

Q&A

with Professor Frank Kelly

Professor Kelly holds the chair in Environmental Health at King's College London, where he is Director of the Analytical & Environmental Sciences Division. His team were key partners in the NERC-funded Clean Air for London (ClearfLo) project, and he holds the post of Director of the Environmental Research Group, which operates the London Air Quality Network to monitor pollution across the city.

Here, he answers some key questions about air pollution in the UK's capital.

What is air pollution? What are the harmful particles in the air that could be harming us?

Air pollution generally refers to either particles or particulate matter (PM) and a range of different gasses such as nitrogen dioxide and ozone. For PM we generally concentrate on PM10 which is any particle that is less than ten microns in diameter, which means it is small enough to enter your respiratory system via your nose and upper airways. The next classification is PM2.5 – anything less than 2.5 microns in diameter – and then the third classification is ultra-fine or nanoparticles and they are very small indeed, less than 0.1 of a micron. If you consider that a human hair is only 50 microns thick, then these particles are all invisible to the naked eye.

The gasses include nitrogen dioxide – in urban areas one of the major sources is from vehicle exhaust – and ozone, O₃, which comes from the conversion of oxides of nitrogen and hydrogen into ozone by ultraviolet radiation, making it a spring and summer pollutant. Ozone is a very powerful oxidant and nitrogen dioxide is a free radical. This means both are highly reactive gasses. This means when they enter your respiratory system these gasses can cause a lot of problems.

In London, and big cities, what are the main causes of air pollution?

In this day and age it is the transport sector which is the main source of air pollutants in urban areas. The bigger cities, such as London, Manchester and Birmingham, have the bigger air pollution problems simply because of the number of vehicles on the road and the amount of congestion. A lot of the pollutants, the particles and the gasses, come from the exhaust. Increasingly European regulations and standards have been bringing traffic volumes and congestion under control but the wear and tear of tyres and road surfaces and the generation of particles from brakes are all increasingly important sources of particles in urban areas.

Are there other sources of air pollution, like industry?

In most of the large UK cities heavy industry is not within the urban area but outside. But there are still smaller sectors of industry which will be operating within the urban areas, and will produce some pollution. It may be just through the energy they are using or it may be through the heating systems. Also in big cities there are many fast food operations, many restaurants, and these are all generating particles, and nitrogen dioxide from the gas they burn.

What are the known health effects of exposure to air pollution?

There are both short-term, acute effects and long-term effects. The short-term effects generally occur in a sub-section of the population who tend to be particularly susceptible to pollution. They tend to be individuals who already have a disease, either a respiratory or cardiovascular condition such as asthma or chronic obstructive pulmonary disease, and these individuals

find that whenever pollution concentrations rise they experience effects such as difficulty breathing, or they are not able to exercise freely or even walk as far as they normally would. There are very good warning systems now that these people can use to understand when pollution is going to be higher so they can manage their medication. The more serious effects come from long term exposure to pollution, meaning many decades of exposure, and we know through research that people who live in areas with higher pollution concentrations tend to have lower life expectancies, which is why we link pollution exposure to premature death. This has been initially studied in America in the '90s and subsequently confirmed right across the world. These robust associations have been seen everywhere. So, it is clear that something about the air that you breathe can influence the respiratory and cardiovascular systems, which ultimately means that someone can have a life-threatening condition earlier than they should have done. It is estimated there are 9,500 premature deaths attributed to air pollution exposure in London each year. That takes into account exposure to the PM2.5 pollution and nitrogen dioxide pollution, which is particularly high in London.

You're doing research in east London focusing on schoolchildren. What can you say about this so far?

East London tends to have very high traffic volumes, including a lot of diesel vehicles. As a consequence, nitrogen dioxide concentrations are very high. There is a lot of residential housing and schools which are close to busy roads, so the study in schoolchildren has looked at their respiratory function in relation to their exposure to air pollution. The initial findings from the first three years suggested these children had lower lung capacities than expected for their age and ethnicity. We are just finishing off the last three years of the study, and the preliminary analysis suggests those initial findings are robust, so it does seem to be that if a child grows up in a more polluted environment then there is the potential for the child's lung not to develop as fully as it should do in a less polluted environment.

It's a particularly difficult public health issue because when children reach the age of around 18 their lungs stop growing altogether. Children exposed to air pollution therefore never have the capacity to catch up missed lung growth, so the teenage years really are an important window for full lung development. It can mean that later in life, if you end up having another challenge to your lungs, then it could have a



Polluted London's hazy skyline.

much bigger effect than it would do in someone who was not exposed to those early life effects.

What does the future of clear air look like in London?

In London, the major challenge is to clear up our transport system. A large part of that is the public transport system, so the busses and the taxis and the diesel trains all need to be modernised, and to use a much cleaner energy source such as electricity. There are still far too many private vehicles on the roads in London which leads to a lot of congestion, and it's quite clear now that if you own a diesel unfortunately it will produce a lot more pollution than an equivalent sized petrol vehicle. So we need to remove diesel vehicles from the roads in London and ultimately, we need to decrease the volume of traffic. We also need to encourage more active transport, more walking and cycling. There is a real health dividend to be gained if we decrease pollution. It's a win-win situation.

What can people do to protect themselves from city air pollution?

As we go through this transition period towards a cleaner urban environment, people can increasingly take informed decisions about their own exposures. So they can, for example, avoid rush hour and cycling on very busy roads. They can look for alternative routes where they might be able to reduce their exposure. Generally, any lifestyle change that decreases their own personal emissions as they move around the city, and to avoid other people's emissions, will be useful in both the short and long term.