AIR POLLUTION AND HEALTH

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Some health effects associated with air pollution are well recognised, such as increases in hospital admissions and deaths from cardiovascular diseases, respiratory diseases and lung cancer. People with pre-existing cardiovascular and respiratory diseases and older people are particularly at risk.

Now, researchers are finding that air pollution may be associated with a much wider range of health conditions, including diabetes and neurological disease, as well as exposure during pregnancy being associated with miscarriages, low birth weight and pre-term births. Much new research has been published in the last year.

Toxic air pollution (fine particulates, PM; and nitrogen dioxide, NO_2) causes more than 40,000 deaths in Britain each year[2]. The Royal College of Physicians and the Royal College of Paediatrics and Child Health state:

> "In most cases legislated concentration limits do not represent a 'safe' level for the population as a whole, but are often talked about as levels considered to not pose a 'significant risk' to health. This begs the question of the meaning of 'significant' – given, for example, that impacts of exposure to fine particles have been observed at very low concentrations and that there is no evidence for a threshold for exposure at the population level".

Public Health England has estimated that health effects from air pollution cost the NHS and social care services more than £40 million annually[3].

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[2] Royal College of Physicians/Royal College of Paediatrics and Child Health (2016). Report: Every breath we take: the lifelong impact of air pollution. file:///C:/Users/GILLAN~1/AppData/Local/Temp/Air_pollution_main%20report_WEB_1_0_0.pdf

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[3] Public Health England (2018). Estimation of costs to the NHS and social care due to the health impacts of air pollution. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/708855/Estimation_of_costs_to_the_NHS_and_social_care_due_to_the_health_impacts_of_air_pollution_-_summary_report.pdf

Of the 29,000 deaths annually from exposure to $PM_{2.5}$ in the UK, the Committee on the Medical Effects of Air Pollutants (COMEAP) estimates only a small fraction relate to exposures in excess of legal limits[4]. This means we **must** get levels of $PM_{2.5}$ much lower than they are in North Hertfordshire.

Levels of NO_2 have been illegally high in most urban areas of Britain since 2010, and Hitchin is no exception. The annual average AQO for NO_2 has been regularly exceeded at Paynes Park and Stevenage Road in Hitchin[5]. There are aspirations but no real action from NHDC to encourage walking and cycling but experience indicates little will come of these in terms of reducing traffic movements. We only know levels of air pollution where monitors are installed – they may be higher elsewhere.

ADULTS

Lung cancer

Higher exposures to $PM_{2.5}$ and PM_{10} cause higher risk of lung cancer in adults[6].

Asthma & respiratory diseases

Studies in several cities in Britain show adults are 1.4 – 2.1% more likely to be admitted to hospital for asthma on days with high NO_2 pollution.[7]

Even relatively low traffic-related air pollution increase risks of respiratory and allergic airways problems in susceptible people[8].

Dementia

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[4] COMEAP. The mortality effects of long-term exposure to particulate air pollution in the United Kingdom. London: Health Protection Agency, 2010. www.gov.uk/government/publications/comeap-mortality-effects-of-long-term-exposure-to-particulate-air-pollutionin-the-uk

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[5] NHDC. Local Air Quality Management Annual Status Report 2018.

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[6] Raaschou-Nielsen O, et al. (2013). Air pollution and lung cancer incidence in 17 European cohorts: prospective analyses from the European Study of Cohorts for Air Pollution Effects (ESCAPE). Lancet Oncology 14(9):813-22.

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[7] Evangelopoulos, D et al (2019). Personalising the Health Impacts if Air Pollution: Interim Statistics Summary for a Selection of Statements. Report by King's College London. http://www.erg.kcl.ac.uk/Research/home/projects/personalised-health-impacts.html

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[8] Bowatte G, et al. (2017). Traffic-related air pollution exposure is associated with allergic sensitization, asthma, and poor lung function in middle age. Journal of Allergy & Clinical Immunology 139(1):122-129.

Air pollution is linked to a higher chance of developing dementia (Alzheimer's and vascular dementia) according to a 2018 study by London University researchers[9]. At all ages people's health was at risk from breathing dirty air, but the research found that people over 50 in areas with the highest levels of NO_2 had a 40% greater risk of developing dementia than those with the least NO_2 pollution. Increases in dementia risk were also observed with $PM_{2.5}$ specifically from traffic sources. When compared to people living outside London, with clean air, presumably the difference in risk would be even greater. The link between higher pollution and higher levels of dementia could not be explained by any other risk factors.

Long-term exposure to PM_{10} is associated with loss of mental ability, in maths and verbal tests, in older people[10].

Diabetes

A meta-analysis which included three studies on $PM_{2.5}$ and four studies on NO_2, showed an 8–10% increased risk of type 2 diabetes per 10 μg/m^3 increase in exposure to both pollutants, with stronger associations being observed in women[11].

Heart attack and strokes

A 10-year study of air pollution exposure and coronary artery calcification (hardening of the arteries) showed that $PM_{2.5}$ and $NO_2$are strong risk factors for atherosclerosis[12]. Nearly 7,000 people were monitored in six US cities with traffic-pollution levels commonly seen around the world. Moving house from a low-pollution rural area to a high-pollution metropolitan area would cause atherosclerosis to increase 38% faster every year.

According to an October 2019 report from King's College London, people of all ages are at higher risk of heart attack on high air pollution days than lower pollution days, related to $PM_{2.5}$ particles[13]. Each year on average, high air pollution days in London are responsible for 87 more cardiac arrests.

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[9] Are noise and air pollution related to the incidence of dementia? A cohort study in London, England Iain M Carey et al. BMJ Open. 2018; 8(9): e022404.

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[10] Zhang X, Chen X, Zhang X. (2018). The impact of exposure to air pollution on cognitive performance. Proceedings of the National Academy of Sciences U S A. 115(37):9193-9197.

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[11] Eze IC, et al. (2015). Association between ambient air pollution and diabetes mellitus in Europe and North America: systematic review and meta-analysis. Environmental Health Perspectives 123:381–9.

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[12] Association between air pollution and coronary artery calcification within six metropolitan areas in the USA (the Multi-Ethnic Study of Atherosclerosis and Air Pollution): a longitudinal cohort study. Kaufman JD et al. (2016). Lancet 388(10045):696-704.

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The risk of emergency hospitalisation for stokes is greater on high air pollution days, by 3.9% in Derby, for example. This is related to NO_2 levels. In London, more people are admitted to hospital for strokes on high air pollution days than on low pollution days, and these strokes could be prevented by lowering NO_2 air pollution. Living near a busy road in London increases risk of hospitalisation for strokes by 6.6%.

BABIES AND CHILDREN

Children are even more susceptible to air pollution than adults.

Miscarriage, stillbirths and premature births

Long-term and short-term exposure to traffic pollution increases the risk of miscarriages. A 2019 paper shows a 10-ppb increase in 7-day average levels of NO_2 increases the risk of spontaneous miscarriage by 16% [14]. This is akin to the number of miscarriages caused by smoking during pregnancy. The average seven-day NO_2 level in the week preceding the miscarriages was 34 micrograms per cubic metre (µg/m^3) of air – the air quality objectives that NHDC works to are: 200 µg/m^3 not to be exceeded more than 18 times a year for one hour, and an annual mean of 40 µg/m^3. This means that some women in North Hertfordshire have definitely experienced a miscarriage caused by traffic pollution.

A study of more than half a million births and stillbirths in London suggest that exposure to higher levels of ozone (O_3) and traffic non-exhaust $PM_{2.5}$ (from brakes and road dust) during pregnancy may increase risk of preterm birth and stillbirth[15]. An increase in O_3 exposure was associated with higher risk of preterm birth, all-cause stillbirth, and with 22% increased odds of asphyxia-related stillbirth. $PM_{2.5}$ was associated with 3% increased odds of preterm birth and 7% increased odds of stillbirth.

Low birth weight

Living near busy roads contributes to low birth weights in babies. According to which city has been analysed, the risk of low birth weight is increased by 0.1 – 0.4% with high NO_2 pollution[16].

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[13] Evangelopoulos, D et al (2019). Personalising the Health Impacts if Air Pollution: Interim Statistics Summary for a Selection of Statements. Report by King's College London. http://www.erg.kcl.ac.uk/Research/home/projects/personalised-health-impacts.html
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[14] Leiser CL, et al. (2019). Acute effects of air pollutants on spontaneous pregnancy loss: a case-crossover study. Fertility & Sterility 111(2):341-347. Summary only: https://www.ncbi.nlm.nih.gov/pubmed/?term=fuller+m+utah+miscarriage+pollution&report=abstract
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[15] Smith RB, et al. (2020). Impacts of air pollution and noise on risk of preterm birth and stillbirth in London.
Environ Int. 134:105290.
https://www.sciencedirect.com/science/article/pii/S0160412019314734?via%3Dihub
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[16] Evangelopoulos, D et al (2019). Personalising the Health Impacts if Air Pollution: Interim Statistics Summary for a Selection of Statements. Report by King's College London. http://www.erg.kcl.ac.uk/Research/home/projects/personalised-health-impacts.html

Infant mortality

In 2019, research into air pollution in Britain was reported that looked at the births and deaths of 8 million babies[17]. The study found that exposure to air pollution from road traffic is associated with reductions in children's lung functions as early as the first trimester of pregnancy. In the most pollutes areas, the risk of post-neonatal deaths increased by 11% for NO_2 and 12% for PM_{10}. The risk of deaths in infancy increased by 7% for NO_2 and 4% for PM_{10}.

Brain and cognition

Traffic-related air pollution has been linked to poorer cognitive (brain) development in young children[18], and continued significant exposure may produce neuroinflammation and altered brain immune responses in early adulthood.[19]

Reduced lung growth and poor lung function

Many research studies have shown the damage caused to children's lungs by traffic pollution. Roadside NO_2 pollution stunts lung growth in children by 7.7% in Birmingham and by 12.5% in London[20]. This lack of growth is permanent and cannot be remedied at an older age. Living near busy roads contributes to a 4.7% (Birmingham) and an 8.7% (London) greater chance of reduced lung function in children over the long term.

Asthma

Four million children develop asthma every year worldwide as a result of NO_2 pollution from traffic[21]. About 92% of paediatric asthma cases attributable to NO_2 exposure occurred in areas with annual

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[17] European Lung Foundation International Congress (2019). Abstract no: PA297, "Effects of air pollution on all cause neonatal and post-neonatal mortality: population based study", by Sarah Kotecha et al.

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[18] Sunyer J et al. Association between traffic-related air pollution in schools and cognitive development in primary school children: a prospective cohort study. PLoS Medicine 2015;12:e1001792 10.1371/journal.pmed.1001792

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[19] Calderón-Garcidueñas L et al. Long-term air pollution exposure is associated with neuroinflammation, an altered innate immune response, disruption of the blood-brain barrier, ultrafine particulate deposition, and accumulation of amyloid beta-42 and alpha-synuclein in children and young adults. Toxicol. Pathol. 2008;36:289–310. 10.1177/0192623307313011

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[20] Evangelopoulos, D et al (2019). Personalising the Health Impacts if Air Pollution: Interim Statistics Summary for a Selection of Statements. Report by King's College London. http://www.erg.kcl.ac.uk/Research/home/projects/personalised-health-impacts.html

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average NO_2 concentrations lower than the WHO guideline of 21 parts per billion. According to the researchers, the adequacy of the WHO guideline for NO_2 concentrations might need to be revisited.

In London, a child is 4.2% more likely to be admitted to hospital for asthma on days with high NO_2 pollution, compared to days when pollution is lower. Increases in hospitalisation of children occur in all cities studied so far[22].

High PM_{10} particle pollution causes exacerbation of cough, wheezing and breathlessness in asthmatic children[23].

According to research funded by UNICEF, "Every day, millions of our children are exposed to dangerous levels of pollution in the areas where they live, learn and play" [24]. Children are disproportionately exposed to air pollution while on the school run and in the school playground. PMs are highly dangerous, as they can penetrate deep into the lungs and into the brain.

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[21] Achakulwisut P, et al. (2019). Global, national, and urban burdens of paediatric asthma incidence attributable to ambient NO_2 pollution: estimates from global datasets.Lancet Planetary Health. 3(4):e166-e178. https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(19)30046-4/fulltext
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[22] Evangelopoulos, D et al (2019). Personalising the Health Impacts if Air Pollution: Interim Statistics Summary for a Selection of Statements. Report by King's College London. http://www.erg.kcl.ac.uk/Research/home/projects/personalised-health-impacts.html
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[23] Evangelopoulos, D et al (2019). Personalising the Health Impacts if Air Pollution: Interim Statistics Summary for a Selection of Statements. Report by King's College London. http://www.erg.kcl.ac.uk/Research/home/projects/personalised-health-impacts.html
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[24] The Toxic School Run, a Unicef UK Research Briefing by Harriet Edwards (Unicef) and Abigail Whitehouse (Queen Mary's University London). September 2018.