Vegetation and vehicle emissions around primary schools across urban Australia: associations with academic performance

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Introduction

Evolving evidence suggests that vegetation surrounding schools is beneficial to children's academic performance, however vehicle emissions are adversely related. Little is known about concurrent impacts of vegetation and vehicle emissions on academic performance. This study examined associations of vegetation and vehicle emissions near urban Australian primary schools with children's academic performance.

Method

- Assessment of 3,745 primary schools in urban areas (population ≥ 10,000) of Australia in 2018 using:

  a. Evaluation of the Normalized Difference Vegetation Index (NDVI) within school yards and buffers (100, 300 and 1,000 m).

  b. Calculation of the Weighted road density (WRD) as a vehicle emissions proxy (with same buffers).

- Cross-sectional associations and mediating pathways between vegetation and vehicle emissions and standardized average school scores in Literacy (Reading, Writing, Language Conventions) and Mathematics for Grades 3 and 5.

- Linear modeling for school socio-educational status.

Results

- **Significant positive associations** between vegetation and Reading in Grades 3 and 5, Mathematics in Grade 3 (all buffers), Writing in Grade 3 (100 and 300 m), and Language Conventions in Grades 3 and 5 (most buffers).

- **Negative association** between vehicle emissions and Reading and Mathematics in Grades 3 and 5 (most buffers), and Language Conventions in Grade 3 (300 and 1,000 m) and Grade 5 (100 – 1,000 m).

- Within 300 m, vehicle emissions partially **mediated associations** between vegetation with Mathematics in Grade 3, Reading and Language Conventions in Grade 5.

Fig. 1. Open Street Map road types used for WRD (right), and distribution of primary schools (left) within the study for the Melbourne area showing buffers used for the analysis.

OSM Road types
- motorway
- primary
- residential
- secondary
- tertiary
- trunk
- unclassified

Primary Schools
- School polygon
- Buffer 100 m
- Buffer 300 m
- Buffer 1,000 m

0   12   24 km

Conclusions

- Using Australia wide data, this study provides further evidence that vegetation around primary schools is associated with higher academic achievement.

- Vehicle emissions were negatively associated with children's scores (Reading, Mathematics and language conventions).

- Future research should be conducted to confirm findings, include on-site measurement of vehicle emissions and audits of vegetation (amount and type) around schools.
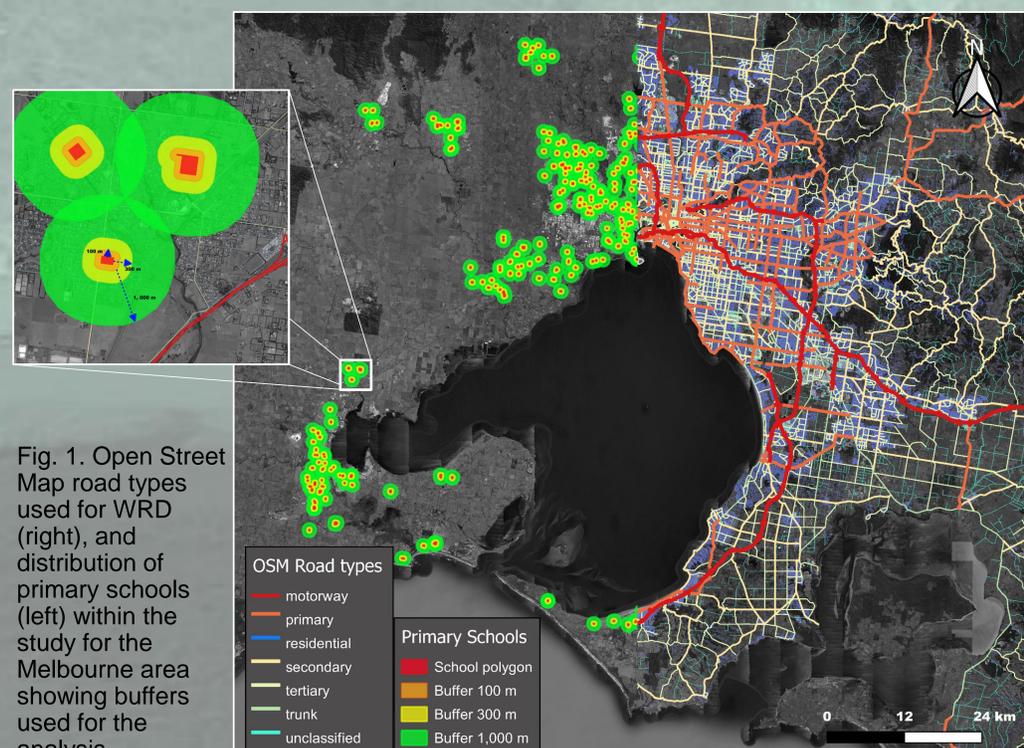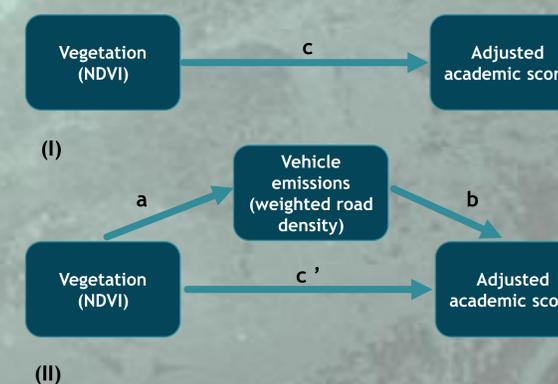

Fig. 2. The total effect of vegetation on academic scores (I); the indirect effect of the vegetation on academic scores through the mediator variable (a and b pathways in II); and the direct effect of vegetation on academic scores (c/ pathway in II).

Acknowledgments

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