Health Care Without Harm

DOCTORS FOR CLEAN AIR

LUNG CARE FOUNDATION

Health Impacts Of Air Pollution

A Compilation of Health & Air Pollution Studies

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Air pollution was responsible for
7 million
premature deaths in 2016,
of these almost
600,000
were children under 5 years old.
BREATHELIFE
Clean Air. Healthy Future.
World Health Organization
CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS
UN environment

In Polluted Cities

Breathing Kills!

DOCTORS FOR CLEAN AIR

Introduction

"The health effects of air pollution imperil human lives. This fact is well documented" - Eddie Bernice Johnson

In 2016, ambient air pollution caused 4.2 million deaths*

- **16% of the lung cancer deaths.**
- **25% of chronic obstructive pulmonary disease (COPD) deaths.**
- **17% of ischaemic heart disease and stroke deaths.**
- **26% of respiratory infection deaths.**

* Source: WHO | Mortality and burden of disease from ambient air pollution [Internet]. WHO. [cited 2019 Nov 28]. Available from: http://www.who.int/gho/phe/outdoor_air_pollution/burden_text/en/

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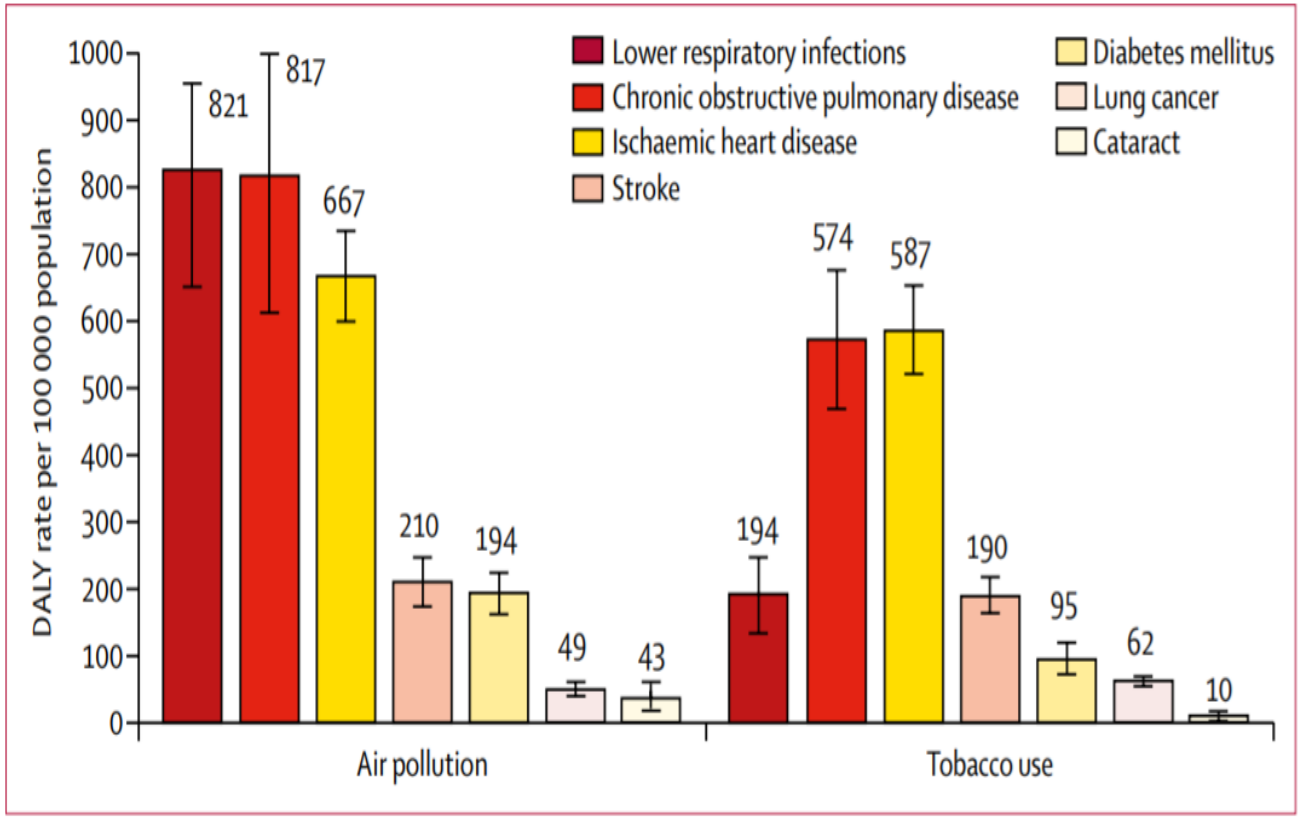
- Of the total 480·7 million DALYs in India in 2017, 38·7 million or 8·1% were attributable to air pollution.

- Of the total DALYs attributable to air pollution in India in 2017, the largest proportions were from lower respiratory infections (29·3%), chronic obstructive pulmonary disease (29·2%), and ischaemic heart disease (23·8%), followed by stroke (7·5%), diabetes (6·9%), lung cancer (1·8%), and cataract (1·5%).



DALY rates attributable to air pollution and tobacco use in India, 2017

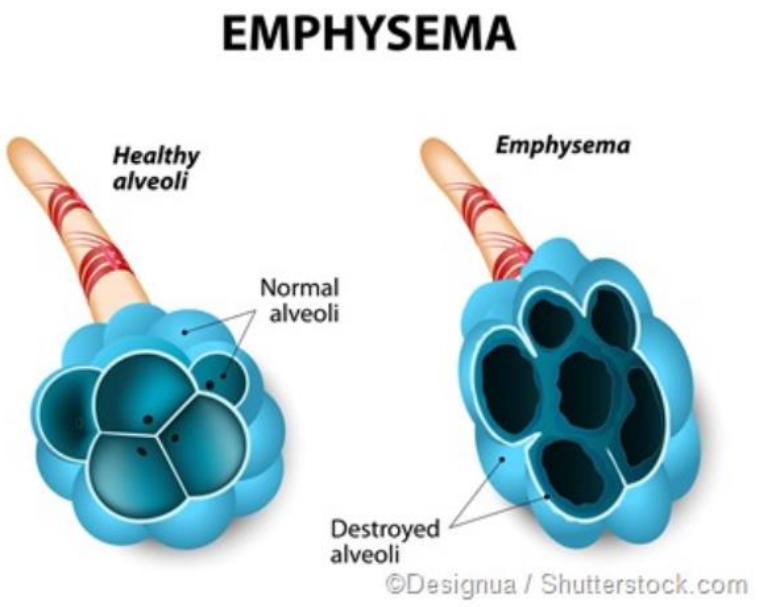
Balakrishnan K, Dey S, Gupta T, Dhaliwal RS, Brauer M, Cohen AJ, et al. The impact of air pollution on deaths, disease burden, and life expectancy across the states of India: the Global Burden of Disease Study 2017. The Lancet Planetary Health. 2019 Jan;3(1):e26–39.

Available from: https://www.thelancet.com/action/showPdf?pii=S2542-5196%2818%2930261-4

DOCTORS FOR CLEAN AIR

Air Pollution And Respiratory Effects

- Airway obstruction
- Cough
- Wheezing
- Shortness of breath
- Asthma
- Emphysema
- Chronic Obstructive Pulmonary disease (COPD)
- Lung Cancer
- Pneumonia
- Tuberculosis



https://www.news-medical.net/health/Air-Pollution-and-Lung-Health.aspx

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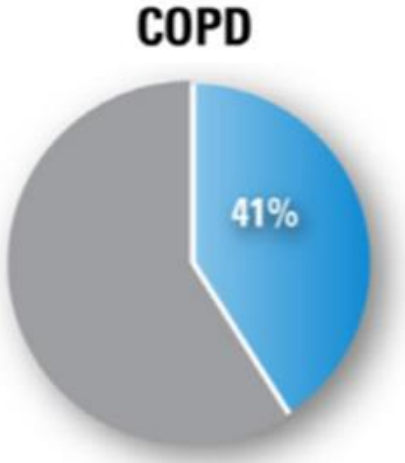
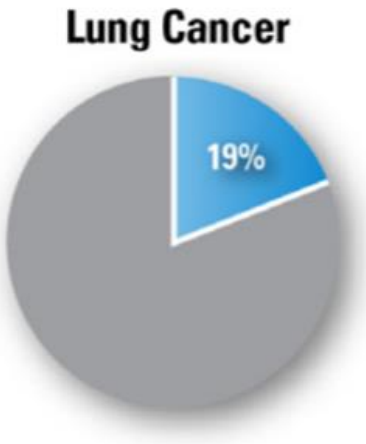
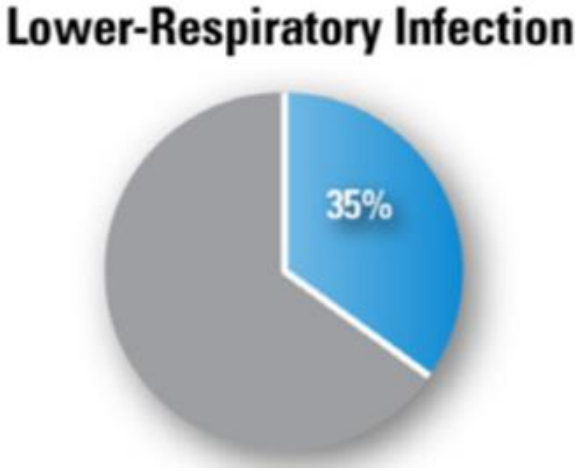
According to State of global Air Report 2019- Air pollution accounts for 41% of global deaths from chronic obstructive pulmonary disease (COPD), 19% of deaths from lung cancer, 35% of deaths from lower-respiratory infection.







Health Effects Institute. 2019. State of Global Air 2019. Special Report. Boston, MA: Health Effects Institute. Available from: https://www.stateofglobalair.org/sites/default/files/soga_2019_report.pdf

DOCTORS FOR CLEAN AIR

Study: Air pollution, weather, and associated risk factors related to asthma prevalence and attack rate by Ho WC et al (2007).

Objective: To investigate the relationship of air pollution and weather to adolescent asthma prevalence and attack rate.

A 6-month study (October 1995 to March 1996) in Taiwan with the study population of 1,139,452 students. A stratified random sample of 64,660 students was analyzed for asthma prevalence and attack rate.

The study demonstrated that air pollution is related to asthma attack rate.

Ho WC, Hartley WR, Myers L, Lin MH, Lin YS, Lien CH, et al. Air pollution, weather, and associated risk factors related to asthma prevalence and attack rate. Environ Res. 2007 Jul;104(3):402–9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/17316602

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Study: Outdoor air pollution and emergency room visits at a hospital in Delhi by Pande JN et al (2002).

Study was undertaken to correlate the daily levels of various pollutants with the number of patients visiting the All India Institute of Medical Sciences, New Delhi casualty for aggravation of certain defined cardiorespiratory disorders from January 1997 to December 1998.

Findings: Emergency room visits for asthma, chronic obstructive airway disease (COAD) and acute coronary events increased by **21.30%, 24.90%** and 24.30% respectively on account of higher than acceptable levels of pollutants.

Pande JN, Bhatta N, Biswas D, Pandey RM, Ahluwalia G, Siddaramaiah NH, et al. Outdoor air pollution and emergency room visits at a hospital in Delhi. Indian J Chest Dis Allied Sci. 2002 Mar;44(1):13–9. Available from: http://www.indiaenvironmentportal.org.in/files/Outdoor%20air%20pollution.pdf

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Study: Pulmonary Health Effects of Air Pollution by Kurt OK et al (2016)

Two studies of Chinese school children in 2013 and 2014, found long-term exposure to ambient air pollution was associated with a number of adverse effects, such as wheezing, cough or phlegm.

A systematic review published in 2015 suggests that exposure in early childhood to traffic-related air pollution (TRAP) containing PM2.5 was associated with an increased incidence of asthma up to the age of 12 years.

Study from Japan in 2014 of 10,069 children aged 6-9 years found traffic-related air pollution (TRAP) associated with development of asthma.

Kurt OK, Zhang J, Pinkerton KE. Pulmonary Health Effects of Air Pollution. Curr Opin Pulm Med. 2016 Mar;22(2):138–43. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4776742/pdf/nihms-759816.pdf

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Study: Outdoor air pollution and lung cancer: Recent epidemiologic evidence by Vineis P et al (2004)

The Harvard Six Cities Study was based on 8,111 residents of 6 U.S. cities, followed from 1974 through 1989. Exposure was estimated on the basis of average levels of pollution over the risk period, assuming residential stability. The total number of lung cancer deaths was reported as 8.4% of 1,429 (or 120).

Nafstad et al. studied lung cancer incidence among 16,209 (40 to 49 year) old men living in Oslo. Exposure assessment was based on measured concentrations of 2 gaseous air pollutants (NO2and SO2) available from 1974 to 1995. The authors found a risk ratio of 1.08 for an increment of 10µg/m3 of NO2.

Vineis P, Forastiere F, Hoek G, Lipsett M. Outdoor air pollution and lung cancer: Recent epidemiologic evidence. International Journal of Cancer. 2004;111(5):647–52. Available from: https://onlinelibrary.wiley.com/doi/epdf/10.1002/ijc.20292

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Study: Effects of particulate air pollution on the respiratory health of subjects who live in three areas in Kanpur, India by Sharma M et al (2004)

The authors assessed the relationship between daily changes in respiratory health and particulate levels with diameters of (a) less than 10 micron (PM10) and (b) less than 2.5 micron (PM2.5) in Kanpur, India.

The subjects (N = 91) were recruited from 3 areas in Kanpur: Indian Institute of Technology, Vikas Nagar, a typical commercial area and the residential area of Juhilal Colony. All subjects resided near to air quality monitoring sites.

Air quality and peak expiratory flow rate samplings were conducted for 39 d. Once during the sampling period, lung-function tests (i.e., forced expiratory volume in 1 s, forced vital capacity) were performed on each subject.

The authors used a statistical model to estimate that an increase of 100 microg/m3 of the pollutant PM10 could reduce the mean peak expiratory flow rate of an individual by approximately 3.2 l/min.

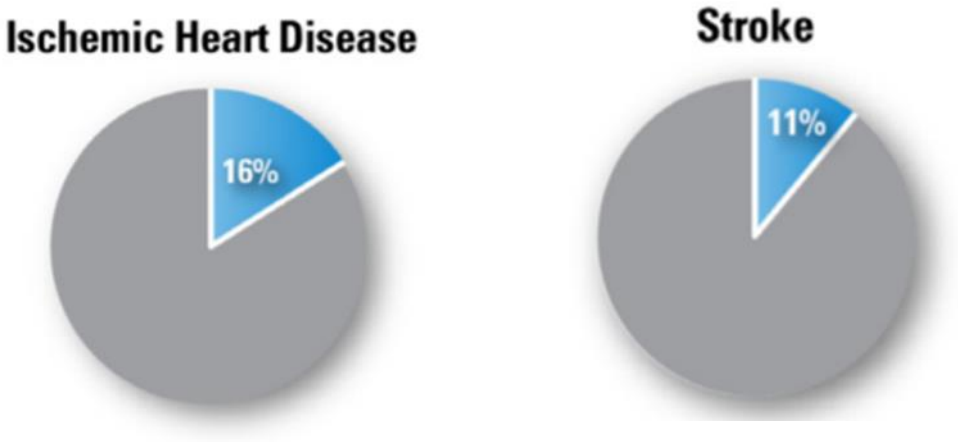
Sharma M, Kumar VN, Katiyar SK, Sharma R, Shukla BP, Sengupta B. Effects of particulate air pollution on the respiratory health of subjects who live in three areas in Kanpur, India. Arch Environ Health. 2004 Jul;59(7):348–58. Available from: https://www.researchgate.net/publication/7525600_Effects_of_Particulate_Air_Pollution_on_the_Respiratory_Health_of_Subjects_Who_Live_in_Three_Areas_in_Kanpur_India

Air Pollution & Cardiovascular Effects

DOCTORS FOR CLEAN AIR

Air Pollution And Cardiovascular Effects

- Increase risk of Myocardial infarction
- Coronary artery disease
- Ischemic heart disease
- Heart failure
- Arrhythmias
- Stroke
- Increase risk of cardiovascular mortality
- Hypertension
- Arteriosclerosis



16% of deaths from ischemic heart disease, and 11% of deaths from stroke (**State of global Air Report 2019)**

Bourdrel T, Bind M-A, Bejot Y, Morel O, Argacha J-F. Cardiovascular effects of air pollution. Archives of Cardiovascular Diseases. 2017 Nov;110(11):634–42. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5963518/pdf/nihms949393.pdf

Health Effects Institute. 2019. State of Global Air 2019. Special Report. Boston, MA: Health Effects Institute. Available from: https://www.stateofglobalair.org/sites/default/files/soga_2019_report.pdf

DOCTORS FOR CLEAN AIR

Study: A 10-year time-series analysis of respiratory and cardiovascular morbidity in Nicosia, Cyprus: the effect of short-term changes in air pollution and dust storms by Middleton N et al (2008)

The effect of changes in daily levels of particulate matter (PM10) and ozone (O3) on hospitalization for all, cardiovascular and respiratory causes in the two hospitals in Nicosia during 1 January 1995 and 30 December 2004 was investigated.

Results: For every 10 µg/m3 increase in daily average PM10 concentrations, there was a 0.9% increase in all-cause and 1.2% increase in cardiovascular admissions. With respect to respiratory causes, an effect was observed only in the warm months. All-cause and cardiovascular admissions were 4.8% and 10.4% higher on dust storm days respectively.

Middleton N, Yiallouros P, Kleanthous S, Kolokotroni O, Schwartz J, Dockery DW, et al. A 10-year time-series analysis of respiratory and cardiovascular morbidity in Nicosia, Cyprus: the effect of short-term changes in air pollution and dust storms. Environ Health. 2008 Jul 22;7(39):1–16. Available from: https://ehjournal.biomedcentral.com/track/pdf/10.1186/1476-069X-7-39

DOCTORS FOR CLEAN AIR

Study: Global association of air pollution and heart failure: a systematic review and meta-analysis by Shah AS et al (2013)

To assess the association between air pollution and acute decompensated heart failure including hospitalization and heart failure mortality.

There was a positive association between short-term increase in PM ($PM_{2.5}$ 2·12% per 10 μg/m^3) and gaseous components (NO2- 1·70% per 10 parts per billion, SO2- 2·36% per 10 parts per billion, CO - 3·52% per 1 part per million) and an increased risk of hospitalization or death from congestive heart failure, with the strongest associations on the day of exposure, and more persistent effects for PM2.5.

Shah AS, Langrish JP, Nair H, McAllister DA, Hunter AL, Donaldson K, et al. Global association of air pollution and heart failure: a systematic review and meta-analysis. The Lancet. 2013 Sep;382(9897):1039–48. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3809511/

DOCTORS
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Study: Long-term air pollution exposure and cardio-respiratory mortality: a review. Environ Health by Hoek G et al (2013)

A 2013 meta-analysis found that an average increase of 11% in cardiovascular mortality was associated with a 10 µg/m3 increase in annual PM 2.5 concentration.

Hoek G, Krishnan RM, Beelen R, Peters A, Ostro B, Brunekreef B, et al. Long-term air pollution exposure and cardio- respiratory mortality: a review. Environ Health. 2013 Dec;12(1):43. Available from: https://ehjournal.biomedcentral.com/track/pdf/10.1186/1476-069X-12-43

DOCTORS
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Study: Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE Project by Cesaroni G et al (2014)

1,00,166 people were enrolled from 1997 to 2007 and followed for an average of 11.5 years.
Findings: Annual increases of 10 µg/m3 in PM10 and 5 µg/m3 in PM2.5 were associated with increased risks of coronary events (myocardial infarction and unstable angina) of 12% and 13%, respectively.
Conclusion: Long term exposure to particulate matter is associated with incidence of coronary events.

Cesaroni G, Forastiere F, Stafoggia M, Andersen ZJ, Badaloni C, Beelen R, et al. Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE Project. BMJ [Internet]. 2014 Jan 21 [cited 2019 Nov 29];348. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3898420/

Air Pollution & Brain

DOCTORS FOR CLEAN AIR

Air Pollution And Brain

- Autism/autistic spectrum disorders
- Oxidative stress
- Neuroinflammation
- Neurodegenerative diseases
- Depression
- Decrease cognitive function
- Developmental disabilities
- Behavioral abnormalities and many more

https://www.momscleanairforce.org/fine-particle-brain-damage/

Costa LG, Cole TB, Coburn J, Chang Y-C, Dao K, Roque P. Neurotoxicants Are in the Air: Convergence of Human, Animal, and *In Vitro* Studies on the Effects of Air Pollution on the Brain. BioMed Research International. 2014;2014:1–8. Available from: http://downloads.hindawi.com/journals/bmri/2014/736385.pdf

DOCTORS
FOR CLEAN AIR

Study: Growing Evidence for the Impact of Air Pollution on Depression by Ali NA, Khoja A (2019)

According to data from China (Chen S etal) published in 2018, every 1 standard deviation rise in particulate matter over an average PM2.5 concentration increases the likelihood of having mental illness (including depression) by 6.67%, translating to an annual medical expense of $22.88 billion USD.

Mohan Kumar et al found that air pollutants, specifically particulate matter, induce inflammation and oxidative stress in the brain that can lead to the manifestation of depression.

Vert et al found that the rate of depression was 2 times higher for each 10 µg/m3 increase in the nitric oxide level.

Ali NA, Khoja A. Growing Evidence for the Impact of Air Pollution on Depression. Ochsner Journal. 2019;19(1):4–4.
Available from: http://www.ochsnerjournal.org/content/ochjnl/19/1/4.full.pdf

DOCTORS FOR CLEAN AIR

Study: Neurotoxicants are in the Air: Convergence of Human, Animal and *In Vitro* Studies on the Effects of Air Pollution on the Brain by Costa LG et al (2014)

Two studies by Volk et al. found that residential proximity to freeways and gestational and early life exposure to traffic-related air pollution were associated with autism (OR = 1.86; 95% CI 1.04–3.45).

Newman et al. reported hyperactivity in 7-year-old children associated with early life exposure to traffic related air pollution.

Costa LG, Cole TB, Coburn J, Chang Y-C, Dao K, Roque P. Neurotoxicants Are in the Air: Convergence of Human, Animal, and *In Vitro* Studies on the Effects of Air Pollution on the Brain. BioMed Research International. 2014;2014:1–8. Available from: http://downloads.hindawi.com/journals/bmri/2014/736385.pdf

DOCTORS FOR CLEAN AIR

Study: Costa LG, Cole TB, Coburn J, Chang Y-C, Dao K, Roque P. Neurotoxicants Are in the Air: Convergence of Human, Animal, and *In Vitro* Studies on the Effects of Air Pollution on the Brain

Diesel exhaust exposure was significantly associated with autism spectrum disorders (ASD), particularly in boys. There is increasing evidence indicating that children with ASD have higher levels of oxidative stress as well as increased neuro inflammation and systemic inflammation, these are the typical effects found in individuals exposed to severe air pollution.

Costa LG, Cole TB, Coburn J, Chang Y-C, Dao K, Roque P. Neurotoxicants Are in the Air: Convergence of Human, Animal, and *In Vitro* Studies on the Effects of Air Pollution on the Brain. BioMed Research International. 2014;2014:1–8. Available from: http://downloads.hindawi.com/journals/bmri/2014/736385.pdf

DOCTORS FOR CLEAN AIR

Study: Air pollution and daily emergency department visits for depression by Szyszkowicz M et al (2009)

Objective: To investigate the potential correlation between ambient air pollution exposure and emergency department (ED) visits for depression.

A hierarchical clusters design was used to study 27,047 ED visits for depression in six cities in Canada.

Findings: The percentage increase in daily ED visits was **15.5%** for CO per 0.8 ppm and **20.0%** for NO2 per 20.1 ppb. **7.2%** increase in the risk of emergency department visits for depressive episodes with every **19.4 µg/m3** of PM10 concentration (October-March).

The results support the hypothesis that ED visits for depressive disorder correlate with ambient air pollution.

Szyszkowicz M, Rowe BH, Colman I. Air pollution and daily emergency department visits for depression. Int J Occup Med Environ Health. 2009;22(4):355–62. Available from: https://www.ncbi.nlm.nih.gov/pubmed/20197262

DOCTORS
FOR CLEAN AIR

Study: Air Pollution and Emergency Department Visits for Depression: A Multicity Case-Crossover Study by Szyszkowicz M etal (2016)

Aim: To investigate the associations between ambient air pollution and emergency department (ED) visits for depression.
ED visits for depression were retrieved from the National Ambulatory Care Reporting System. A case-crossover design was employed for this study.

Findings: For females, exposure to ozone was associated with increased risk of an ED visit for depression between 1 and 7 days after exposure, for males, between 1 and 5, and 8 days after exposure, with odds ratios ranging between 1.02 and 1.03.
These findings suggest that there is a positive association between exposure to air pollution and ED visits for depression.

Szyszkowicz M, Kousha T, Kingsbury M, Colman I. Air Pollution and Emergency Department Visits for Depression: A Multicity Case-Crossover Study. Environmental Health Insights. 2016 Jan;10:155–61. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5006648/pdf/ehi-10-2016-155.pdf

DOCTORS FOR CLEAN AIR

Study: Association between ambient and household air pollution with carotid intima-media thickness in peri-urban South India: CHAI-Project by Ranzani OT et al (2019)

To evaluate the association between ambient fine particulate matter [particulate matter with an aerodynamic diameter of 2.5 mm (PM2.5)] and biomass fuel use on carotid intima-media thickness CIMT), a surrogate of atherosclerosis, in India. Analyzing of the third follow-up of the Andhra Pradesh Children and Parent Study cohort (2010–2012), which recruited participants from 28 peri-urban villages.

Findings: Among 3278 participants mean PM2.5 was 32.7 µg/m3 , and 60% used biomass. Positive associations was found between within-village variation in PM2.5 and CIMT in all participants [1.79%, 95% CI), 0.31 to 3.90 per 1 µg/m3 of PM2.5] and in men (2.98%, 95% CI, 0.23–5.72, per 1 µg/m3 of PM2.5). Use of biomass cooking fuel was associated with CIMT in all participants. Ambient and household air pollution were positively associated with CIMT in a peri-urban population of India.

Ranzani OT, Mila C, Sanchez M, Bhogadi S, Kulkarni B, Balakrishnan K, et al. Association between ambient and household air pollution with carotid intima-media thickness in peri-urban South India: CHAI-Project. International Journal of Epidemiology. 2019 Oct 11;dyz208. Available from: https://academic.oup.com/ije/advance-article/doi/10.1093/ije/dyz208/5585954

Air Pollution &
Reproductive & Neonatal Effects

DOCTORS FOR CLEAN AIR

Air Pollution And Reproductive And Neonatal Health

- Low fertility rate
- Sperm aneuploidy
- Abortion
- Low birth weight
- Intrauterine growth reduction
- Neonatal mortality
- Post neonatal mortality

PERSPECTIVES Editorial

Air pollution may have an impact on adverse reproductive outcomes in both females and males.

Impact of Air Pollution on Reproductive Health

It has long been known that air pollution can affect human health. Dockery et al. (*1*) and Schwartz (*2*) reported that increasing concentrations of pollutants are responsible for the significant increase of daily mortality. Respirable particulate matter is considered to be responsible for this increase. This association has been repeatedly observed in the United States (*1,2*), Europe (*3*), Brazil (*4*), and China (*5*). The results sparked discussions on new standards for levels of particulate matter ≤ 10 µm (PM_{10}), as well as proposals to measure, separately, respirable particles < 2.5 µm ($PM_{2.5}$).

Similar data were observed on the effect of air pollution on neonatal and postneonatal mortality (*6,7*). These data raise questions about whether pollution influences birth weight or other pregnancy outcomes. The list of end points in reproductive toxicology has expanded in recent years to include many functional birth defects.

In 1987, Generoso et al. (*8*) postulated that the mutagen ethylene oxide increased the incidence of developmental abnormalities and death of mouse fetuses when early zygotic stages were exposed to the mutagen. Later, Rutledge (*9*) was able to induce fetal abnormalities by other mutagens. These results contradict the perception of experimental teratology that most induced embryonic damage resulting in adverse developmental consequences originates from treatment during organogenesis and that earlier exposure of the conceptus produces death rather than persistent developmental consequences.

If the hypothesis is correct that air pollutants can similarly affect fetal development in humans, inducing not only infant mortality and birth defects but also developmental abnormalities such as functional defects, an appropriate test area would be a highly polluted environment such as the Black Triangle, which includes the Czech Republic, the former East Germany, and Poland. This region is one of the largest sources of pollution in Europe, resulting from the combustion of brown coal in power plants and heavy industrialization.

There have only been a few reports on the potential association of pregnancy outcome with air pollution. Bobak and Leon (*6*) reported an association of total suspended particulate (TSP) and SO_2 with neonatal and postneonatal mortality in the Czech Republic. Woodruff et al. (*7*) found that early postneonatal mortality was associated with the PM_{10} level for selected causes of death in the United States. Wang et al. (*10*) reported an increasing exposure–response relationship between SO_2 and TSP levels and low birth weight (LBW; < 2,500 g). Bobak and Leon (*11*) observed an association of TSP and SO_2 with LBW in an ecologic study in the Czech Republic in 1986–1988.

Perera et al. (*12*) observed the impact of air pollution on the biomarkers used by molecular epidemiologists in polluted regions of Poland. The new potential of molecular epidemiology became apparent during the analysis of the effects of prenatal exposure to polycyclic aromatic hydrocarbons (PAHs) from ambient pollution on fetal development (*13*). The increase of PAH–DNA adducts in leukocytes from umbilical cord blood was inversely correlated to the decrease in birth weight and head circumference. Air pollution also increased DNA adducts in the placenta (*14*). The bulky DNA adducts were affected by the concentration of carcinogenic PAHs in the last month of pregnancy and glutathione *S*-transferase M1 (GSTM1) and *N*-acetyltransferase 2 (NAT2) polymorphisms. Newborns with intrauterine growth retardation (IUGR) also had higher levels of DNA adducts (*15*).

The mother's lifestyle is also an important factor. For example, DNA adducts in the placenta were higher in women who smoked cigarettes or were exposed to environmental tobacco smoke, and were inversely correlated with vitamin C plasma levels (*15*). Similarly, causes of IUGR and LBW were higher in smoking mothers than in nonsmoking mothers (*13,16*).

Recently, Dejmek et al. (*16*) examined a group of mothers for the possible impact of PM_{10} and $PM_{2.5}$ on IUGR. They observed an increase in IUGR if the concentration of PM_{10} during the first month of pregnancy increased above 40 mg/m³. Such average monthly concentrations of PM_{10} are not an exception in industrial regions and large cities during the winter. This observation corresponds to earlier experiments on mice (*8,9*) in which the period shortly after conception was most susceptible to induced developmental changes by air pollutants.

IUGR is one of the most common consequences of mutagenic exposure around the time of implantation. Reduced fetal growth is an important predictor of neonatal morbidity and mortality. In a recent study, Barker (*17*) showed a relationship between some serious adult risks (namely, noninsulin-dependent diabetes, hypertension, and coronary heart disease) and impaired growth in the prenatal and early postnatal period. In this study, Barker (*17*) implied that higher exposure to pollutants during the early stages of intrauterine life may be responsible for diseases in middle age.

These data suggest that exposure to particulate matter (or associated air pollutants) early in pregnancy may adversely affect fetal growth. Regardless of which toxicant associated with particulate matter could affect fetal growth, the biologic mechanisms remain to be explained. The active components of these complex mixtures must be inhaled and absorbed into the maternal blood stream. Highly biologically active compounds (e.g., PAHs) might interfere with some processes in the development or nourishment of the fetus. Analyzing the same mothers from an earlier study (*16*), Dejmek et al. (*18*) observed an increased risk of IUGR after exposure to carcinogenic PAHs > 15 ng/m³ in the first gestational month. Therefore, we hypothesize that exposure to carcinogenic PAHs in early gestation may influence fetal growth. The association between PM_{10} and IUGR observed earlier may be explained, in part, by PAHs adsorbed to air particles.

Binkova et al. (*19*) analyzed the genotoxicity and embryotoxicity of urban air particulate matter from the same region where the mothers studied by Dejmek et al. (*16*) lived. The analysis (*19*) used an *in vitro* acellular assay coupled with ^{32}P-postlabeling of DNA adducts and a chick embryotoxicity screening test. In both assays, the highest activity was found for fractions containing mainly PAHs. These results are in agreement with the other studies (*20,21*) which show that PAHs account for most of the mutagenic activity from the neutral fraction of urban air. This is the first report in which the biologic activities of complex

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Volume 107, Number 11, November 1999 • Environmental Health Perspectives

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1566709/pdf/envhper00516-0014.pdf

DOCTORS FOR CLEAN AIR

Study: **Air pollution and human fertility rates by Nieuwenhuijsen MJ et al (2014)**

Aim: To assess the association between traffic related air pollution and fertility rates in humans in Barcelona, Spain (2011–2012).
General fertility rate was calculated - number of live births per 1000 women between the ages of 15 and 44 years per census tract.

Findings: Statistically significant reduction of fertility rates with an increase in traffic related air pollution levels, particularly for the coarse fraction of particulate matter was found. According to authors this was the first study in humans which showed an association between reduced fertility rates and higher traffic related air pollution levels.

Nieuwenhuijsen MJ, Basagana X, Dadvand P, Martinez D, Cirach M, Beelen R, et al. Air pollution and human fertility rates. Environment International. 2014 Sep;70:9–14. Available from: https://www.rtihs.org/sites/default/files/29228%20Martinez%202014%20Air%20pollution%20and%20human%20fertility%20rates.pdf

DOCTORS FOR CLEAN AIR

Study: The relationship between exposure to air pollution and sperm disomy by Jurewicz J et al (2015).

The study population consisted of 212 men who were attending an infertility clinic for diagnostic purposes. Sperm aneuploidy for chromosomes 13, 18, 21, X, and Y was assessed using multicolor fluorescence in situ hybridization. Air quality data were obtained from the Air Base database.

Findings: Positive associations were observed between exposure to PM2.5 and disomy Y (P = 0.001), sex chromosome disomy (P = 0.05) and disomy 21 (P = 0.03). Exposure to PM10 was associated with disomy 21 (P = 0.02). A separate analysis conducted among men who were nonsmokers (n = 117) showed that the relationship between PM2.5 and disomy Y and disomy 21 remained significant. These findings indicate that exposure to air pollution induces sperm aneuploidy.

Jurewicz J, Radwan M, Sobala W, Polańska K, Radwan P, Jakubowski L, et al. The relationship between exposure to air pollution and sperm disomy. Environ Mol Mutagen. 2015 Jan;56(1):50–9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/24989325

DOCTORS FOR CLEAN AIR

Study: Fetal growth and maternal exposure to particulate matter during pregnancy by Dejmek J et al (1999)

Authors examined the possible impact of particulate matter up to 10 micron (PM10) and up to 2.5 micron (PM2.5) in size on intrauterine growth retardation (IUGR) risk in a highly polluted area of Northern Bohemia (Teplice District). The study group includes all singleton full-term births of European origin over a 2-year period in the Teplice District.

Findings: Increase in IUGR were associated with PM 10 levels over 40 µg/m3 and PM 2.5 levels over 37 µg/m3 during early pregnancy in the highly polluted district of Teplice. This relationship remained after controlling for season.

Dejmek J, Selevan SG, Benes I, Solansky I, Sram RJ. Fetal growth and maternal exposure to particulate matter during pregnancy. Environ Health Perspect. 1999 Jun;107(6):475–80. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1566587/pdf/envhper00511-0091.pdf

DOCTORS FOR CLEAN AIR

Study: The impact of polycyclic aromatic hydrocarbons and fine particles on pregnancy outcome by Dejmek J et al (2000).

The impact of c-PAHs and fine particles on IUGR was analyzed in Teplice and in Prachatice, a region with similarly high c-PAH but low particle levels. All European, single live births occurring in a 4-year period in Teplice (n = 3,378) and Prachatice (n = 1,505) were included. Mean PM(10), PM(2.5,) and c-PAHs levels during the 9 gestational months (GM) were estimated for each mother.
For each 10 ng increase of c-PAHs in the first Gestational month, the Adjusted odds ratio was 1.22 (CI, 1.07-1.39). The results proved that exposure to c-PAHs in early gestation may influence fetal growth.

Dejmek J, Solansky I, Benes I, Lenícek J, Sram RJ. The impact of polycyclic aromatic hydrocarbons and fine particles on pregnancy outcome. Environ Health Perspect. 2000 Dec;108(12):1159–64. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1240197/pdf/ehp0108-001159.pdf

https://metro.co.uk/2019/09/18/study-finds-carbon-particles-air-pollution-placentas-pregnant-women-10763154/

DOCTORS
FOR CLEAN AIR

Study: Exposures to fine particulate matter (PM2.5) and birthweight in a rural-urban, mother-child cohort in Tamil Nadu, India by Balakrishnan K et al (2018)

Objective: To examine whether PM2.5 exposures during pregnancy were associated with birth weight in an integrated rural-urban, mother-child cohort in the state of Tamil Nadu, India.

1285 pregnant women were recruited in the first trimester of pregnancy from primary health care centers and urban health posts and followed them until birth to collect antenatal care data and birth weight. Estimation of pregnancy period PM2.5 exposures through direct serial measurements of 24-h household PM2.5 concentrations, performed across each trimester.

Findings: A 10-µg/m3 increase in pregnancy period PM2.5 exposures was associated with a 4g decrease in birth weight and 2% increase in prevalence of low birth weight. The study provides some of the first quantitative effects estimates for linking rural-urban PM2.5 exposures and birth weight in India.

Balakrishnan K, Ghosh S, Thangavel G, Sambandam S, Mukhopadhyay K, Puttaswamy N, et al. Exposures to fine particulate matter (PM2.5) and birthweight in a rural-urban, mother-child cohort in Tamil Nadu, India. Environmental Research. 2018 Feb 1;161:524–31. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29227900

DOCTORS FOR CLEAN AIR

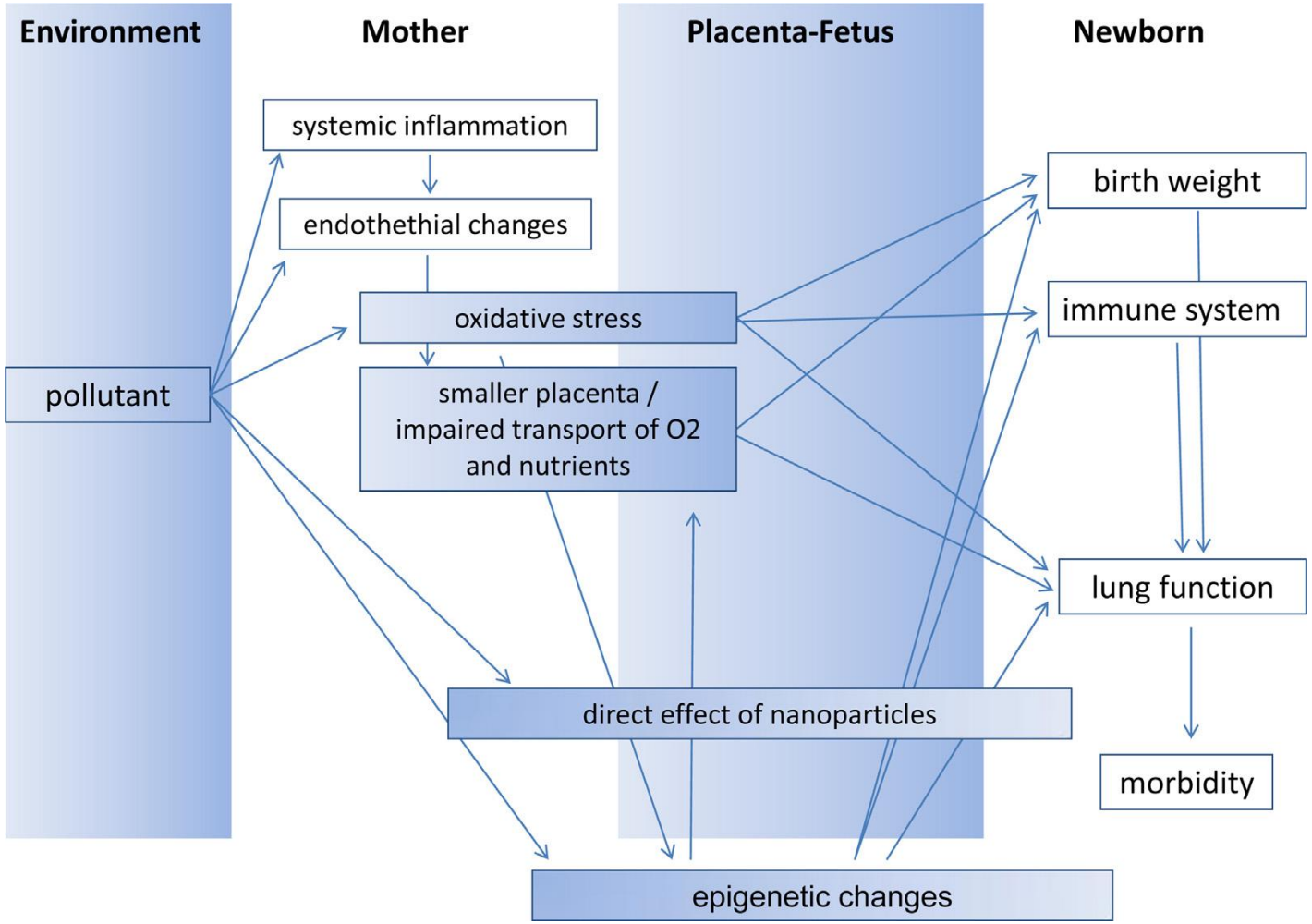
Study: Impact of air pollution on reproductive health by Sram R (1999) Woodruff et al. (1997) found that post neonatal mortality was associated with the PM10 level in the United States.

Bobak and Leon (1999) observed an association of total suspended particles and SO2 with Low birth weight in an ecologic study conducted in the Czech Republic in 1986-1988. **Barker (1995)** showed a relationship between some serious adult risks (namely, noninsulin-dependent diabetes, hypertension, and coronary heart disease) and impaired growth in the prenatal and early postnatal period. In this study, Barker (1995) implied that higher exposure to pollutants during the early stages of intrauterine life may be responsible for diseases in middle age.

Sram R. Impact of air pollution on reproductive health. Environ Health Perspect. 1999 Nov;107(11):A542–3. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1566709/pdf/envhper00516-0014.pdf

DOCTORS FOR CLEAN AIR

Direct And Indirect Impact Of Air Pollution In Pregnancy On Adverse Birth Outcomes And Lung Development



Korten I, Ramsey K, Latzin P. Air pollution during pregnancy and lung development in the child. Paediatric Respiratory Reviews. 2016 Aug 19;21:38–46. Available from: https://www.researchgate.net/publication/307887003_Air_pollution_during_pregnancy_and_lung_development_in_the_child

Air Pollution & Diabetes

DOCTORS FOR CLEAN AIR

Study: Ambient air pollution in relation to diabetes and glucose-homoeostasis markers in China: a cross-sectional study with findings from the 33 Communities Chinese Health Study by Yang BY et al (2018)

Between April 1 and Dec 31, 2009, a total of 15,477 participants aged 18–74 years were recruited from a large cross-sectional study (the 33 Communities Chinese Health Study) from three cities in Liaoning province, northeastern China.

Findings: All the studied pollutants were significantly associated with increased diabetes prevalence (eg, the adjusted odds ratios associated with an increase in IQR for PM1, PM2·5, and PM10 were 1·13, 95% CI 1·04–1·22; 1·14, 1·03–1·25; and 1·20, 1·12–1·28, respectively). These air pollutants were also associated with higher concentrations of fasting glucose, 2 h glucose and 2 h insulin. Long-term exposure to air pollution was associated with increased risk of diabetes in a Chinese population, particularly in individuals who were younger or overweight or obese.

Yang BY, Qian Z (Min), Li S, Chen G, Bloom MS, Elliott M, et al. Ambient air pollution in relation to diabetes and glucose-homoeostasis markers in China: a cross-sectional study with findings from the 33 Communities Chinese Health Study. The Lancet Planetary Health. 2018 Feb 1;2(2):e64–73. Available from: https://www.thelancet.com/action/showPdf?pii=S2542-5196%2818%2930001-9

DOCTORS
FOR CLEAN AIR

Study: Ambient air pollution and diabetes: A systematic review and meta-analysis by Yang B-Y et al (Available online 2019)

Review of epidemiological studies to quantify the association between air pollutants and type 2 diabetes (T2D), and to answer if diabetes patients are more vulnerable to air pollutants.

Out of 716 articles identified, 86 were used for this review and meta-analysis. Meta-analyses showed significant associations of PM2.5 with T2D incidence (11 studies; HR=1.10, 95% CI=1.04–1.17 per 10 µg/m3 increment) and prevalence (11 studies; OR=1.08; 95% CI=1.04–1.12 per 10 µg/m3 increment) of PM10 with T2D prevalence (6 studies; OR=1.10; 95% CI=1.03–1.17 per 10 µg/m3 increment) and incidence (6 studies; HR=1.11; 95% CI=1.00–1.22 per µg/m3 increment), and of NO2 with T2D prevalence (11 studies; OR=1.07; 95% CI=1.04–1.11 per 10 µg/m3 increment).

Conclusion: Recent publications strengthened the evidence for adverse effects of ambient air pollutants exposure (especially for PM) on T2D and that diabetic patients might be more vulnerable to air pollutants exposure.

Yang B-Y, Fan S, Thiering E, Seissler J, Nowak D, Dong G-H, et al. Ambient air pollution and diabetes: A systematic review and meta-analysis. Environmental Research. 2019;180:1-11. Available from: https://reader.elsevier.com/reader/sd/pii/S0013935119306140?token=435839E629DDD063803843DB7E7BE552DDBB2DD7CF828F0CCF45D3FE9CBF75BCE12F7201AD2E7B1EFEC760D7E7ED240A

DOCTORS FOR CLEAN AIR

Study: Air Pollution as a Risk Factor for Type 2 Diabetes by Rao X et al (2015)

Kramer et al (2010) conducted an investigation of the association of incident T2DM with ambient air pollution using data from the Study on the Influence of Air Pollution on Lung, Inflammation and Aging (SALIA) cohort in Germany. Non diabetic women who were 54–55 years old at baseline (1985–1995) were followed until 2006.

The authors found that T2DM incidence increased by 15% per interquartile range of traffic-related PM or by 15% to 42% per interquartile range of NO2.


TOXICOLOGICAL SCIENCES, 143(2), 2015, 231–241

doi: 10.1093/toxsci/kfu250

CONTEMPORARY REVIEW

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Air Pollution as a Risk Factor for Type 2 Diabetes

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Rao X, Patel P, Puett R, Rajagopalan S. Air Pollution as a Risk Factor for Type 2 Diabetes. Toxicological Sciences. 2015 Feb;143(2):231–41. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4306726/pdf/kfu250.pdf

DOCTORS FOR CLEAN AIR

Air Pollution as a Risk Factor for Type 2 Diabetes by Rao X et al (2015)

Andersen et al. followed 51,818 participants of the Danish Diet, Cancer, and Health cohort in the Danish National Diabetes Register from baseline (1993–1997) to 2006. Nitrogen dioxide levels were measured at the residential addresses of the cohort participants.

After an average of 9.7 years of follow-up, they detected a positive association between air pollution and confirmed cases of diabetes [hazard ratio (HR) 1.04 (95% CI 1.03–1.08)] per interquartile range of 4.9 mg/m2 mean NO2 levels].

Rao X, Patel P, Puett R, Rajagopalan S. Air Pollution as a Risk Factor for Type 2 Diabetes. Toxicological Sciences. 2015 Feb;143(2):231–41. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4306726/pdf/kfu250.pdf

DOCTORS FOR CLEAN AIR

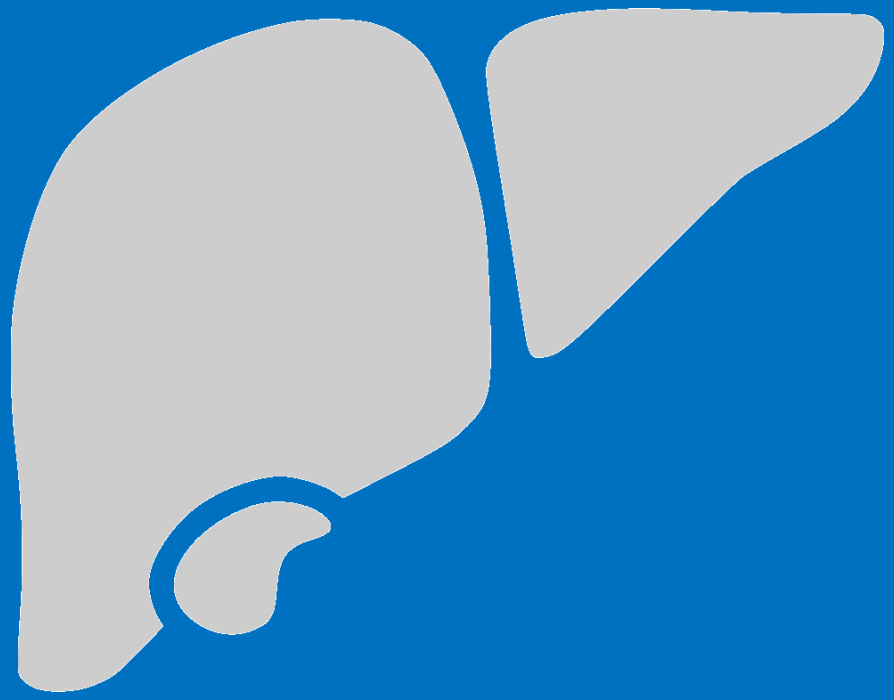
Air Pollution as a Risk Factor for Type 2 Diabetes by Rao X et al (2015)

In one of the few incident studies of T2DM and ambient air pollution exposure among African-Americans, Coogan et al (2012) followed 3992 women residing in Los Angeles from 1995 to 2005.

The authors reported that those who had higher exposure to air pollutants (PM2.5 and NO2) were more likely to develop T2DM. The incidence rate ratio (IRR) for T2DM for a 10 mg/m3 increase in PM2.5 was 1.63 (95% CI 0.78–3.44), and the IRR for NO2 (per 12.4 parts per billion) was 1.14 (95% CI 1.07–1.46).

Rao X, Patel P, Puett R, Rajagopalan S. Air Pollution as a Risk Factor for Type 2 Diabetes. Toxicological Sciences. 2015 Feb;143(2):231–41. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4306726/pdf/kfu250.pdf

Air Pollution & Liver



DOCTORS FOR CLEAN AIR

Air Pollution And Liver

Diseases	Air pollutants	Mechanism of action
Hepatotoxicity	Coal fly ash	Lipid peroxidation, Hepatic megalocytosis, DNA damage
	$PM_{2.5}$ or CB	Generation of ROS, Lipid peroxidation, Genotoxicity, ER stress
	DEP	Genotoxicity, Generation of ROS
NAFLD and Type II diabetes	$PM_{2.5}$ or CB	Kupffer cell activation and Production of pro-inflammatory cytokine, Impaired hepatic glycogen storage, glucose intolerance and insulin resistance, Alteration of lipid homeostasis and Visceral adipose tissue inflammation, Imbalance in circulating leptin/adiponectin levels
	DEP	Oxidative stress, DNA damage
Liver fibrosis	The total extracts or the PAH fraction of airborneparticles	Mitochondrial and Hematogenic damage
Liver cancer	2-NBA, 3-NBA	Genotoxicity, Mutagenic and Carcinogenic activity

Kim JW, Park S, Lim CW, Lee K, Kim B. The Role of Air Pollutants in Initiating Liver Disease. Toxicol Res. 2014 Jun;30(2):65–70. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4112066/pdf/toxicr-30-65.pdf

DOCTORS FOR CLEAN AIR

Study: Particulate matter air pollution and liver cancer survival Deng H et al (2017)

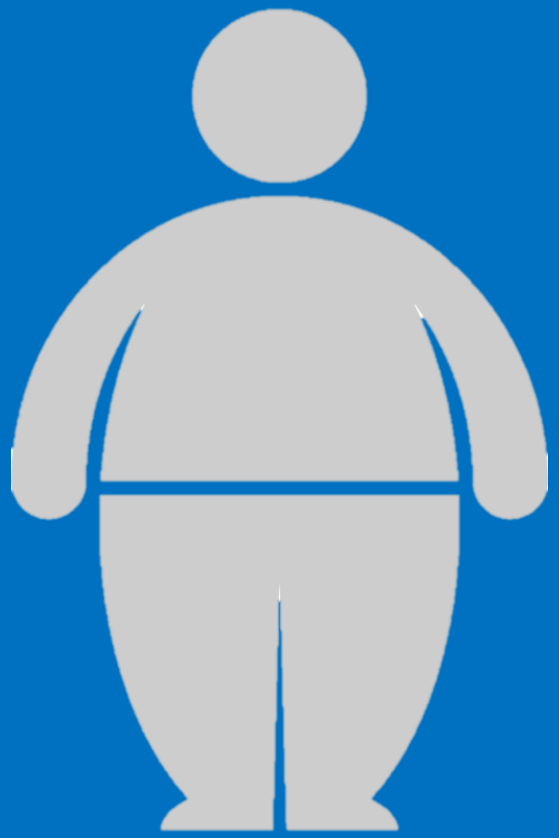
Twenty thousand, two hundred and twenty-one California Cancer Registry patients with hepatocellular carcinoma (HCC) diagnosed between 2000 and 2009 were used to examine the effect of exposure to ambient PM with diameter <2.5 µm ($PM_{2.5}$) on HCC survival.

Findings: $PM_{2.5}$ exposure after diagnosis was statistically significantly associated with HCC survival. After adjustment for potential confounders, the all-cause mortality hazard ratios (HR) associated with a 1 standard deviation (5.0 µg/m^3) increase in $PM_{2.5}$ was 1.18 (95% CI: 1.16-1.20); 1.31 (95% CI:1.26-1.35) for local stage, 1.19 (95% CI:1.14-1.23) for regional stage, and 1.05 (95% CI:1.01-1.10) for distant stage.

Exposure to elevated $PM_{2.5}$ after the diagnosis of hepatocellular carcinoma may shorten survival, with larger effects at higher concentrations.

Deng H, Eckel SP, Liu L, Lurmann FW, Cockburn MG, Gilliland FD. Particulate matter air pollution and liver cancer survival. Int J Cancer. 2017 15;141(4):744–9. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5505313/pdf/nihms875329.pdf

Air Pollution & Obesity



DOCTORS FOR CLEAN AIR

Study: Traffic-related air pollution and obesity formation in children: a longitudinal, multilevel analysis by Jerrett M et al (2014)

Participants were drawn from a prospective cohort of children who lived in 13 communities across Southern California (N = 4550). Children (5-11 years)were enrolled while attending kindergarten and first grade and followed for 4 years, with height and weight measured annually.

Findings: Traffic pollution was positively associated with growth in BMI. The effect size in the adjusted model indicated about a 13.6% increase in annual BMI growth when comparing the lowest to the highest tenth percentile of air pollution exposure, which resulted in an increase of nearly 0.4 BMI units on attained BMI at age 10.

Jerrett M, McConnell R, Wolch J, Chang R, Lam C, Dunton G, et al. Traffic-related air pollution and obesity formation in children: a longitudinal, multilevel analysis. Environ Health. 2014 Dec;13(1):49. Available from: https://ehjournal.biomedcentral.com/track/pdf/10.1186/1476-069X-13-49

DOCTORS FOR CLEAN AIR

Study: Impact of ambient air pollution on obesity: a systematic review by An R et al (2018)

A literature search was conducted in the PubMed and Web of Science for peer-reviewed articles published until September 2017 that assessed the relationship between air pollution and body weight status.

Result: Sixteen studies met the selection criteria and were included in the review. They were conducted in seven countries, including the US, China, Canada, Italy, Netherland Serbia and South Korea. Commonly examined air pollutants included PM, NO_2, SO_2, O_3, and overall air quality index. Among a total of 66 reported associations between air pollution and body weight status, 29 (44%) found air pollution to be positively associated with body weight, 29 (44%) reported a null finding, and the remaining eight (12%) found air pollution to be negatively associated with body weight.

Conclusion: Concurrent evidence regarding the impact of air pollution on body weight status remains mixed.

An R, Ji M, Yan H, Guan C. Impact of ambient air pollution on obesity: a systematic review. Int J Obes (Lond). 2018;42(6):1112–26. Available from: https://www.nature.com/articles/s41366-018-0089-y

DOCTORS FOR CLEAN AIR

Study: Ambient air pollution and overweight and obesity in school-aged children in Barcelona, Spain by de Bont J et al (2019)

Authors studied 2660 children aged 7-10 years during 2012 in Barcelona.

Results: An interquartile range increase in PM_{10} home (5.6 µg/m^3) was associated with a 10% increase in the odds of being overweight or obese. Children exposed to the highest tertile of Ultra fine particle (UFP)-school (>27,346 particles/cm^3) had a 30% higher odds of being overweight or obese compared to the lowest tertile of UFP exposure. Authors observed that exposure to NO_2, $PM_{2.5}$ or Elemental carbon at schools was associated with higher odds of overweight or obese at medium compared to low levels of exposure.

Conclusion: Exposure to ambient air pollution, especially at school, was associated with childhood risk for overweight and obesity. A cautious interpretation is warranted because associations were not always linear and because school and home air pollution measurements were not directly comparable.

de Bont J, Casas M, Barrera-Gómez J, Cirach M, Rivas I, Valvi D, et al. Ambient air pollution and overweight and obesity in school-aged children in Barcelona, Spain. Environ Int. 2019 Apr;125:58–64. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6380992/?report=reader

Air Pollution & Skin

DOCTORS FOR CLEAN AIR

Air Pollution And Skin

- Atopic Dermatitis
- Skin Aging
- Contact Dermatitis
- Psoriasis
- Urticaria
- Eczema,
- Pigmentation
- Acneiform Eruptions
- Acne
- Skin Cancer

https://www.theguardian.com/environment/2016/jul/15/air-pollution-causes-wrinkles-and-premature-ageing-new-research-shows

Puri P, Nandar SK, Kathuria S, Ramesh V. Effects of air pollution on the skin: A review. Indian J Dermatol Venereol Leprol [serial online] 2017 [cited 2019 Dec 5];83:415-23. Available from: http://www.ijdvl.com/article.asp?issn=0378-6323;year=2017;volume=83;issue=4;spage=415;epage=423;aulast=Puri

DOCTORS FOR CLEAN AIR

Air Pollution And Skin

- **Exposure to ozone has been associated with urticaria, eczema, contact dermatitis and other nonspecific eruptions.**
- **Polyaromatic hydrocarbons cause skin cancer, extrinsic skin aging, pigmentation and acneiform eruptions.**
- **Oxides have been associated with increased prevalence, as well as exacerbations of atopic dermatitis in children.**

Puri P, Nandar SK, Kathuria S, Ramesh V. Effects of air pollution on the skin: A review. Indian J Dermatol Venereol Leprol [serial online] 2017 [cited 2019 Dec 5];83:415-23. Available from: http://www.ijdvl.com/article.asp?issn=0378-6323;year=2017;volume=83;issue=4;spage=415;epage=423;aulast=Puri

DOCTORS FOR CLEAN AIR

Air Pollution And Skin

Study: Symptoms of atopic dermatitis are influenced by outdoor air pollution by Kim J (2013)

Long-term study to evaluate the clinical effects of outdoor air pollution on skin symptoms in patients with Atopic dermatitis (AD).

Twenty two patients (17 boys and 5 girls) enrolled with AD living in Seoul, Korea, and followed them for 18 months between July, 2009, and December, 2010.

The authors obtained daily mean concentrations of particulate matters (PMs), nitric oxides (NO, NO2, NOx), volatile organic compounds (VOCs) including benzene, toluene, ethyl-benzene, xylene, and styrene, and 24 hour average temperature and relative humidity from the closest monitoring sites to each patient's residence during the study period to estimate the patients' exposure to outdoor air pollution and meteorological conditions.

Kim J, Kim E-H, Oh I, Jung K, Han Y, Cheong H-K, et al. Symptoms of atopic dermatitis are influenced by outdoor air pollution. Journal of Allergy and Clinical Immunology. 2013 Aug 1;132(2):495-498.e1. Available from: https://www.jacionline.org/article/S0091-6749(13)00666-0/pdf

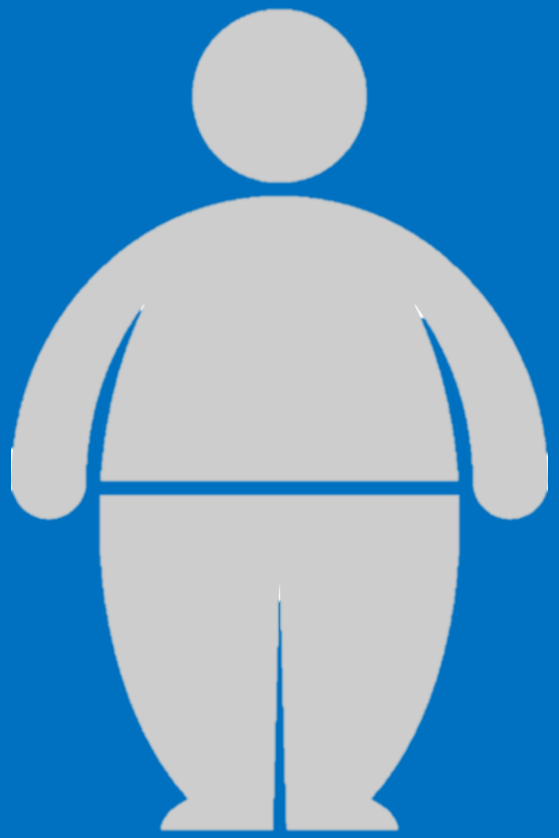
DOCTORS FOR CLEAN AIR

Air Pollution And Skin

The authors found that AD symptoms were associated with the levels of outdoor air pollutants such as PM, toluene, and total volatile organic compounds (TVOC). This association varied according to season, and the lag effect of PM10, benzene, and TVOC on AD symptoms was found after exposure. The authors' findings suggest that outdoor air pollution acts as an aggravating factor in AD.

Kim J, Kim E-H, Oh I, Jung K, Han Y, Cheong H-K, et al. Symptoms of atopic dermatitis are influenced by outdoor air pollution. Journal of Allergy and Clinical Immunology. 2013 Aug 1;132(2):495-498.e1. Available from: https://www.jacionline.org/article/S0091-6749(13)00666-0/pdf

Air Pollution & Obesity



DOCTORS FOR CLEAN AIR

Study: Traffic-Related Air Pollution, Climate, and Prevalence of Eczema in Taiwanese School Children by Lee Y-L et al (2008)

Nationwide survey of middle-school students in Taiwan from 1995 to 1996 was conducted. The 12-month prevalence of eczema was compared with air monitoring station data of temperature, relative humidity, and criteria air pollutants.

A total of 317,926 children attended schools located within 2 km of 55 stations.

Findings: Prevalence rates of recurrent eczema were 2.4 and 2.3% in boys and girls, respectively, with prevalence rates of flexural eczema 1.7% in both sexes. After adjustment for possible confounders, flexural eczema was found to be associated with traffic-related air pollutants, including nitrogen oxides and carbon monoxide. Recurrent eczema was associated with traffic-related air pollution only in girls.

Lee Y-L, Su H-J, Sheu H-M, Yu H-S, Guo YL. Traffic-Related Air Pollution, Climate, and Prevalence of Eczema in Taiwanese School Children. J Invest Dermatol. 2008 Oct 1;128(10):2412–20. Available from: https://www.jidonline.org/article/S0022-202X(15)33632-0/pdf

DOCTORS FOR CLEAN AIR

Study: Acute health effects of urban fine and ultrafine particles on children with atopic dermatitis by Song S et al (2011)

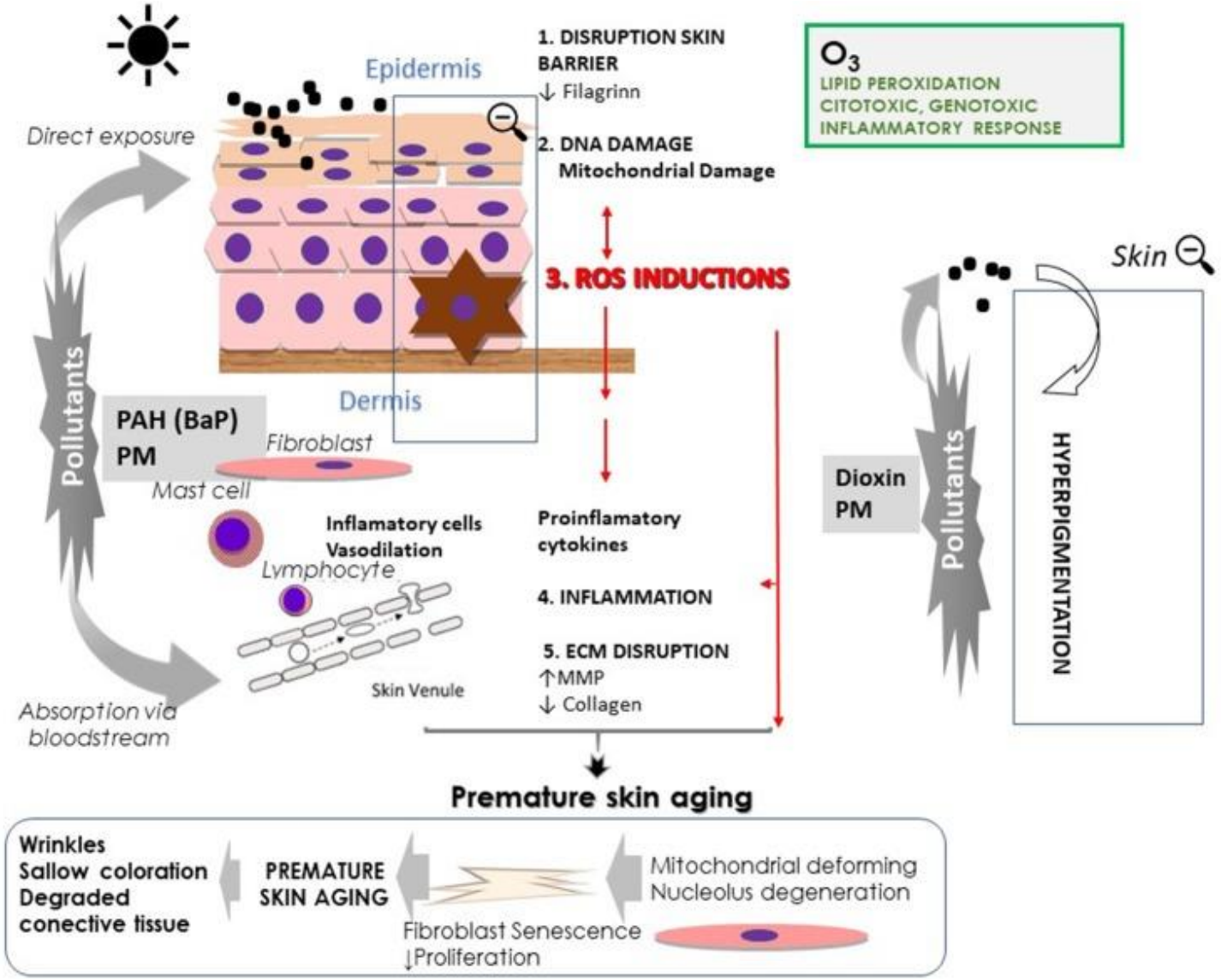
Forty one schoolchildren, 8-12 years old, who had been diagnosed with atopic dermatitis were included.

For 67 consecutive days, all of them measured their symptoms in a diary. To assess exposure, the daily ambient mass concentrations of particulate matter less than 10, 2.5 and 1 μm and concentrations of submicron particles (0.01- 1 μm) were measured at a local school.

Findings: Significant associations were found between the concentrations of ultrafine particles and the itchiness symptom in children with atopic dermatitis. The results suggested that the concentration of ambient ultrafine particles may exacerbate skin symptoms in children with atopic dermatitis.

Song S, Lee K, Lee Y-M, Lee J-H, Lee SI, Yu S-D, et al. Acute health effects of urban fine and ultrafine particles on children with atopic dermatitis. Environ Res. 2011 Apr;111(3):394–9. Available from: https://www.ncbi.nlm.nih.gov/pubmed/21367405

DOCTORS
FOR CLEAN AIR



Skin responses to air pollutions (particulate matter, PM; polycyclic aromatic hydrocarbons PAH; and ozone, O_3) and ultraviolet radiation.

Parrado C, Mercado-Saenz S, Perez-Davo A, Gilaberte Y, Gonzalez S, Juarranz A. Environmental Stressors on Skin Aging. Mechanistic Insights. Front Pharmacol [Internet]. 2019 Jul 9 [cited 2019 Dec 5];10. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6629960/

Air Pollution & Gastrointestinal Effects

DOCTORS FOR CLEAN AIR

Air Pollution And Gastrointestinal Effect

- Appendicitis
- Inflammatory bowel disease/ Crohn disease
- Increases Intestinal Permeability

Salim SY, Kaplan GG, Madsen KL. Air pollution effects on the gut microbiota. Gut Microbes. 2014 Mar 1;5(2):215–9. Available from: https://www.tandfonline.com/doi/pdf/10.4161/gmic.27251?needAccess=true

DOCTORS FOR CLEAN AIR

Study: Ambient air pollution correlates with hospitalizations for inflammatory bowel disease: an ecologic analysis by Anantha krishnan AN et al (2011)

Data from the Wisconsin Hospital Association (WHA) for the year 2002 was used to identify the number of IBD-related hospitalizations for each of the 72 counties in Wisconsin.

Results: There was a mean of 81.3 Inflammatory bowel disease (IBD) hospitalizations/100,000 population per county. The total criteria pollutant emissions density correlated significantly with adult IBD hospitalizations. On Poisson regression, a 1-log increase in the density of total criteria pollutant emission was associated with a 40% increase in the rate of IBD hospitalizations. Total air emissions of criteria pollutants appear to be associated with hospitalizations for IBD in adults.

Ananthakrishnan AN, McGinley EL, Binion DG, Saeian K. Ambient air pollution correlates with hospitalizations for inflammatory bowel disease: an ecologic analysis. Inflamm Bowel Dis. 2011 May;17(5):1138–45. Available from: https://www.ncbi.nlm.nih.gov/pubmed/20806342

DOCTORS FOR CLEAN AIR

Study: The inflammatory bowel diseases and ambient air pollution: a novel association by Kaplan GG et al (2010)

The health improvement network (THIN) database in the United Kingdom was used to identify incident cases of Crohn's disease (n=367) or ulcerative colitis (n=591), and age and sex-matched controls.

Findings: Overall, NO(2), SO(2), and PM(10) were not associated with the risk of IBD. However, individuals ≤23 years were more likely to be diagnosed with Crohn's disease if they lived in regions with NO(2) concentrations within the upper three quintiles (odds ratio (OR)=2.31; 95% confidence interval (CI)=1.25-4.28), after adjusting for confounders.

Air pollution exposure was not associated with the incidence of IBD. However, residential exposures to SO(2) and NO(2) may increase the risk of early-onset ulcerative colitis and Crohn's disease, respectively.

Kaplan GG, Hubbard J, Korzenik J, Sands BE, Panaccione R, Ghosh S, et al. The inflammatory bowel diseases and ambient air pollution: a novel association. Am J Gastroenterol. 2010 Nov;105(11):2412–9. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3180712/pdf/ajg2010252a.pdf

DOCTORS FOR CLEAN AIR

Study: Effect of ambient air pollution on the incidence of appendicitis by Kaplan GG et al (2009)

Identification of 5191 adults who had been admitted to hospital with appendicitis between Apr. 1, 1999, and Dec. 31, 2006. The air pollutants studied were ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, and suspended particulate matter of less than 10 µ and less than 2.5 µ in diameter.

An increase in the interquartile range of the 5- day average of ozone was associated with appendicitis. In summer (July–August), the effects were most pronounced for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and particulate matter less than 10 µ in diameter.

The findings suggest that some cases of appendicitis may be triggered by short-term exposure to air pollution.

Kaplan GG, Dixon E, Panaccione R, Fong A, Chen L, Szyszkowicz M, et al. Effect of ambient air pollution on the incidence of appendicitis. CMAJ. 2009 Oct 27;181(9):591–7. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2764754/pdf/1810591.pdf

Air Pollution and Kidney

Review Article
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pISSN 2093-4777 · eISSN 2093-6931

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Particulate Matter (Fine Particle) and Urologic Diseases

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Table 1. Summary of studies on the effects of particulate matter on the kidneys

Study	Method	Subjects	Main result
O'Neill et al. (2008) [15]	Prospective cohort	6,814 Men and women aged 44–84 years who were free of clinical cardiovascular disease at baseline	Chronic and recent PM were not associated with current urinary albumin or microalbuminuria
Lue et al. (2013) [16]	Quantitative study of consecutive patients	Confirmed acute ischemic stroke patients aged ≥21 years, residing in the Boston (MA, USA) metropolitan region between 1999 and 2004	Exposure associated with living near a major roadway contributed to reduced renal function (via the estimated glomerular filtration rate)
Mehta et al. (2016) [17]	Prospective cohort	2,280 Male volunteers from the greater Boston area aged 21–80 years	Long-term $PM_{2.5}$ exposure negatively affected renal function and increased renal function decline (via the estimated glomerular filtration rate)

Kim E-A. Particulate Matter (Fine Particle) and Urologic Diseases. Int Neurourol J. 2017 Sep 30;21(3):155–62. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5636961/pdf/inj-1734954-477.pdf

Xu et al. (2016) [18]	Cross-sectional study	Renal biopsy series including 71,151 native biopsies at 938 hospitals spanning 282 cities in China between 2004 and 2014	Long-term exposure to high levels of $PM_{2.5}$ was associated with an increased risk of membranous nephropathy.
Yang et al. (2017) [19]	Cross-sectional population-based study	21,656 Adults evaluated between 2007 and 2009 in New Taipei City who were participating in the Health Screening Program	Exposure during the previous year to PM_{10} and PMCoarse, but not $PM_{2.5}$, was associated with reduced renal function and chronic kidney disease.
Raaschou-Nielsen et al. (2011) [21]	Retrospective cohort study	54,304 Participants in the Danish Diet Cancer and Health cohort	Nitrogen oxides were weakly associated with kidney cancer, without statistical significance.
Raaschou-Nielsen et al. (2017) [20]	Retrospective cohort study	European Study of Cohorts for Air Pollution Effects included 14 cohorts of 289,002 participants, with at least 20 incident kidney parenchyma cancer cases during follow-up.	An increased risk of kidney cancer was associated with PM, although not to a statistically significant extent.

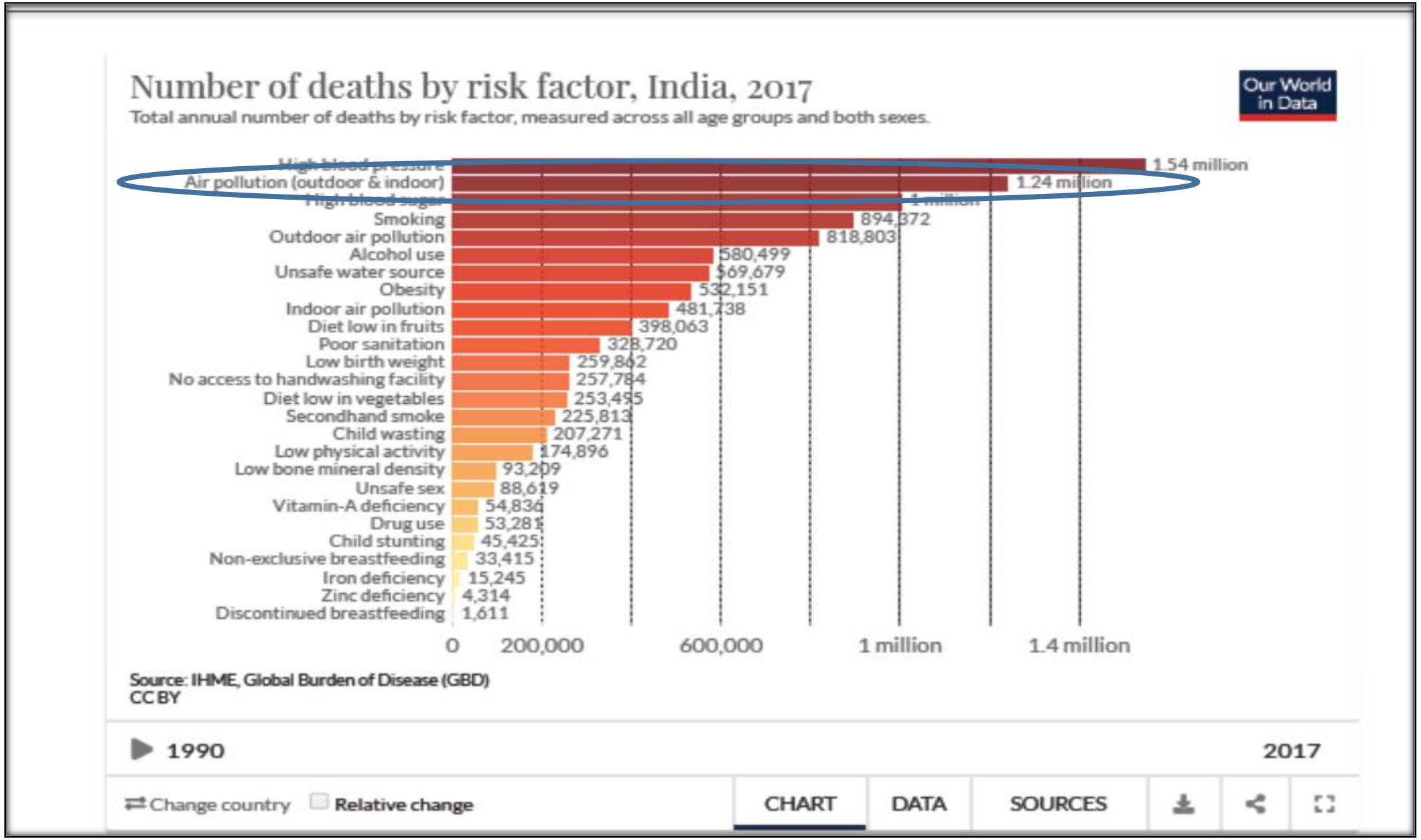
Kim E-A. Particulate Matter (Fine Particle) and Urologic Diseases. Int Neurourol J. 2017 Sep 30;21(3):155–62. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5636961/pdf/inj-1734954-477.pdf

Standard level of criteria air pollutants and their sources with health impact based on the United States Environmental Protection Agency

Air pollutants®	Major source of emission	Averaging time	Standard level	Health impact target organs
Particle pollutants				
$PM_{2.5}$	Motor engines, industrial activities, smokes	24 h	35 μg/m³	Respiratory and cardiovascular diseases, CNS and reproductive dysfunctions, cancer
PM_{10}		24 h	150 μg/m³	
Ground-level ozone	Vehicular exhaust, industrial activities	1 h	0.12 mg/m³	Respiratory and cardiovascular dysfunctions, eye irritation
Carbon monoxide	Motor engines, burning coal, oil and wood, industrial activities, smokes	1 h	35 mg/m³	CNS and cardiovascular damages
Sulfur dioxide	Fuel combustion, burning coal	1 h	75 μg/m³	Respiratory and CNS involvement, eye irritation
Nitrogen dioxide	Fuel-burning, vehicular exhaust	1 h	100 μg/m³	Damage to liver, lung, spleen, and blood
Lead	Lead smelting, industrial activities, leaded petrol	3 months average	0.15 μg/m³	CNS and hematologic dysfunctions, eye irritation
Polycyclic aromatic hydrocarbons*	Fuel combustion, wood fires, motor engines	1 year	1 ng/m³	Respiratory and CNS involvement, cancer

*Air quality standards according to the European Union; ®$PM_{2.5}$ is stand for PM of 2.5 μ or less. PM_{10} is stand for PM of 10 μ or more. PM = Particulate matter, CNS = Central nervous system

Ghorani-Azam A, Riahi-Zanjani B, Balali-Mood M. Effects of air pollution on human health and practical measures for prevention in Iran. J Res Med Sci [Internet]. 2016 Sep 1 [cited 2019 Nov 27];21. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5122104/



https://ourworldindata.org/air-pollution

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KEY OBJECTIVES

AWARENESS

AMONG GENERAL PUBLIC

Doctors must educate the general public about the serious ill-effects of Air Pollution and the damage to their health and future generations due to breathing dirty air.

AWAKENING

FOR NEED FOR FASTER ACTION

Citizens and policy makers must realize the threat to mankind due to air pollution and recognize Air Pollution as a National Health Emergency.

COMMITMENT

BY CITIZENS & POLICY MAKERS

Doctors to influence Citizens, Administrators and Policy Makers for the need for urgent and stricter actions for Clean Air for their health.

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LUNG CARE FOUNDATION

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Health Care Without Harm

Healthcare Without Harm

Works to transform health care worldwide so that it reduces its environmental footprint, becomes a community anchor for sustainability and a leader in the global movement for environmental health and justice.

DOCTORS
FOR CLEAN AIR

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If We Don’t Act Today, Millions Die

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