Impact of Air Pollution on Reproductive Health" (1999), by Radim Srám [1]

By: Bains, Ajeet Keywords: Respirable air pollutants [2]

Radim Srám is a scientist who as of 2019 studies public health and genetics at the Department of Genetic Toxicology and Nanotoxicology of the Institute of Experimental Medicine of the Academy of Sciences in Prague, Czech Republic. As of 2019, the institute is known as the Institute of Experimental Medicine CAS. In 1977, Srám earned his doctorate for his work on the genetic risks of certain mutagens, or chemicals, and how they cause mutations in genetic material, or DNA. From 1991 to 2013, Srám focused his research on the effects of polluted environments on human health in Prague, Czech Republic. He has since published several papers on human health, including the effects of pollution on respiratory function, pregnancy [3] outcomes, mortality, and cancer. As of 2019, one of his latest publications on human health is an article published in 2012 called "Personal Exposure to Carcinogenic Polycyclic Aromatic Hydrocarbons in the Czech Republic".

Srám divides the article into three sections. In the first section of the article, he discusses early experiments that tested whether exposure to chemicals could induce developmental abnormalities, and in some cases, even death. He also mentions early evidence that show how exposure to air pollution and certain chemicals, such as polycyclic aromatic hydrocarbons, or PAHs, can affect fetal development. In the second section of the article, Srám mentions that intrauterine growth retardation [4], or IUGR, is one of the most common causes of exposure to chemicals during the time of embryotic implantation [5]. IUGR is a condition in which the size of a fetus [6] inside a woman's uterus [7] is smaller than it should be due to lack of growth during fetal development. In addition, he discusses some potential toxic effects of air pollution in urban environments on fetal development. In the third section of the article, Srám explains how air pollutants can result in differences in the number of chromosomes an infant is born with. Furthermore, Srám discusses how a mother's lifestyle can cause abnormalities during fetal development.

In the first section of the article, Srám discusses two early experiments that studied how exposure to chemicals and air pollutants can affect fetal development by causing infant mortality or birth defects [8]. In 1987, scientist Walderico Generoso published an early study that tested whether mice developed genetic mutations after they were exposed to a chemical known as ethylene oxide. Ethylene oxide is a common agricultural pesticide. Generoso claimed that when mice were exposed to ethylene oxide during early fetal development, they often died or had developmental abnormalities. A few years later, another scientist named Joe Rutledge found several other chemicals that could induce abnormalities during fetal development. Srám states that an appropriate location to test whether or not pollutants actually have the capacity to affect fetal development would be the Black Triangle, which includes the Czech Republic, the former East Germany, and Poland. As of 2019, the Black Triangle is one of the largest sources of pollution in Europe, resulting from the combustion of brown coal in power plants.

Srám then describes an article published in 1998 by Frederica Perera, a professor of Environmental Health Sciences at Columbia University [9] in New York, New York. Srám states that Perera's experiment took place in Poland, where she observed the effects of prenatal exposure to polycyclic aromatic hydrocarbons, or PAHs, from air pollution on fetal development. PAHs are chemicals that naturally occur in coal, crude oil, and gasoline. PAHs also form small particles in the air when coal or oil is burned. When a pregnant woman inhales active components of toxins present in the air, the toxins are then absorbed into the bloodstream and ultimately reach the fetus [6]. Perera's experiment showed that an increase of PAH bound to DNA in white blood cells from umbilical cord [10] blood correlated to a decrease in infant birth weight and head circumference. The experiment showed that air pollution also increased DNA adducts in the placenta [11]. DNA adducts are pieces of DNA bound to a potentially cancerous chemical. The experiment demonstrated that the concentration of potentially cancerous PAHs in the last month of pregnancy [3] affected the number of bulky DNA adducts present.

Srám goes on to state that Perera also observed that newborns with intrauterine growthretardation [4], or IUGR, also had higher levels of DNA adducts. IUGR occurs when a fetus [6] is smaller than it should be because it is growing at a slower rate inside the uterus [7]. According to Perera, the mother's lifestyle is also an important factor. For example, Perera found that DNA adducts in the placenta [11] occurred more frequently in women who smoked or inhaled tobacco smoke. Perera also concluded that DNA adducts in the placenta [11] occurred less frequently in women who had high vitamin C levels in blood plasma. In addition, Srám adds that cases of IUGR and low birth weight were higher in mothers who smoked than in mothers who did not smoke.

In the second section of the article, Srám explains how IUGR is one of the most common consequences of chemical exposure around the time of implantation [5]. According to David Barker, who was a public health researcher and physician at Guy's Hospital in London, England, reduced fetal growth is an important predictor of neonatal disease and mortality. In a 1995 study Barker showed the relationship between various diseases in adults such as noninsulin-dependent diabetes, hypertension, and coronary heart disease, and impaired growth in the prenatal and early postnatal period. In that study, Barker found that higher exposure to pollutants during early development within the uterus [7] may lead to diseases later on during adulthood. Srám

claims that Barker's data suggests that exposure to air pollutants early in pregnancy [3] may adversely affect fetal growth. Biologically active compounds may interfere in the development or nourishment of the fetus [6]. In his study, Barker observed an increased risk of IUGR after a high exposure to PAHs within the first gestational month. Srám uses the data collected from Barker's study in order to conclude that exposure to potentially cancerous PAHs in early development may influence fetal growth.

Srám then discusses further analysis of the toxic effects of urban air pollution on fetal development. In 1999 in Prague, Czech Republic, researcher Blanka Binková published an article that analyzed the genotoxicity and embryotoxicity of urban air particulate matter from two different districts in Czech Republic. In that study, Binková conducted an embryotoxicity screening test. An embryotoxicity screening test is a test used to identify any substances that have entered the maternal system and crossed over into the system responsible for providing oxygen, glucose, and other nutrients to a fetus [6]. An embryotoxicity screening test looks to identify any substances that are capable of causing malformations in the fetus [6]. Binková found that the highest activity was found for fractions containing mainly PAHs. Srám claims that the results from Binková's experiment are in agreement with the other studies which show that PAHs account for most of the chemical activity of all matter in urban air.

In the third section of the article, Srám discusses how a mother's lifestyle can lead to fetal abnormalities, and how air pollution can affect the number of chromosomes an infant is born with. He claims that children are very sensitive during the stages of fetal development. Because of this, Srám states that the choices a mother makes during pregnancy [3], such as smoking, influence a child's development. Srám then shifts his focus toward how air pollution can affect the number of chromosomes in mature gametes, an occurrence known as aneuploidy [12]. Aneuploidy is a chromosomal mutation often correlated with infertility [13], spontaneous abortions, perinatal mortality, and mental retardation [4]. A gamete is a mature male or female germ cell that can combine with another of the opposite sex and undergo fertilization [14], eventually leading to the development of a fetus [6].

Srám describes other studies in which sperm [15] samples were taken from several young men living in highly polluted areas. Those men had Y chromosome disomy, which is when two copies of the Y chromosome are present, rather than the normal amount of one Y chromosome present in males. The frequency of Y chromosome disomy was five times higher in samples collected in the winter than in samples collected during the summer, which corresponds with changes of air pollutant concentrations as seasons change during the year. In addition, the frequency of sperm [15] with Y chromosome disomy was much higher among smokers than nonsmokers. The author states that those differences may also be related to differences in air pollutant composition or in the level of air pollution. He goes on to state that increased frequency of Y chromosome disomy may heighten the risk of having a child with aneuploidy [12]. Srám concludes the section by stating that the data indicates air pollution may have an impact on harmful reproductive outcomes in both females and males.

Since Srám's article was published in 1999, the article has prompted further research into the effects of air pollutants on fetal and infant development. As of 2019, Srám's article "Impact of Air Pollution on Reproductive Health" has been cited by multiple studies that observe how air pollutants cause both infant mortality and a range of respiratory diseases in people living in developed and developing countries.

Sources

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In 1999, researcher Radim Srám, sometimes spelled Radim Šrám, published his article "Impact of Air Pollution on Reproductive Health" in the journal Environmental Health Perspectives. In the article, Srám analyzes the effects of exposure to air pollution, which can include harmful chemicals, on fetal growth and development. Srám discusses how industrialized countries such as the US and China have led to an increase in the global amount of respirable air pollutants. He mentions the influence that air pollution may have on the development of several birth defects, as well as the death of fetuses in the womb and infants after birth. Throughout his article, Srám summarizes the findings of several studies, and he describes the harmful developmental effects of common air pollutants, which has prompted further research in developed and developing countries into how air pollutants can cause birth defects and other diseases.

Subject

Effect of air pollution on [24] Pollutants [25] Pollution [26] Air contaminants [27] Air pollution [28] Air pollutants [29] Reproductive Health [30]

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