Evaluating population level interventions: Health Impacts of a Clean Air Zone

Birmingham City Council

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Clean air zones (CAZs) and Low Emission Zones (LEZs) are a strategy many cities have introduced to reduce traffic-related emissions. A category D CAZ which **aimed to reduce nitrogen dioxide (NO_2) in the shortest time possible** was introduced in June 2021 in Birmingham (although exemptions apply). We summarise findings of the three components of our approach: 1) air quality indicators; 2) literature review of health impacts; 3) short term health outcomes; and discuss the challenges of evaluating population level interventions.

Aim 1: Impact of Birmingham CAZ on air quality

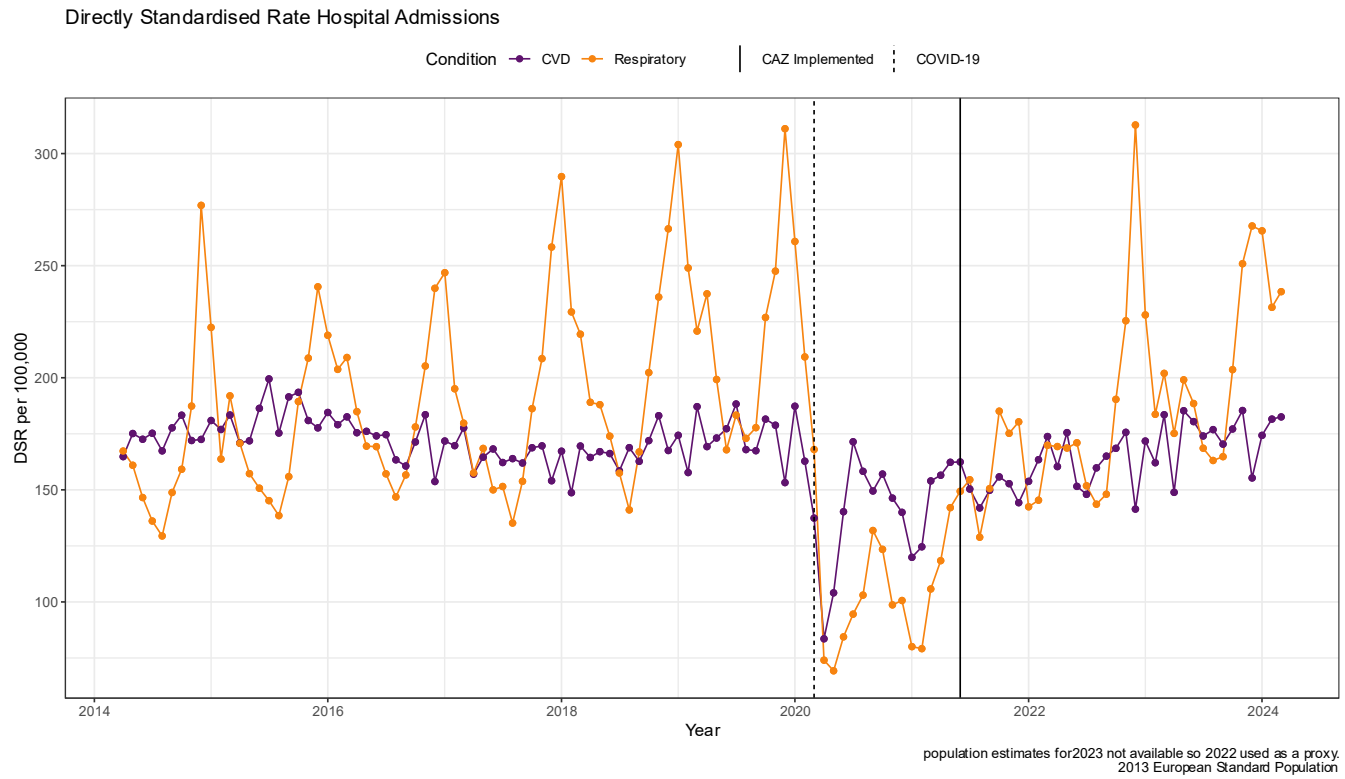
- **In 2024 NO_2 in the CAZ reduced by an average of 27% compared to 2019 (pre-covid)**
- **'Non-compliant' vehicles entering the CAZ reduced** from 15.2% (June 2021) to 3.8% (August 2025)
- Liu et al. (2023) found during year one of implementation the Birmingham CAZ led to **modest but significant reductions in roadside NO_2 and NOx within and outside the CAZ**

Aim 2: Literature review of the health impact of CAZs

- Reviewed **18 peer-reviewed studies** evaluating CAZs impact on health, measured using health data (not predicted from air quality improvements)
- Evaluated a range of different CAZ and LEZ policies in Germany, Japan, UK, Belgium and Sweden (challenge for comparing)
- Common methods were (controlled) interrupted time series (ITS) and difference-in-differences
- **Positive impacts for respiratory, cardiovascular disease (CVD), diabetes, birth outcomes, general health and wellbeing,** but not consistently identified
- Some studies identified no positive impact on the outcomes but only 1 study specified a negative impact (subjective life satisfaction)
- Systematic review (Chamberlain et al. 2023) found current evidence suggests **LEZs can reduce air pollution-related health outcomes, with the most consistent effect on CVD**

Aim 3: Investigate measurable short-term health impacts of Birmingham CAZ

Whilst only ~5% of Birmingham residents live in the CAZ, all Birmingham residents were included in the analysis. Directly standardised rates (DSRs) over time were calculated for CVD and respiratory hospital admissions (emergency and all admissions). DSRs were compared to core cities, England and West Midlands region averages and cities with a CAZ and age-specific inhaler prescription rates were calculated (data not shown). ITS analysis was utilised for some outcomes, including a continuous COVID-19 impact factor, calculated using England DSR.



We found that whilst air quality has significantly improved, and previous studies and biological plausibility links this to improved health outcomes, evidence of this was not found in our **short-term analysis** of the whole Birmingham population with **longer term follow up and analysis of primary care data needed**.

Many reasons why real-world population level interventions are hard to evaluate:

- Aggregate or proxy data (intervention defined by city of residence)
- Difficult to isolate impact of intervention from **other policies**
- **Phased intervention implementation**
- **Confounding factors**
- **Seasonality**
- Existing inequalities
- Data availability
- Control limitations
- Impact of **other events**
- **Wider determinants** of health
- **Heterogenous interventions** affecting ability to compare
- Only looking at short-term impact, **follow up needed** to understand long term impacts

RESET RESHAPE RESTART

Liu, B., Bryson, J.R., Sevinc, D. et al. Assessing the Impacts of Birmingham's Clean Air Zone on Air Quality: Estimates from a Machine Learning and Synthetic Control Approach. Environ Resource Econ 86, 203–231 (2023).
Chamberlain RC, Fecht D, Davies B, Laverty AA, Health effects of low emission and congestion charging zones: a systematic review, The Lancet Public Health, Volume 8, Issue 7, 2023, Pages e559-e574

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