NO_2 exposure and asthma among over-50s in Ireland: a microdata analysis

Seán Lyons
ESRI and Trinity College Dublin

Environmental Protection Agency

tilda
Staidéar Fadaimseartha na hÉireann um Dhul in Aois
The Irish Longitudinal Study on Ageing

ESRI

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Agenda

1. Introduction and background
2. Example: Local NO_2 concentrations and asthma
3. Motivation and methodology
4. Data used in the study
5. Preliminary results
6. What is needed to enable this sort of research

Goal: Find causal health effects from environmental factors

Ideal data would combine, for a large, representative sample or population of individuals,

1. Detailed, accurate information on health outcomes
2. And specific exposures to environmental pollutants or amenities
3. And socioeconomic/behaviour information
4. Observing same people more than once (i.e. longitudinal)

What we actually have

Health & socioeconomic microdata

- TILDA (over 50s)
- Healthy Ireland
- GUI (children)
- CSO Census and surveys

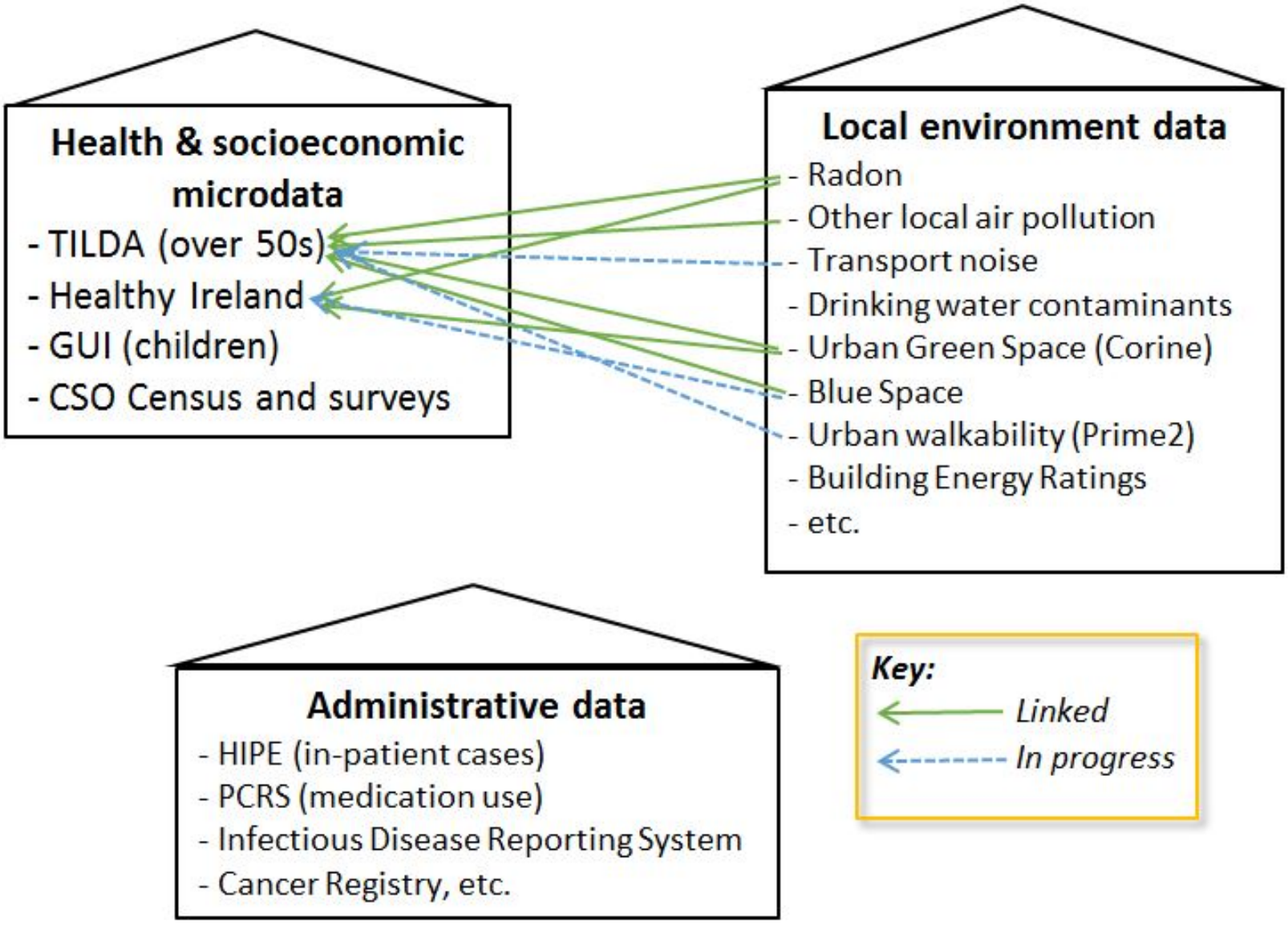
Local environment data

- Radon
- Other local air pollution
- Transport noise
- Drinking water contaminants
- Urban Green Space (Corine)
- Blue Space
- Urban walkability (Prime2)
- Building Energy Ratings
- etc.

Administrative data

- HIPE (in-patient cases)
- PCRS (medication use)
- Infectious Disease Reporting System
- Cancer Registry, etc.

Examples of linking



SSM - Population Health 4 (2018) 206–215

Contents lists available at ScienceDirect

SSM - Population Health

journal homepage: www.elsevier.com/locate/ssmph

Article

Urban green space and obesity in older adults: Evidence from Ireland

Seraphim Dempsey[a], Seán Lyons[a,b], Anne Nolan[a,b,c,*]

[a] Economic and Social Research Institute, Sir John Rogerson's Quay, Dublin, Ireland
[b] Department of Economics, Trinity College Dublin, Ireland
[c] The Irish Longitudinal Study on Ageing, Trinity College Dublin, Ireland

Health and Place 54 (2018) 110–117

Contents lists available at ScienceDirect

Health & Place

journal homepage: www.elsevier.com/locate/healthplace

Coastal blue space and depression in older adults

Seraphim Dempsey[a], Mel T. Devine[b], Tom Gillespie[c], Seán Lyons[a,d], Anne Nolan[a,d,e,*]

[a] Economic and Social Research Institute, Sir John Rogerson's Quay, Dublin, Ireland
[b] Energy Institute, School of Electrical and Electronic Engineering, University College Dublin, Ireland
[c] Socio-Economic Marine Research Unit, National University of Ireland, Galway, Ireland
[d] Department of Economics, Trinity College Dublin, Ireland
[e] The Irish Longitudinal Study on Ageing, Trinity College Dublin, Ireland

Social Science & Medicine 220 (2019) 254–263

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

An investigation of the effect of accessibility to General Practitioner services on healthcare utilisation among older people

Gretta Mohan[a,b,*], Anne Nolan[a,b], Seán Lyons[a]

[a] Economic and Social Research Institute, Whitaker Square, Sir John Rogerson's Quay, Dublin 2, Dublin, Ireland
[b] The Irish Longitudinal Study on Ageing, Lincoln Gate, Trinity College, Dublin, Ireland

Journal of Environmental Radioactivity 182 (2018) 12–19

Contents lists available at ScienceDirect

Journal of Environmental Radioactivity

journal homepage: www.elsevier.com/locate/jenvrad

High Radon Areas and lung cancer prevalence: Evidence from Ireland

Seraphim Dempsey[a], Seán Lyons[a,b], Anne Nolan[a,b,c,*]

[a] The Economic and Social Research Institute, Sir John Rogerson's Quay, Dublin 2, Ireland
[b] Department of Economics, Trinity College Dublin, Ireland
[c] The Irish Longitudinal Study on Ageing, Trinity College Dublin, Ireland

Example: Local NO_2 concentrations and asthma

- Linking simulated local NO_2 exposures to TILDA residential addresses to assess potential health effects.
- Primary focus on asthma cases among TILDA respondents.
- Efforts to circumvent potential bias in self-reporting of asthma through data on use of obstructive airway disease (OAD) medications.

The team

- Dr Anne Nolan, Mr Philip Carthy, Dr Seán Lyons; ESRI & TCD (econometric modelling; knowledge of TILDA data)
- Prof. Margaret O'Mahony, Aonghus Ó Domhnaill, Prof. Brian Broderick; TCD. Dr. Aoife Donnelly; TUD. Dr. Owen Naughton; IT Carlow (Local NO_2 simulations; knowledge of emissions processes)
- Dr. Frank Moriarty, RCSI. (Classification of medications for obstructive airway disease)
- Prof. Martina Hennessy, TCD (medicine)

Motivation

- NO_2 often used in epidemiological studies as a marker of combustion-related outdoor air pollution (Achakulwisut et al. 2019)
- Also known to be directly associated with asthma and other respiratory diseases, particularly in young children (Bowatte et al. 2014)
- Evidence of direct effect in adults is more inconsistent (Guarnieri & Balmes 2014; Le Moual et al. 2013)
- Area-based studies have difficulty disentangling complex sources of variability in populations:
  A better understanding of the complex relationships between socioeconomic, nutritional, lifestyle and environmental conditions might help to study their joint and independent roles in asthma (Le Moual et al. 2013)

Methodology: logistic regression models

Model 1: Self-reported Asthma

$$\mathbb{P}(asthma_i = 1 \mid NO_2, \mathbf{X}) = \Lambda(\alpha + \beta_0 NO_{2_i} + \beta_1 High\ NO_{2_i} + \sum \beta_k \mathbf{X}_{ki})$$

Model 2: OAD Medications

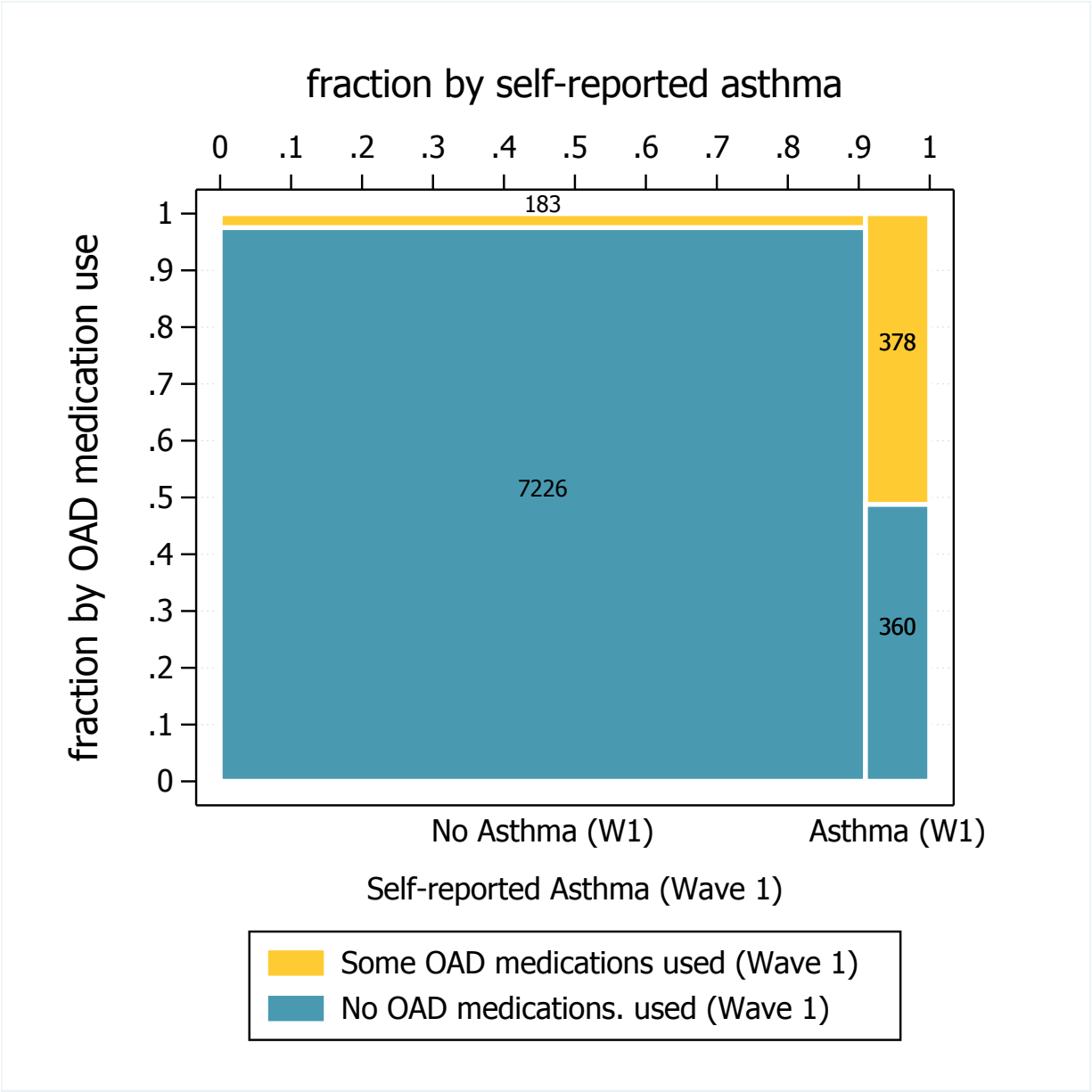
$$\mathbb{P}(medications_i = 1 \mid NO_2, \mathbf{X}) = \Lambda(\alpha + \beta_0 NO_{2_i} + \beta_1 High\ NO_{2_i} + \sum \beta_k \mathbf{X}_{ki})$$

- $\Lambda(z) = \frac{e^z}{1+e^z}$, the c.d.f. of the logistic function.
- $\mathbf{X}$ is a vector of socioeconomic and health factors.
- We also carry out a number of robustness checks using various alternative specifications.

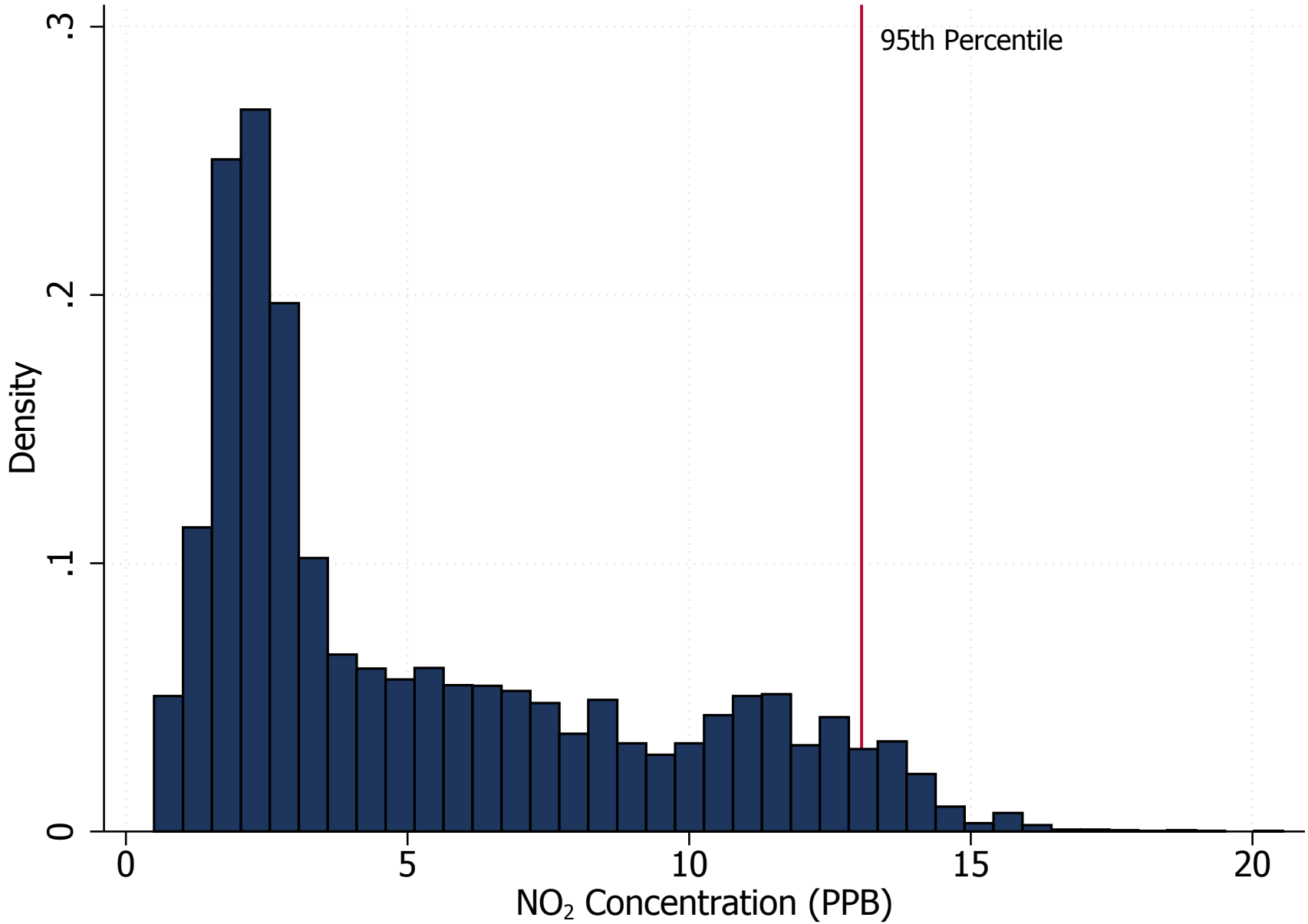
The Irish Longitudinal Study on Ageing (TILDA)

- Nationally-representative longitudinal study of the over-50s in Ireland
- Three modes of data collection: CAPI, SCQ, health assessment
- Extensive data on health status, use of medications and socioeconomic characteristics
- Each participant's address is geo-coded
- Harmonised with SHARE, ELSA, HRS
- At baseline (2010), 8,504 over 50s (and partners of any age) participated
- Further waves in 2012, 2014, 2016 and 2018, with 6th wave planned for 2020

Asthma Outcomes (TILDA Wave 1)



Distribution of NO_2 among TILDA respondents



Descriptive Statistics: Socioeconomic Controls

	Freq.	%
Gender		
Male	3,727	45.75
Female	4,419	54.25
Age Category		
50-64	4,652	57.11
65-74	2,155	26.45
$\geq$ 75	1,339	16.44
Income Category		
0 - 9,999	645	7.92
10,000 - 19,999	1,656	20.33
20,000 - 39,999	2,699	33.13
40,000 - 69,999	1,554	19.08
$\geq$ 70,000	699	8.58
Not reported	893	10.96
Marital Status		
Married	5,616	68.94
Never married	789	9.69
Sep/divorced	551	6.76
Widowed	1,190	14.61

	Freq.	%
Employment Status		
Employed	2,926	35.92
Retired	3,032	37.22
Other	2,188	26.86
Smoking Status		
Never	3,556	43.65
Past	3,104	38.1
Current	1,486	18.24
Educational Attainment		
Primary/none	2,493	30.6
Secondary	3,251	39.91
Third/higher	2,402	29.49
Medical Cover		
Not covered	842	10.34
Medical insurance	3,276	40.22
Medical card	4,028	49.45
Mobility		
No difficulty walking 100m	7,547	92.65
Difficulty walking 100m	599	7.35
Total	8,146	100

Preliminary modelling results

Dep. Var: $\mathbb{P}$(Self-reported Asthma (W1))		Sign and significance†
NO_2 Exposure	NO_2 (PPB)	$++$
	$NO_2 > P_{95}$	$+$
Gender	Male	[ref.]
	Female	$+++$
Age Category	50-64	[ref.]
	65-74	
	$\geqslant$75	$---$
Smoking Status	Never	[ref.]
	Past	$+++$
	Current	$-$
Medical Cover	Not covered	[ref.]
	Medical insurance	
	Medical card	$+++$
Mobility	No difficulty walking 100m	[ref.]
	Difficulty walking 100m	$+++$
N	8,146	

† Significance levels: $^{+}p<0.1$; $^{++}p<0.05$; $^{+++}p<0.01$

Robustness checks

- NO_2 exposure coefficients in self-reported asthma and medication use models very similar
- Pollutant coefficients stable across TILDA waves
- Marginal effect on High NO_2 dummy variables generally about 10x larger than PPB coefficients, though statistical significance of High NO_2 term varies
- Implied scale of pollution effect big enough to be policy-relevant

What is needed to enable this sort of research

- All datasets must have detailed spatial identifiers; e.g. TILDA locations are geocoded due to how sampling was done
- Access protocols to allow spatial linking under secure conditions
- Use environmental exposure variables in a format that does not increase risk of disclosiveness
  - E.g. code variables as quantiles of exposure rather than continuous variables; integer levels NO_2 exposure with top coding
- Protocol to allow researchers access to the linked anonymised data

References

References I

Achakulwisut, P., Brauer, M., Hystad, P., & Anenberg, S. C. (2019). Global, national, and urban burdens of paediatric asthma incidence attributable to ambient NO2 pollution: Estimates from global datasets. *The Lancet Planetary Health*, *3*(4), e166–e178. doi:10.1016/s2542-5196(19)30046-4

Bowatte, G., Lodge, C., Lowe, A. J., Erbas, B., Perret, J., Abramson, M. J., ... Dharmage, S. C. (2014). The influence of childhood traffic-related air pollution exposure on asthma, allergy and sensitization: A systematic review and a meta-analysis of birth cohort studies. *Allergy*, *70*(3), 245–256. doi:10.1111/all.12561

Bowatte, G., Lodge, C. J., Knibbs, L. D., Lowe, A. J., Erbas, B., Dennekamp, M., ... Dharmage, S. C. (2017). Traffic-related air pollution exposure is associated with allergic sensitization, asthma, and poor lung function in middle age. *Journal of Allergy and Clinical Immunology*, *139*(1), 122–129.e1. doi:10.1016/j.jaci.2016.05.008

References II

Fuertes, E., Heinrich, J., Bowatte, G., Lodge, C. J., Lowe, A. J., Erbas, B., ... Dharmage, S. C. (2015). The influence of childhood traffic-related air pollution exposure on asthma, allergy and sensitization. *Allergy*, *70*(10), 1350–1352. doi:10.1111/all.12611

Gauderman, W. J., Avol, E., Lurmann, F., Kuenzli, N., Gilliland, F., Peters, J., & McConnell, R. (2005). Childhood asthma and exposure to traffic and nitrogen dioxide. *Epidemiology*, 737–743. doi:10.1097/01.ede.0000181308.51440.75

Guarnieri, M., & Balmes, J. R. (2014). Outdoor air pollution and asthma. *The Lancet*, *383*(9928), 1581–1592. doi:10.1016/s0140-6736(14)60617-6

McConnell, R., Berhane, K., Yao, L., Jerrett, M., Lurmann, F., Gilliland, F., ... Peters, J. (2006). Traffic, susceptibility, and childhood asthma. *Environmental Health Perspectives*, *114*(5), 766–772. doi:10.1289/ehp.8594

References III

Moual, N. L., Jacquemin, B., Varraso, R., Dumas, O., Kauffmann, F., & Nadif, R. (2013). Environment and asthma in adults. *La Presse Médicale*, *42*(9), e317–e333. doi:10.1016/j.lpm.2013.06.010