AMBIENT AIR POLLUTION AND ITS EFFECT ON CHILDREN

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Abstract: This review is intended to study the close relation between ambient air pollution and its ill effect on children. The review focuses on respiratory diseases in children owing to increasing air pollution, including asthma, deficits in lung functioning and growth, as well as exposure to ambient air pollutants. In addition to the above, the present review highlights mortality, pregnancy outcomes, allergies, IUGR, , vitamin D deficiency, weakening of immune system in children, premature births, childhood cancer, radiations from electronic gadgets etc There are many other toxic air pollutants that are regularly released into the air. Some of these pollutants, are not regularly monitored and have not been adequately researched, are also potentially harmful to the children. Ambient air pollution significantly increases the cases of morbidity and mortality, resulting in a significant economic cost to any society and nation. Growth of cities changing lifestyle and is most root cause of air pollution. These issues need immediate attention and must be dealt seriously in order to protect the health of children and support sustainable development for present and future generations.

Keywords: Ambient air pollution, Children, Radiations, Ill-Health effects

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Introduction

Children are future of a nation and they need to be safeguarded from potential harm prevailing in their surroundings. A very important field of is the study of the adverse health effects of ambient air pollution in children. A policy statement in 2004 was issued by The Committee on Environmental Health of the American Academy of Pediatrics emphasizing the link between ambient air pollution and children's health[1] Children are known to be more vulnerable to the adverse health effects of air pollution due to their minute ventilation, immature immune system, involvement in vigorous activities, the longer periods of time they spend outdoors[2,3] and the continuing development of their lungs during the early post neonatal period[4].A large number of epidemiological studies have reported an association between exposure to criteria air pollutants and several morbidity [5,6] and mortality [7,8] outcomes in children. Criteria air pollutants consist of six air pollutants that are regulated on the basis of their potential to cause adverse health and/or environmental effects: ozone (O_3), particulate matter (PM), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide and lead. In the present review, we intend to focus on the adverse health outcomes associated with exposure to various air pollutants in children. The purpose of the present article is to inform the society, pediatricians about the current epidemiological evidence on the associations between ambient air pollution and adverse health effects in children.

Adverse effect on pollutants on children health

1. **Neurodevelopmental and behavioral effects of inorganic lead**

Children rather than adults are considered a sensitive risk group for lead because, on a body weight basis, their dietary intake, absorption and total retention are markedly higher. In addition, the blood–brain barrier is not yet fully developed in young children, and specific behavioral characteristics such as hand-to-mouth and playground activities put them at higher risk of exposure. For these reasons, both cross-sectional and prospective epidemiological studies have been done in order to test the assumption that children are particularly at risk for neuro-developmental effects at even low environmental levels of exposure to inorganic lead.

2. **Delinquent and antisocial behavior**

Several studies have attempted to relate lead exposure to deviant behavior in young and adolescent boys. Using in vivo X-ray fluorescence to measure lead in the bones of 301 primary-school boys, Needleman et al.[9A] reported an association between bone lead levels and antisocial behavior as rated by teachers, parents and the boys themselves. Organic mercury can primarily be considered a risk factor for neuro-behavioral deficit in children from fish-eating populations. Inorganic forms of mercury reaching the marine environment, either by way of atmospheric deposition or by direct discharge of industrial sewage effluents, are converted into methylmercury by microorganisms and bio-accumulate in the marine food chain.

3. **Infants Mortality**

Ambient air pollution has been linked to increased mortality in children [8] and adults [9B]. Sudden infant death syndrome, a leading cause of post neonatal mortality in Canada [10] and other developed countries [11], has been associated with exposure to criteria air pollutants[12] In a systematic review of the literature on the association between ambient air pollution and infant mortality, Glinianaia et al [7] observed a consistent and significant association between PM and post neonatal mortality due to respiratory causes, as well as sudden infant death syndrome. Other studies have reported a significant relationship between ambient air levels of criteria air pollutants and mortality in children less than five years of age [13].

4. **Problems during pregnancy**

Ambient levels of criteria air pollutants have been associated with adverse effects on pregnancy including premature birth, intrauterine growth retardation (IUGR)[14], low birth weight, abnormal birth length, abnormal head circumference [15] and small size for gestational age [16]. However, no specific trimester has been identified as the most vulnerable period of gestation during which air pollution might be most harmful to the fetus.

5. Birth Defects

Air pollutants have also lead to several birth defects. Ritz et al [17] observed a significant association between prenatal exposure to carbon monoxide and cardiac ventricular septal defects, while O_3 was associated with an increased risk of aortic artery and valve defects, as well as pulmonary artery and valve defects.

6. Adverse effect on respiratory health

Exposure to ambient levels of criteria air pollutants has been associated with several acute and chronic adverse respiratory health effects in both asthmatic [18] and nonasthmatic [19] children, although asthmatic children have been shown to be more susceptible to the adverse health effects of ambient air pollution [18]. Several studies have linked ambient air pollution to an increased prevalence of asthma symptoms [20,21], as well as an increased incidence [22] and prevalence [22,23] of childhood asthma, particularly among children who regularly engage in sporting activities and those with increased asthma medication use [20,21,24], increased asthma emergency department visits [6,21,25,26] and increased hospitalization due to asthma [27–29]. Other studies have documented an inverse relationship between exposure to criteria air pollutants and lung function in both asthmatic [30] and nonasthmatic [19] children. There is evidence suggesting that current levels of ambient air pollutants may cause deficits in lung function growth in children [31–33]. Ambient air pollution has been associated with increased reporting of respiratory symptoms among nonasthmatic children [34], as well as increased respiratory hospital admissions [34,35] and emergency department visits [36] for children.

7. Absenteeism in School

Although the results from epidemiological studies suggest that both short-term and long-term exposure to ambient air pollution may contribute to illness-related school absenteeism, these data are not consistent. Day-to-day changes in the levels of criteria air pollutants (PM_{10}, SO_2, NO_2 and O_3) have been associated with illness-related absenteeism[37–40], while short-term changes in O_3 and SO_2 have been linked to respiratory illness-related elementary school absenteeism [37,38]. However, Park et al [39] did not observe a correlation between varying ambient air levels of NO_2 and illness-related school absences. Rondeau et al[40] reported a link between long-term exposure to ambient levels of O_3 and illness-related school absenteeism, but did not find anything for acute exposure. In addition, the investigators did not find any significant association between daily levels of ambient air pollution and respiratory illness-related school absenteeism [40].

8. Change in immunity

Exposure to ambient levels of criteria air pollutants has been shown to cause alteration in the immune system in children. Leonardi et al [41] studied the impact of ambient air pollution on the immune system of school children between nine and 11 years of age in 17 cities in Europe and found that ambient air pollution may alter both cellular and humoral immunity in children. However, a study conducted in Chile by Ruiz et al [42] found no association between ambient air pollution and the humoral immune system in children. Emerging evidence from animal toxicological studies suggest that ambient air pollution may cause suppression of host immunity [43,44].

9. Vitamin D deficiency among children

In the tropics, children who live in regions with higher levels of ambient air pollution have been shown to be at increased risk of developing vitamin D-deficiency rickets compared with those residing in less polluted areas [45]. The amount of solar radiation in the ultraviolet B range reaching ground level has been found to be inversely related to the level of ambient air pollution (haze). Ultraviolet B radiation emitted by the sun is required for the conversion of 7-dehydrocholesterol to cholecalciferol (vitamin D_3) [45].

10. Other pollutants

Although the present article is restricted to the health effects of criteria air pollutants, there are many other toxic air pollutants regularly released into the air that have the potential to harm children [46]. Studies are appearing in the literature identifying potential exposures and health effects [47–49]. The effects of air pollutants on genetic material are being investigated [50,51]. Further studies may lead to a better understanding of not only childhood disorders, but possibly adult ones too.

Traffic-related air pollution is a complex mixture of many chemicals, of which many are known or suspected carcinogens. In 1987 the International Agency for Research on Cancer (IARC) classified diesel and gasoline exhaust as, respectively, probably (Group 2A) and possibly (Group 2B) carcinogenic to humans, mainly on the basis of animal experiments and epidemiological studies on exposed adults[52]. In 1989, however, a case-control study performed in Denver in the United States showed elevated risk of cancer among children living near streets with high traffic density[53-54]. Since then a number of epidemiological studies have addressed the hypothesis that air pollution from traffic causes cancer, particularly leukemia, in children.

Benzene is one of the traffic-related air pollutants and occurs in the urban atmosphere due to evaporation from and incomplete combustion in petrol engines, as well as evaporation related to petrol stations and the refuelling of cars. The importance of ambient concentrations and proximity to petrol engines for the exposure of children to benzene has been documented[55]. Occupational studies have shown that exposure to benzene causes acute myeloid leukaemia [56] and probably also other histological subtypes of leukaemia in adults and may also, therefore, be suspected of causing leukaemia in children.

Conclusion

Significant morbidity and mortality in children is attributed to ambient air pollution at great economic cost to society. As our cities grow and our population increases, we need to be aware of air pollution and its effects on children. Further studies are needed in Canada to improve our understanding of air pollution on the health of children to aide policy-makers in decisions that relate to the sustainability of development.

Consideration needs to be given to emerging science on non-regulated pollutants that may be affecting the health of children today and may also be endangering future generations by affecting genetic material. Local data from different environments will help pediatricians in their roles as clinicians, educators and advocates. Significant research opportunity needs to be created to collect these data. This challenge needs to be addressed if we are to protect the health of children in the coming generations.

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