The physical and social impact of traffic-related air pollution on the health of Scottish residents

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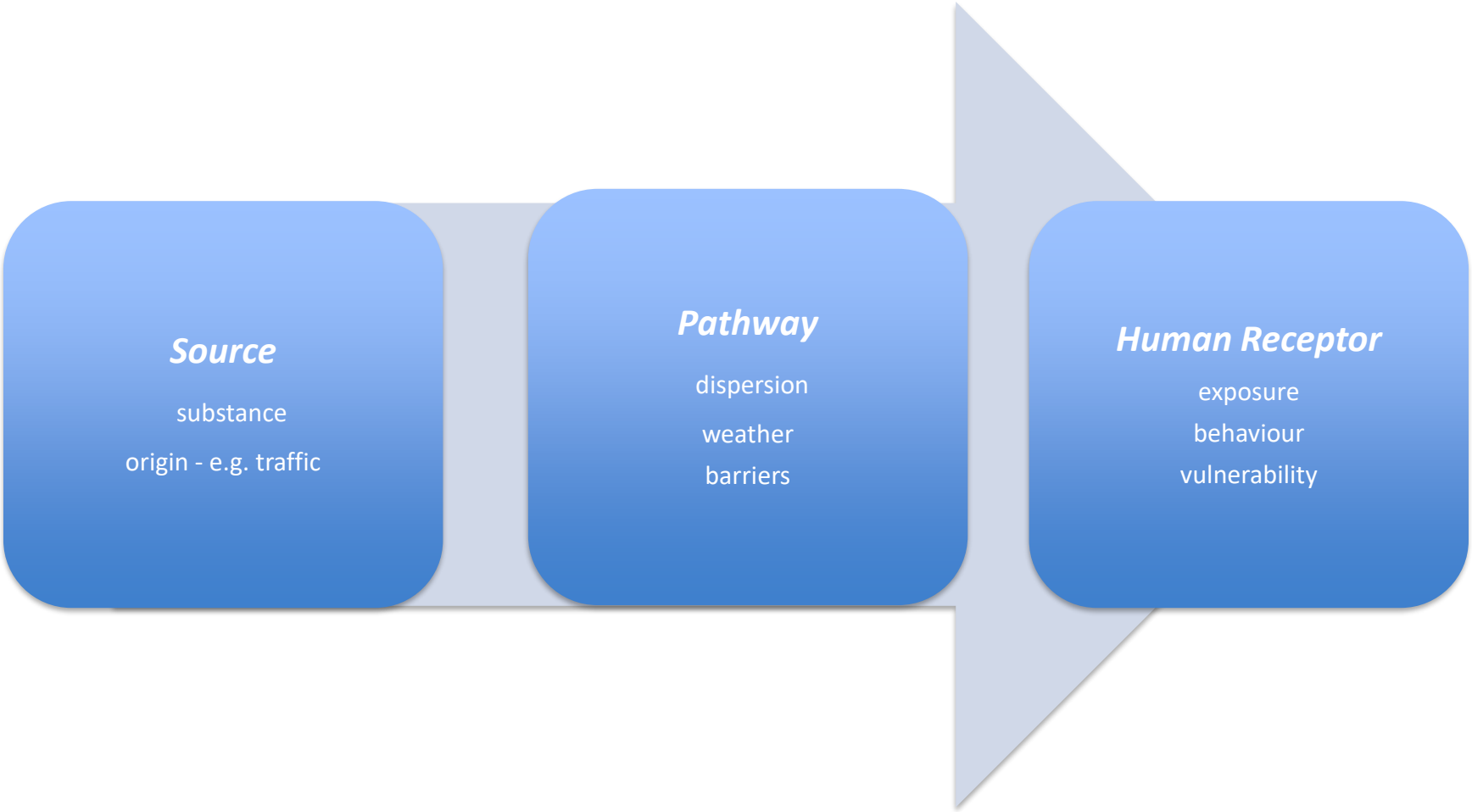
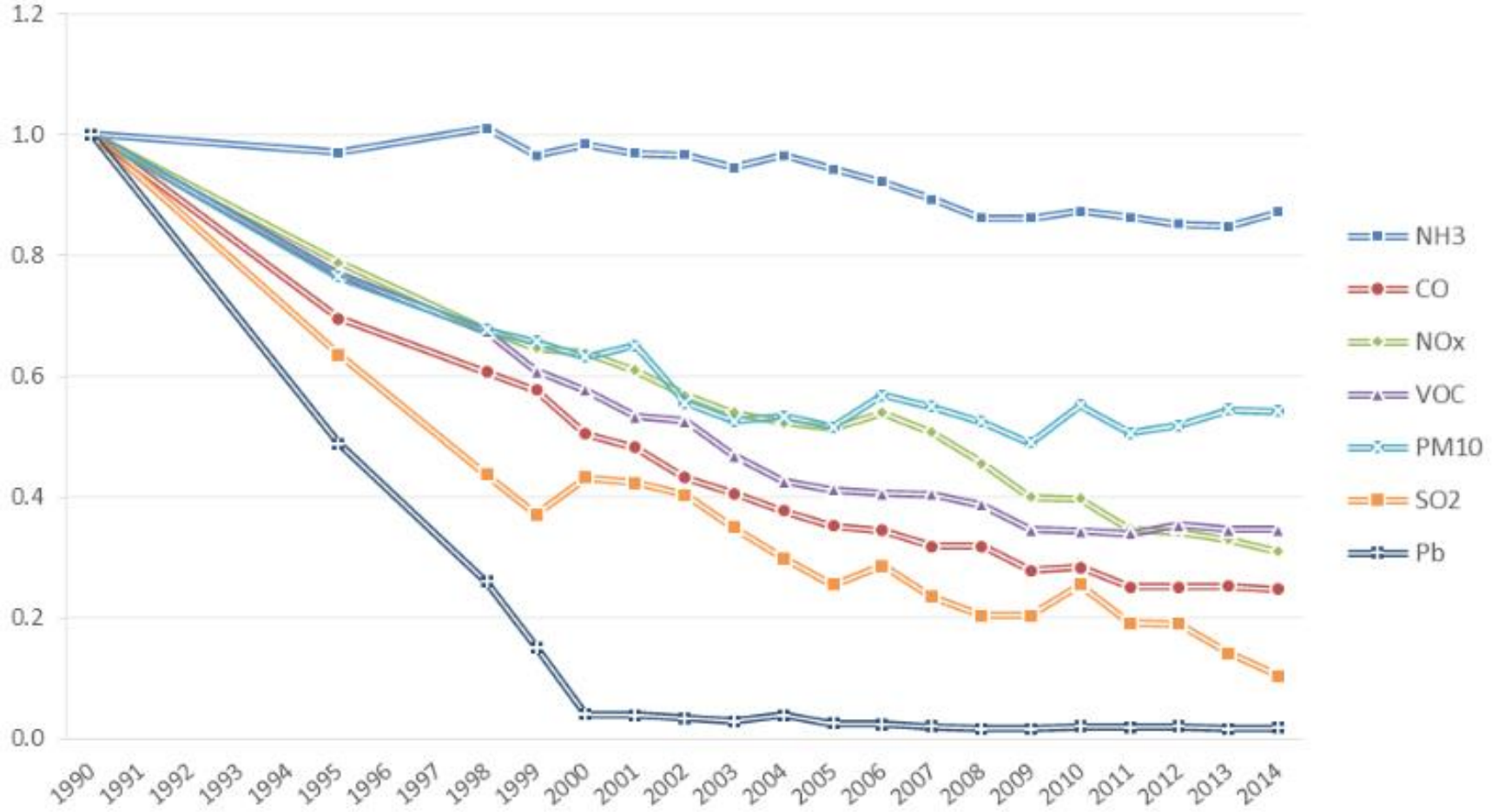
Exposure Dynamics

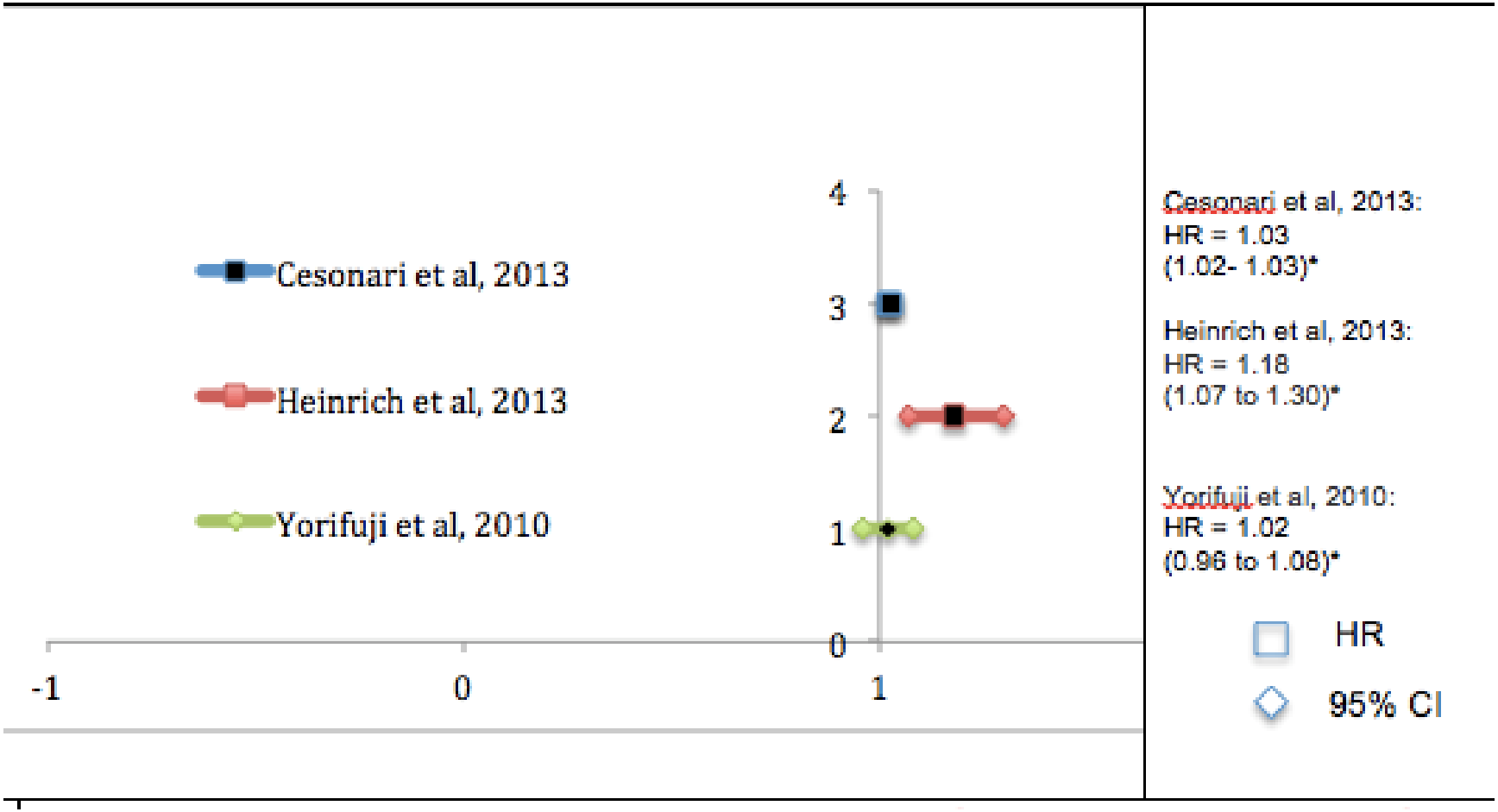


Scottish air pollution trends for all regulated emissions, 1990 (baseline) to 2014

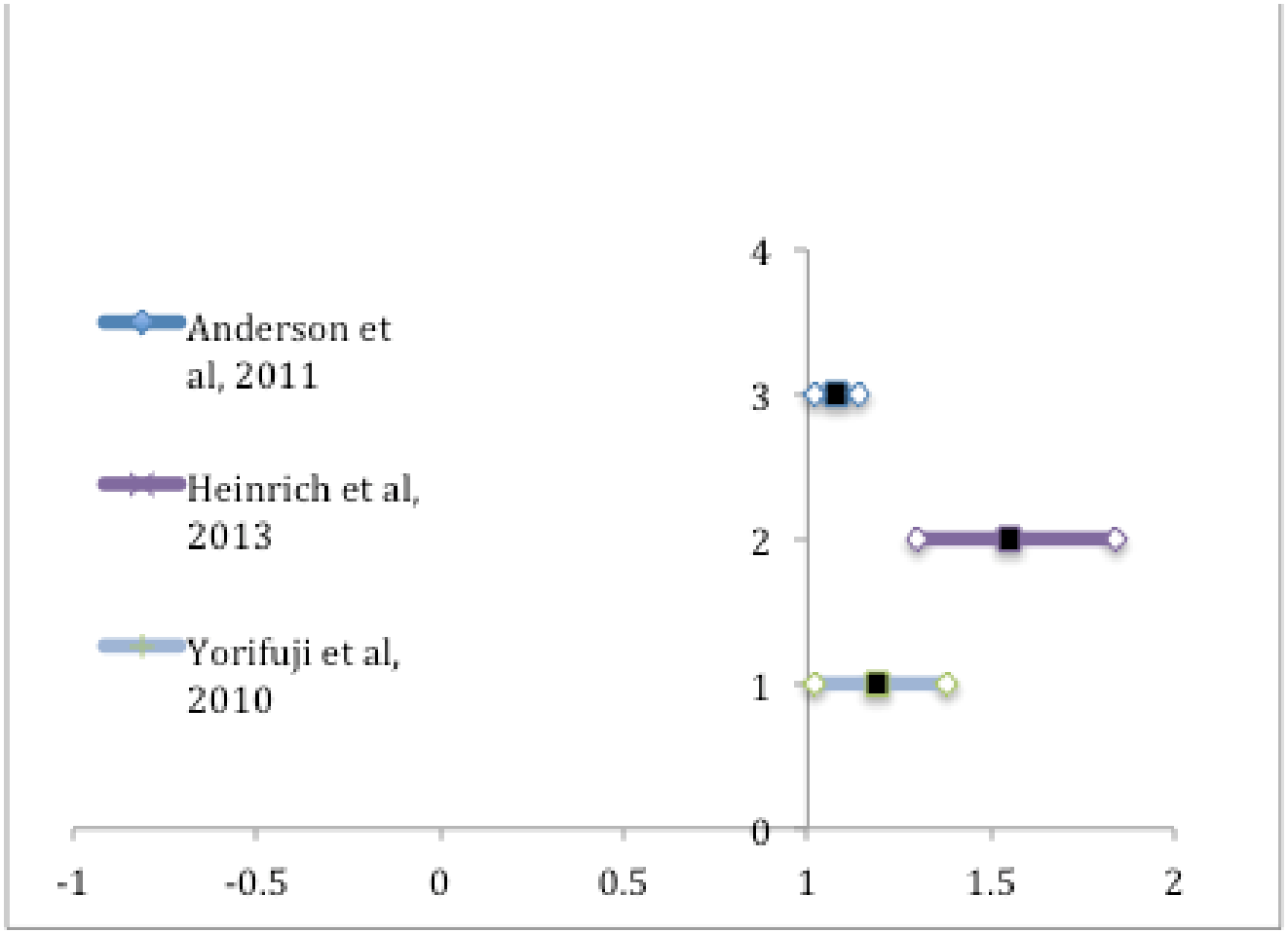
Bailey et al., 2016, p13



Forest plot showing the HR results for all cause mortality from exposure to elevated levels of traffic-related NOx/NO_2 emissions



Forest Plot showing meta analysis for HR for respiratory/lung disease from NOx/NO_2 exposure



Anderson et al, 2011: HR = 1.08 (1.02-1.14)*

Heinrich et al, 2013: HR = 1.55 (1.30-1.84)*

Yorifuji et al, 2010: HR = 1.19 (1.02-1.38)*

HR

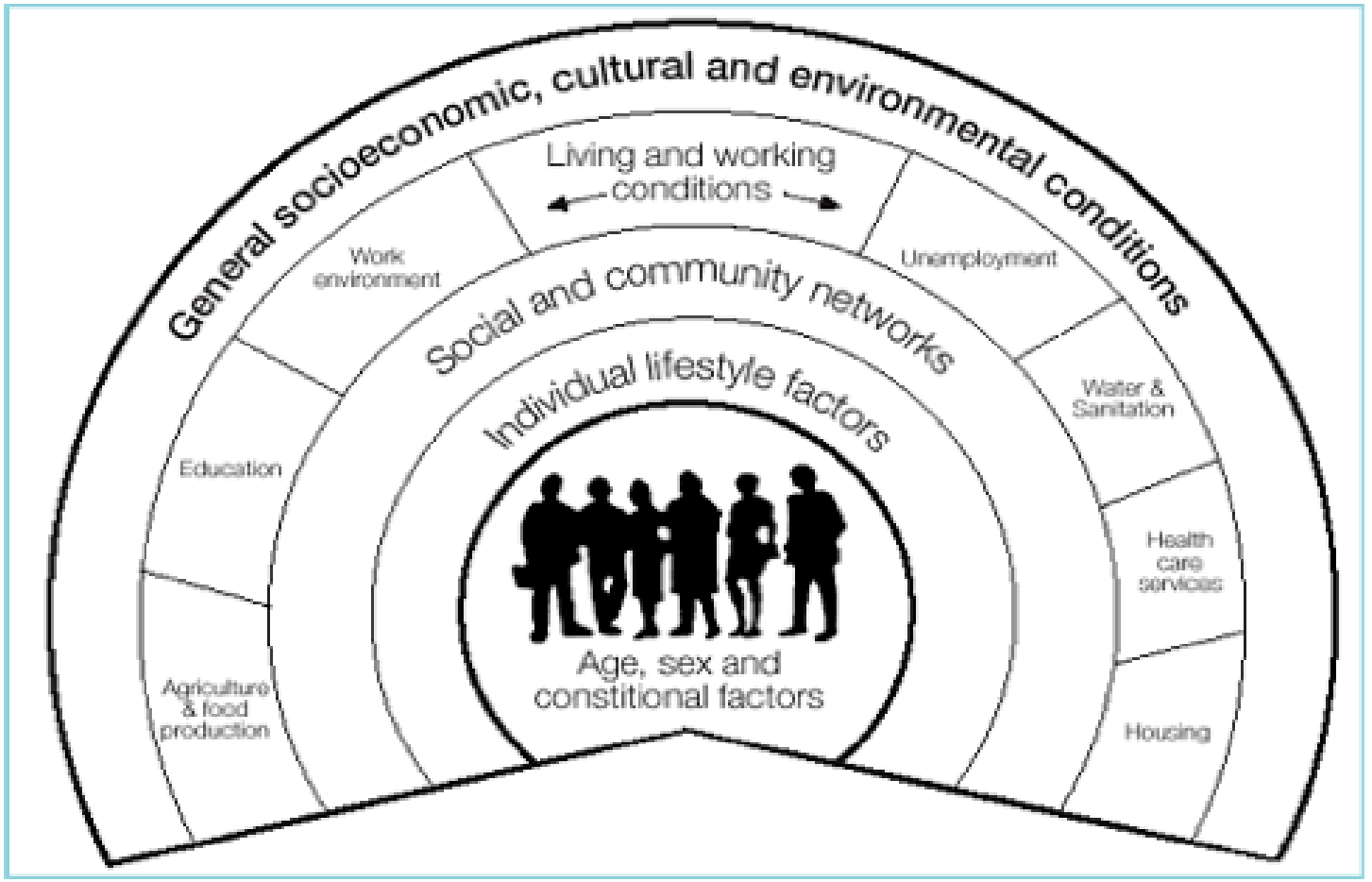
95% CI

Number of papers reporting each health-related outcome

Outcome	Count
Negative birth outcome – small for gestational age, low birth weight, small head circumference, length	10
Cause specific mortality – CVD, IHD, cerebrovascular disease, respiratory disease, lung cancer, all cause	9
COPD/respiratory infections	4
Asthma	4
Allergies	2
Pre-eclampsia	2
IHD/CVD	1
Stroke	1
Diabetes	1
Systemic inflammatory markers	1
Mitochondrial function	1

A conceptual model of the main determinants of health

(Whitehead et al., 2001, p314)



Confounding factors considered in the cohort studies

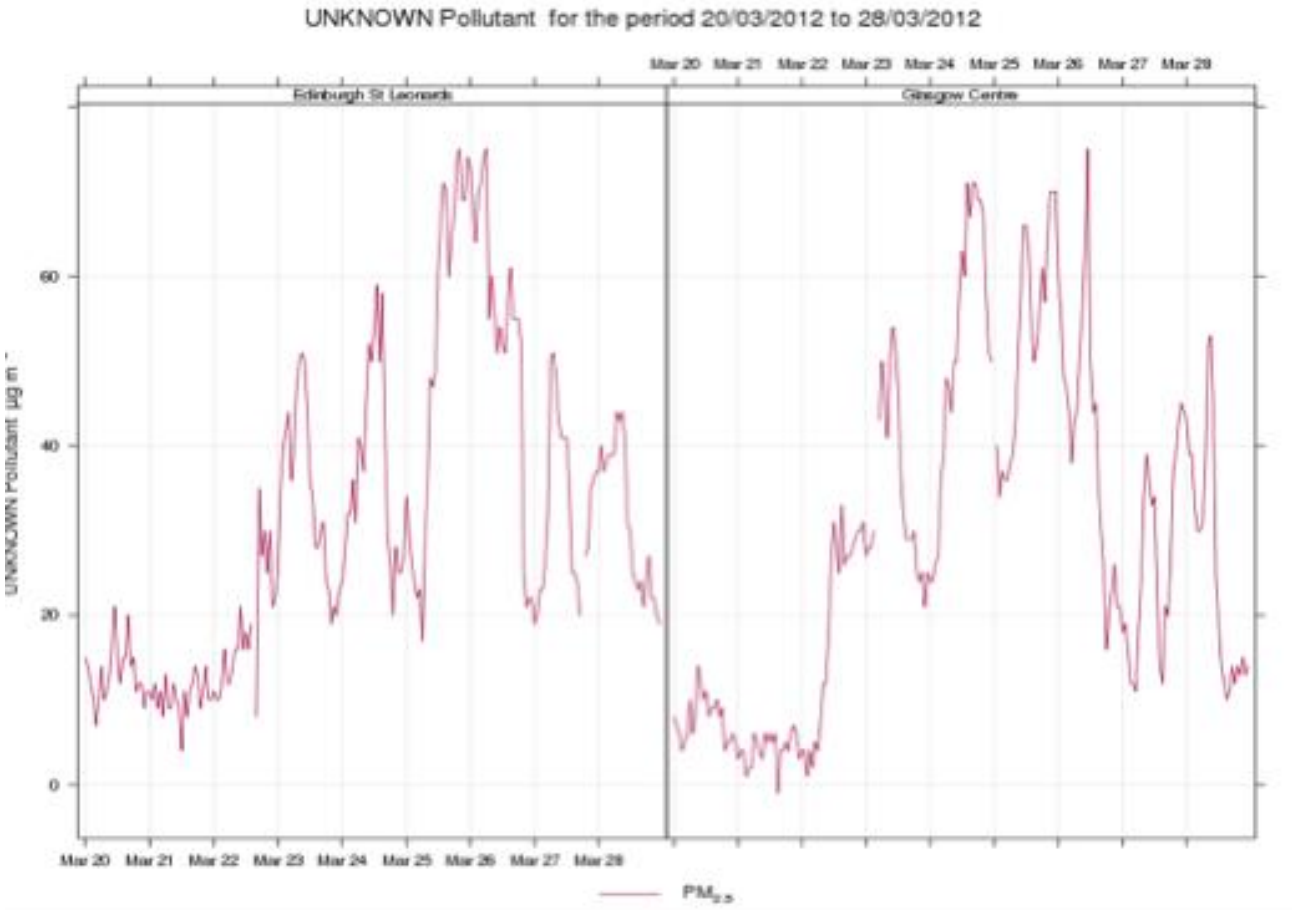
Confounding condition	Number of studies taking each condition into account
Obesity	14
HT	13
Asthma	12
CVD	11
Diabetes	11
Respiratory disease	11
Diet	10
Allergies	7
Exercise	6
Hyperlipidemia	4
Viral outbreaks	4

Scottish (Air Quality) Needs Assessment Study

(McAllister and Hyland, 2014)

- Less than 1% of Scottish residents live in AQMAs
- Most are aged between 29-40 years (75%)
- Men (54%)
- 19% of AQMA residents are in the most deprived quintile.
- Mortality and hospitalization rates were lower in AQMA residents
- Reducing air pollution
  - by 13µgm^3 = reduction AQMA attributable deaths 73 pa
  - by 1µgm^3 =reduction non-AQMAs 153 attributable deaths.
  - AQMA attributable hospitalisations = 1,961;
  - non-AQMA attributable hospitalisations = 27,517.

Record of air pollution levels recorded at air quality monitoring sites in Edinburgh and Glasgow, 20-28th March 2012

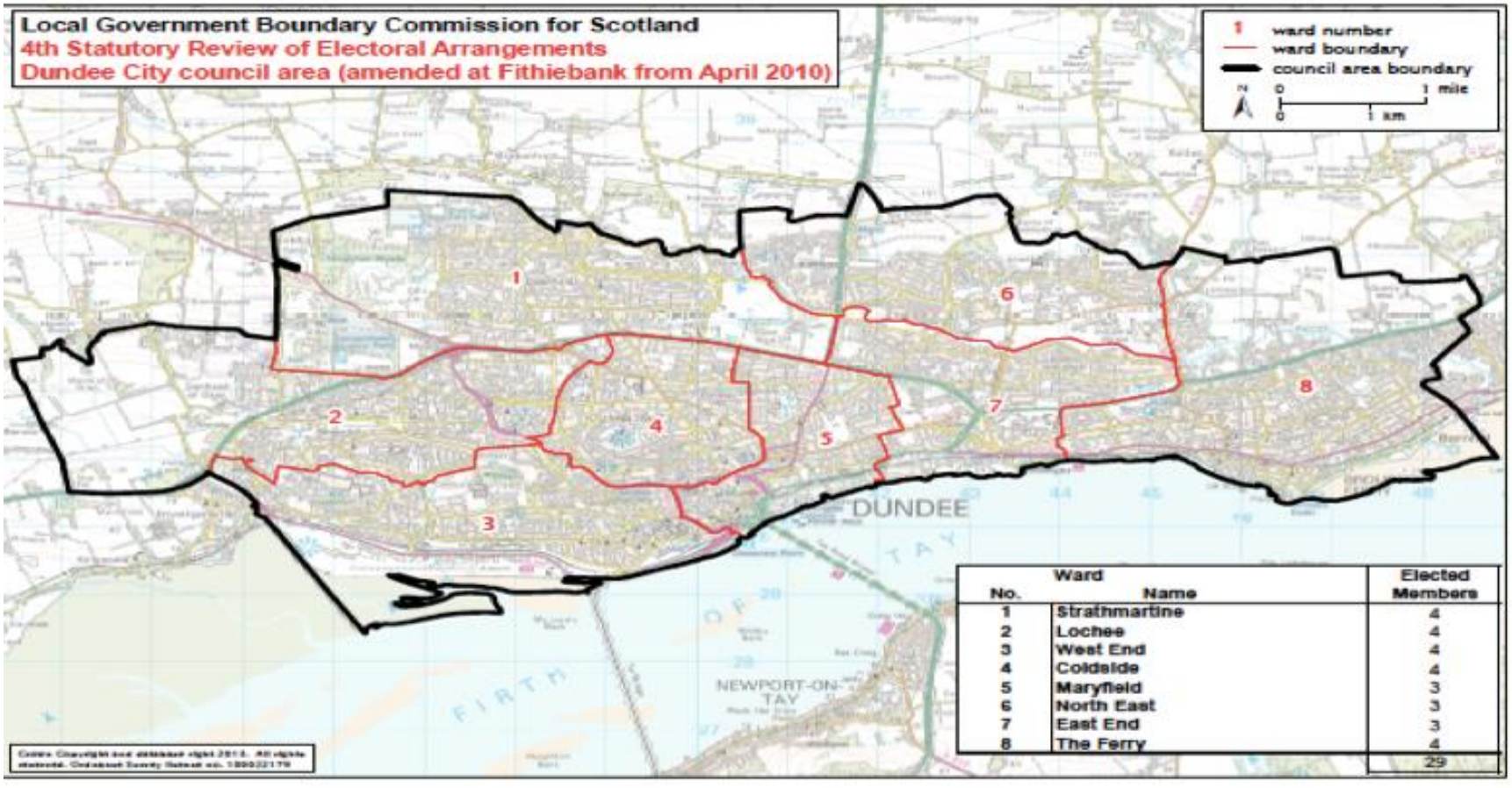


NHS 24 calls for air pollution related symptoms one week, during (20/03-28/03/12) and one week after high levels of air pollution recorded in Glasgow and Edinburgh

		Records by Area		Possible Pollution Symptoms	
Date Range	Total Records	Edinburgh St Leonards	Glasgow Central	Edinburgh St Leonards	Glasgow Central
13/03 - 19/03/2012	26,709	43	111	10	22
20/03 - 28/03/2012	29,459	40	147	8	37
29/03 - 04/04/2012	39,780	39	114	4	22
TOTAL	**95,992**	**284**	**30,152**	**228**	**691**

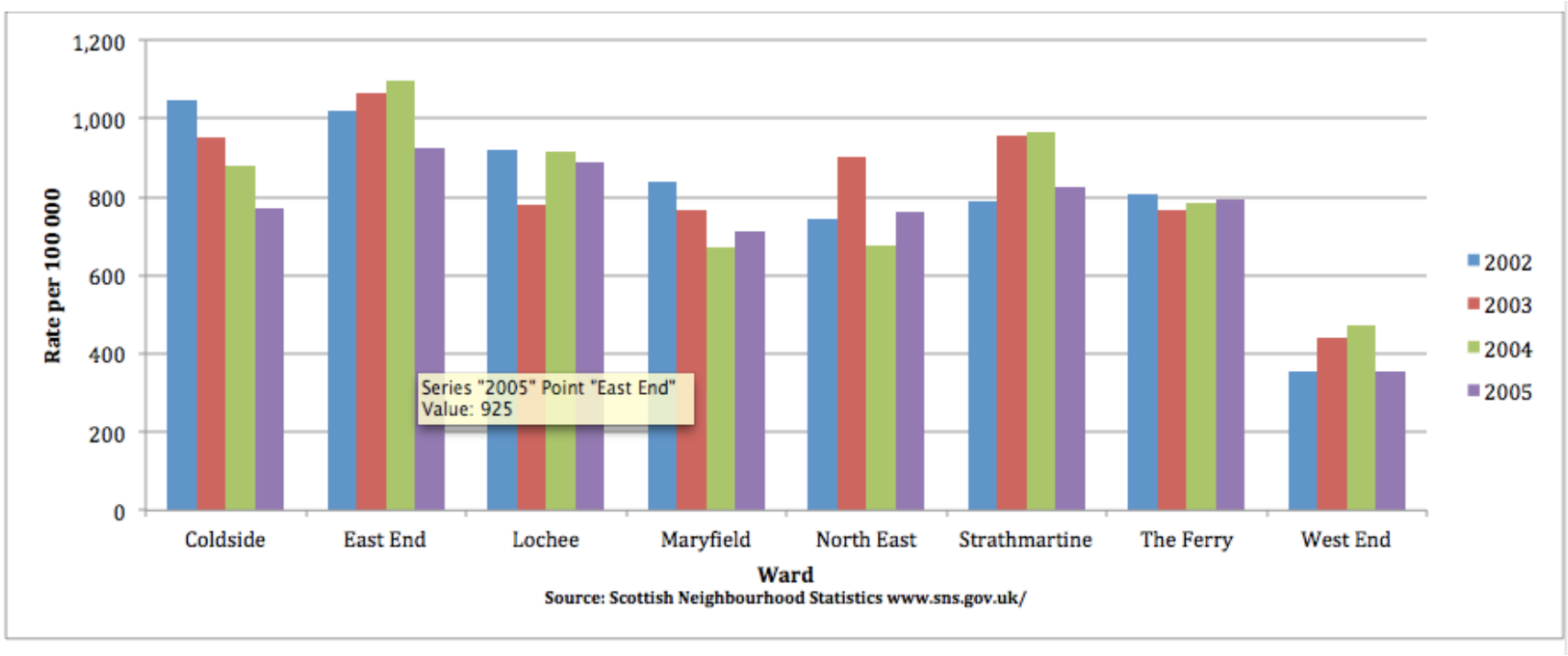
Note: shaded row indicates the week of elevated air pollution.

Dundee Ward Areas

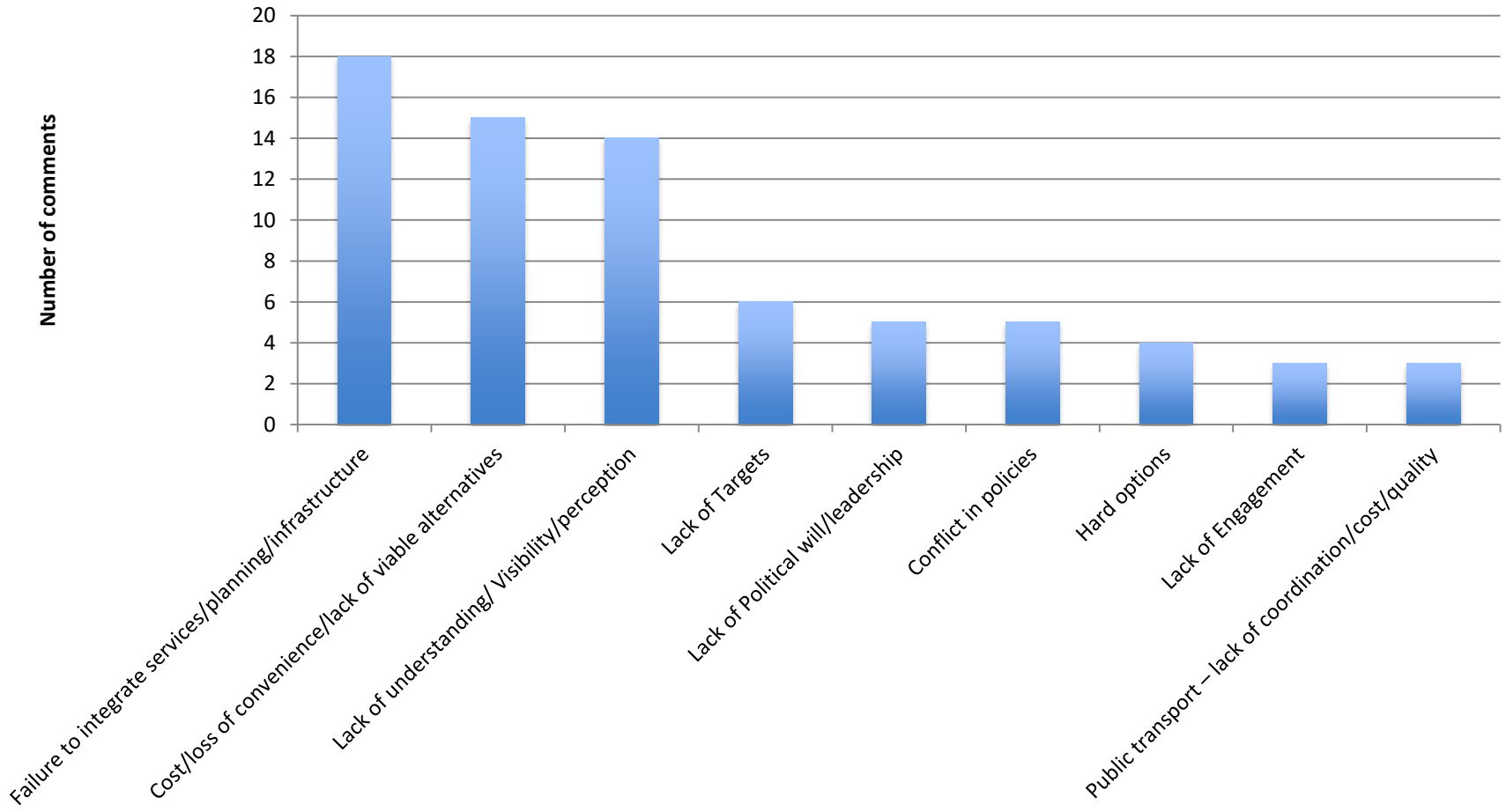


Ward No.	Name	Elected Members
1	Strathmartine	4
2	Lochee	4
3	West End	4
4	Coldside	4
5	Maryfield	3
6	North East	3
7	East End	3
8	The Ferry	4
		29

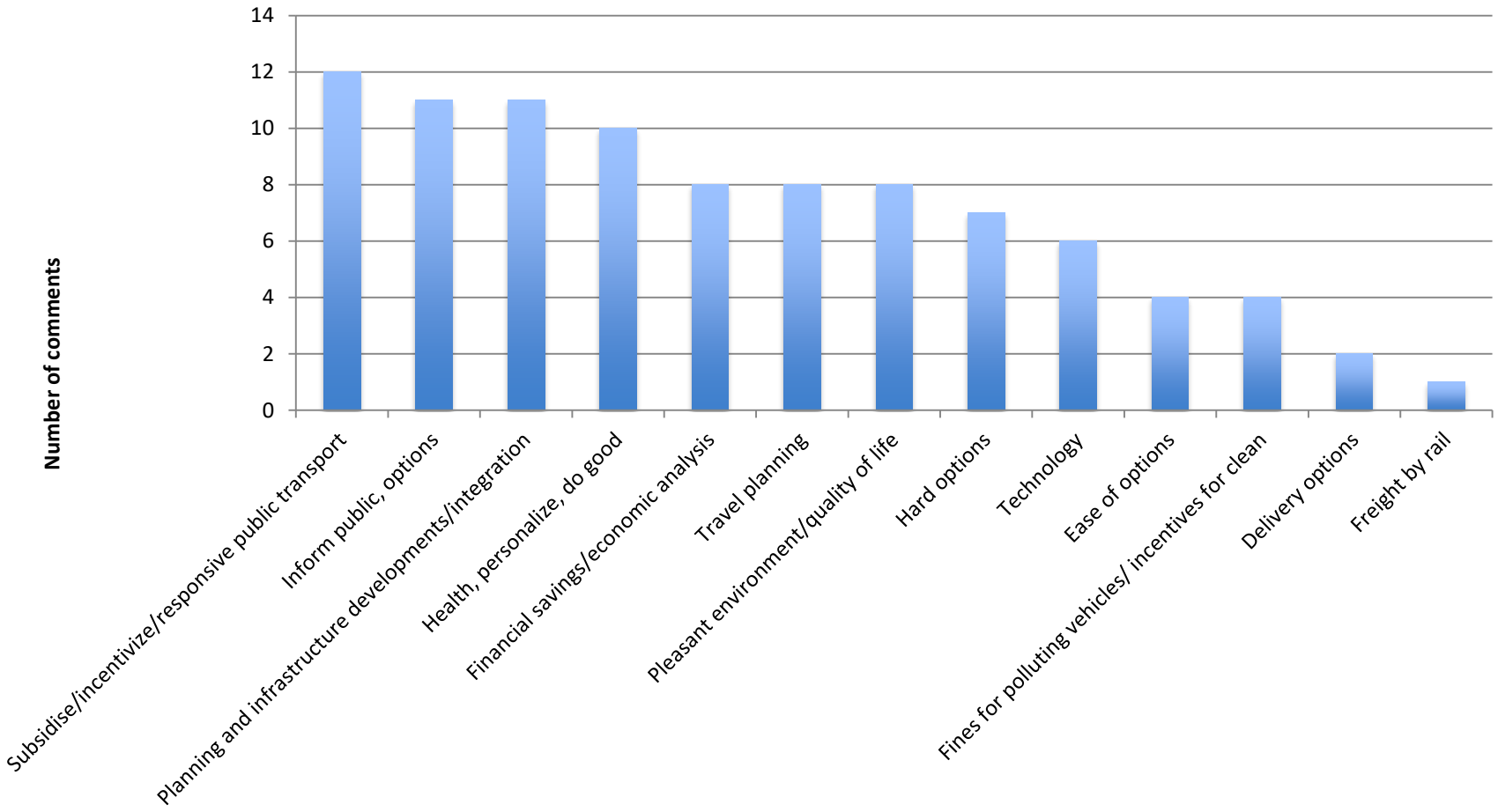
Coronary Heart Disease Admissions, by Dundee Ward, both sexes, all ages, 2002-2005



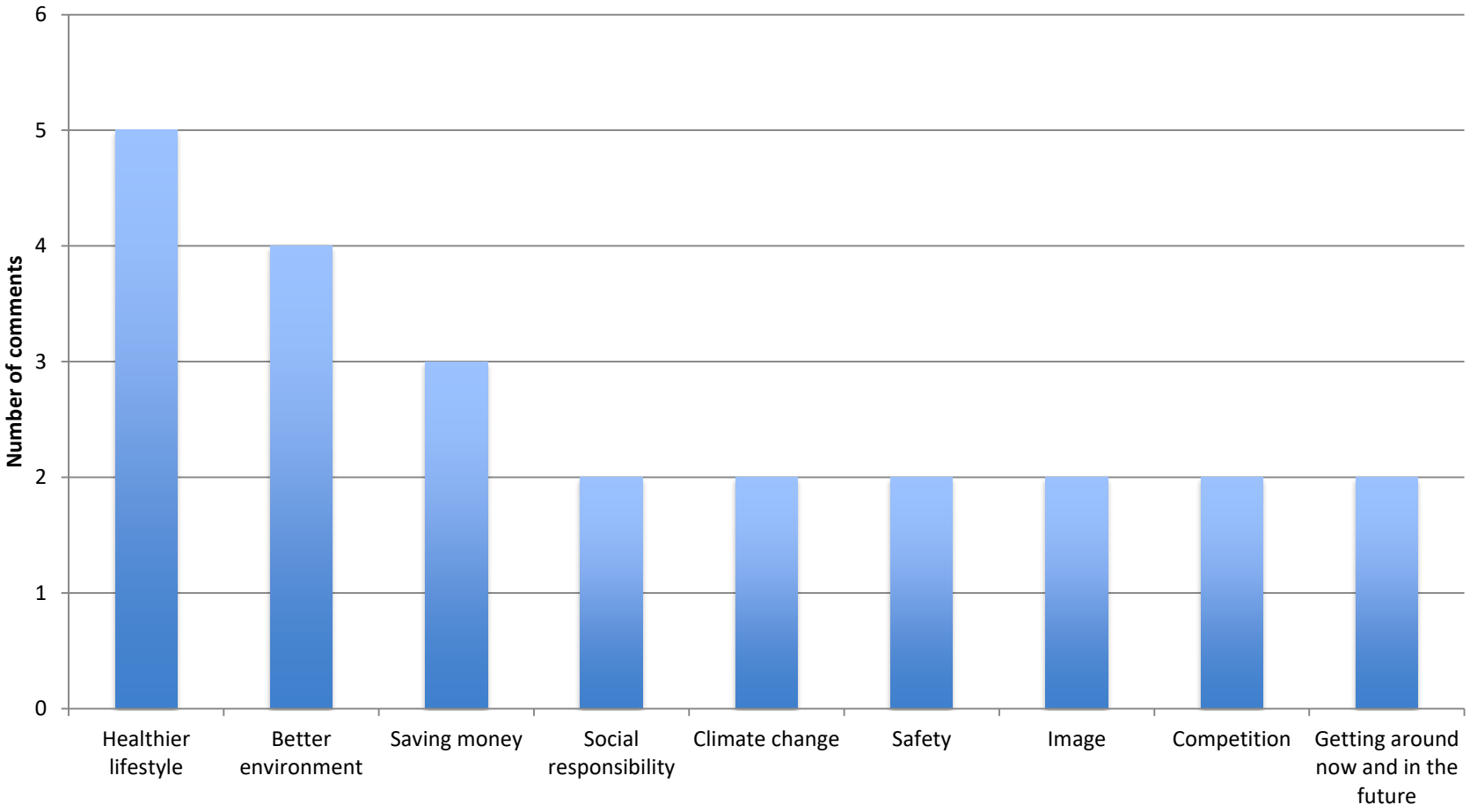
Air Pollution - Perceived barriers to change



Air Pollution - Perceived incentives for change

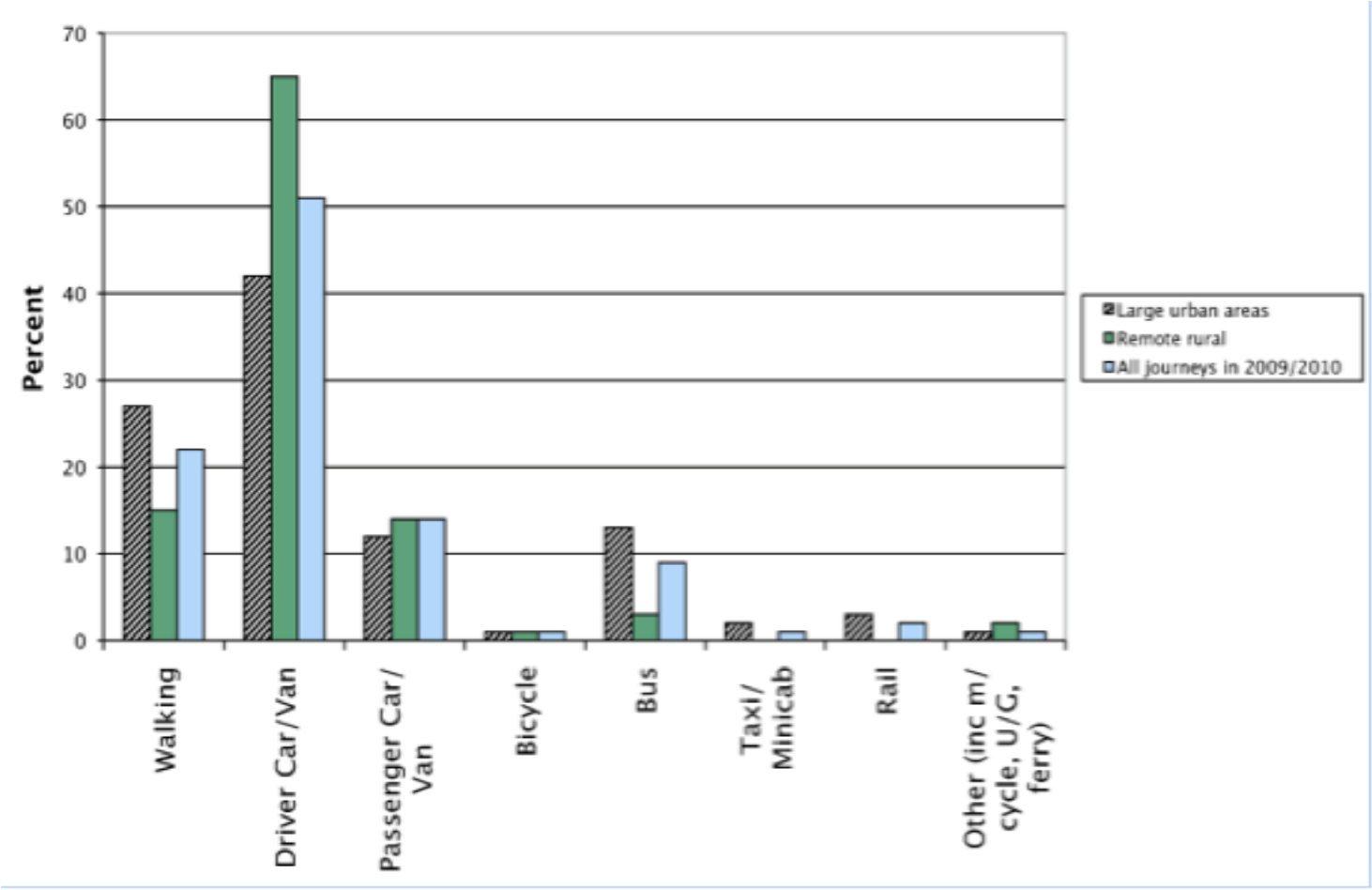


Key themes to encourage behaviour change



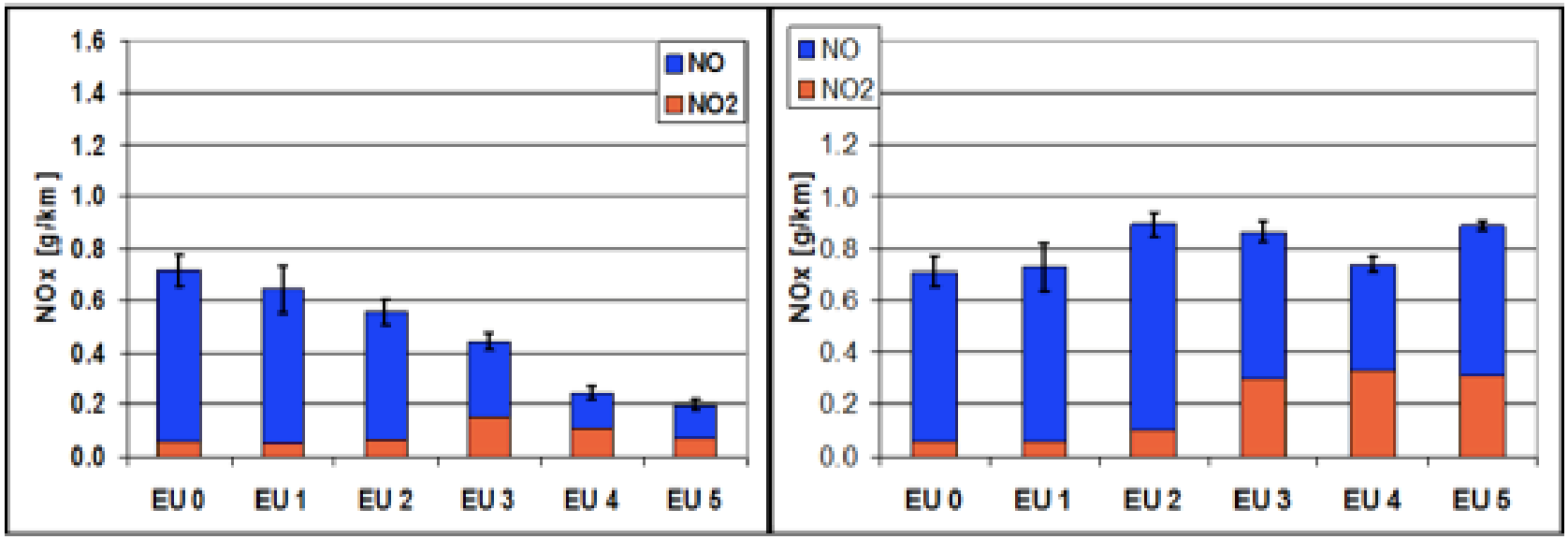
Main mode of travel - large urban, remote rural and Scotland, 2009/2010.

(Transport Scotland, 2017)



Type approval (left) and real-world emissions (right) from diesel light duty vehicles across Euro standards.

(European Commission, 2013, p22).



Estimated premature deaths from urban air pollution exposure, Europe and Scotland

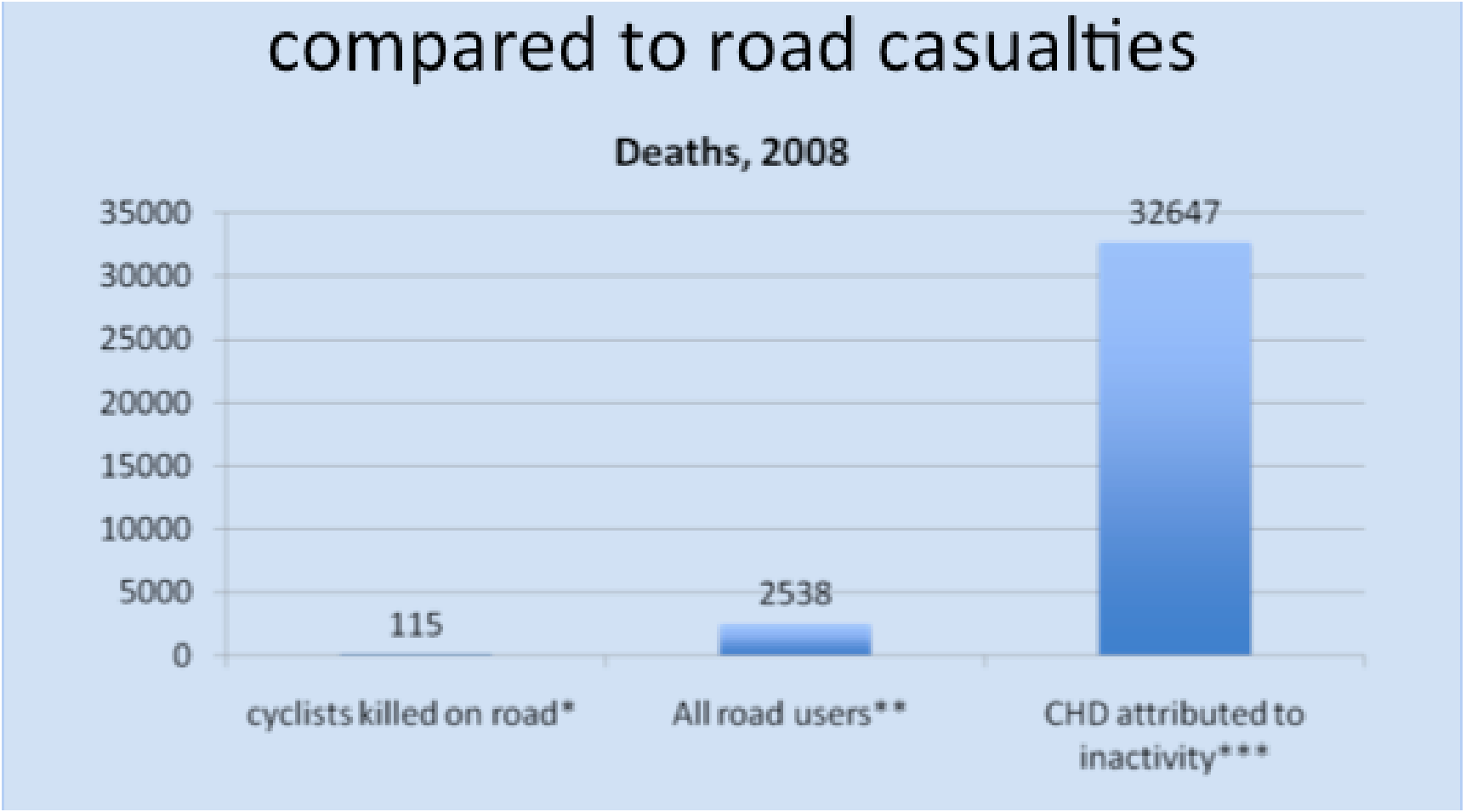
	Europe	Scotland
Total Population	510 100 000[1]	5 373 000[2]
Percentage population urban	73.6%[3]	81%[4]
Urban population exposure above WHO guideline levels	446 034 600[5]	24 066[6]
Premature deaths from ambient air pollution	509 100[7]	24[7]
Adjustment for traffic-related contribution to air pollution		14[8]
Value of a statistical life (VSL)[9]2010		£32.2m[10]

Estimated loss of productivity due to air pollution related illness, Europe and Scotland

Measure	Europe	Scotland
Restricted activity days per annum	569 million[1]	
Number of days per exposed person (days/exposed population)	1.3[2]	1.3[3]
Total days lost activity		31 286[4]
Cost	£184 per day[5]	£5 755 443[6] per annum

Risk of physical inactivity compared to road accidents, deaths UK, 2008

(Cavill, 2013)



The cost comparison for active travel interventions in Scotland, based on YLL and cost per QALY

Active Travel Intervention	Cost per QALY[1]	Cost to reduce YLL in Scotland[2]
Cycling Demonstration Town (Government funded initiative to encourage cycling 2005-2008)	£5,000	£22 474 000
Sustainable Travel Towns (Government initiative to support Smarter Choices and sustainable travel 2004-2009)	£900	£4 045 500
TravelSmart Department of Transport funded initiative running 2013-2015)	£300-£2 500	£1 348 500 - £11 237 500
Pedometers (local initiatives)	£2 900 - £9 400	£13 035 500 - £42 253 000
Get Walking Keep Walking (Ramblers)	£2 700	£12 136 500

Cost benefit analysis of LEZ in Scotland – annual estimated value

	Cost (£m)	Savings (£m)
LEZ	4.5	
TravelSmart[1]	1.3 - 11	
Reduction premature deaths		32
Reduction in sickness absence		6
Total per LEZ	6.8-11	
Total for Scotland[2]	**27.2-44**	**38**

Traffic related air pollution harms health.

Chapter 1 describes what is known about traffic-related air pollution and current regulatory and policy directives to reduce pollution

What are the health effects - type and quantity?

Chapter 2 presents the findings from a rapid assessment of the evidence through a review of the literature on the health impact of traffic-related air pollution in Scottish residents living near busy roads

Is the evidence sufficient to demonstrate causality?

Chapter 3 reports on an assessment of the strength of evidence that traffic-related air pollution causes ill health

How many people in Scotland are being affected?

Chapter 4 demonstrates how the application of national guidance has been used to estimate the impact of traffic-related air pollution the health of residents in Air Quality Management Areas.

Why has it been difficult to achieve further reductions in traffic related air pollution?

Chapter 5 explores the perception of barriers and incentives for change amongst key agencies involved in air pollution management.

How can policy achieve change?

Chapter 6 describes a critique of the latest Scottish policy to reduce traffic related air pollution and support behavior change.

Will the cost of policy implementation paradoxically lead to ill health?

Chapter 7 considers the cost and benefits of a low emission zone proposal and the willingness to pay for improved health.

Does air pollution have a physical and social impact on the health of Scottish residents?

Chapter 8 summarises the findings and presents conclusions and recommendations for further research.

Conclusions

- The evidence suggests there is little impact on population health from traffic-related air pollution at current emission levels.
- There may be health effects for vulnerable individuals but this is difficult to prove.
- The wider socioeconomic benefits of improving air quality in Scotland must be considered in policy development and implementation.
- It is unlikely that the Clean Air For Scotland Strategy will deliver improved air quality and health without substantial investment, better alignment of planning and a greater public engagement to support public and active transport options.
- This is the first time a health and socioeconomic approach to traffic-related air pollution from problem to policy has been documented for Scotland.

Research Recommendations

Source reduction

- Improve emissions from vehicles
- Review urban planning.

Pathway

- Investigate how behaviour of individuals leads to increased exposure

Health

- Improve understanding of vulnerability

Policy development

- Assess the costs, opportunity costs and benefits by sector (business, health, society) taking into account changing background levels, new technology and policy implementation over time.

Acknowledgements

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