NO_2 and MORTALITY – CIGARETTE SMOKING OR YELLOW FINGERS?

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Nitrogen dioxide and mortality: review and meta-analysis of long-term studies

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	Total or natural mortality		
	Studies n	RR (95% CI)	I^2 %
NO_2			
All countries	12	1.041 (1.019–1.064)	89
Asia	1	1.020 (1.000–1.030)	
North America	5	1.027 (0.987–1.069)	95
Europe	6	1.066 (1.029–1.104)	72

European Respiratory Journal 2014

Table S4. Estimates of effects of NO_2 from multi-pollutant models on natural and cause-specific mortality.

	Risk measu-rement*	Total or natural mortality			Cardiovascular mortality			Respiratory mortality		
		effect	95%CI		effect	95%CI		effect	95%CI	
Gehring, 2006					**cardiopulmonary**					
NO_2 IQR (24 µg/m^3) single	RR	1.19	1.02	1.39	1.74	1.29	2.33			
with traffic indicator		no changes (data not shown)								
Jerrett, 2009					**Ischemic heart disease**					
NO_2 IQR (4 ppb) single	RR	1.17	1.00	1.36	1.45	1.10	1.92			
with traffic indicator		1.13	0.97	1.32	1.39	1.05	1.85			
Lipfert, 2009										
NOx IQR (10 ppb) single	RR	1.08	1.06	1.1						
with traffic indicator		1.01	not reported							
Hart, 2011										
NO_2 IQR (8 ppb) single	%IR	8.20	4.50	12.10	6.90	0.60	13.60	5.90	-7.40	21.10
with PM_{10} and SO_2		7.40	2.40	12.50	6.80	-1.40	15.70	5.60	-12.00	26.60
Gan, 2011					**Coronary heart disease**					
NO_2 IQR (8 µg/m^3) single	RR				1.04	1.01	1.08			
with $PM_{2.5}$ and BC					1.03	0.99	1.07			
Cao, 2011										
NOx (10 µg/m^3) single	%IR	1.50	0.40	2.50	2.30	0.60	4.10	2.60	-0.20	5.60
with TSP		1.40	0.30	2.50	1.50	-0.40	3.30	2.10	-1.00	5.30
Cesaroni 2013										
NO_2 IQR (11 µg/m^3) single	HR	1.03	1.02	1.04						
with $PM_{2.5}$		1.02	1.01	1.03						
with traffic indicator		no changes (data not shown)								

* RR= relative risk; %IR= percentage increase in risk; HR= hazard risk

Quantifying the health impacts of ambient air pollutants: recommendations of a WHO/Europe project

Marie-Eve Héroux · H. Ross Anderson · Richard Atkinson · Bert Brunekreef · Aaron Cohen · Francesco Forastiere · Fintan Hurley · Klea Katsouyanni · Daniel Krewski · Michal Krzyzanowski · Nino Künzli · Inga Mills · Xavier Querol · Bart Ostro · Heather Walton

Table 1 Pollutant–health outcome pairs for which HRAPIE project recommends concentration–response functions (modified from WHO 2013b)

Pollutant metric	Health outcome	Group	RR (95 % CI) per 10 μg/m^3
NO_2, annual mean over 20 μg/m^3	Mortality, all (natural) causes, age 30+ years	B*	1.055 (1.031–1.080)

International Journal of Public Health 2015

Traffic air pollution and mortality from cardiovascular disease and all causes: a Danish cohort study

Raaschou-Nielsen, Environmental Health 2012

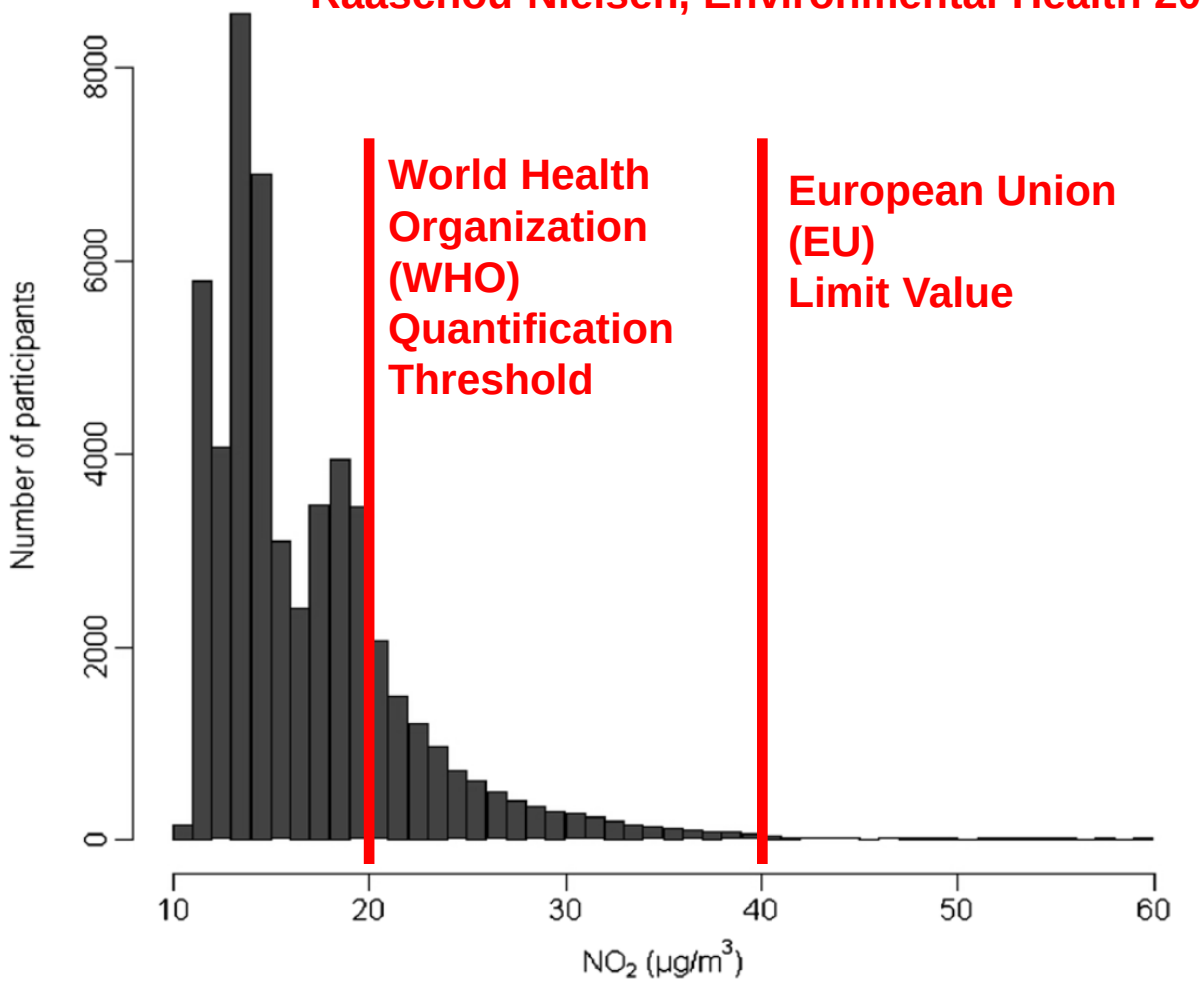
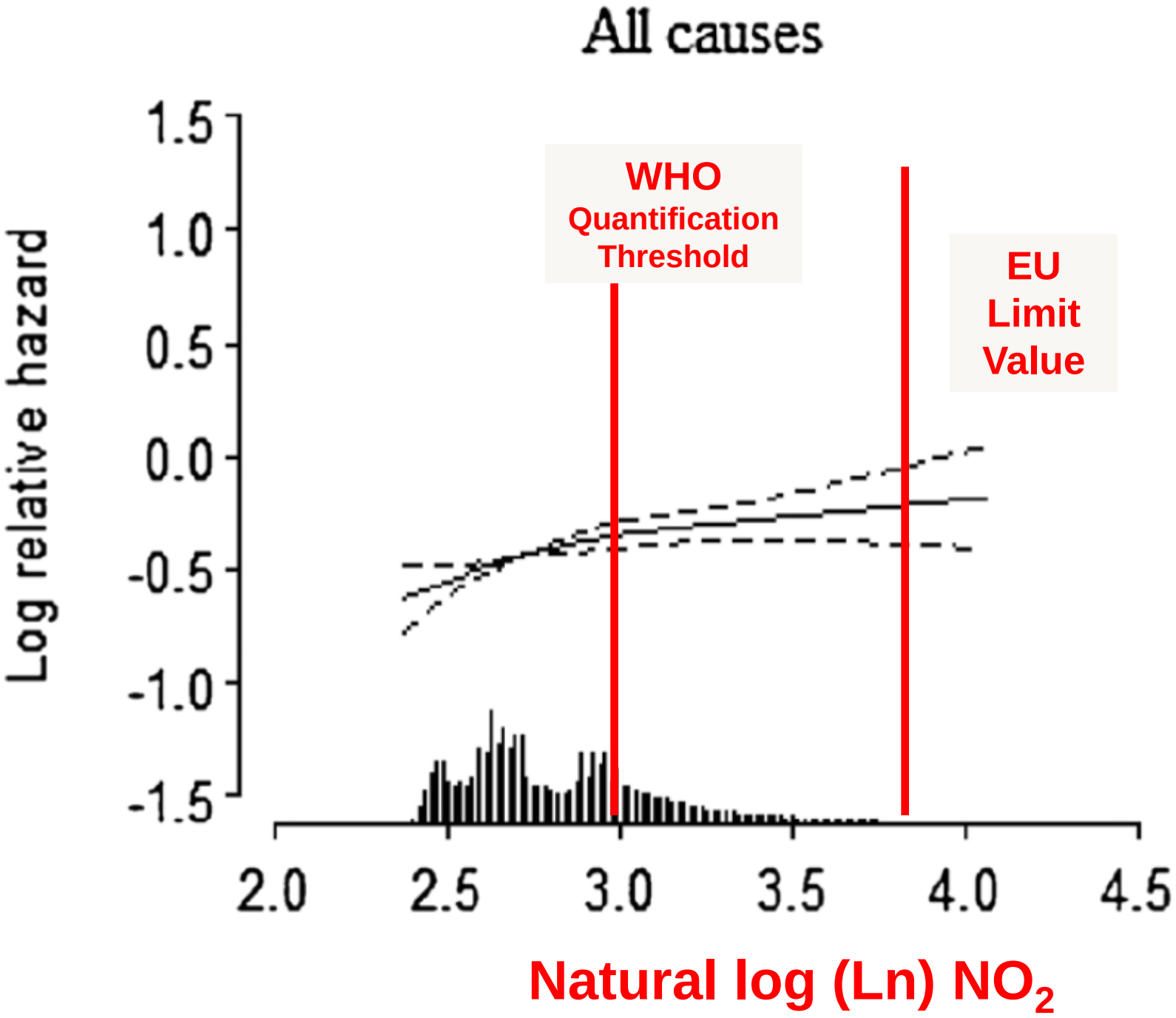


Figure 1 Distribution of NO_2. Time-weighted average concentrations of NO_2 at the residential addresses of 52 061 cohort participants from 1971 onwards.


All causes
Log relative hazard
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
2.0
2.5
3.0
3.5
4.0
4.5
WHO
Quantification
Threshold
EU
Limit
Value
Natural log (Ln) NO_2

Understanding the Health Impacts of Air Pollution in London

For: Transport for London and the Greater London Authority

By: Heather Walton, David Dajnak, Sean Beevers, Martin Williams, Paul Watkiss and Alistair Hunt

Date: 14th July 2015 FINAL

Table E1 Mortality burden of $PM_{2.5}$ and NO_2 in London

Pollutant (2010 concentrations)	Life years lost as a result of equivalent deaths in 2010	Equivalent deaths at typical ages in 2010
Anthropogenic* $PM_{2.5}$	52,630 (9287 to 98,648)[a]	3,537 (624 to 6,632)[a]
NO_2 (less certain) (30% overlap with $PM_{2.5}$)[10]	*Up to 88,113 (51,629 to 121,918)[a]*	*Up to 5,879 (3444 to 8138)[a]*
Total	52,630 *up to 140,743*	3,537 *up to 9,416*

* defined in glossary (Annex 11)

[a] Ranges based on plausibility intervals (statistical and other uncertainties) from COMEAP (2010) for $PM_{2.5}$ and 95% confidence intervals (statistical uncertainty) from WHO (2013b) for NO_2. The central estimates are added for the total but not the plausibility or confidence intervals because the probability of the estimate being at the same far end of the range in both cases is unlikely.

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Understanding the Health Impacts of Air Pollution in London

The NO_2 results need to be interpreted cautiously. Whilst at least 70% of the effect of NO_2 in the original studies is independent of $PM_{2.5}$, it remains unclear to what degree NO_2 represents the effect of primary particles (or other traffic pollutants). This is because NO_2 concentrations are very closely correlated with traffic pollutants. For burden calculations, the total effect on mortality would be the same if NO_2 was acting as an indicator of other traffic pollutants and these other pollutants were present in London in the same proportions as in the original studies.

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Air quality in Europe — 2016 report

Table 10.1 **Premature deaths attributable to $PM_{2.5}$, NO_2 and O_3 exposure in 41 European countries and the EU-28 in 2013**

Country	Population	$PM_{2.5}$		NO_2		O_3	
		Annual mean (c)	Premature deaths	Annual mean (c)	Premature deaths	SOMO35 (c)	Premature deaths
Total (b)			**467 000**		**71 000**		**17 000**
EU-28 (b)			**436 000**		**68 000**		**16 000**

European Environment Agency

Distinguishing the associations between daily mortality and hospital admissions and nitrogen dioxide from those of particulate matter: a systematic review and meta-analysis

BMJ Open

2016

I C Mills,[1] R W Atkinson,[2] H R Anderson,[2,3] R L Maynard,[4] D P Strachan[2]

Conclusions: The association between short-term exposure to NO_2 and adverse health outcomes is largely independent of PM mass. Further studies should attempt to investigate whether this is a generic PM effect or whether it is modified by the source and physicochemical characteristics of PM. This finding strengthens the argument for NO_2 having a causal role in health effects.

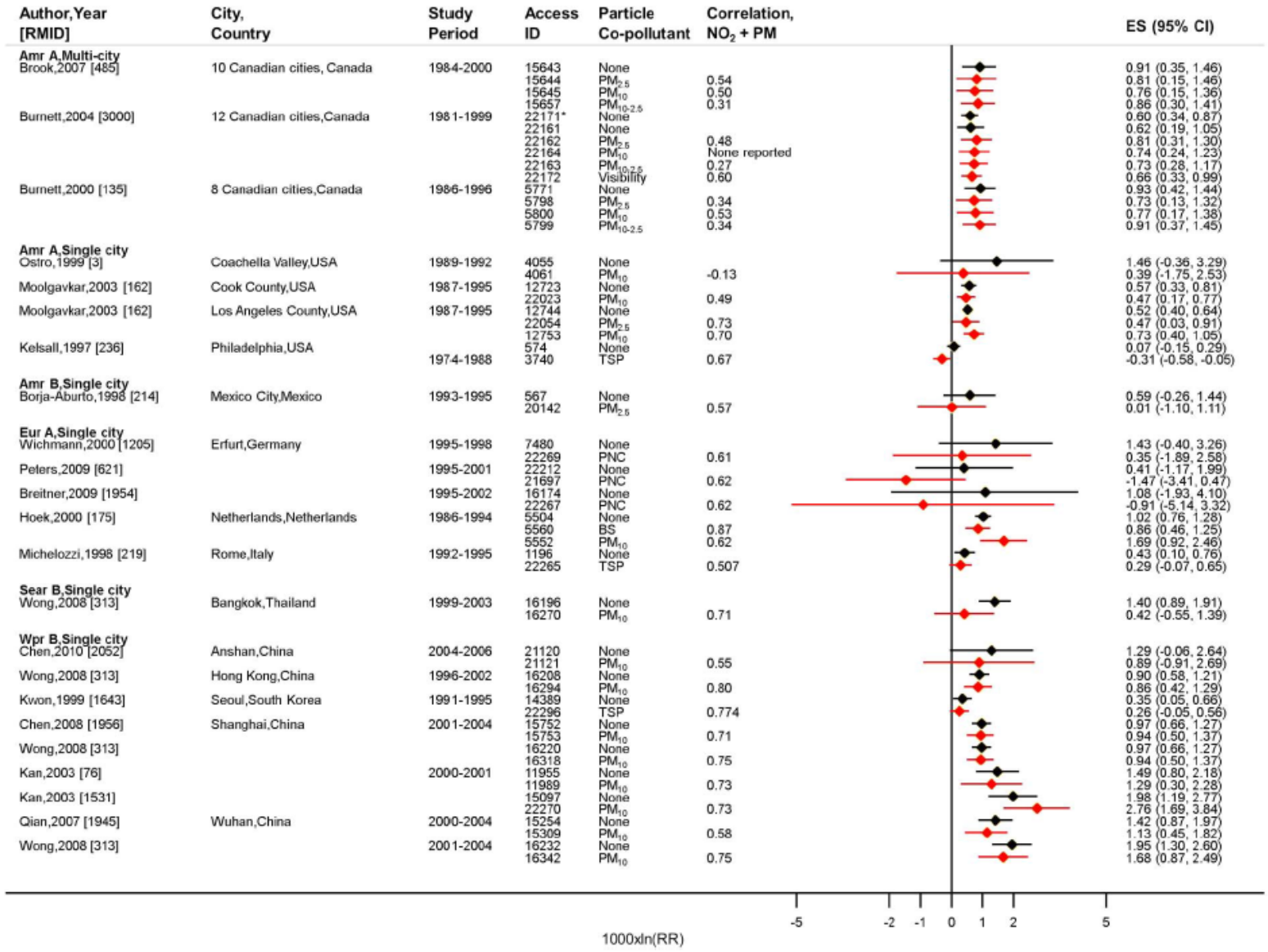

Figure 1 All available studies providing two-pollutant model estimates for meta-analysis for all-cause mortality, all ages, 24-hour NO_2. 1000×ln (RR) approximates to a percentage change per 10 μg/m^3. *Single-pollutant model estimate for days with both NO_2 and visibility (coefficient of haze, COH) data in Burnett *et al*,[18] [RMID 3000]. —●— NO_2, single-pollutant —●— NO_2 adjusted for PM.

TALKING POINTS

- **ASSOCIATIONS BETWEEN NO_2 AND MORTALITY RATHER INDEPENDENT FROM PM MASS** (*VARIOUS METRICS; BOTH LONG TERM AND SHORT TERM*)
- **IS THIS NO_2 BY ITSELF OR NO_2 REPRESENTING A COMPLEX MIXTURE** (*SMOKING, YELLOW FINGERS OR A BIT OF BOTH*)**?**