Higher air pollution days trigger hundreds of cardiac arrests and hospitalisations for strokes and asthma

- **New data from King's College London show 124 additional out-of-hospital cardiac arrests and 424 hospital admissions for stroke and asthma on higher pollution days**
- **Head of NHS in England warns "this is a health emergency"**
- **Data covers 9 major cities: London, Birmingham, Bristol, Derby, Liverpool, Manchester, Nottingham, Oxford and Southampton**

New data being released by King's College London and UK100, a network of local leaders, shows that hundreds of children and adults are suffering out-of-hospital cardiac arrests or being sent to hospital for strokes or severe asthma attacks on days when air pollution levels are higher in nine major cities across England. It has triggered a warning from the head of the NHS in England that "the climate emergency is in fact also a health emergency", while Mayor of London Sadiq Khan said this is a "public health crisis".

The figures show the immediate, short-term impact of high air pollution on individuals and sit alongside figures that show the long-term impact of air pollution, which is estimated to contribute to up to 36,000 deaths every year. In total, across nine major cities, higher air pollution days trigger an additional 124 out-of hospital cardiac arrests, 231 hospitalisations for stroke and 193 children and adults hospitalised for asthma.

The research, which will be published in full in November, is being released ahead of the International Clean Air Summit being hosted by the Mayor of London, Sadiq Khan and UK100 this week (Wednesday 23 October).

It will bring together government ministers, businesses, the head of NHS England, mayors and political leaders from across the UK and the world alongside the Director General of the World Health Organisation, Tedros Adhanom and the former head of the UN Framework Convention on Climate Change, Christiana Figueres.

Following the publication of the Environment Bill last week, the summit is expected to push the UK Government to provide new powers and resources to local authorities to clean up our air alongside a timetable for implementing WHO targets on PM2.5, one of the most dangerous forms of pollution.

Simon Stevens, chief executive of NHS England said:

"As these new figures show, air pollution is now causing thousands of strokes, cardiac arrests and asthma attacks, so it's clear that the climate emergency is in fact also a health emergency.

"Since these avoidable deaths are happening now - not in 2025 or 2050 - together we need to act now. For the NHS that is going to mean further comprehensive action building on the reduction of our carbon footprint of one fifth in the past decade.

"So our NHS energy use, supply chain, building adaptations and our transport will all need to change substantially."

Polly Billington, Director of UK100, a network of 94 local leaders, said:

"Air pollution is a problem in towns and cities across the country , with children and adults being hospitalised for life threatening conditions. That is an individual tragedy for each of them, and collectively a huge burden on our NHS. Local government needs additional powers and resources to address this public health crisis, alongside a timetable for when air pollution levels will meet WHO guidelines."

The Mayor of London, Sadiq Khan said: "London's lethal air is a public health crisis - it leads to thousands of premature deaths in the capital every year, as well as stunting the development of young lungs and increasing cases of respiratory illness. An issue as serious as this requires urgent innovative action which is why on top of bold measures like the ULEZ and cleaning up our bus fleet, I'm hosting an International Clean Air Summit this week, bringing together city leaders, ministers, global NGOs and industry representatives. We need government to match London's ambition and introduce a legally binding target of meeting World Health Organization (WHO) guidelines by 2030 so we can clean up our filthy air once and for all."

Dr Heather Walton, health expert on the project at Environmental Research Group, King's College, London said:

"The impact of air pollution on our health has been crucial in justifying air pollution reduction policies for some time, and mostly concentrates on effects connected to life-expectancy. However, health studies show clear links with a much wider range of health effects. This project provides short statements of fact, backed up by supporting evidence. We have released a sample of these statements about the effects in a number of UK cities, ahead of publication of the full report in November. This wider range of impacts on our health provides additional evidence of the important need for further action to reduce air pollution."

London

Higher air pollution days in London are responsible for 87 more out of hospital cardiac arrests, and 251 children or adults being hospitalised for asthma or strokes.

Birmingham

Higher air pollution days in Birmingham are responsible for 12 more out of hospital cardiac arrests, and 53 children or adults being hospitalised for asthma or strokes.

Bristol

Higher air pollution days in Bristol are responsible for 4 more out of hospital cardiac arrests, and 18 children or adults being hospitalised for asthma or strokes.

Derby

Higher air pollution days in Derby are responsible for 0 more out of hospital cardiac arrests, and 16 children or adults being hospitalised for asthma or strokes.

Liverpool

Higher air pollution days in Liverpool are responsible for 4 more out of hospital cardiac arrests, and 24 children or adults being hospitalised for asthma or strokes.

Manchester

Higher air pollution days in Manchester are responsible for 6 more out of hospital cardiac arrests, and 28 children or adults being hospitalised for asthma or strokes.

Nottingham

Higher air pollution days in Nottingham are responsible for 3 more out of hospital cardiac arrests, and 16 children or adults being hospitalised for asthma or strokes.

Oxford

Higher air pollution days in Oxford are responsible for 6 more out of hospital cardiac arrests, and 4 children or adults being hospitalised for asthma or strokes.

Southampton

Higher air pollution days in Southampton are responsible for 2 more out of hospital cardiac arrests, and 14 children or adults being hospitalised for asthma or strokes.

ENDS

For further information:

bex.bolland@uk100.org or 07718108996

alex.bigham@uk100.org or 07830 195 812

About UK100

UK100 is a network of highly ambitious local government leaders committed to clean air and 100% clean energy. It is the only network for UK local authorities urban, suburban and rural, focused solely on climate change, clean air and clean energy policy. UK100's local leaders are committed to working together to tackle these challenges and are implementing innovative solutions to protect their residents.

UK100 on Clean Air: As well as taking action locally, UK100's network is united in calling on the UK government to do more. Clean air is a national problem that needs national action that enables locally designed solutions. Working with civil society, the public sector and business, UK100 is calling for legislation that protects us from dirty air and makes the UK a world leader in clean technologies and solutions. www.UK100.org

Editor's Notes

1.   The data is a subset of material to be published in an upcoming report from King's College London's Environmental Research Group, titled *Personalising The Health Impacts of Air Pollution,* due to be published in November 2019*. The initial report is here:*
http://www.erg.kcl.ac.uk/Research/home/projects/personalised-health-impacts.html

This King's College London study was funded by the Clean Air Fund https://www.cleanairfund.org/

2.   UK air pollution could cause 36,000 deaths a year
https://www.kcl.ac.uk/news/uk-air-pollution-could-cause-36000-deaths-a-year

3.   Higher and lower air pollution days: Higher pollution days vs lower pollution days:

King's College London defined this by assuming that typical higher air pollution days were at the middle of the top half of the annual range of pollutant levels and typical lower air pollution days were at the middle of the bottom half of the range of levels. In more technical terms, this is the difference between the 75th and 25th percentile of daily average particulate matter concentrations. We simplified the distribution to assume that the top half of the days were all at the 75th percentile level and the bottom half at the 25th percentile. We then did calculations for a hypothetical scenario where the days at the 75th percentile were reduced to the 25th percentile.

4.   Detailed hospitalisation breakdowns

Each year on average, higher air pollution days in London are responsible for 87 more cardiac arrests outside hospital, 144 more hospitalisations for stroke, 74 children and 33 adults hospitalised with asthma, 338 in total.

Each year on average, higher air pollution days in Birmingham are responsible for 12 more cardiac arrests outside hospital, 27 more hospitalisations for stroke, and 15 children and 11 adults hospitalised with asthma, 65 in total.

Each year on average, higher air pollution days in Bristol are responsible for 4 more cardiac arrests outside hospital, 9 more hospitalisations for stroke, and 5 children and 4 adults hospitalised with asthma, 22 in total.

Each year on average, higher air pollution days in Derby are responsible for 8 more hospitalisations for stroke, and 5 children and 3 adults hospitalised with asthma, 16 in total.

Each year on average, higher air pollution days in Liverpool are responsible for 4 more cardiac arrests outside hospital, 12 more hospitalisations for stroke, and 7 children and 5 adults hospitalised with asthma, 28 in total.

Each year on average, higher air pollution days in Manchester are responsible for 6 more cardiac arrests outside hospital, 14 more hospitalisations for stroke, and 8 children and 6 adults hospitalised with asthma, 34 in total.

Each year on average, higher air pollution days in Nottingham are responsible for 3 more cardiac arrests outside hospital, 8 more hospitalisations for stroke, and 5 children and 3 adults hospitalised with asthma, 19 in total.

Each year on average, higher air pollution days in Oxford are responsible for 6 more cardiac arrests outside hospital, 2 more hospitalisations for stroke, and 1 child and 1 adult hospitalised with asthma, 10 in total.

Each year on average, higher air pollution days in Southampton are responsible for 2 more cardiac arrests outside hospital, 7 more hospitalisations for stroke, and 4 children and 3 adults hospitalised with asthma, 16 in total.

BACKGROUND

The public are understandably interested in the size of the effect of air pollution on health and, in particular, the risks to them as individuals, or at least to individuals like them. Typical statements about the impact of air pollution on health have been communicated in terms of numbers of premature deaths or life years lost. This is mainly because (i) it is assumed that people are most concerned about the most severe endpoints and these usually have a dominant influence on cost-benefit analysis (ii) most places collect mortality statistics routinely, there are a lot more studies for this endpoint (iii) there are also more studies on all-cause mortality because it is a clearly defined endpoint without confusion as to whether a disease has been diagnosed correctly (iv) overall impact on the population as a whole is the output of interest for public health practitioners.

As a measure of population impact, an input into cost-benefit analysis and a general headline for the media, the above types of statements remain influential. However, the acknowledgement of the risks of air pollution and the motivation to change behaviour may be increased by summary statements with which individuals can more easily identify. Life years can seem a rather abstract concept and deaths may seem too distant in time for many in the population. So, there is a role for summary statements on more common adverse health effects of air pollution and in particular groups (due to susceptibility or travel behaviour).

The aim of the project is to develop statements on the effects of air pollution on health outcomes that may be more familiar to the public or specific groups of the public than life years, life expectancy or numbers of deaths. A supporting aim was to ensure a clear route from simple statements, understandable to a wide range of the public, to the detailed technical justification for the numbers quoted. This document is one link in the chain of evidence from simple statement to full technical details. The latter will be available in a full research report, currently in preparation.

There are many scientific studies on the effects of air pollution on a wide variety of disease outcomes but their conclusions are written for scientists rather than the public, and it could be difficult for a member of the public to judge its quality or put a particular study into context. There are, however, documents that pull together consensus positions on the evidence including Committee reports (e.g. COMEAP, 1998; WHO, 2013; US EPA various dates) and also systematic reviews/meta-analyses (e.g. Brook et al 2010; Mills et al, 2015; Hoek et al 2012). Meta-analyses pool quantitative information across studies so are useful to give a sound basis for estimating the size of the air pollution effect. Finally, there are health impact assessments which have quantified effects in particular places or for particular policy scenarios. Some of these only cover mortality (e.g. EEA, 2018) and some are becoming outdated (COMEAP, 1998) but other more recent publications do cover disease outcomes (Holland 2014; APHEKOM 2011; Walton et al 2015). Their methods vary substantially, and they are not necessarily written in language accessible by less specialist readers. The work in this project is based on expert Committee positions, pooled results across several studies or large studies that themselves cover results from many different places. The project did not do its own pooling of the most up to date data, its own review of the latest evidence on causality (if we understand how a pollutant has a particular effect, it strengthens the evidence), or detailed mapping of air pollution exposures at a small spatial scale. (This would have required a very long project given the range of outcomes addressed!). Nonetheless, it is substantially more robust than statements based on single studies or by non-experts, relying on past detailed work by others.

[NB. links to the references mentioned above will be in the final report]

STRUCTURE AND DEVELOPMENT OF THE STATISTICS

The statements are constructed from three basic components. The first of these is some measure of exposure, where we have used air quality monitoring data from regulatory based monitoring networks in the UK, France and Poland. It is recognised that fixed point monitoring data are at best a surrogate for the actual exposures of people as they go about their daily lives. However, the overwhelming majority of short-term epidemiological studies are based on this measure of exposure, hence its use here. The next step is to obtain a numerical relationship between the air pollutant concentration ('exposure') and the change in the health outcome in question. This numerical relationship is termed the 'concentration response function' or CRF. It usually takes the form of a single numerical coefficient in a form equivalent to a percentage increase over the baseline. This is given directly in some statements. The percentage change in the health outcome due to pollutant exposure then has to be combined with the baseline rate of the outcome or disease. Here the 'baseline rate' is the numbers of the outcome expected in the absence of air pollution exposure. The result then allows us to construct quantitative statements giving the effect of a given exposure to an air pollutant on a particular health outcome or disease.

AIR POLLUTION EXPOSURE

We used air quality data from regulatory monitoring networks. In the UK this was the so-called Automatic Urban and Rural Network (AURN) data published by Defra (https://uk-air.defra.gov.uk/networks/network-info?view=aurn). For France and Poland, we used the data submitted under the requirements of the European Air Quality Directive of 2008 (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02008L0050-20150918) and available on the AIRBASE database run by the European Environment Agency (https://data.europa.eu/euodp/en/data/dataset/data_airbase-the-european-air-quality-database-7). For each city we

used both urban background and roadside data, where available. Although arguably the urban background stations are a better surrogate for the exposure of the whole population, there are nonetheless situations where schools, hospitals and other sensitive locations may be situated at the roadside. Roadside data was available in several UK cities but not in Poland.

CONCENTRATION RESPONSE FUNCTIONS

After extensive exchange and discussion, we have chosen the health outcomes for which we thought the evidence was persuasive and adequately quantified. We have included these health outcomes and concentration-response functions (CRFs) that associate them with the concentrations of specific pollutants in Table 1 below (for the current list of statements, there will be more in the final report).

The CRFs we used, depending on the study design and the question under investigation, reflect either the effects of short-term exposures, i.e. effects taking place on the same day or a few days after the occurrence of higher pollutant concentrations, or the effects of long-term exposures, i.e. those occurring after many years or life-long exposures. The reference time period is specified in the corresponding Tables and text and leads to different types of statements.

We preferred to use CRFs that were based on European studies. However, when there was not enough evidence coming from European studies and there was no reason to think that the effects in Europe would be largely different, we used CRFs based on global estimates. We placed emphasis in using CRFs either included in established reports, such as those from WHO or COMEAP, which are based on the collective opinion of many prominent experts, or in good quality meta-analyses for more recent findings.