

**FOR  
EVERY  
CHILD IN  
DANGER**

**unicef**   
UNITED KINGDOM

**A BREATH OF TOXIC AIR**

**UK CHILDREN IN DANGER**

RESEARCH PAPER

# **A BREATH OF TOXIC AIR: UK CHILDREN IN DANGER**

JUNE 2018

## TINY PARTICLES AND LITTLE LUNGS

Air pollution is an invisible but dangerous threat to children's health. Toxic emissions can damage children's growth and leave them with lasting health problems. This not only violates a child's right to health, but also their future. It could impact their right to education, their right to play and ultimately, their right to life.

**At least 1 in 3 babies are growing up in areas of the UK with unsafe levels of particulate matter, the most dangerous pollutant for our health.<sup>1</sup>**

The World Health Organization (WHO) estimates that over 70% of towns and cities in the UK have unsafe levels of fine particulate matter (PM2.5).<sup>2</sup> This refers to tiny particles of pollution in the air that have a diameter less than 2.5 µm, smaller than the width of a human hair.<sup>3</sup>

These tiny particles are the most dangerous for our health as they're able to penetrate deep into our lungs, and potentially even into our bloodstream and our brains. For babies and young children, these health effects are even more acute. Exposure to toxic particulates during these critical early stages of development can leave a child with stunted lungs, with respiratory conditions like asthma and reduced brain development.

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<sup>1</sup> New Unicef UK analysis in this paper

<sup>2</sup> Unicef UK analysis of WHO stats – 71% of UK towns and cities included in WHO (2018) Global Ambient Air Quality Database – using the latest available data <http://www.who.int/airpollution/data/cities/en/>

<sup>3</sup> World Health Organisation (2018) Ambient (outdoor) air quality and health [http://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](http://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

While all children are vulnerable to air pollution, the youngest children are most at risk. The people who contribute least to the problem are being impacted the most.

This research paper seeks to estimate the number of children in the UK that are growing up in areas that breach the level of PM2.5 the WHO recommends – an annual average level no higher than 10 micrograms per cubic meter of air ( $\mu\text{g}/\text{m}^3$ ). The term “unsafe” in this document refers to any level on or above this threshold, however in reality there is no safe level of particulate matter for humans to breathe in.<sup>4</sup>

Unicef UK analysed the WHO’s outdoor air pollution database and the Office of National Statistics’ (ONS) population data to reach these estimates. It demonstrates the scale of children’s exposure to toxic particulates across the UK and the harm this could be doing to their health.

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<sup>4</sup> World Health Organization (2018) Ambient (outdoor) air quality and health [http://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](http://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

## KEY FINDINGS

1. Around **1 in 3 babies** are growing up in areas of the UK with unsafe levels of particulate matter – nearly 270,000 babies under the age of 1 in the UK.
2. An estimated **1.6 million under-fives** are growing up in areas of the UK with unsafe levels of particulate matter – one third of all 0-5 year olds in the UK.
3. At least **4.5 million children** in the UK are growing up in areas with unsafe levels of particulate matter – 30% of 0-18 year olds in the UK.
4. The health effects from PM2.5 exposure **cost the NHS and social care services over £40 million each year.**<sup>5</sup> Even the smallest improvement in exposure could reap major rewards for children and the UK taxpayer.
5. Areas with **young populations tend to have disproportionately high levels** of particulate matter – 75% of the local authorities with the youngest populations in the UK also have unsafe levels of particulate matter.
6. Children **tend to live in more deprived communities in England**, where particulate matter concentrations are often higher.<sup>6</sup>

## CONCLUSION & RECOMMENDATIONS

Children are particularly vulnerable to the health impacts of toxic air and Unicef UK's analysis highlights the concerning levels of exposure that they are facing. The youngest and poorest children are carrying the weight of this burden.

The Government has not yet prioritised interventions to protect children's health. While significant progress has been made in the UK to tackle air pollution, this has tended to

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<sup>5</sup> Public Health England (2018) Estimation of costs to the NHS and social care due to the health impacts of air pollution

<sup>6</sup> Public Health England (2018) Ibid.



focus on lowering vehicle emissions to reach legal limits rather than reducing the exposure of vulnerable populations.

To change this, the Government should:

- **Prioritise and fund measures that protect children** and other vulnerable groups from toxic air in places they live, learn and play.
- Create **ambitious networks of clean air zones** that lower pollution and create child-friendly urban areas that promote walking, cycling and public transport.
- Commit to urgent action to **reduce particulate matter**, meeting WHO levels by 2030 at the latest.
- Expand **air quality monitoring and data collection** to better reflect children's exposure, so that children and their families have the information they need to protect their health.
- Ensure **children's rights are at the centre of policy making**, and that all information is disseminated in an accessible and child-friendly way.
- Carry out detailed **research into the health impacts** and risk for all children – broken down by age, disability, gender, ethnicity and socio-economic background – and the impact on pregnant women and fetuses.

This paper is based on publically available data for PM2.5; much more research is needed to examine children's exposure in detail. While there are limitations to the data used in this paper (see pages 10 and 11), our analysis suggests this is likely to be an underestimation. More research is also needed to examine the link between high exposure to PM2.5 and the impact on pregnant women and unborn babies.

# ANNEX

## THE CURRENT EVIDENCE BASE

Children are physiologically **far more susceptible** to air pollution than adults as their lungs, brains and immune systems are still developing. They tend to **receive higher doses** of toxic air than adults as children breathe twice as fast.<sup>7</sup> Children also tend to be more physically active than adults and spend more time outside.<sup>8</sup> When children walk along main roads they are often in buggies or walking at the height of traffic fumes, so are often exposed to more roadside emissions and particulate dust which rests at ground level.<sup>9</sup>

Children growing up in polluted areas are **up to four times more likely to have reduced lung function** compared to their peers growing up in less polluted areas.<sup>10 11</sup> A child with smaller lungs may have increased vulnerability to future health problems. Exposure to high levels of air pollution can increase a child's risk of getting asthma. Over the course of their life it can increase their risk of developing lung cancer and cardiovascular disease.<sup>12 13</sup>

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<sup>7</sup> World Health Organization (2008) Children are not little adults  
[http://www.who.int/ceh/capacity/Children\\_are\\_not\\_little\\_adults.pdf](http://www.who.int/ceh/capacity/Children_are_not_little_adults.pdf)

<sup>8</sup> UNICEF (2016) Clear the air for children - [https://www.unicef.org/publications/index\\_92957.html](https://www.unicef.org/publications/index_92957.html)

<sup>9</sup> Kenagy, H.S. Lin, C. Wu, H. Heal, M.R. (2016) Greater nitrogen dioxide concentrations at child versus adult breathing heights close to urban main road kerbside [Air Qual Atmos Health](#). 2016;9:589-595. Epub 2015 Sep 15

<sup>10</sup> Chen Z, Salam MT, Eckel SP, Breton CV, Gilliland FD (2015) Chronic effects of air pollution on respiratory health in Southern California children: findings from the Southern California Children's Health Study. *J Thorac Dis* 2015;7:46–58.

<sup>11</sup> Wood, HE, Marlin, N, Mudway, IS, Bremner, SA, Cross, L, Dundas, I, Grieve, A, Grigg, J, Jamaludin, JB, Kelly, FJ, Lee, T, Sheikh, A, Walton, R & Griffiths, CJ 2015, 'Effects of air pollution and the introduction of the London Low Emission Zone on the prevalence of respiratory and allergic symptoms in schoolchildren in east London: A sequential cross-sectional study' *PLoS One*, vol 10, no. 8, e0109121. DOI: 10.1371/journal.pone.0109121

<sup>12</sup>IARC (2013) Air pollution and Cancer  
<https://www.iarc.fr/en/publications/books/sp161/AirPollutionandCancer161.pdf>

<sup>13</sup> World Health Organization (2012) *Press Release No.213*, IARC WHO

Emerging evidence suggests that exposure to particulate matter (PM) during pregnancy, infancy and early childhood **can impact the growth of a foetus and baby's brain** which in turn could impact on their cognitive outcomes such as memory.<sup>14</sup> It has also been linked with low birth weight and stunted organ development in new babies.<sup>15</sup>

## UNICEF UK ANALYSIS AND FINDINGS

### 1) NUMBER OF BABIES AND CHILDREN LIVING IN UNSAFE AREAS

- Around **1 in 3 babies** are growing up in areas of the UK with unsafe levels of particulate matter – nearly 270,000 babies under the age of 1 in the UK.
- An estimated **1.6 million under-fives** are growing up in areas of the UK with unsafe levels of particulate matter – one third of all 0-5 year olds in the UK.
- At least **4.5 million children** in the UK are growing up in areas with unsafe levels of particulate matter – 30% of 0-18 year olds in the UK.

Unicef UK has undertaken new statistical research that estimates the number of babies, young children and children growing up in areas of the UK that have annual levels of particulate matter on and above levels the WHO recommends. It maps ONS population data against the WHO's outdoor air pollution database.

Throughout this research, Unicef UK defines unsafe particulate matter levels as those on or above WHO annual guidelines.<sup>16</sup> However, it is important to note there is no such thing

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<sup>14</sup> RCP and RCPCH (2016) Every breath we take: the lifelong impact of air pollution pg. 42

<sup>15</sup> Pedersen M et al, (2013) *Ambient air pollution and low birthweight: a European cohort study (ESCAPE)*, The Lancet Respiratory Medicine, Volume 1, No. 9, p695–704 p.695

<sup>16</sup> World Health Organization (2018) Outdoor air quality and health [http://www.who.int/en/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](http://www.who.int/en/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)



as a safe level of exposure to particulate matter. Health impacts have been evidenced even at low levels of exposure. <sup>17 18</sup>

## 2) ARE YOUNGER POPULATIONS DISPROPORTIONATELY AT RISK?

Of the 20 local authorities in the country with the highest proportion of babies living in them, 70% also have levels of PM2.5 above WHO's recommended limit. This suggests areas with young populations tend to be disproportionately exposed to high concentrations of PM2.5, and therefore the health impacts are further skewed towards babies and young children.

Ranking by proportion of babies	Local authority	Unsafe PM2.5 levels recorded	Proportion of babies within local authority (Under 1 year old)
1	Barking and Dagenham	Yes	1.95
2	Slough	No	1.81
3	Newham	Yes	1.79
4	Waltham Forest	Yes	1.72
5	Luton	No	1.67
6	Greenwich	Yes	1.66
7	Hackney	Yes	1.63
8	Peterborough	No	1.61
9	Forest Heath	No	1.60
10	Merton	Yes	1.60
11	Hounslow	Yes	1.59
12	Brent	Yes	1.58
13	Redbridge	Yes	1.58
14	Croydon	Yes	1.57
15	Lewisham	Yes	1.55
16	Thurrock	Yes	1.54
17	Reading	No	1.54
18	Watford	No	1.53
19	Wandsworth	Yes	1.53
20	Birmingham	Yes	1.53

Figure 1: Polluted local authorities mapped against ONS data for the proportion of babies per local authority population

<sup>17</sup> World Health Organization (2012) *Press Release No.213*, IARC WHO

<sup>18</sup> Peters A et al. (2014) 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](https://doi.org/10.1136/bmj.f7412);348:f7412 p.2

### 3) HOW MUCH DOES PM2.5 COST THE NHS AND SOCIAL CARE?

Every year, the health effects from PM2.5 exposure cost the NHS and social care services **over £40 million**. PHE research shows that even the smallest improvement in air quality could reap massive rewards for children and the UK taxpayer.<sup>19</sup>

The above figure takes into account the health costs for the following conditions: coronary heart disease, stroke, lung cancer and childhood asthma. It does not take into account the health costs of other impacts on children, for instance reduced lung function or cognitive damage, as there is little available data to model this impact. Where low birth weight cases were also considered (where the research is still emerging) it was estimated there could be 173,886 new cases from 2017 to 2035.<sup>20</sup> Therefore it's likely the overall financial costs of air pollution on children's health are even higher; more data collection on children's health and air pollution is needed to examine this in detail.

### 4) HOW DOES THIS INTERACT WITH SOCIO-ECONOMIC FACTORS?

PHE research shows that children tend to live in the more deprived communities in England **where particulate matter concentrations are higher**, and therefore they recommend prioritising research into the impact of interventions on children.<sup>21</sup>

This is supported by the findings in the UK-based Marmot Review which found that **individuals in deprived areas tend to experience more adverse health effects** at

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<sup>19</sup> Public Health England (2018) Estimation of costs to the NHS and social care due to the health impacts of air pollution <https://www.gov.uk/government/publications/air-pollution-a-tool-to-estimate-healthcare-costs>

<sup>20</sup> Public Health England (2018) *ibid.*

<sup>21</sup> Public Health England (2018) *ibid.*

the same level of exposure compared to those from less deprived areas.<sup>22</sup> Air pollution exposure **interacts and compounds many other barriers to health and well-being** that children from lower income backgrounds face for instance they are less likely to have access to green spaces, adequate transport, health and education services.<sup>23</sup>

## APPENDIX

### 1) METHODOLOGY

PM2.5 data was extrapolated from [the WHO's outdoor air pollution database – May 2018 update](#), and overlaid with population estimates taken from the [ONS mid-year 2016 estimate](#). PM2.5 data was also taken from the [Mayor of London's datastore](#).

### 2) LIMITATIONS

- ONS data is broken down by local authority and the WHO's database is broken down by monitoring sites; therefore all figures in this research are an estimate of population exposure, for instance Leamington Spa is listed as a urban area with unsafe levels of PM2.5 in the WHO database so this has been mapped against its respective local authority – Warwick City Council - to estimate population exposure.
- Unicef UK recognises that the WHO database doesn't imply everyone in the equivalent local authority will be exposed to unsafe levels of pollution, however it's likely that children in these local authorities will come into contact with unsafe pollution levels in areas they live, learn and play.
- Additionally, there are only 146 PM2.5 monitors run by DEFRA across the UK,<sup>24</sup> therefore the data collected at these sites is unlikely to fully represent human

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<sup>22</sup> Marmot, M. et al (2010) Strategic Review of Health Inequalities in England Post 2010 (Marmot Review) p.80

<sup>23</sup> Public Health England (2016) Working Together to Promote Active Travel: a briefing for local authorities

<sup>24</sup> DEFRA (2018) <https://uk-air.defra.gov.uk/networks/network-info?view=aur>

exposure as they are not situated in all the places where people are breathing in air – this could underestimate actual level of exposure for many children.

- This analysis has not factored in exposure from nitrogen dioxide pollution, which is also harmful for children’s health and found at illegal concentrations across UK cities.<sup>25</sup> If this was also included it is likely that the statistics for each area would be even higher as additional local authorities would be included. Previous estimates suggest more than 8 million children are growing up in areas with illegal levels of nitrogen dioxide.<sup>26</sup>
- The most recent average annual readings available in the WHO's outdoor air pollution database (2018) for each monitoring site were used to carry out this analysis, this ranges from readings taken in 2013 to 2016.

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<sup>25</sup> DEFRA (2017) Air quality plan for nitrogen dioxide (NO<sub>2</sub>) in UK (2017)

<https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017>

<sup>26</sup> Independent (2017) <https://www.independent.co.uk/environment/air-pollution-uk-children-london-yorkshire-humber-areas-illegal-levels-nitrogen-dioxide-labour-party-a8130466.html>

# FOR EVERY CHILD IN DANGER



**At least one in three babies are growing up in areas of the UK with unsafe levels of air pollution. Toxic emissions pose a serious and dangerous threat to their health. The youngest children are the most vulnerable, yet contribute least to the problem.**

Unicef UK is calling for a six point plan to protect every child's right to breathe clean air:

1. Prioritise and fund measures that protect children
2. Ensure children's rights are at the centre of policy making
3. Create ambitious networks of clean air zones that tackle vehicle emissions
4. Commit to urgent action to reduce particulate matter to safe levels by 2030
5. Expand air quality monitoring and data collection to better reflect children's exposure
6. Carry out detailed research into the health impacts and risk for all children

Find out more  
[unicef.uk/cleanair](https://unicef.uk/cleanair)

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