# Personal exposure to indoor air pollution for hybrid office workers in the UK – pilot study

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UKIEG 2022
23.06.2022
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Hi my name is Alejandro Moreno and I will be presenting today on behalf of my co authors, Leonidas Bourikas Our presentation looks at Personal exposure to air pollutants of hybrid office workers in the UK.

This is a peer-reviewed, accepted author manuscript of the following poster presentation: Moreno Rangel, A., & Bourikas, L. (2022). Personal exposure to indoor air pollution for hybrid office workers in the UK – pilot study. Poster session presented at UKIEG Conference 2022.

# Hybrid working approach between office and home.

Changes is working patterns

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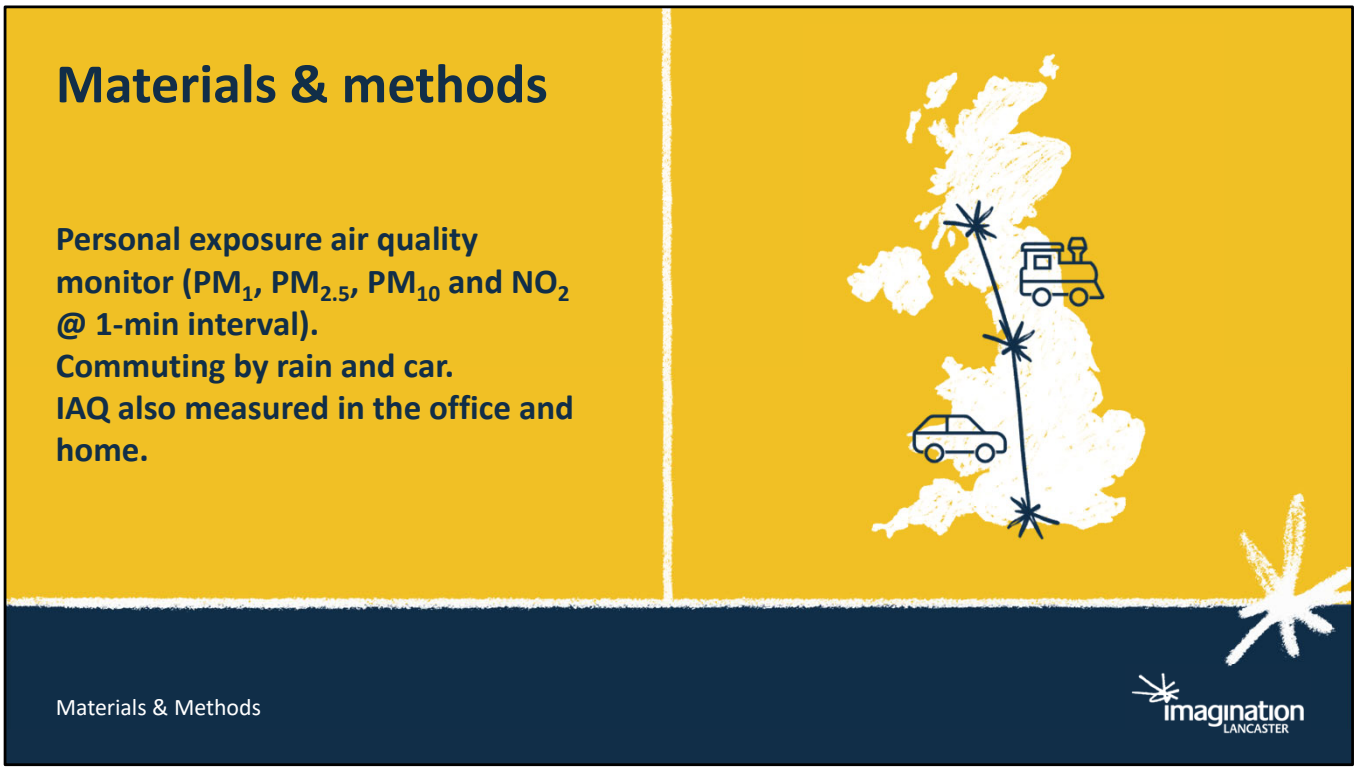
The recent COVID-19 pandemic has changed working patterns worldwide with remote working and flexible hours. In many cases, a hybrid working approach between office and work from home has been favoured by employees and employers alike. This has raised concerns about the indoor environmental quality as residential space and furniture have been repurposed as workspace. Some studies have looked at indoor air pollution differences between home and offices with confronting results.


However, there is one thing that many of these studies agree, particularly those looking at the covid-19 lockdown differences, is that the human behaviour, heating and ventilation systems and control remained the same as if we were still out for most of the day. In Dwellings, as you may know, ventilation rates are likely to be lower compared with regulation requirements for office buildings. This could potentially lead to higher exposure to air pollutants at home with marked health impacts (i.e., respiratory diseases). Existing literature has investigated the home-office indoor air quality and relevant health connections. However, very little has been done to address the air pollution exposure during

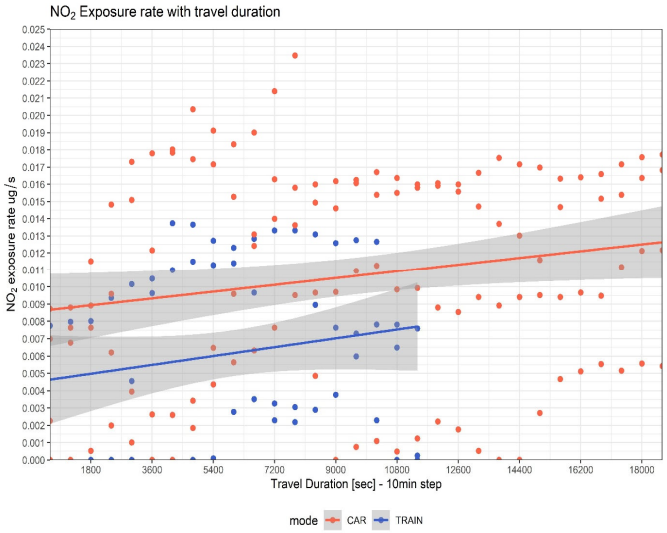
commuting.




This pilot study collected data from participants carrying a wearable air pollution sensor between November and December 2021. $PM_1$, $PM_{2.5}$, $PM_{10}$ and nitrogen dioxide ($NO_2$) were measured at 1-minute intervals during commuting (by train and car) to and from Lancaster University from different parts of the UK and during working time (office and home). This is a first attempt to study air pollution transects across densely populated (and heavy traffic) areas in this part of the UK. The statistical analysis was carried on R for all the air pollutants although on this presentation, only the results from nitrogen dioxide will be presented to make the presentation shorter.

## Car VS Train

**The $NO_2$ measurements from both car and train as a mode of transport suggest an increasing trend of exposure in relation to the duration of travel.**




Results & discussion

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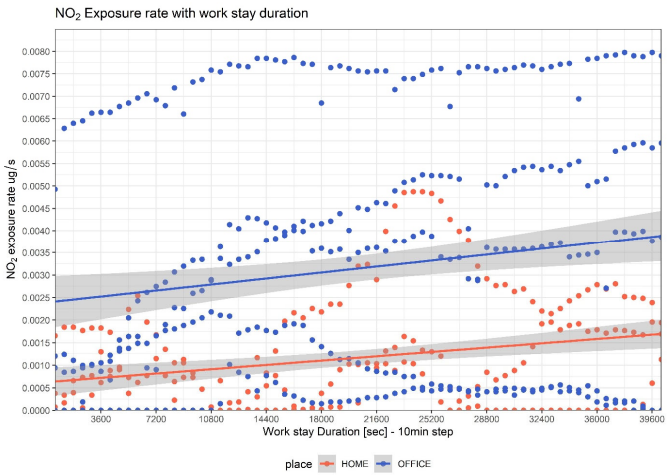
OK, so The nitrogen dioxide exposure shown here corresponds to the mode of commuting - train vs car. In red the car and in blue the train. The car passengers were subjected to higher nitrogen dioxide concentrations than those travelling by train. Usually, car journeys were longer than train. It was also observed that exposure in the car was higher during peak hour traffic outside large cities as expected. Weather conditions have not been taken into consideration. The increasing exposure with the duration of travel also indicates the impact of the vehicles themselves on the air quality in the passenger cabins. During the monitoring periods, all pollutant concentration levels have remained between the

moderate to acceptable range.

## Home VS Office

**The $NO_2$ measurements from the office and home office shows a similar increasing trend with the increasing duration at work. However, levels in the office were considerably higher than those at home.**




Results & discussion

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Here, the nitrogen dioxide exposure data corresponds to the workplace. In red working at home while the blue is at the office. It shows a similar increasing trend with the increasing duration at work. Nitrogen dioxide levels in the office were distinctly higher on some days than others. Days with higher nitrogen dioxide in the office were usually Mondays which, according to recorded office occupancy, were one of the busiest days in the office and nearby parking. While the presence of people in the office does not directly impact the nitrogen dioxide concentrations, it could indicate that the increased traffic on the university campus and the nearby dual carriage road and motorway could affect the

air quality and exposure levels within the office space.

## Recommendations

$NO_2$ during commuting can play an important part in hybrid workers' personal exposure to air pollutants, especially during extended commuting times.

Working from home and avoiding commuting is likely to expose office workers to lower air pollutants levels than working from the office or hybrid working.

Results & discussion

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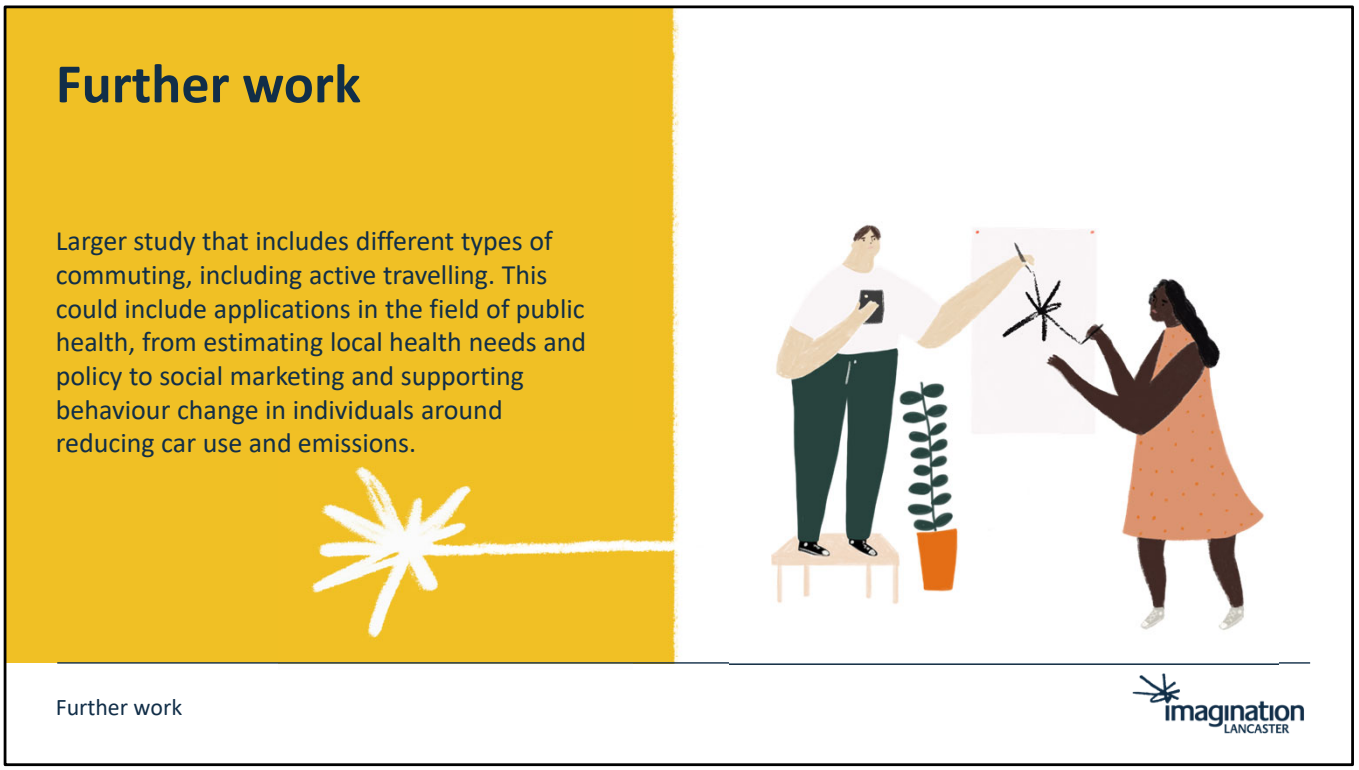
The results suggest that exposure to nitrogen dioxide during commuting can play an important part in hybrid workers' personal exposure to air pollutants, especially during extended commuting times. Public transport and trains are likely to have better indoor air quality than cars mainly due to the cabin ventilation systems they use and the routes they follow. Particularly as trains often travel away from roads with heavy traffic. This is valid probably only for long commutes between cities as discussed in this study and not within the city.

According to this pilot study's results, working from home and avoiding commuting is likely to expose office

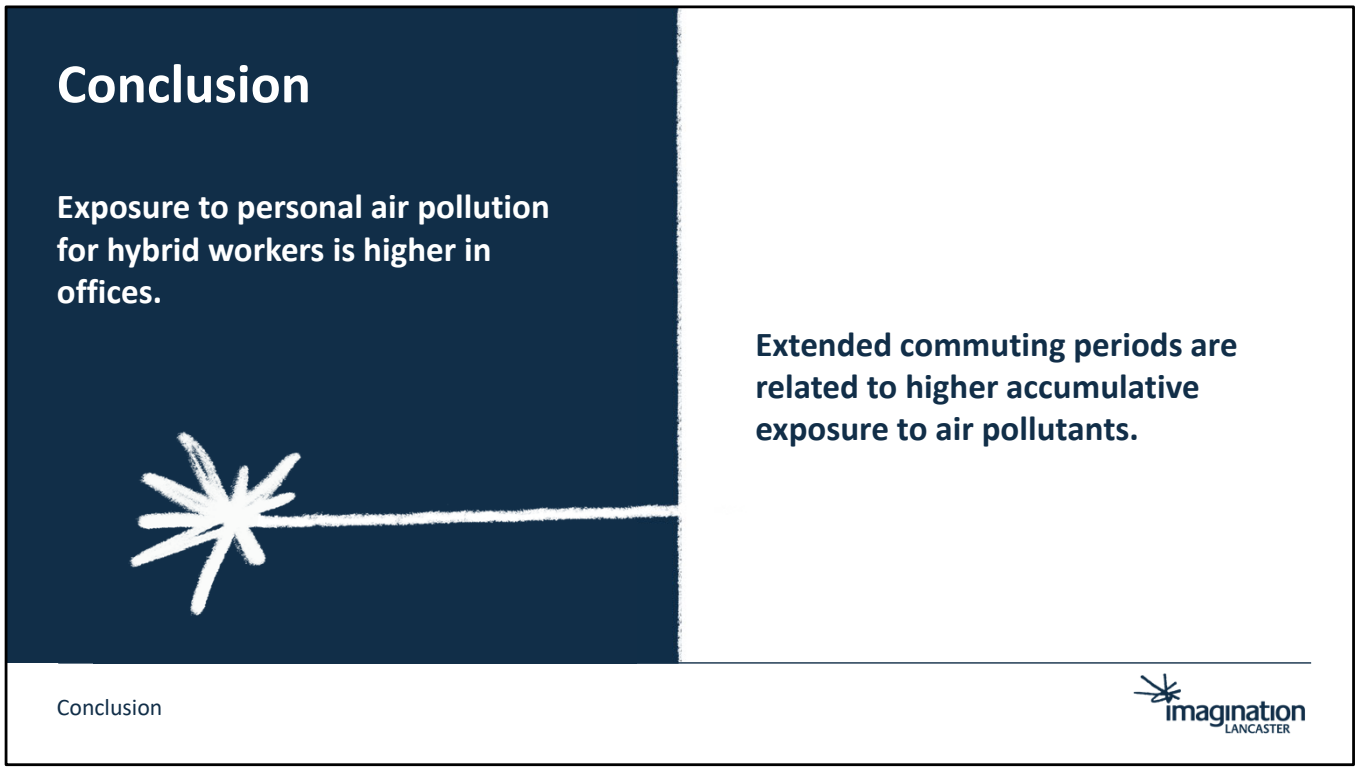
workers to lower air pollutants levels than working from the office or hybrid working. The observed exposure levels are expected to be exacerbated for transects across cities during hours with peak traffic. However, this suggests that people's workplaces might not be the main cause of exposure to air pollutants.



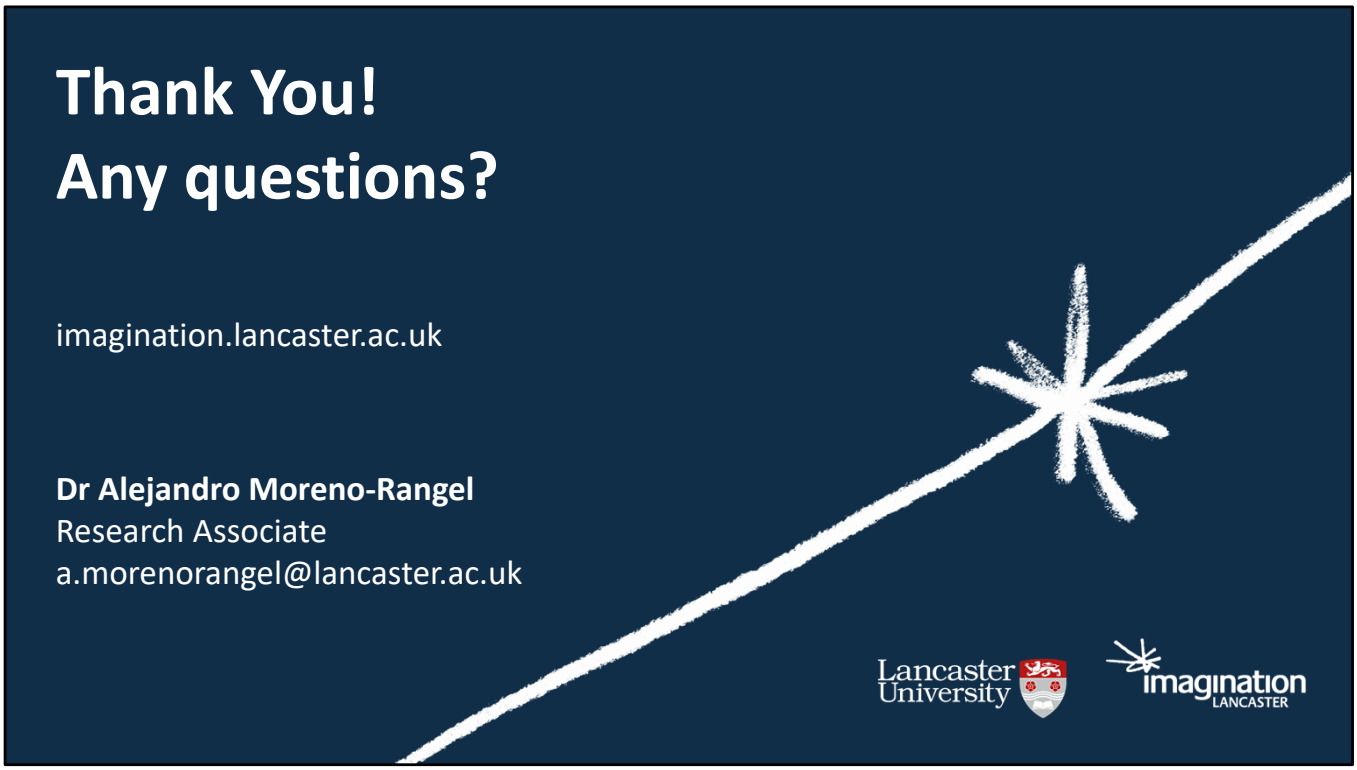

The findings from a larger study have a number of potential applications in the field of public health, from estimating local health needs and policy to social marketing and supporting behaviour change in individuals around reducing car use and emissions. This is particularly timely as the UK moves forward from the COVID-19 pandemic and into a new hybrid way of working.

Further work should look at the exposure during typical commute across a city and inter-city transects both by train and car for popular commuting routes. In terms of building air quality, ventilation parameters need to be considered, and buildings at different locations need to

be studied, controlling for room size, occupancy behaviour, HVAC settings, and local weather conditions.




While the findings cannot be generalised, they suggest that personal exposure to air pollution for hybrid workers is higher in offices and that extended commuting periods are related to higher accumulative exposure to air pollutants. Further work should also explore the impact of building design, neighbourhood and commute to personal exposure to air pollution with a bigger sample size.




This concludes my presentation, thank you all for listening and if you do have any comments or questions, please feel free to email me.