COVID-19 Impacts on Air Quality in Oxford City

Image: Toa Heftiba / unsplash.com

Summary

- The air pollutants of public health concern in Oxford are particulate matter ($PM_{2.5}$ and PM_{10}) and nitrogen dioxide (NO_2)
- Traffic levels reduced by up to 70% in Oxford City Centre in spring 2020.
- Air quality improved marginally; with reduced NO_2 levels of up to 22%.
- A wide range of policy measures – far beyond traffic reduction – will be necessary to reduce particulate levels and achieve greater health benefits.

Air pollution is the largest risk to human health in the UK, estimated to contribute to 1 in 20 early deaths among those living in Oxford.[1]

Traffic is often perceived to be the main contributor to local air pollution, however domestic heating, industry, and agriculture are the main emissions sources in the UK.

The COVID-19 pandemic was a unique opportunity to understand the effect of changes in the way we live our lives and how these impact on air quality in Oxford City. Our research studied these changes, providing a window into the future.

What do we know about air pollution and human health?

We know that air pollution is a public health concern responsible for up to 36,000 early deaths each year in the UK.[2] However overall air quality has improved in recent decades, due to cleaner transport and industry.[3]

The pollutants which continue to be a public health concern are particulate matter (PM) – solid and liquid particles suspended in the air– and nitrogen dioxide (NO_2), a colourless gas. PM is classified by size (diameter of particles) and it is the smaller particles – known as 'fine particulates' – or $PM_{2.5}$ the most harmful for human health as they penetrate deep into the lungs and circulatory system. Larger 'coarse' particles are known as PM_{10}.

Long-term (chronic) air pollution over many years or decades increases the risk of child and adult asthma, stroke, heart disease and lung cancer.[2] Emerging evidence also suggests a direct link with risk of adverse birth outcomes, dementia, metabolic diseases, such as diabetes, and cancers.

We also know that harms of air pollution happen at very low exposure levels, reflected in updated World Health Organisation 2021 Global Air Quality Guidelines [4] (Box 1). The guidelines are based on multiple studies undertaken in many different countries, which show the risk of early death increases with short and long-term exposure to air pollution, after accounting for other relevant factors. [5,6]

Any reduction in pollutant concentrations will therefore deliver benefits for human health.

Box 1: UK Air Quality Objectives (England) and WHO Global Guidelines (summary).

	Time Duration	Air Quality Objective (England) (μg m^{-3})	WHO (2021) (μg m^{-3})
$PM_{2.5}$	Annual mean	25*	5
NO_2	Annual mean	40	10

Table is simplified see [4] and [7] for full details
*Under consultation for revised annual mean target value

What is the legal basis for improving air quality?

The Local Air Quality Management (LAQM) regime is the statutory process by which local authorities monitor, assess and take action to improve local air quality to achieve compliance with UK Air Quality Objectives (Box 1). The Environment Act 2021 has established a legally binding duty for the UK Government to bring forward two new air quality targets by 31 October 2022. The objectives include:

- Reducing the ambient annual mean level of $PM_{2.5}$
- Reducing population exposure to $PM_{2.5}$

The Act will also introduce changes in the LAQM Policy Guidance, in particular, introducing the concept of "Relevant public authority". These authorities will be required to have a more active role in working with LAs on air quality, acting as "Air Quality partners" within the LAQM framework.

What research was carried out?

The COVID-19 pandemic was a unique 'natural' experimental opportunity for researchers to study what happens to air pollutant levels when traffic levels are abruptly and significantly reduced. These circumstances provide a window into the future air quality impacts of a 'low-traffic' city.

In the OxAria study, researchers measured air pollutant levels before, during and after COVID-19 'lockdown. Importantly, they used machine learning and advanced statistical methods to remove the effects of weather and seasonal trends.

What did we learn?

The COVID-19 pandemic led to major traffic reductions of 70% and 38% during the first and second lockdowns in Oxford city (Fig 1).

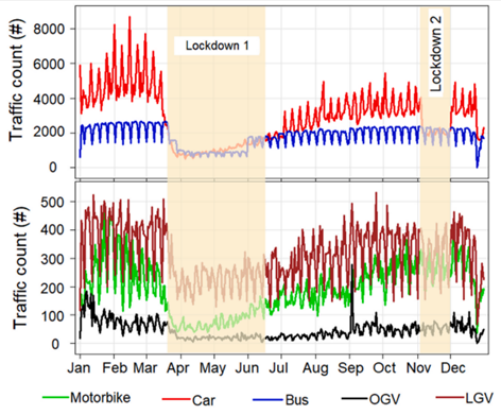

Figure 1. Daily traffic counts in Oxford High Street (Jan- Dec 2020)

These traffic reductions resulted in only marginal air quality improvements:

- NO_2 concentrations **reduced by 22% in the first lockdown and 2% in the second lockdown.**
- PM_{10} concentrations **increased during the second lockdown.**
- There were **no significant changes in $PM_{2.5}$ concentrations.**

If sustained, these changes would save 48 years of life among the Oxford population.[8]

Policy Implications

To achieve greater health benefits a broader set of clean air measures will be required far beyond traffic reduction both at local and national levels. These include reducing emissions from heating, industry, agriculture, and construction.

Authors

This briefing note was prepared by Suzanne Bartington (University of Birmingham) on behalf of the OxAria study team.

Contact

Email: oxaria@contacts.bham.ac.uk
Twitter: @OxAria_UK

Funding

OxAria has received funding from the Engineering and Physical Sciences Research Council [EP/R511742/1] and Natural Environment Research Council [NE/V010360/1].

Citation

Bartington S.E., Bush, T., Anderson R., Abreu P. Singh A. and Leach F. 2022. COVID-19 Impacts on Air Quality in Oxford City. Oxford, UK.

References

[1] Public Health England. 2014. Estimating local mortality burdens associated with PM2.5 exposure. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/332854/PHE_CRCE_010.pdf [accessed 12 April 2022]

[2] Royal College of Physicians. 2016. Every breath we take the lifelong impact of air pollution. Available at: https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution [accessed 12 April 2022)

[3] Defra. 2021. Air Pollution in the UK 2020. Available at: https://uk-air.defra.gov.uk/library/annualreport/index [accessed 12 April 2022]

[4] World Health Organization. 2021. WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. World Health Organization. Available at: https://apps.who.int/iris/handle/10665/345329 [accessed 12 April 2022]

[5] Orellano P, Reynoso J, Quaranta N, Bardach A, Ciapponi A. Short-term exposure to particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), and ozone (O_3) and all-cause and cause-specific mortality: Systematic review and meta-analysis. Environ Int. 2020;142:105876. doi: 10.1016/j.envint.2020.105876

[6] Chen J, Hoek G. Long-term exposure to PM and all-cause and cause-specific mortality: A systematic review and meta-analysis. Environ Int. 2020;143:105974. doi: 10.1016/j.envint.2020.105974.

[7] Defra. 2021. UK Air Quality Objectives. Available at: https://uk-air.defra.gov.uk/assets/documents/Air_Quality_Objectives_Update.pdf [accessed 13 May 2022]

[8] Singh A, Bartington SE, Song C, Ghaffarpasand O, Kraftl M, Shi Z, Pope FD, Stacey B, Hall J, Thomas GN, Bloss WJ, Leach FCP. Impacts of emergency health protection measures upon air quality, traffic and public health: evidence from Oxford, UK. Environ Pollut. 2022;293:118584. doi: 10.1016/j.envpol.2021.118584.