

The impact of poor air quality on health in Birmingham

**Evidence from
Birmingham Children's Hospital NHS Foundation Trust**

1. About Birmingham Children's Hospital

- 1.01 Birmingham Children's Hospital NHS Foundation Trust is an internationally recognised hospital delivering care to children and young people from Birmingham, the West Midlands and across the UK. It has contact with approximately 1 in 8 of the children resident in Birmingham in any given year. The hospital also provides an integrated 0-25 mental health service in partnership with other organisations across Birmingham. The Trust is also in the process of acquiring Birmingham Women's NHS Foundation Trust to form the NHS's first foundation trust dedicated to integrated family care.
- 1.02 The majority of services are delivered from a major hospital facility on Steelhouse Lane in Birmingham City Centre, built up from an original victorian hospital building. This is a constrained site on the edge of the Colmore Business District, bounded by the A38 and Lawley Middleway
- 1.03 Given its identifiable role as a leading children's hospital, the trust is often named in media reporting as a site affected by adverse air quality. Although these readings are taken away from the entrance to the hospital, they obviously cause concern and distress to visitors.

2. The impact of air quality on the health of children in Birmingham

- 2.01 In addition to the evidence on the health effects of air quality in adults, there is a growing body of literature that indicates there should be concern about the impact of air quality on the health of Birmingham's children.
- 2.02 Given the evidence around adult harm is well summarised, and will be submitted from other sources, this submission focuses on harm in children, and learning from the Trust's recent smokefree zone consultation.

Birth outcomes

- 2.03 Several studies have examined potential ways that air pollutants can have an impact on birth outcomes. One review encompassed forty one studies that used a range of measures such as birth certificates, health records and questionnaires and have also studied different major pollutants. The best evidence was the increased exposures to SO₂ during pregnancy made pre-term births more likely, and that increased exposure to PM_{2.5} during pregnancy made low birth weight births more likely.¹
- 2.04 Children who are low birth weight are more likely to have poorer growth in childhood. The impact of this is a higher incidence of adult diseases, such as type 2 diabetes, hypertension and circulatory disease.

Congenital anomalies

- 2.05 Air pollution may contribute towards congenital anomalies. In particular both NO₂ and SO₂ were related to increased numbers of children born with coarctation of the aorta, and tetralogy of Fallot, both significant defects in the structural arrangement of the newborn heart. The increased risk from NO₂ was the larger of the two influences with an

increase in 10ppb increasing the likelihood by around 20%. Other relationships were found between O₃ exposure and cleft lip, and PM₁₀ and atrial-septal heart defects.²

Infant mortality

- 2.05 Long term exposure to particulate matter has been linked with overall child mortality. A large study in California found that every 10µg/m³ increased exposure to PM₁₀ increased the risk of death by 5% between the first month and first year of life. A larger proportion of the increased risk was due to Sudden Infant Death Syndrome (SIDS) and respiratory causes of death.³
- 2.06 The relationship between particulate matter and infant mortality has been confirmed by a number of studies identified in a systematic review. The increased risk was found for post-neonatal infant deaths (between one month and one year of life) and for deaths from SIDS.⁴
- 2.07 Other reviews have indicated that short and long term exposures to CO and NO₂ increases the risk of SIDS.⁵

Asthma

- 2.08 COMEAP has previously issued two statements on the relationship between air pollution and the exacerbation of asthma symptoms in those, initially in 1995 and updated in 2010. In both statements the Committee agreed that the evidence supported the view that ambient air pollution causes irritation and inflammatory responses of the airways and exacerbates symptoms.⁶
- 2.09 There is some evidence from a systematic review that short term exposure to air pollutants increases the number of visits to emergency departments and admissions to hospital. Whilst this relationship was true amongst patients of all ages the effect was stronger in children.⁷
- 2.10 COMEAP concluded in 2010 that the evidence is consistent with the possibility that outdoor air pollution might play a role in causing asthma amongst susceptible individuals.⁶
- 2.11 COMEAP used a variety of evidence to arrive at that statement, which at times was apparently contradictory or found no association. Taken overall the evidence was of a consistent but modest relationship between air quality and the proportion of children with asthma (prevalence). There was a stronger weight of evidence that asthma was more common children who lived in proximity to roads, especially those carrying heavy goods traffic, and that a characteristic of these traffic emissions may be responsible for a relationship. Another explanation would be that air quality is more likely to cause asthma in individuals already susceptible.⁸
- 2.12 More recent systematic reviews of studies that followed children from birth have restated the relationship between childhood exposure to traffic-related air pollution and subsequent risk of developing asthma. The relationship was particularly strong amongst children with increased exposure to PM_{2.5} and black carbon.⁹

- 2.13 A second recent systematic review included a wider range of studies that related childhood asthma to long-term traffic-related air pollution. It included studies that looked at the effects of older children, not just from birth. It identified forty two studies and a large subset of these was able to be included in a pooled estimate to identify the most likely relationship between different pollutants and asthma diagnoses.¹⁰ The most likely risk of developing asthma for traffic related air pollutants are set out in table 1.

Pollutant	Incremental increase	Increased risk of developing asthma
Black Carbon	$0.5 \times 10^{-5} \text{ m}^{-1}$	8%
NO ₂	4µg/m ³	5%
PM _{2.5}	1µg/m ³	3%
PM ₁₀	1µg/m ³	5%

Table 1. The relationship between air quality and risk of developing asthma.

Childhood Leukaemia

- 2.14 Exposure to residential traffic after birth increases the risk of childhood leukaemia. A systematic review encompassed both European and American studies and a range of methods to examine exposure to traffic during childhood, although predominantly based around home address. Studies typically included onset of leukaemia in under-14 year olds. There was no increased leukaemia risk from prenatal exposure.¹¹
- 2.15 Benzene is often cited as the most likely traffic pollutant that influences the risk of childhood leukaemia,¹¹ although more recent studies have also found associations between childhood leukaemia and 1,3-butadiene.¹²

Middle ear infection

- 2.16 Some studies have identified a link between childhood middle ear infection, diagnosed in outpatient visits, and several markers of traffic related air pollution such as PM_{2.5}, NO and SO. Wood smoke was also significantly related to middle ear infection.¹³

3. Smoke free zone

- 3.01 In many countries, smoke-free zones are adopted around public buildings.¹⁴ In the UK, voluntary smokefree zones have been used in public spaces and play areas to protect children from smoke.
- 3.02 The Trust routinely receives feedback from the family members of patients about people smoking outside of the hospital. This is a poor patient and family experience for who visit and causes anxiety for parents and children who have to walk past people smoking on their way to hospital appointments and visits.
- 3.03 A way to address the feedback would be to create a smoke-free zone around the hospital boundaries. The zone BCH proposed would encompass the sides of the hospital that patients typically approach from, and would cover all of the entrances from the Emergency Department on Steelhouse Lane to the entrance for the new clinical building
- 3.04 After initial discussions with Birmingham City Council, an eight week on-line consultation was carried out by Birmingham Children's Hospital to understand how strongly people felt about the hospital pursuing establishment of the zone. The consultation ran from the 3rd August until the 28th September 2016
- 3.05 The consultation questionnaire was well responded to with over 1,100 people completing it.
- 3.06 The majority of people who responded supported action to stop people from smoking outside of the hospital and agreed that a smoke-free zone was the right way to do this. Support was very strong amongst staff, and also family members of patients. Many family members shared experiences of walking past people smoking with their children to illustrate their concerns.
- 3.07 The majority of the respondents who were strongly against the proposal indicated that they did not frequently walk through the proposed zone. Over half of respondents against the zone both did not live in Birmingham and did not walk through the proposed zone.
- 3.08 In order to inform people that they were in a smoke free zone, respondents almost wholly agreed that signs were required.
- 3.09 There is no consistent evidence base around harm from outdoor environmental tobacco smoke inhaled by passing bystanders. The Trust's primary motivation for pursuing the zone is the experience and reaction of children, young people and families. Smoking is perceived as a harmful behaviour, and people expect to be able to arrive at an NHS site without walking through exhaled tobacco smoke.
- 3.10 To support families who already smoke, the Trust requires that Local Authority and NHS commissioners provide effective, responsive and accessible stop smoking services for them to refer people who smoke to.

- 3.11 The consultation demonstrated that people are very willing to be engaged on this topic, pragmatic in their consideration of the issues, and recognise not only harm, but also the experience of the environment as important factors in their decision making.

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Glossary

- 5.01 CO – Carbon Monoxide, a poisonous gas often produced through incomplete combustion
- 5.02 COMEAP – Committee on the Medical Effects of Air Pollutants, a government committee advising on health effects
- 5.03 Hypertension – Raised Blood Pressure that can contribute to a range of serious medical conditions including heart attack, and stroke
- 5.04 NO_x – A group of mono-nitrogen oxide gases, produced during combustion.
- 5.04 PM_{2.5/10} – Measures of fine particulate matter in the air
- 5.05 SIDS – Sudden Infant Death Syndrome, a more appropriate and descriptive term that has replaced the colloquialism of 'cot death'
- 5.06 SO₂ – Sulphur Dioxide, a harmful gas that reacts to produce other compounds including sulphuric acid. The majority of SO₂ originates from human sources

References

- ¹ Shah PS, Balkhair T, Knowledge Synthesis Group on Determinants of Preterm/LBW births. Air pollution and birth outcomes: a systematic review. *Environment international*. 2011 Feb 28;37(2):498-516.
- ² Vrijheid M, Martinez D, Manzanares S, Dadvand P, Schembari A, Rankin J, Nieuwenhuijsen M. Ambient air pollution and risk of congenital anomalies: a systematic review and meta-analysis. *Environmental health perspectives*. 2011 May 1;119(5):598.
- ³ Woodruff TJ, Grillo J, Schoendorf KC. The relationship between selected causes of postneonatal infant mortality and particulate air pollution in the United States. *Environmental health perspectives*. 1997 Jun;105(6):608.
- ⁴ Glinianaia SV, Rankin J, Bell R, Pless-Mulloli T, Howel D. Does particulate air pollution contribute to infant death? A systematic review. *Environmental health perspectives*. 2004 Oct 1:1365-70.
- ⁵ Litchfield I, Hwang BF, Jaakkola J. The Role of Air Pollution as a Determinant of Sudden Infant Death Syndrome: A Systematic Review and Meta-analysis. *Epidemiology*. 2011 Jan 1;22(1):S165-6.
- ⁶ COMEAP. Does Outdoor Air Pollution Cause Asthma? 2010
- ⁷ Zheng XY, Ding H, Jiang LN, Chen SW, Zheng JP, Qiu M, Zhou YX, Chen Q, Guan WJ. Association between air pollutants and asthma emergency room visits and hospital admissions in time series studies: a systematic review and meta-analysis. *PloS one*. 2015 Sep 18;10(9):e0138146.
- ⁸ Gowers AM, Cullinan P, Ayres JG, ANDERSON H, Strachan DP, Holgate ST, Mills IC, Maynard RL. Does outdoor air pollution induce new cases of asthma? Biological plausibility and evidence; a review. *Respirology*. 2012 Aug 1;17(6):887-98.
- ⁹ Bowatte G, Lodge C, Lowe AJ, Erbas B, Perret J, Abramson MJ, Matheson M, Dharmage SC. The influence of childhood traffic-related air pollution exposure on asthma, allergy and sensitization: a systematic review and a meta-analysis of birth cohort studies. *Allergy*. 2015 Mar 1;70(3):245-56.
- ¹⁰ Khreis H, Kelly C, Tate J, Parslow R, Lucas K, Nieuwenhuijsen M. Exposure to traffic-related air pollution and risk of development of childhood asthma: a systematic review and meta-analysis. *Environment International*. 2016 Nov 21.
- ¹¹ Boothe VL, Boehmer TK, Wendel AM, Yip FY. Residential traffic exposure and childhood leukemia: a systematic review and meta-analysis. *American journal of preventive medicine*. 2014 Apr 30;46(4):413-22.
- ¹² Symanski E, Lewis PG, Chen TY, Chan W, Lai D, Ma X. Air toxics and early childhood acute lymphocytic leukemia in Texas, a population based case control study. *Environmental Health*. 2016 Jun 14;15(1):70.
- ¹³ MacIntyre EA, Karr CJ, Koehoorn M, Demers PA, Tamburic L, Lencar C, Brauer M. Residential air pollution and otitis media during the first two years of life. *Epidemiology*. 2011 Jan 1;22(1):81-9.
- ¹⁴ Royal College of Physicians of London. Tobacco Advisory Group. Passive smoking and children. A report by the Tobacco Advisory Group of the Royal College of Physicians. 2010.