Evaluating the impact of School Street Interventions on air quality at Primary Schools in Oxfordshire

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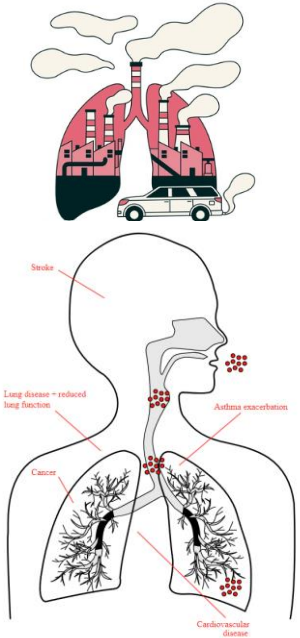
Background

- Traffic pollution in the UK poses serious health risks
- Long-term exposure increases the risk of asthma, heart disease, and impaired lung and cognitive development in children [1].
- Short-term exposure to NO_2 can trigger asthma attack, respiratory irritation, and reduce lung function in children [2].
- Children can be exposed to high levels of traffic related air pollution when travelling to and from school settings [3].



Study Focus

- School Streets aim to improve road safety and air quality around schools through traffic restrictions during drop-off and pick-up times.
- School Street interventions have expanded in the UK in recent years but there is limited evidence for impacts on local air quality.
- This study evaluates the impact of School Street schemes on air pollution at four Oxfordshire Primary Schools, compared to six control schools.

Study Design and Intervention

- **Study Design**
  - Retrospective observational study
  - May 2022 – June 2024
- **Data**
  - Hourly NO_2 data (May 2022 – Jan 2024) were collected at intervention (n=4) & control (n=6) locations using Zephyr® sensors
  - Defra AURN (Roadside and Urban Background) in Oxford City used as reference points
- **Intervention**
  - Introduced in Feb 2023 at four schools located in Oxford and Abingdon
  - Peak time road closures were site-specific, typically from 08:00-09:00 and 14:30-15:30.

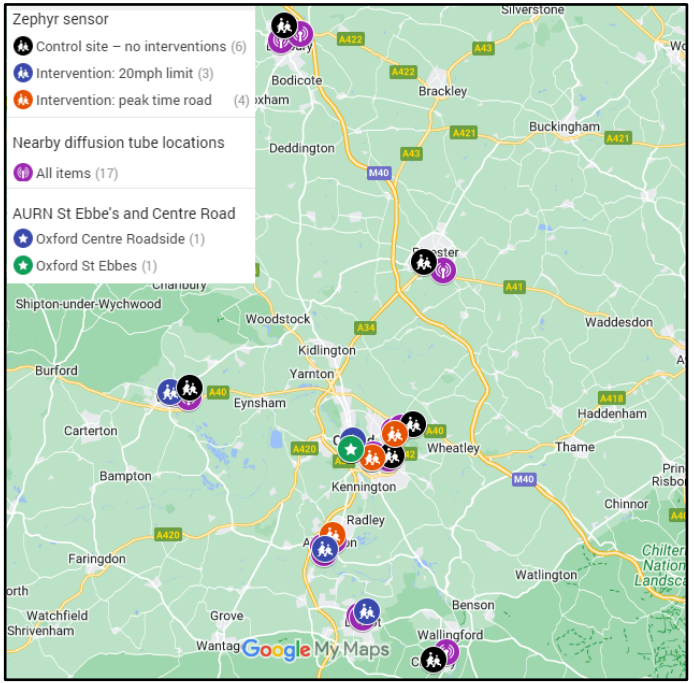


Figure *Air quality monitoring locations*

Methods

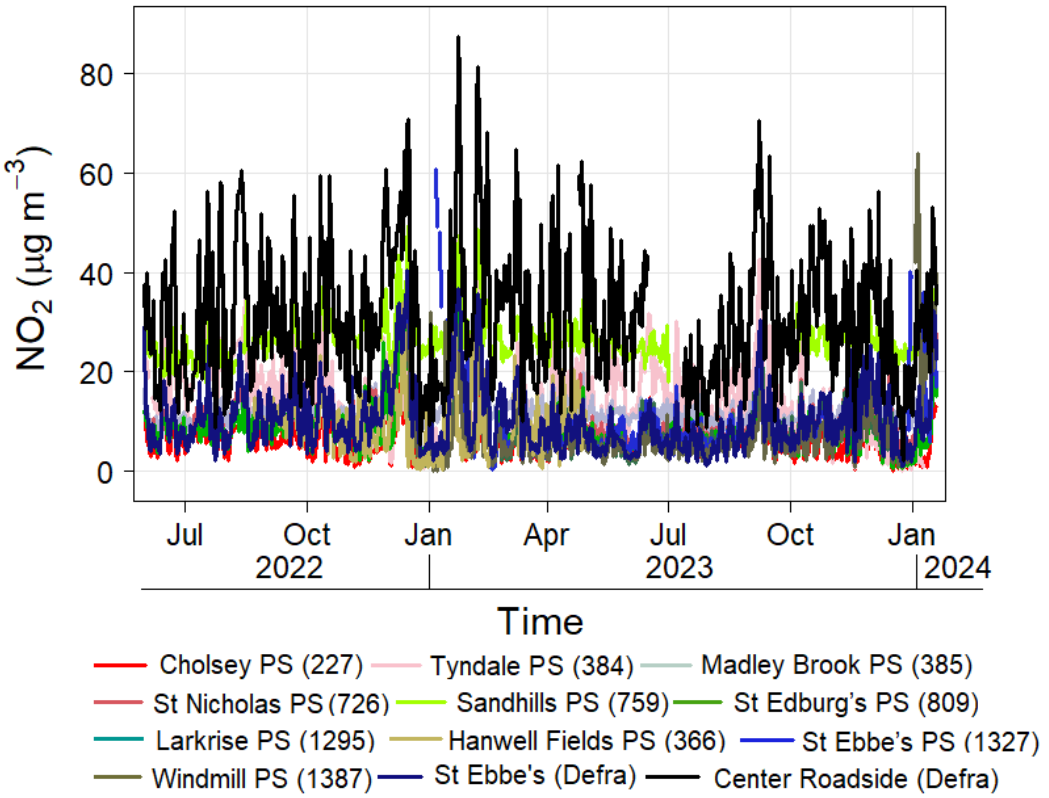
- Sensor performance was assessed by co-located sensor and urban background site at St Ebbe's (Oxford)

- Pearson correlation coefficients were calculated to assess concordance between regulatory and sensor measurements for 24-hour and monthly concentrations for the study period.

- Time-weighted NO_2 concentrations were compared for matched road closure periods between intervention and control sites.

Air Pollution Trends

- All sites demonstrated similar seasonal trends.
- One school was identified as outliers with persistent high NO_2 concentrations located in Witney and Oxford.
- Further work will be undertaken to compare these site measurements to NO_2 diffusion tube data



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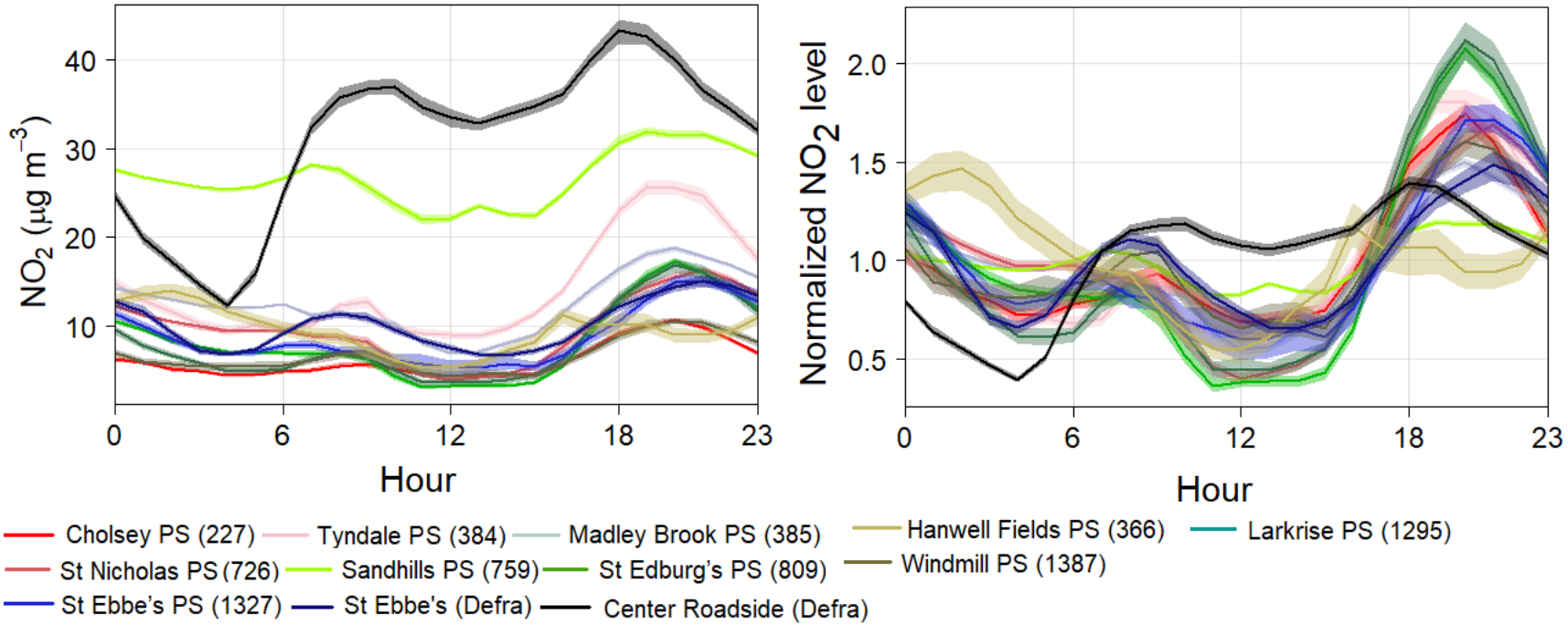
Diurnal profile of NO_2 Concentrations



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Comparison of Air Quality Sensor and Reference Data (St Ebbe's)

- Comparison was performed at St Ebbe's Primary School (intervention site) which is adjacent to a regulatory AURN monitoring location
- High correlation between urban background and sensor data: r=0.92 (daily), r=0.60 (monthly).
- Roadside NO_2 levels measured at Oxford High Street were higher, reflecting traffic-related sources.

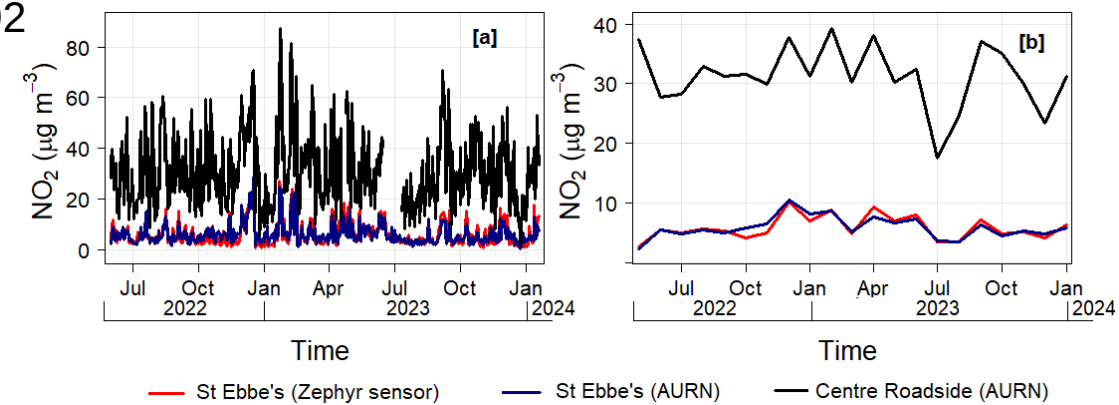

***Figure** a) Daily and b) monthly averaged time series of NO_2 concentrations at St Ebbe's (both Zephyr sensor and AURN) and Center Roadside (AURN)*

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Impact of School Streets on NO_2 Concentrations

- NO_2 levels were typically higher in the morning than the afternoon across all sites.

- Provisional data analysis suggests greater relative reductions in NO_2 concentrations at intervention compared to control locations.

- Reductions were typically higher in morning compared to afternoon closure periods, which may reflect differences in school travel patterns.

School Sensor location	AM restrictions time (term time only)	PM restriction time (term time only)	Overall Changes (AM+PM)
St Ebbe's Primary School Z-1327	08:00-09:00 **Before:** mean(21.4±8.8); median(19.8) **After:** mean (6.8±7.4); median(4.0) **Change:** 68.2% ▼	14:30-15:30 **Before:** mean(15.3±8.9); median(11.5) **After:** mean (3.7±5.6); median(1.9) **Change:** 75.8% ▼	**Before:** mean(17.8±8.8); median(14.8) **After:** mean (5.6±6.5); median(3.0) **Change:** 69.0% ▼
St Nicholas Primary School, Z-726	08:10- 09:00 **Before:** mean(11.3±9.8); median(9.4) **After:** mean (10.2±9.6); median(7.6) **Change:** 10.0% ▼	14:30-15:30 **Before:** mean(7.5±7.0); median(5.8) **After:** mean (6.3±6.2); median(4.4) **Change:** 16.0% ▼	**Before:** mean(9.0±8.4); median(8.0) **After:** mean (7.9±7.9); median(5.9) **Change:** 12.2% ▼
Larkrise Primary School, Z-1295	08:10-09:00 **Before:** mean(15.2±8.4); median(10.6) **After:** mean (7.0±7.8); median(4.1) **Change:** 54.0% ▼	14:30-15:30 **Before:** mean(7.0±4.9); median(4.4) **After:** mean (5.2±6.6; median(2.4) **Change:** 28.6% ▼	**Before:** mean(10.1±6.6); median(6.5) **After:** mean (5.9±7.2); median(2.8) **Change:** 42.0% ▼
Windmill Primary School, Z-1387	08:20 – 09:00 **Before:** mean(14.1±8.0); median(8.7) **After:** mean (7.6±7.1); median(5.7) **Change:** 46.1% ▼	14:30-15:20 **Before:** mean(6.7±5.3); median(2.6) **After:** mean (4.9±5.4); median(.0) **Change:** 27.0% ▼	**Before:** mean(9.7±9.6); median(5.8) **After:** mean (5.9±6.2); median(4.1) **Change:** 39.2% ▼
AURN St Ebbe's **Background site**	08:00 – 09:00 **Before:** mean(15.8±10.5); median(13.6) **After:** mean (12.3±8.7); median(9.6) **Change:** 22.2% ▼	14:30-15:30 **Before:** mean(9.7±8.0); median(7.7) **After:** mean (7.2±4.7); median(5.9) **Change:** 25.8% ▼	**Before:** mean(12.5±9.7); median(9.0) **After:** mean (10.0±7.2); median(7.1) **Change:** 20.0% ▼

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Changes in NO_2 Concentrations at control sites

School Sensor location	AM restrictions time (term time only)	PM restriction time (term time only)	Overall Changes (AM+PM)
St Edburg's Primary School Z-809	08:00-09:00 **Before:** mean(10.7±11.9); median(6.9) **After:** mean (6.2±7.2); median(3.4) **Change:** 42.1% ▼	14:30-15:30 **Before:** mean(5.4±7.2); median(1.9) **After:** mean (4.2±5.8); median(1.9) **Change:** 22.2% ▼	**Before:** mean(7.5±9.7); median(3.0) **After:** mean (5.0±6.4); median(2.4) **Change:** 33.3% ▼
Hanwell Fields Primary School, Z-366	08:00-09:00 **Before:** mean(10.1±10.1); median(5.4) **After:** mean (8.1±2.7); median(8.6) **Change:** 19.8% ▼	14:30-15:30 **Before:** mean(9.5±10.1); median(6.1) **After:** mean (9.7±3.5); median(5.0) **Change:** 2.1% ▲	**Before:** mean(9.7±10.1); median(5.9) **After:** mean (9.0±3.4); median(6.5) **Change:** 7.2% ▼
Cholsey Primary School, Z-227	08:00-09:00 **Before:** mean(7.8±7.6); median(5.1) **After:** mean (6.7±7.2); median(4.1) **Change:** 14.1% ▼	14:30-15:30 **Before:** mean(6.2±6.9); median(4.2) **After:** mean (5.1±4.2); median(4.3) **Change:** 17.7% ▼	**Before:** mean(6.8±7.2); median(4.5) **After:** mean (5.8±5.7); median(4.2) **Change:** 14.7% ▼
Madley Brook Primary School, Z-385	08:00-09:00 **Before:** mean(14.7±10.3); median(13.6) **After:** mean (12.0±8.1); median(11.1) **Change:** 18.3% ▼	14:30-15:30 **Before:** mean(10.7±7.6); median(9.7) **After:** mean (10.1±6.0 median(9.5) **Change:** 5.6% ▼	**Before:** mean(12.3±8.9); median(10.9) **After:** mean (10.7±7.0); median(10.1) **Change:** 13.0% ▼
Tyndale Primary School, Z-384	08:00-09:00 **Before:** mean(20.7±18.6); median(15.1) **After:** mean (13.5±11.4); median(10.5) **Change:** 34.8% ▼	14:30-15:30 **Before:** mean(13.9±11.2); median(11.6) **After:** mean (12.7±9.9); median(11.4) **Change:** 8.6% ▼	**Before:** mean(16.6±15.0); median(13.1) **After:** mean (13.0±10.6); median(11.0) **Change:** 21.7% ▼
Sandhills Primary School, Z-759	08:00-09:00 **Before:** mean(30.0±13.1); median(29.6) **After:** mean (28.0±13.9 median(26.8) **Change:** 6.7% ▼	14:30-15:30 **Before:** mean(24.2±7.2); median(25.1) **After:** mean (24.5±11.8); median(24.3) **Change:** 1.2% ▲	**Before:** mean(26.5±11.9); median(26.6) **After:** mean (26.0±12.7); median(25.0) **Change:** 1.9% ▼

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Conclusions

- Air quality sensors have some utility for assessing the impact of targeted interventions on short-term changes in NO_2 concentrations
  - Robust mechanisms for sensor calibration and quality assurance are essential

- Provisional findings suggest a positive benefit of timed road closures for reducing short-term NO_2 concentrations; further analysis is needed to understand changes which can be attributed to the intervention.

- School Streets schemes may be effective for reducing short-term air pollution levels at peak school travel times with potential benefits for child health.

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References

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[3] Unicef UK. 2018. The toxic school run. Available at: https://www.unicef.org.uk/wp-content/uploads/2018/09/UUK-research-briefing-The-toxic-school-run-September-2018.pdf

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