance and also a change in the count of lymphocytes [Fig. 1]³⁹.

7.5 Preventive Measures of the Impact of Pollutants on Pregnancy:

The best and most effective way to prevent the impacts of pollution on mothers' and fetal health is firstly to prevent pollution as much as possible. We need to restrict emission of pollutants into the environment as much as possible in order to make earth a better place for life to survive. The priority may be to remove the pregnant women to a safer place with lower level of air, water and soil pollution. Several measures have already been made by the Government in India for preventing and reducing pollution⁴⁰. Wide spread consideration of alternative energy and renewable energy needs to be implemented in order to reduce environmental pollution⁴⁰. Also, supplementation of vitamins and antioxidants in daily diet of pregnant mothers may help to maintain a healthy pregnancy, good health of both mother and fetus⁴¹. These supplementations may help to combat the adverse impacts of toxic pollutants on maternal and fetal health. Good and balanced diet, improved lifestyle and self-care is known to be significant for maintaining women health⁴². A mother's diet should be rich in foods containing vitamins, minerals and the food must be adequate enough to meet her calorie requirements⁴³.

During pregnancy the developing embryo gets all its nutrition from the mother's body⁴⁴. Thus, the toxic pollutants which enters the pregnant woman's body from air through respiration, from contaminated drinking water or from polluted soil through hand to mouth route or through the food chain may easily reach the developing embryo through the placenta and causes adverse effects on the growing embryo. Toxicants like fluoride is known to adverse effect the growth of the brain and the nervous system⁴⁵. Pregnant women residing in regions with increased environment pollution are at a high risk to develop health issues due to constant exposure to toxic environment pollutants. Pregnant women if possible need to be removed from highly polluted place. Use of mask may be recommended for outdoor activities. Also consumption and supplement of certain antioxidant herbs and spicy vegetables along with purified antioxidant compounds may be beneficial in addressing toxic pollutant induced oxidative stress mediated adverse health conditions⁴⁶ of pregnant mother and developing fetus. Medicinal herbs like Tulsi are also known to have protective effects against heavy metal induced oxidative stress mediated health effects⁴⁷.

Other spice herbs like *Coriandrum* are known to protect against certain chemical induced oxidative damages mediated health issues⁴⁸⁻⁵⁰. Hence, such medicinal spice herbs may be recommended for pregnant women who are regularly unavoidably getting exposed to toxic environment pollutants including toxic heavy metals like lead, cadmium, arsenic and mercury. Proper source of pure, pollution free drinking water needs to be assured for pregnant women in order to safe guard them against contaminated water induced health ailments. Hand should be washed before and after every meal in order to avoid soil pollutants induced toxicity in pregnant women. Hygiene needs to be assured for pregnant mothers. Use of sanitizers may be recommended to combat the risk of microbes induced health ailments in pregnant women and the growing fetus. Thus, the basic preventive and protective measured needs to be adapted in order to prevent the impacts of toxic environment pollutants on maternal and fetal health.

7.6 Conclusion:

Increasing pollution is a serious concern around the globe. Air pollution is known to aggravate other respiratory diseases including COVID-19^{51,52}. Soil and water pollution also impose fatal health impacts. Pregnant women at higher risk of toxic environment pollutant induced adverse health effects. Also, the growing embryo in the mother's womb who is getting exposed to toxic environment pollutants, suffer from the ill effects of the toxicants. Proper human health risk assessment methods should be considered in order to assess the levels of various environment toxicants and the human health risk associated with them⁵³. Also, regular health checkup of pregnant women under proper medical supervision is necessary to assure early detection of any kind of health issue of the mother and the growing fetus. Early medical intervention may help to overcome certain health conditions. Also, recognition of the cause for the same will help to take necessary preventive and protective measures to protect the mother and the baby against toxic environment pollutant exposure.

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