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Active Travel: Benefits and tradeoffs

Audrey de Nazelle

SCOTTISH AIR QUALITY DATABASE AND WEBSITE ANNUAL SEMINAR

22 January 2018, Glasgow

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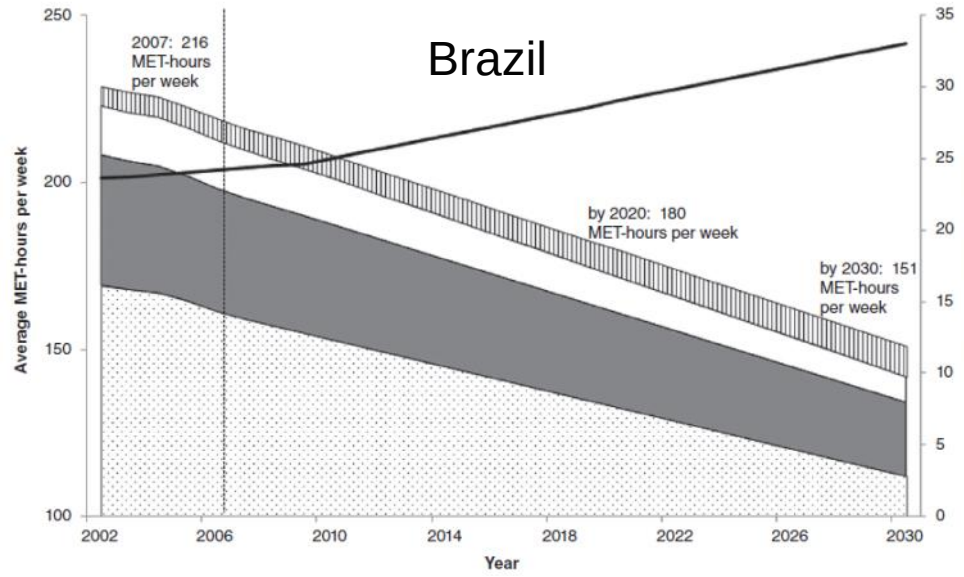
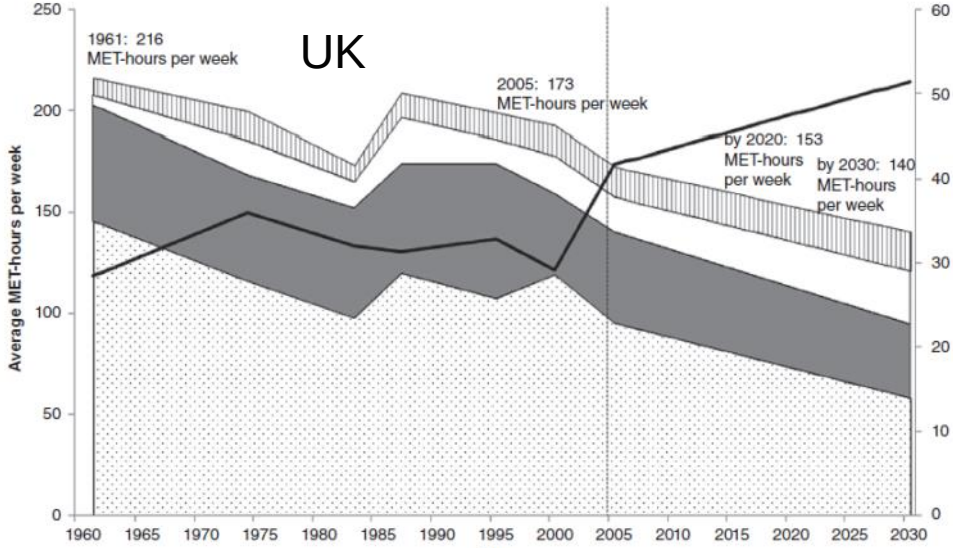
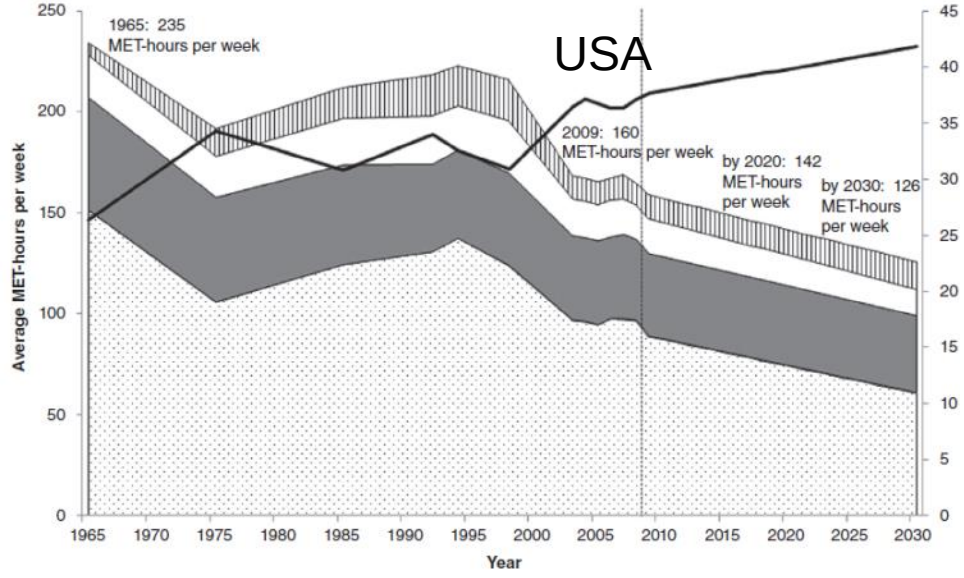
Burden of disease from physical inactivity

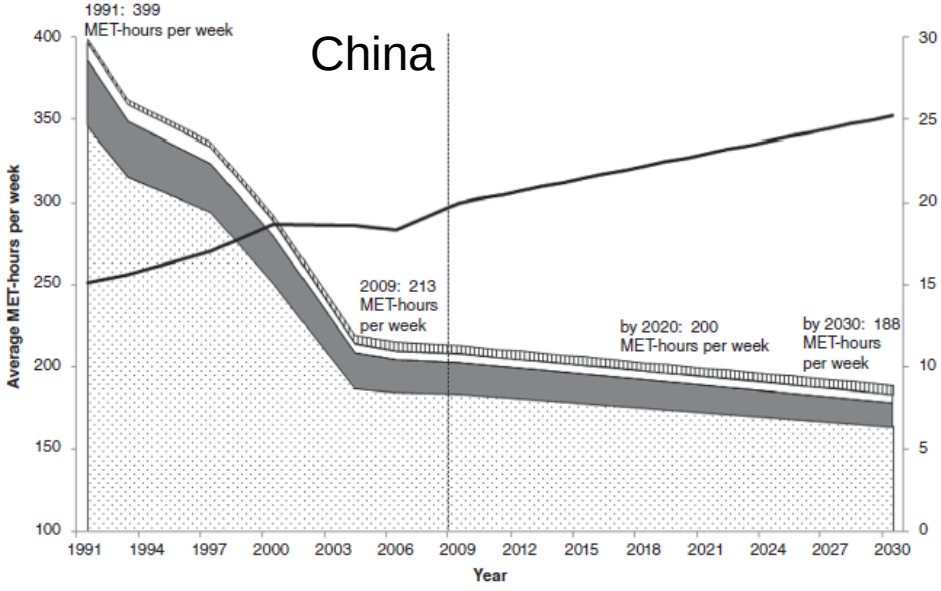
	Coronary heart disease	Type 2 diabetes	Breast cancer	Colon cancer	All-cause mortality
Global	6%	7%	10%	10%	9%
UK	11%	13%	18%	19%	17%

Lee et al, Lancet 2012; 380:219-29









active leisure PA, travel PA, domestic PA, occupational PA, sedentary time.

Trends in physical activity and time in sedentary behaviour: measured for 2000–2005, forecasted for 2006–2030.

Ng & Popkin 2012 Obes Rev

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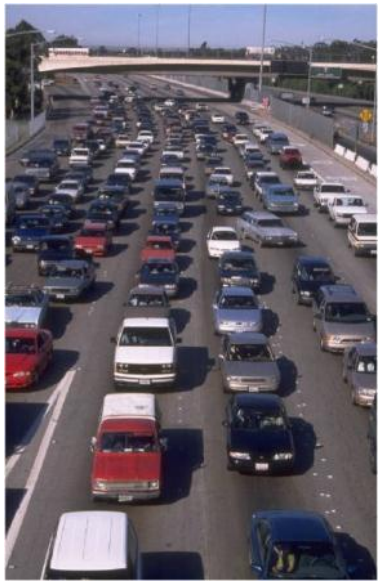
Current major public health challenges

- The gobal physical inactivity pandemic
- Urban air pollution
- Traffic injuries (8th cause of death worldwide, 6 in Western Eu)
- Climate change



→ International calls for multilevel approaches: planning cities for health

→ Active travel policies

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Risks and benefits?

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Travel microenvironments, air pollution, and health

Travel microenvironments

(Barcelona sample, de Nazelle et al. 2013):

Time traveling	% contribution to NO_2 exposure	% contribution to NO_2 inhalation

- Onset of myocardial infarctions (Peters et al., 2013)
- Sub-clinical effects (Adar et al., 2007; McCreanor et al., 2007; Strak et al., 2009; Weichenthal et al., 2011, Kubesch et al., 2014a,b)

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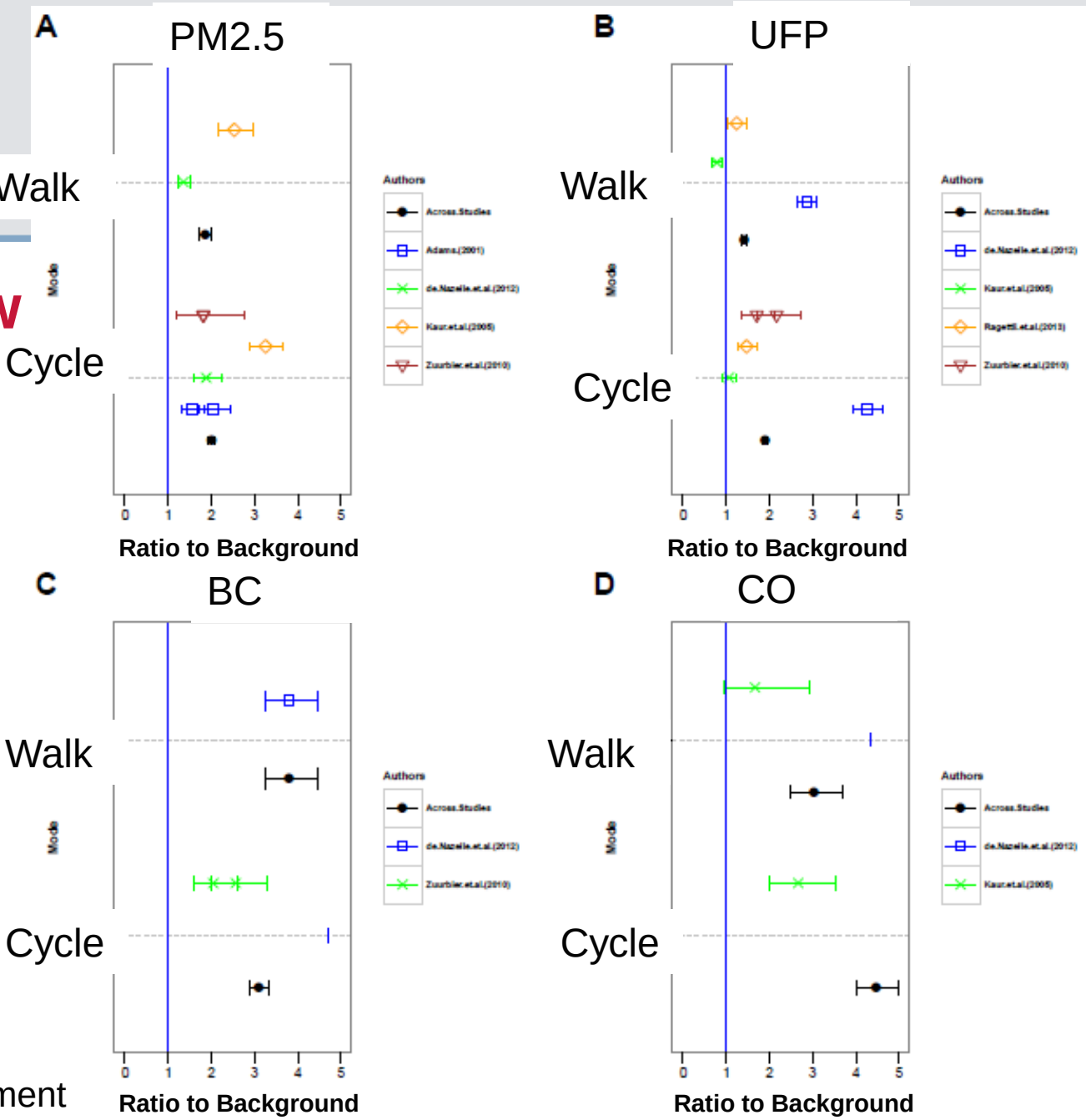
Literature review on exposure contrasts in different modes in Europe:

Modes vs background concentrations



de Nazelle et al. 2017 Environment International v99, pp151-160

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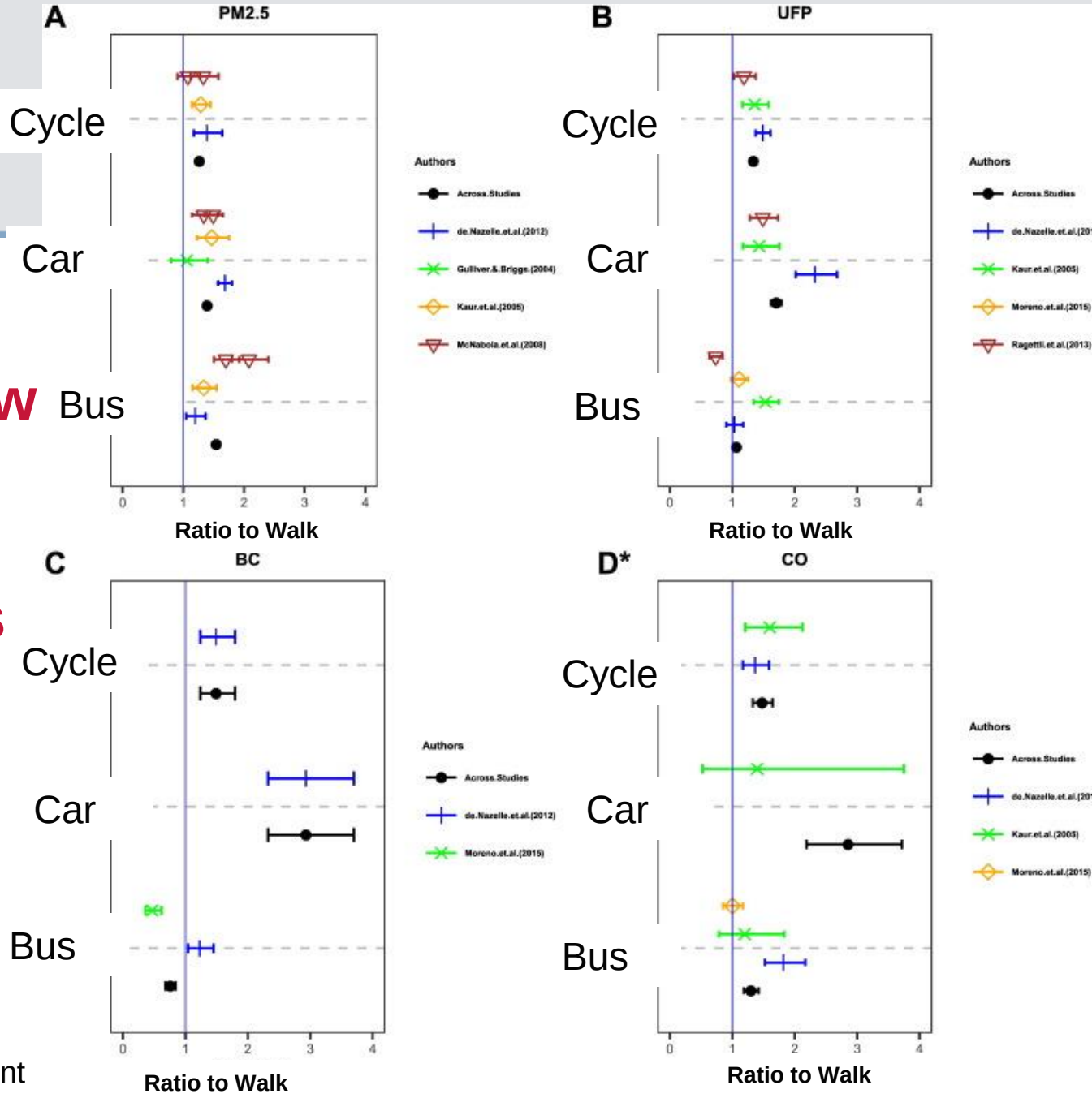
Literature review on exposure contrasts in different modes in Europe:

Modes vs walk



de Nazelle et al. 2017 Environment International v99, pp151-160

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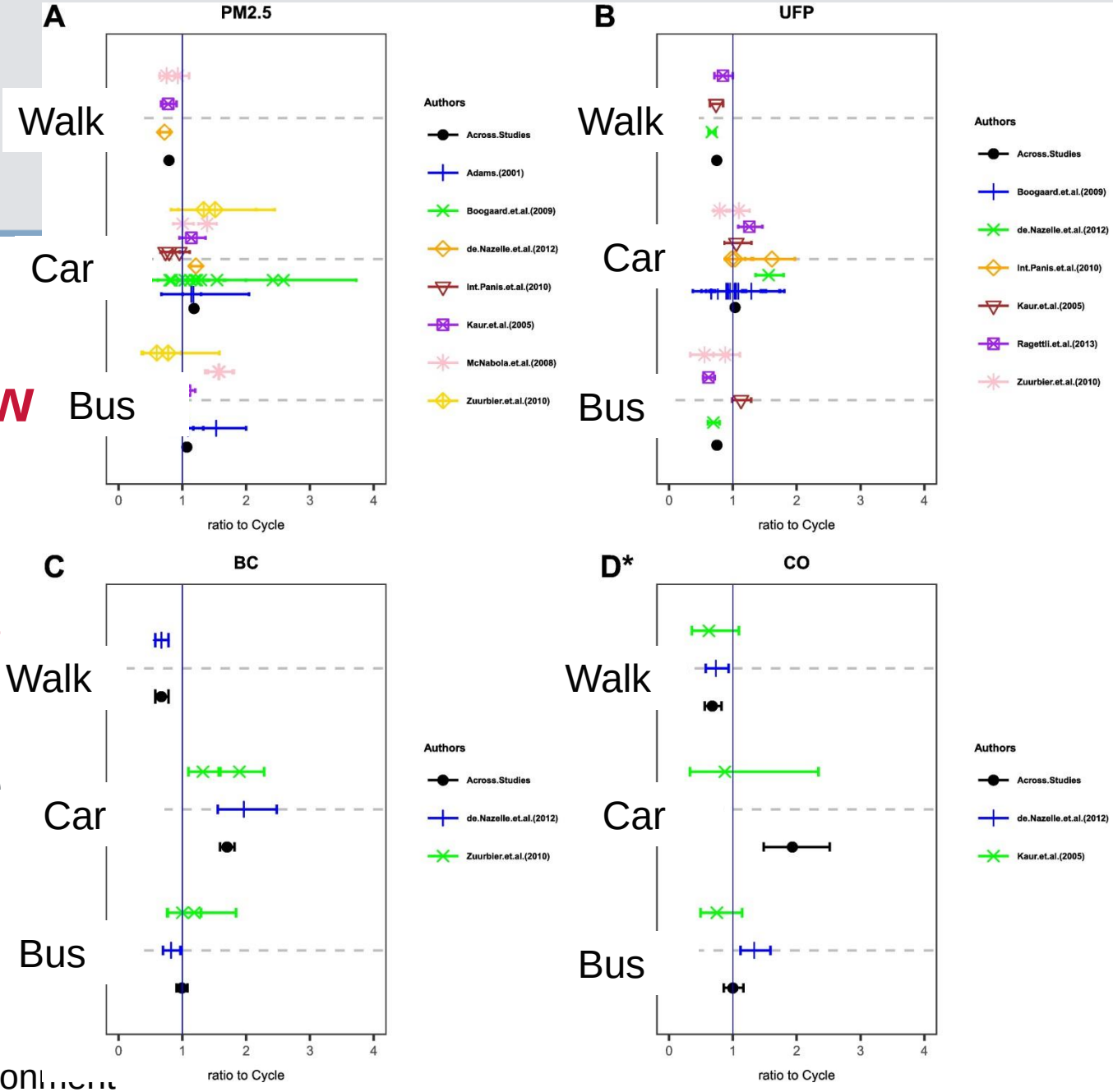
Literature review on exposure contrasts in different modes in Europe:

Modes vs Cycle



de Nazelle et al. 2017 Environment International v99, pp151-160

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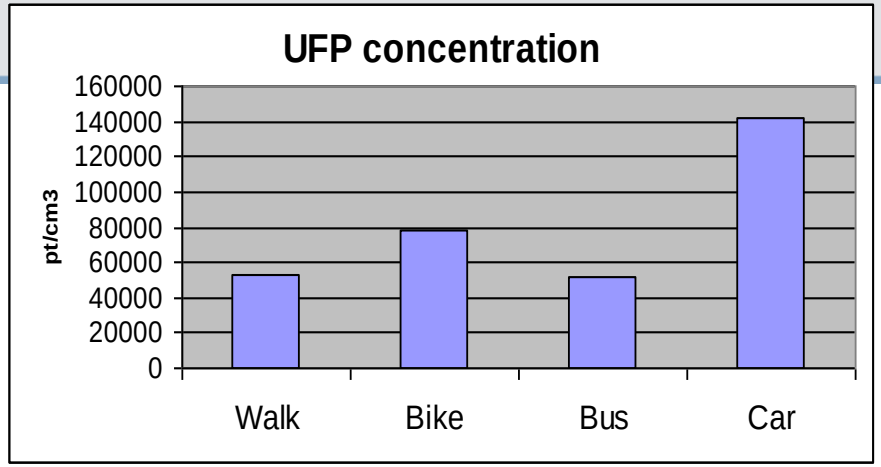
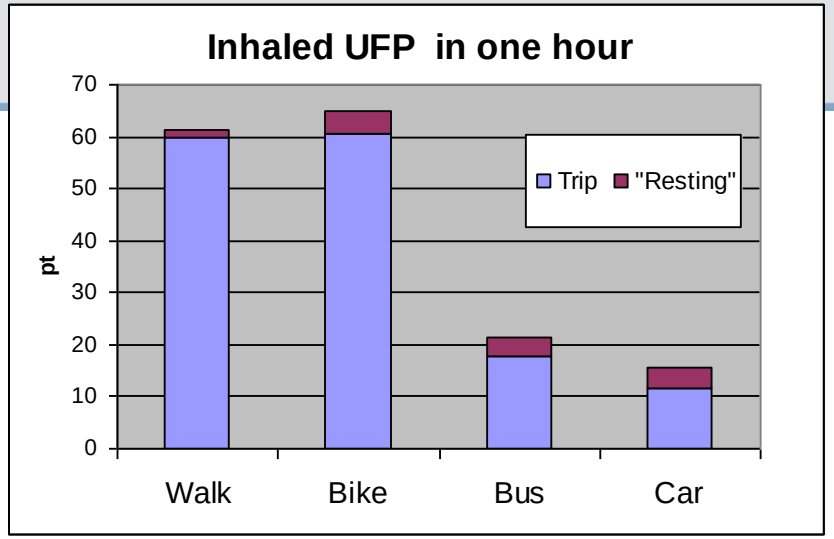
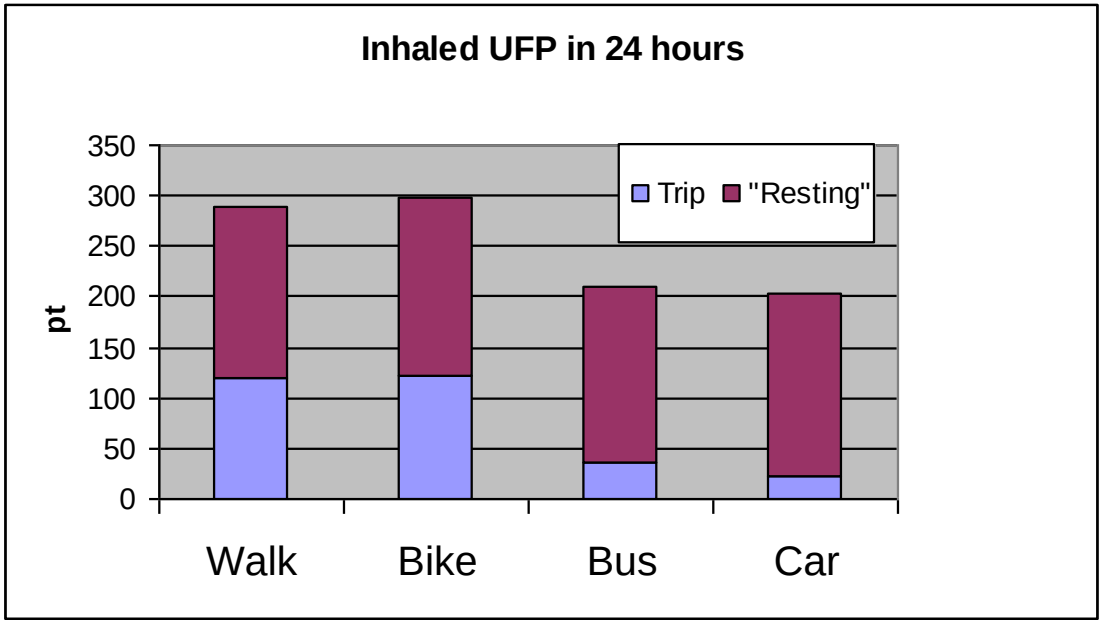
Average concentrations and inhaled doses

de Nazelle et al. 2012 Atmospheric Environment. 59:151-159; 2012





	IR (L/min)	Trip time (min)
Walk	23	49
Bike	37	24
Bus	10	34
Car	10	28



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Air pollution and physical activity: epidemiology

- TAPAS epidemiologic analysis (Andersen et al. 2015 Environmental Health Perspectives):
  - Danish Diet Cancer and Health Cohort (52 061 members, NO2 concentration at home address)
  - **Benefits of outdoor physical activity outweigh risks associated with air pollution exposure**
  - **Some benefits may be attenuated when exposed to high levels of NO2** (for respiratory mortality, benefits of physical activity are halved in high air pollution vs low air pollution, but it is still beneficial to be physical active)

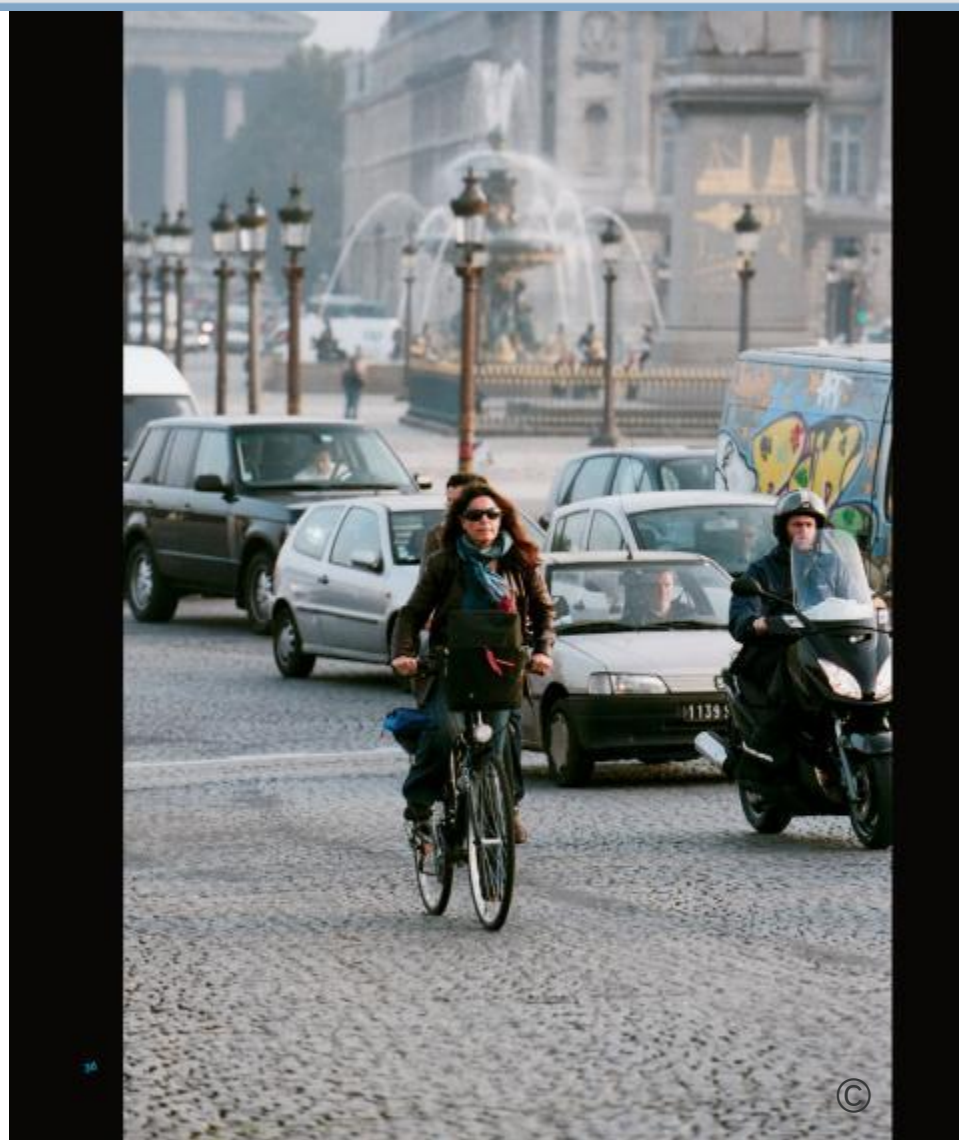

Photo: Gil Garcetti

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AP and PA: Experimental studies

(Kubesch et al. 2014 European Journal of Preventive Cardiology; Kubesch et al. 2014 Occupational Environmental Medicine; Cole-Hunter et al. 2015 J of Exposure Science and Environmental Epidemiology; Matt et al. 2016 Environment International)

TAPAS experimental study Case crossover, 28 volunteers

- Benefits of cycling on respiratory and cardiovascular outcomes even at high air pollution levels
- Exercise may protect against acute adverse effects of air pollution
- Difficulty of disentangling effects

Exercise improves the same physiological mechanisms that air pollution deteriorates

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Latest news:
London air pollution cancels positive health effects of exercise in over 60s

Experimental study comparing health effects of a walk in Hyde park vs Oxford St

Synharay et al. The Lancet 2017

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Risks and benefits of active travel: the PASTA study

PASTA

PHYSICAL ACTIVITY THROUGH SUSTAINABLE TRANSPORT APPROACHES

Open Access Protocol

BMJ Open

Physical Activity through Sustainable Transport Approaches (PASTA): a study protocol for a multicentre project

Regine Gerike,[1,2] Audrey de Nazelle,[3] Mark Nieuwenhuijsen,[4,5,6] Luc Int Panis,[7,8] Esther Anaya,[3] Ione Avila-Palencia,[4,5,6] Florinda Boschetti,[9] Christian Brand,[10] Tom Cole-Hunter,[4,5,6] Evi Dons,[7,11] Ulf Eriksson,[12] Mailin Gaupp-Berghausen,[1] Sonja Kahlmeier,[13] Michelle Laeremans,[7,8] Natalie Mueller,[4,5,6] Juan Pablo Orjuela,[3] Francesca Racioppi,[14] Elisabeth Raser,[1] David Rojas-Rueda,[4,5,6] Christian Schweizer,[14] Arnout Standaert,[7] Tina Uhlmann,[1] Sandra Wegener,[1] Thomas Götschi,[13] on behalf of the PASTA consortium

Environmental Science & Technology

Article

pubs.acs.org/est

Wearable Sensors for Personal Monitoring and Estimation of Inhaled Traffic-Related Air Pollution: Evaluation of Methods

Evi Dons,[*,†,‡] Michelle Laeremans,[†,§] Juan Pablo Orjuela,[∥] Ione Avila-Palencia,[⊥,#,@] Glòria Carrasco-Turigas,[⊥,#,@] Tom Cole-Hunter,[⊥,#,@,▽] Esther Anaya-Boig,[∥] Arnout Standaert,[†] Patrick De Boever,[†,‡] Tim Nawrot,[‡] Thomas Götschi,[●] Audrey de Nazelle,[∥] Mark Nieuwenhuijsen,[⊥,#,@] and Luc Int Panis[†,§]

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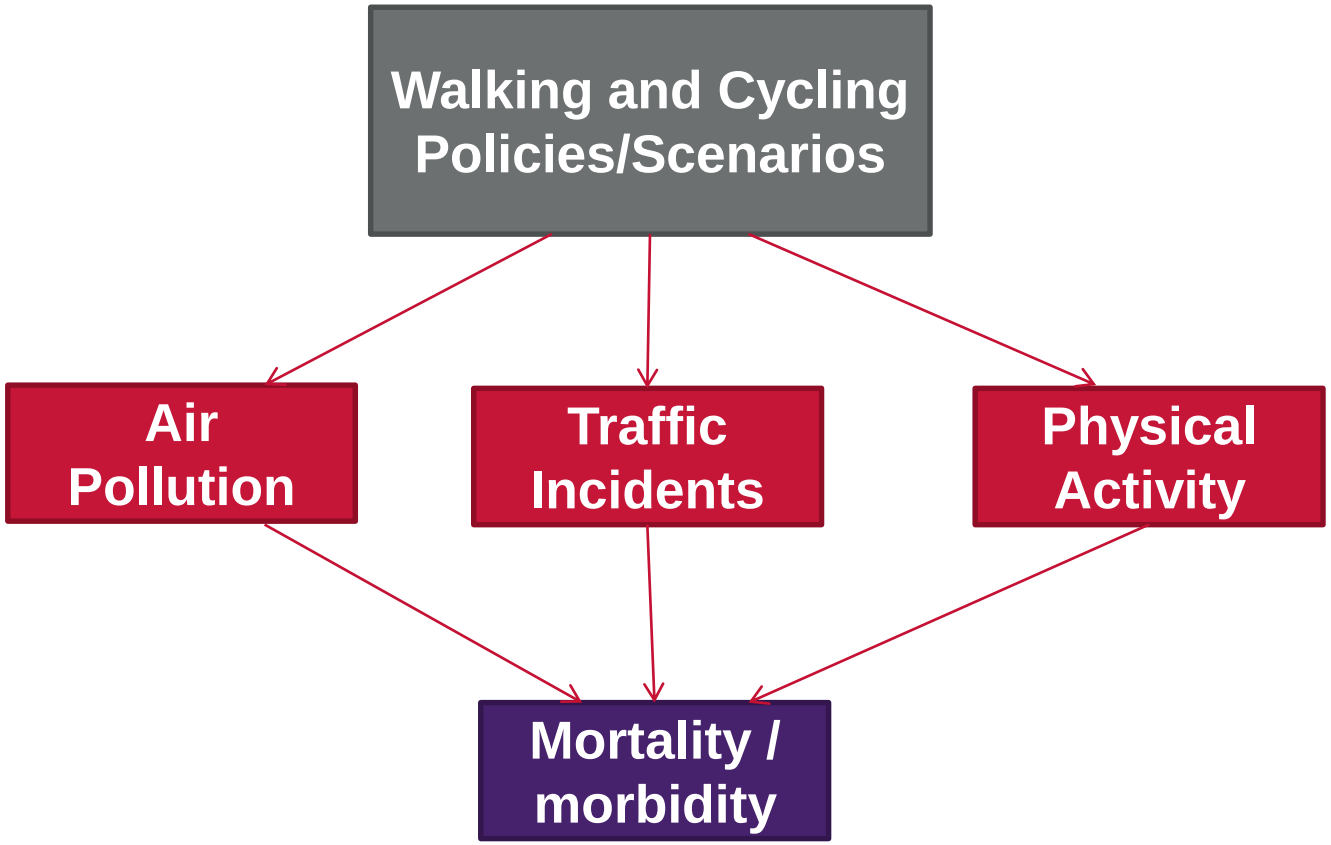
Health impact assessment models of active travel



Rojas-Rueda *et al*. BMJ 2011, Environment International 2012, Preventive Medicine 2013, PLoS One 2016; Rabl and de Nazelle Transport Policy 2012;

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HIA Example: Barcelona BICING case study

Inaugurated March 2007

In 2009: 182 000 subscribers

6000 bikes

425 stations

BMJ

BMJ 2011;343:d4521 doi: 10.1136/bmj.d4521

RESEARCH

The health risks and benefits of cycling in urban environments compared with car use: health impact assessment study

David Rojas-Rueda *predoctoral researcher*[1 2 3], Audrey de Nazelle *researcher*[1 2 3], Marko Tainio *researcher*[4], Mark J Nieuwenhuijsen *research professor*[1 2 3]

PASTAS
ACTIVE TRANSPORTATION
HEALTH IMPACT ASSESSMENT

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Results: mortality in new cyclist population

	Air pollution	Traffic mortality	physical activity
Relative Risk Bike vs Car	1.002	1.0007	0.80
Attributable fraction of mortality	0.002	0.0007	-0.23
Deaths / year	**+0.13**	**+0.03**	**-12.46**

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Health impact assessments (HIA)

- Main message from 20 published studies: Benefits of active travel in terms of physical activity outweigh adverse effects associated with air pollution and/or traffic injuries

Mueller et al. 2015. Health impact assessmen
transportation: A systematic review. Preventive

Preventive Medicine 87 (2016) 233–236

Contents lists available at ScienceDirect

Preventive Medicine

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

Brief Original Report

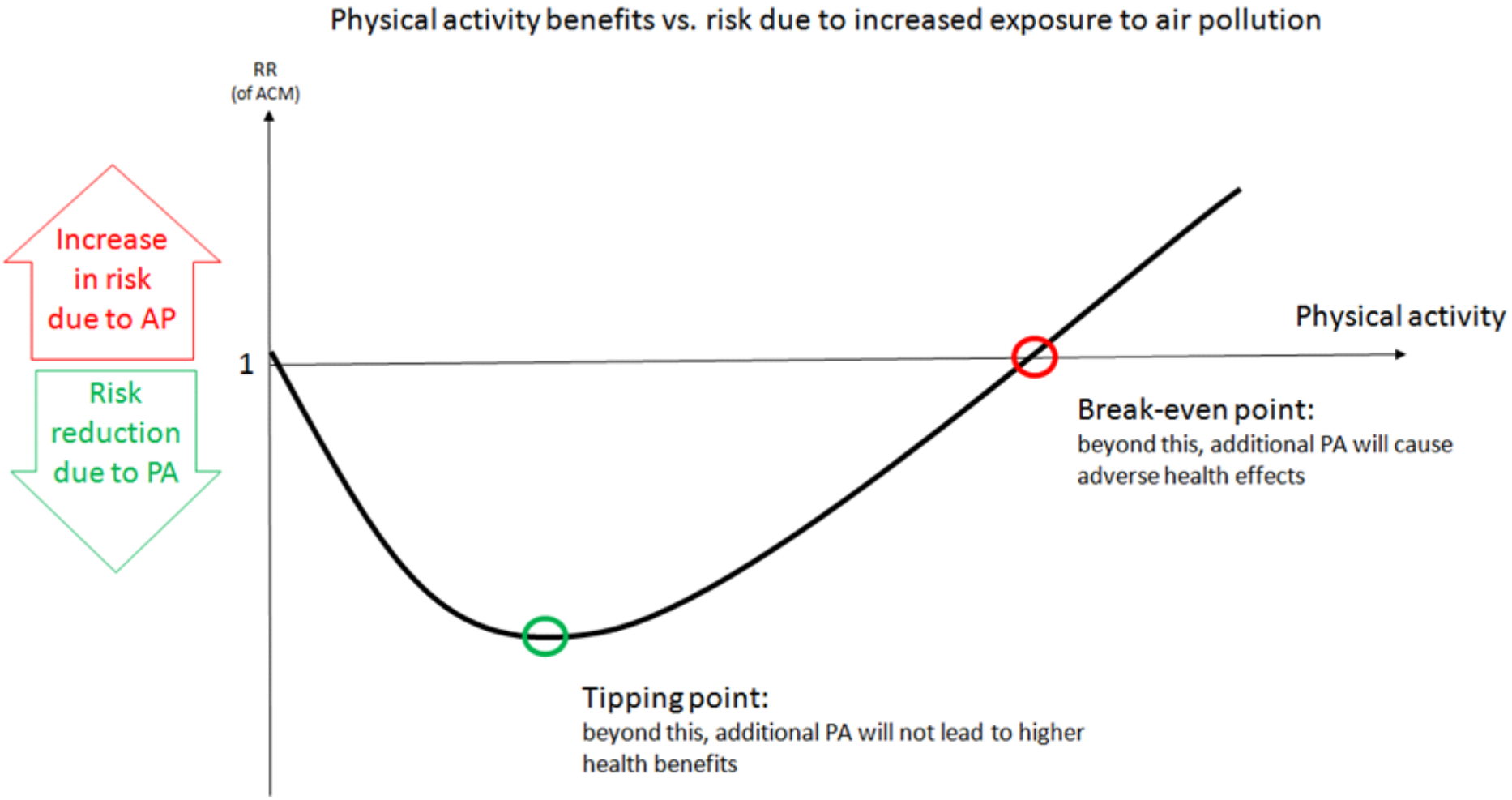
Can air pollution negate the health benefits of cycling and walking?

Marko Tainio [a,*], Audrey J. de Nazelle [b], Thomas Götschi [c], Sonja Kahlmeier [c], David Rojas-Rueda [d,e,f], Mark J. Nieuwenhuijsen [d,e,f], Thiago Hérick de Sá [g], Paul Kelly [h], James Woodcock [a]

[a] UKCRC Centre for Diet and Activity Research, MRC Epidemiology Unit, University of Cambridge School of Clinical Medicine, Institute of Metabolic Science, Cambridge, UK
[b] Centre for Environmental Policy, Imperial College London, London, UK
[c] Physical Activity and Health Unit, Epidemiology, Biostatistics and Prevention Institute, University of Zurich, Zurich, Switzerland
[d] Center for Research in Environmental Epidemiology (CREAL), Barcelona, Spain
[e] Universitat Pompeu Fabra (UPF), Barcelona, Spain
[f] Centro de Investigación Biomédica en Red de Epidemiología y Salud Pública (CIBERESP), Madrid, Spain
[g] Centre for Epidemiological Research in Nutrition and Health, School of Public Health, University of São Paulo, São Paulo, Brazil
[h] Physical Activity for Health Research Centre (PAHRC), University of Edinburgh, UK

- **Current Altmetric score 1122: best score over all articles ever published in Preventive Medicine**
- **In the top 1% of all research outputs ever tracked by Altmetric**

For a given level of air pollution, is there a tipping beyond which additional physical activity does not bring additional benefits, and a "break-even" point beyond which additional physical activity brings greater risks?



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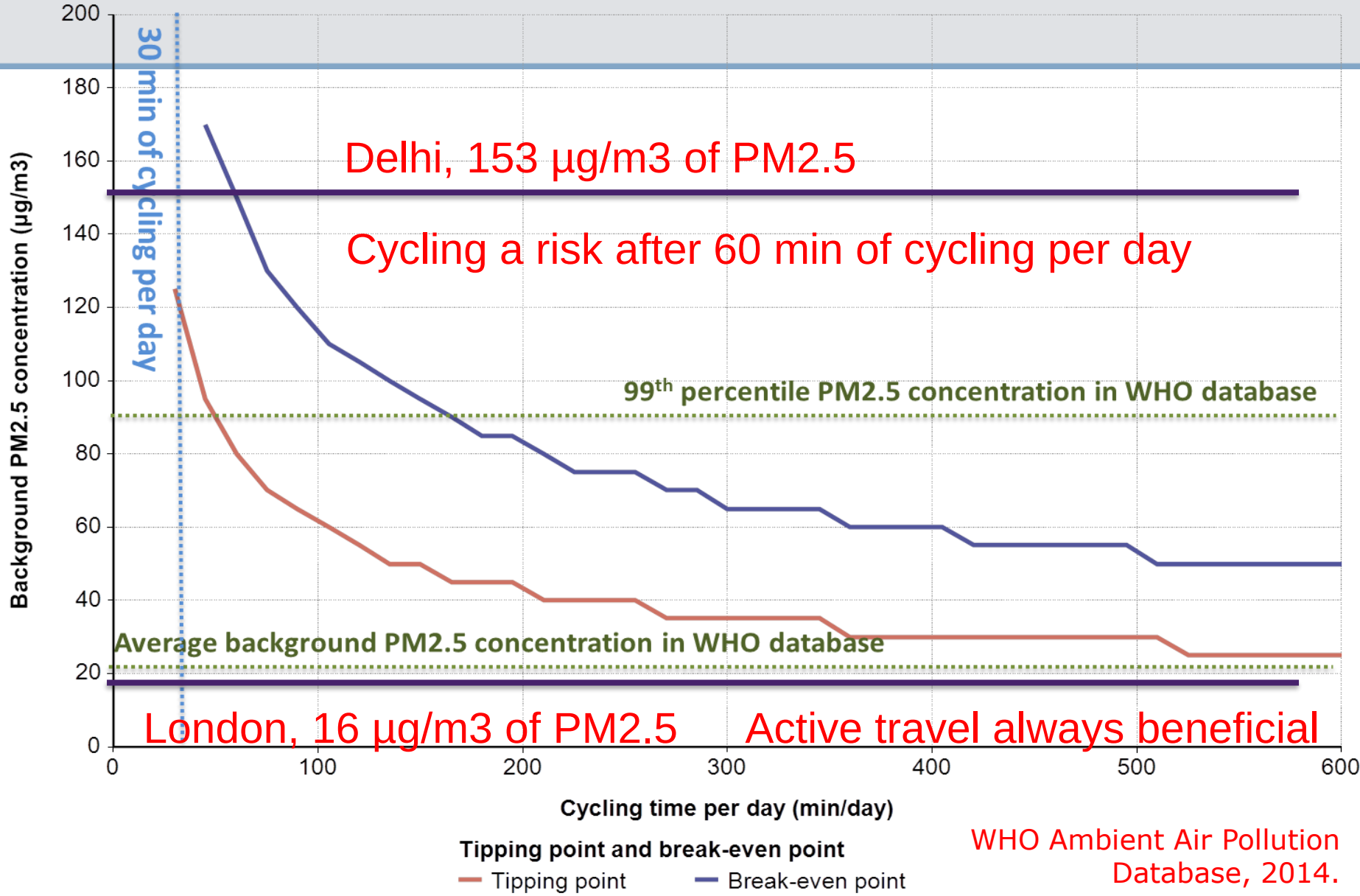
When risks become higher than benefits: Cycling



WHO Ambient Air Pollution Database, 2014.

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Air pollution benefits of active travel?

Changes in air pollution and deaths/year for transport scenarios in Barcelona

scenario	PM2.5 concentration % reduction		Deaths/year attributable to		
		Air pollution General population	physical activity	Traffic mortality	Air pollution travellers
20% in-city car trip reduction, all replaced by biking	**0.32**	**-5**	-33.73	0.08	0.57

Rojas-Rueda et al. Environment International 49 (2012) 100-109

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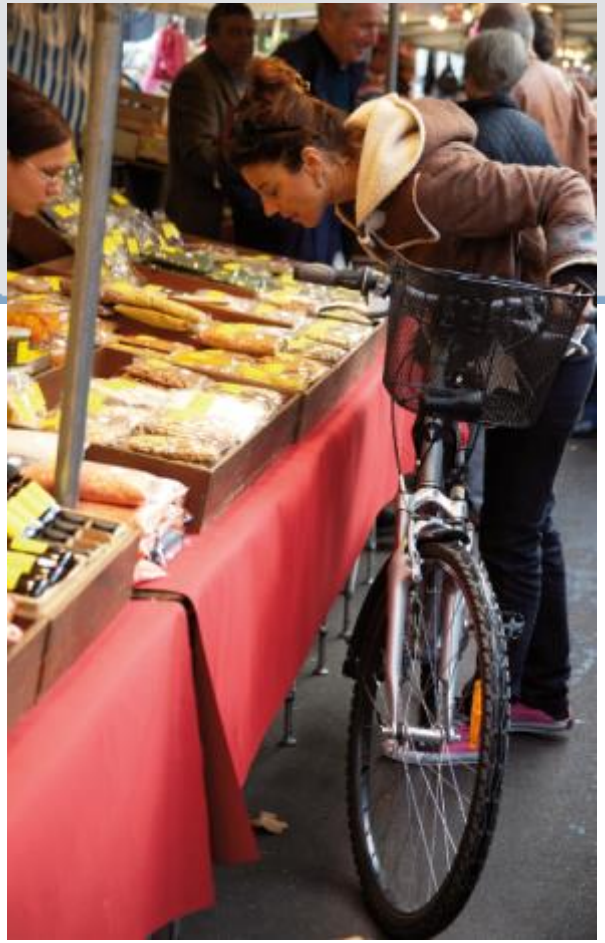
And take a holistic approach…

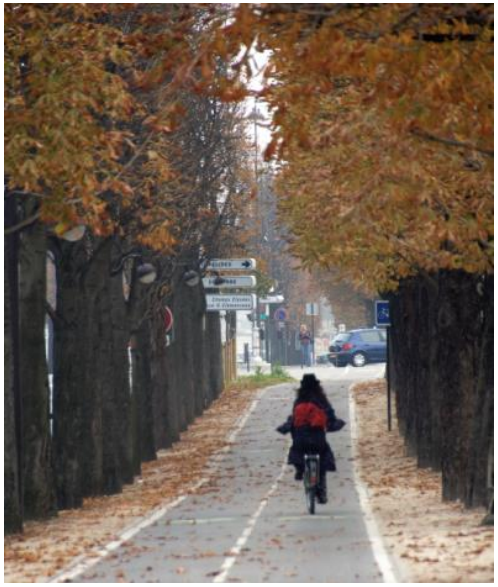
Co-benefits of climate change strategies

Woodcock et al. (2009) Comparison of GHG emission policy scenarios in London: ***death per million people***

scenario	physical activity	Air pollution	Traffic mortality	TOTAL
increased active travel	-528	-21	+11	-538
lower carbon emission vehicles	0	-17	0	-17

Woodcock et al. 2009 The Lancet , v3674, 9705: 1930-1943





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Co-benefits...

Review

Improving health through policies that promote active travel: A review of evidence to support integrated health impact assessment

Audrey de Nazelle [a,b,c,*], Mark J. Nieuwenhuijsen [a,b,c], Josep M. Antó [a,b,c], Michael Brauer [d], David Briggs [e], Charlotte Braun-Fahrlander [f], Nick Cavill [g], Ashley R. Cooper [h], Hélène Desqueyroux [i], Scott Fruin [j], Gerard Hoek [k], Luc Int Panis [l], Nicole Janssen [m], Michael Jerrett [n], Michael Joffe [e], Zorana Jovanovic Andersen [o], Elise van Kempen [m], Simon Kingham [p], Nadine Kubesch [a,b,c], Kevin M. Leyden [q,r], Julian D. Marshall [s], Jaume Matamala [a,b,c], Giorgos Mellios [t], Michelle Mendez [a,b,c], Hala Nassif [u], David Ogilvie [v], Rosana Peiró [w,x], Katherine Pérez [y], Ari Rabl [z], Martina Ragettli [f], Daniel Rodríguez [aa], David Rojas [a,b,c], Pablo Ruiz [ab], James F. Sallis [ac], Jeroen Terwoert [ad], Jean-François Toussaint [u], Jouni Tuomisto [ae], Moniek Zuurbier [k], Erik Lebret [k,m]

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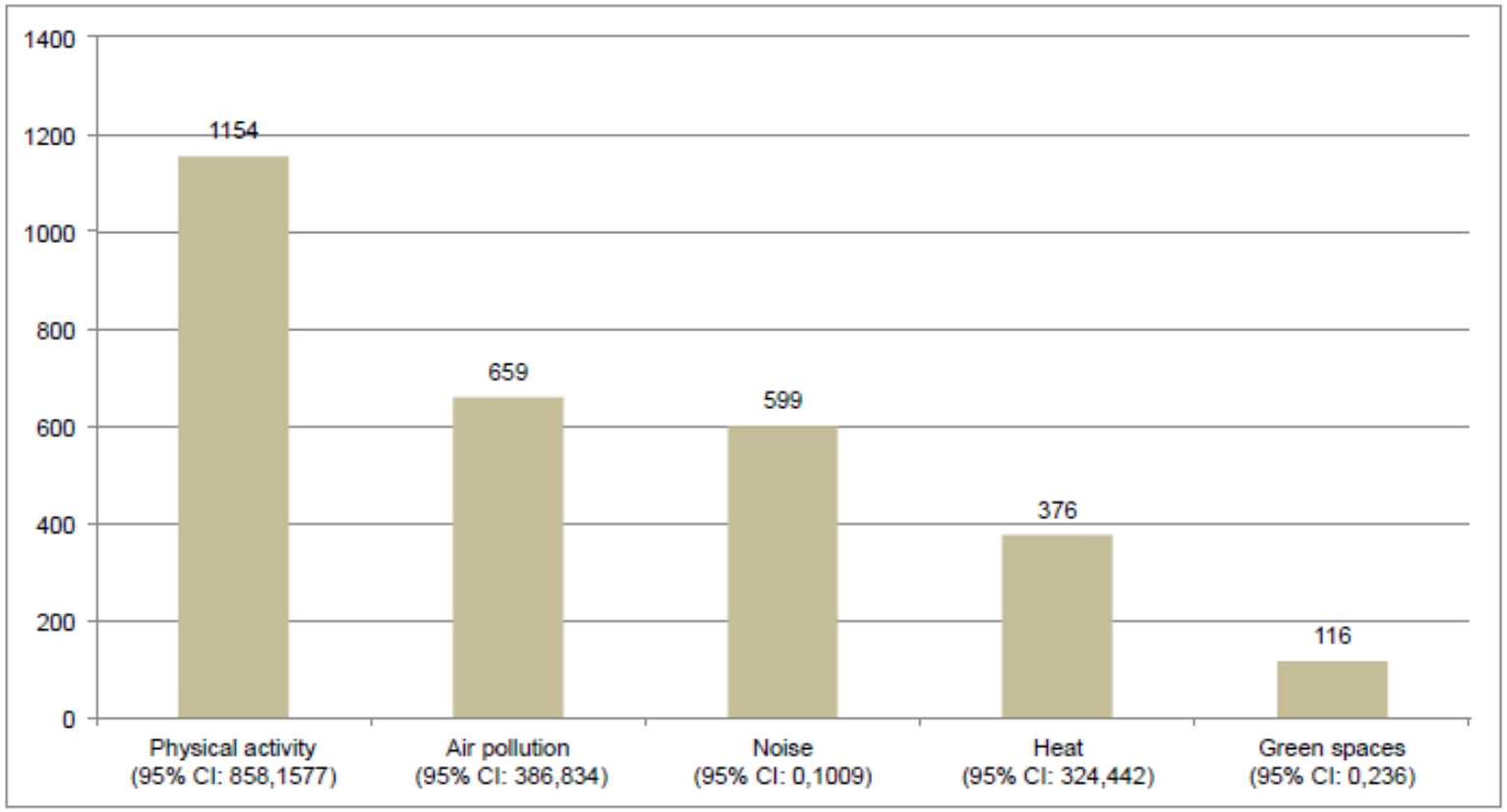
Potential co-benefits of planning strategies…



Estimated preventable deaths under compliance with exposure recommendations by exposure domain in Barcelona, Spain.

Mueller et al Urban and Transport Planning Related Exposures and Mortality: A Health Impact Assessment for Cities EHP June 2016

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Conclusion: Air pollution in cities- can the problem become an opportunity?

Air pollution needs to be tackled, and it offers huge opportunities for co-benefits with appropriate planning strategies

Healthy Streets for London

Prioritising walking, cycling and public transport to create a healthy city

MAYOR OF LONDON

TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

Thank you!

Audrey de Nazelle - anazelle@imperial.ac.uk