

## BCUK Background Briefing | Air pollution

In this background briefing, we explain how the quality of the air we breathe affects our health and how it may be linked to an increased risk of breast cancer.

### What is air pollution?

The World Health Organisation (WHO) describes air pollution as ‘...contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere’ (1). A wide range of different substances can contaminate our air: anything from car fumes to desert dust. Exactly what is in the air you are breathing will depend on where you are, the time of year and the weather.

Air pollution is not a new problem in the UK. Factory emissions and domestic coal burning produced sulphur dioxide and soot, which led to the Great Smog in London in 1952 that killed thousands of people (2). The 1956 and 1968 Clean Air Acts helped tackle these pollutants, but people now in their 60s and 70s, grew up breathing in emissions from leaded petrol and summertime smog.

The sources of air pollution may have changed over recent decades, for example fewer domestic coal fires and home incinerators, increased traffic and pesticide use, but we are all still breathing polluted air.



Fumes from road traffic are the main source of outdoor air pollution in the UK today (CC image, [Ruben de Rijcke](#))

### Why is it a problem?

In 2010, air pollution contributed to 3.2 million premature deaths worldwide (3) and to over 400,000 premature deaths in the European Union (4). A 2010 House of Commons report on air quality stated that: 'poor air quality reduces the life-expectancy of everyone in the UK by an average of 7 to 8 months and up to 50,000 people a year may die prematurely because of it' (5). Health problems resulting from exposure to air pollution have been estimated to cost individuals, businesses, and our health services over £20 billion every year (6).

In 2016 the Environment, Food and Rural Affairs Select Committee described air pollution in the UK as a 'public health emergency' (7).

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### Who is affected?

All of us are exposed to varying levels and different types of air pollution throughout our lives, although some sectors of society are at greater risk of exposure to air pollution than others.

People living in urban areas are likely to be exposed to more pollution from traffic exhaust, whilst those in rural areas may be more exposed to pesticide particles and vapours. People in deprived communities are more likely to live in areas where the outdoor and indoor environments – including the quality of the air – are not as healthy (8). In 2015 nearly 25% of all school children in London were exposed to levels of air pollution that exceeded legal limits (9).

### What are the sources of air pollution?

#### Outdoor air pollution

Below we outline the main sources of air pollution. The build-up of pollutants in the atmosphere, and therefore the quality of our air, is also affected by the weather.

**Road Traffic:** Fumes from road traffic are the main source of outdoor air pollution in the UK today (10); transport is responsible for up to 70 per cent of outdoor air pollutants in urban areas (11). Despite exhaust controls and a reduction in



Pesticide particles can contribute to air pollution (CC image, public domain)

certain emissions, road traffic still produces a wide variety of pollutants, including carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), volatile organic compounds (VOCs - chemicals that start off as solids or liquids, but evaporate easily) and particulate matter - fine particles less than 10 (PM<sub>10</sub>) or 2.5 micrometres in size (PM<sub>2.5</sub>). These pollutants can travel long distances, across cities and countries, and so are not just a problem in the places where they are emitted.

**Industry: Power stations, waste plants** (e.g. landfills and incinerators) and **factories** emit significant levels of air pollutants, including sulphur dioxide, nitrogen oxides and ammonia (12). Emissions of several pollutants (e.g. dioxins) have reduced since the UK introduced stricter regulations and began to phase out coal as a source of power production, however the UK's air is still affected by emissions from European countries that rely on coal (13).

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**Farming:** Suspended **pesticide particles**, such as those from the herbicide glyphosate and insecticide, chlorpyrifos, can contribute to air pollution and can be transported by wind (14). Low relative humidity and high temperature can increase the amount of pesticide spray that evaporates from crops, and increase exposure.

There are several other sources of outdoor air pollution, such as **burning garden waste**, which can emit harmful pollutants including particles and dioxins (15).

### Indoor air pollution

We tend to think of air pollution as being something that affects us when we are outdoors, but many of us spend most of our time inside buildings and vehicles, working, eating and sleeping. Air quality indoors can be affected by several factors (see *figure 1* below).

**Asbestos** was commonly used as a building material in commercial buildings, homes and machinery and although banned from use in 1999 it can still be found in many buildings today.

**Carbon monoxide (CO)**, **nitrogen dioxide (NO<sub>2</sub>)** and **particulates** can all be emitted by gas cookers, fires and wood-burning stoves, and can drift indoors from outdoor sources such as road traffic.

**Biological contaminants** such as pollen and fungal spores can enter buildings and cause

allergies and other health problems. Other biological contaminants found in indoor air include bacteria, viruses, and dust which includes animal dander and detritus from mites.

**Radon** is a natural radioactive gas that can increase the risk of lung cancer, and which can sometimes build up to high concentrations indoors. Levels of radon vary across the UK; you can find out more about the levels of radon in your region on [Public Health England's radon website](#).

**Volatile organic compounds:** are emitted as gases from a wide array of household products. These include a variety of chemicals, some of which may have adverse health effects (16).

**Endocrine (Hormone) disrupting chemicals EDCs:** Endocrine disrupting chemicals or EDCs are present in a wide range of household products, from kitchen cleaners and cosmetics to household furnishings and electrical goods. Whether they are sprayed directly into the air (e.g. air fresheners and cleaners) or they leech out from products over time, EDCs are found in household dust in homes across the UK (17, 18, 19).

### Air pollution and disease

Air pollution is known to be associated with a range of illnesses. In 2013 the International Agency for Research on Cancer (IARC) classified

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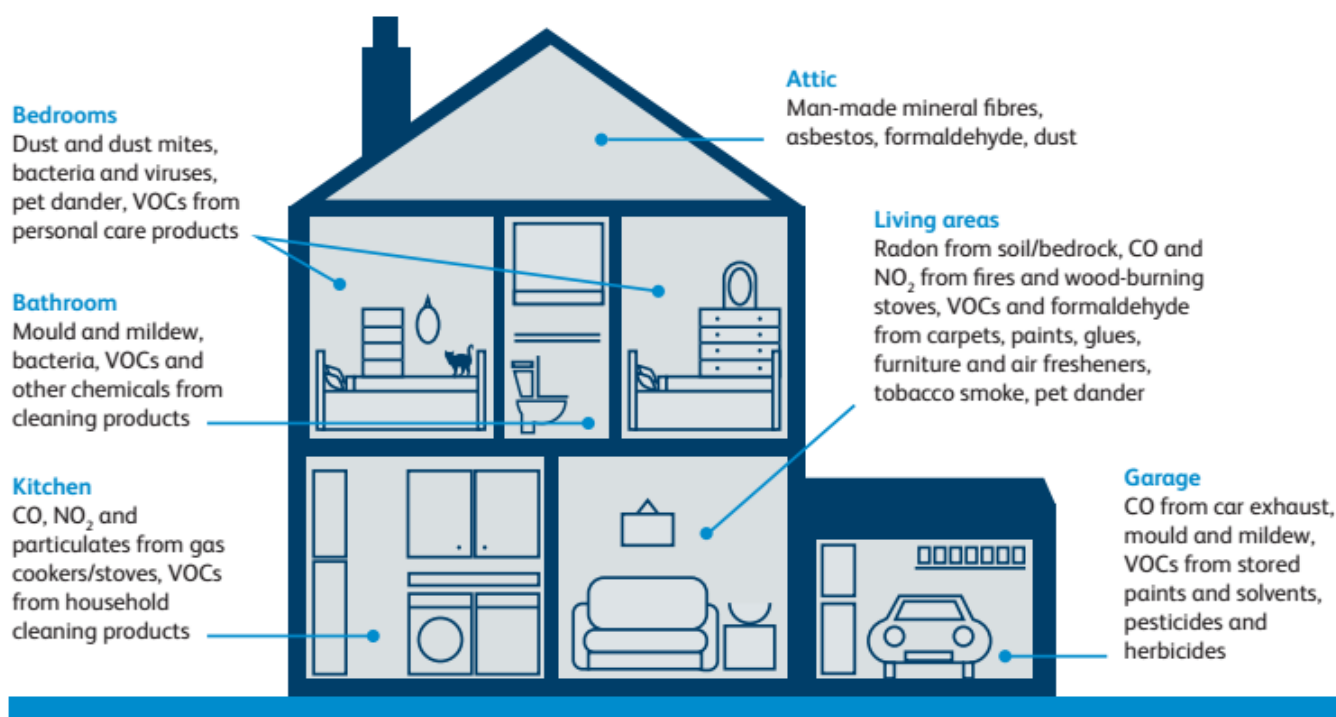


Figure 1 (Reproduced from: Royal College of Physicians. *Every breath we take: the lifelong impact of air pollution. Report of a working party.* London: RCP, 2016. Copyright © 2016 Royal College of Physicians. Reproduced with permission.)

outdoor air pollution as carcinogenic to humans (i.e. capable of causing cancer) (20). It also classifies various indoor air pollutants, such as tobacco smoke and coal fire emissions as carcinogenic (21). Exposure to asbestos can cause lung disease and lung cancer (22). (See more on the [Health and Safety Executive website](#)).

Mould and fungal spores can trigger allergies or make existing health conditions worse (23, 24) and exposure to radon can also cause lung cancer (25, 26). In addition, those whose bodies are less able to compensate for the harmful effects of air pollution, due to ill health or old age, are also

vulnerable. For example, particulate matter can exacerbate cardiovascular diseases, and asthma sufferers are more susceptible to several air pollutants (27).

### Air pollution and breast cancer

Research suggests that high levels of air pollution may also be associated with higher incidence of breast cancer. It is important to note that whilst not all studies demonstrate a clear correlation between high levels of air pollution and increased breast cancer risk, there is evidence to suggest that many of the chemicals present in air

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pollution are linked to an increased risk of the disease.

### Outdoor air pollution

Exposure to **traffic-related air pollution** has been linked with an increased breast cancer risk in several studies (e.g. 28, 29, 30). One Canadian study found that women living in the areas with the highest levels of pollution were almost twice as likely to develop post-menopausal breast cancer compared to those living in the least polluted areas (31).

The main compounds in traffic-related pollution responsible for this increased risk are unknown, however studies suggest that benzene and certain polycyclic aromatic hydrocarbons, such as **benzo (a)pyrene**, as well as **nitrogen oxides** (e.g. NO and NO<sub>2</sub>) may be responsible (32, 33, 34).

It is unclear whether long term exposure to **particulate matter** is associated with increased breast cancer risk, as results of studies vary. Research from China (35) and the U.S. (36) found long-term exposure to particulate matter (specifically PM<sub>2.5</sub>) was associated with elevated risk of breast cancer. Exposure may contribute to the development of breast cancer by particulate matter acting as an oestrogen mimic (37). (For more on adverse effects of oestrogen mimics, see our [background briefing: EDCs and breast cancer](#))

Exposure to particulate matter may affect

mammographic breast density. A large, population-based US study found that women with a higher breast density - known to be a breast cancer risk factor - had higher exposure to PM<sub>2.5</sub> compared to those with a lower breast density (38).

Other studies which examined long term exposure to particulate matter in nurses found no association between exposure to particulate matter and breast cancer risk (39, 40).

### Indoor air pollution

Several chemicals polluting our air indoors have been linked to breast cancer.

Air fresheners, and other artificially scented products, frequently contain **limonene**. Limonene reacts with ozone (present in air) to form **formaldehyde** (41). Research has linked formaldehyde to an increased risk of breast cancer, even at low concentrations (42).

Many household products including kitchen cleaners, detergents and cosmetics contain hormone disrupting chemicals such as **phthalates**, **musks** and **alkylphenols**. These chemicals have been detected in human breast tissue (43, 44) at concentrations which are functionally capable of mimicking oestrogen activity and so lead to an increased risk of breast cancer (45). These products are commonly used in the home and are found in indoor air.



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The incomplete burning of coal, oil, gas, and organic substances like tobacco or meat produces **polycyclic aromatic hydrocarbons** (PAHs). They are a serious problem in developing countries where open fires are used for cooking, but can also pollute the air of home and workplaces in the UK. PAHs have been shown to increase risk for breast cancer (46, 47, 48).

**Benzene** from gas fumes and tobacco smoke has been designated by IARC as a human carcinogen. Occupational exposure to benzene increases the risk of developing breast cancer (49, 50, 51).

Some **flame retardants**, commonly used to reduce the flammability of household furnishings, also pollute our indoor air. They can act as oestrogen mimics (52) and in laboratory studies have been linked to an increased proliferation of breast cancer cells, as well as a potential to reduce the anti-cancer effects of the breast cancer drug tamoxifen (53).

**Organic solvents** such as toluene, methylene chloride, trichloroethylene and formaldehyde, are found in outdoor and indoor air pollution. They are present in cleaning products and some cosmetics. Studies have linked occupational exposures to organic solvents with increases in breast cancer incidence (54, 55). Some solvents, used in manufacture of computer components, cleaning products and cosmetics, cause mammary tumours in laboratory animals (56).

The mostly commonly known source of indoor air pollution is **second hand tobacco smoke**, which contains hundreds of harmful chemicals, including arsenic, benzene and vinyl chloride. Numerous studies have investigated whether there is a link between active or passive smoking and breast cancer, however results are conflicting (57). Nonetheless, there is strong support for the plausibility for an association between smoking and breast cancer (58), and several recent studies and meta-analyses suggest there is a moderate increase in breast cancer risk for those who smoke or are passive smokers (e.g. 59, 60, 61).

### Early exposures

People are vulnerable to the effects of exposure to air pollution during gestation in the womb and early childhood. Some pollutants, when breathed in by the mother, can cross the placenta to the developing baby (62). Environmental effects may last a lifetime, but may take decades to become



Indoor air quality can be affected by several factors, including the use of household products (CC photo, [PiccoloNamek](#))

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apparent (63). For example one recent study (64) found girls that had experienced higher exposure to traffic pollution during gestation reached puberty one month earlier than girls that had been exposed to lower levels of traffic pollution.

### How is the quality of our air regulated?

#### Outdoors

Action to manage and improve air quality is largely driven by EU legislation (which has been transposed into UK law). Air quality directives set legally binding limits for levels and concentrations of major air pollutants that impact public health. The UK, along with several other EU countries, is in breach of the limits on nitrogen dioxide in multiple areas across the country. The UK Supreme Court has called for immediate remedial action to bring pollution within legal limits, and the Government has lost a case at the High Court for its failure to act on air pollution to comply with the Supreme Court's ruling (65).

#### Indoors

Regulating the quality of air indoors is a complex task. Whilst there are examples of successful regulation, such as the bans on smoking in public places and in vehicles carrying children, that have reduced exposure to second hand tobacco smoke, there are also examples of building regulations, designed to improve energy efficiency, that have made indoor air pollution worse by reducing ventilation.



Air pollution mask on Oliver Cromwell statue outside of Westminster Palace (CC photo, [Maina Kiai](#))

An EU research project (66) whose aims included assessment of the health impacts of indoor air pollution, estimated that the UK had among the worst indoor air quality of the EU 27 countries for several health conditions, such as asthma and chronic obstructive pulmonary disease, and sick building syndrome. The UK was identified in the report as among the worst offenders for several sources of indoor air pollution, including: water systems, dampness and mould; furnishing, decoration materials and electric appliances; and cleaning and other household products.

The WHO has published guidelines for the protection of public health from several indoor air pollutants (67). These guidelines can provide a scientific basis for setting standards. They may also be useful as the basis for emissions standards/limits to achieve appropriate source control indoors, which is the specific aim of various existing emission limit-setting and product -labelling initiatives in Europe.

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### Reduce your exposure to air pollution

#### Outdoors

- Avoid walking, running or cycling along busy roads where possible, especially when forecasts indicate high pollution levels (you can check these on the [Defra website](#)).
- Reduce the amount of time spent driving, not only do cars emit air pollution, but the air in cars is often contaminated with pollution from surrounding traffic.
- If you must walk along a busy road, try to walk away from the kerb – you can use the [walkit app](#) to help plan a low air pollution route.
- Minimise the use of garden pesticides.

#### Indoors

- Do not smoke inside your home.
- Avoid using appliances without flues (e.g. freestanding gas and paraffin heaters).

- Properly maintain all boilers, stoves, fires & other appliances that burn fuel of any kind.
- Heat your home sufficiently to prevent damp, while maintaining adequate ventilation – the necessary balance between energy efficiency and pollution control.
- Treat condensation and remove mould.
- Choose less flammable materials such as wool and cotton for home furnishings.
- Avoid using pesticides in your home.
- Try to use fewer cleaning products, and avoid synthetic fragrances used in cleaners, detergents, washing powders and air fresheners. Read our [guide to using safer cleaning products](#).
- Vacuum and damp dust regularly to remove household dust – there is no need to use chemical sprays for dusting.

We welcome your feedback, if you have any comments or suggestions about this leaflet please contact us at [info@breastcanceruk.org.uk](mailto:info@breastcanceruk.org.uk) or on



### Breast Cancer UK position

Breast Cancer UK supports:

- The introduction of a new Clean Air Act, which would:
  - ◊ Tackle the sources of modern air pollution, such as emissions from diesel engines
  - ◊ Safeguard the legal protections in this area provided by EU legislation
  - ◊ Improve on existing legislation, both EU and domestic, to ensure that we enshrine the right to breathe clean air, in law
  - ◊ For more information, see [Client Earth's website](http://www.clientearth.org) (www.clientearth.org)
- Stricter regulation of the chemicals found in household goods such as the phasing out of the use of toxic flame retardants in the manufacture of furniture



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This information has been written for members of the public to help them understand more about how and why certain chemicals may be linked to a potentially increased risk of breast cancer.

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If you would like to receive the information in this leaflet in a different format please contact Breast Cancer UK on 0845680 1322 or email [info@breastcanceruk.org.uk](mailto:info@breastcanceruk.org.uk)