



Qualité de l'air et Santé cardiaque

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Athérosclérose ?







Pourquoi l'athérosclérose ?

1948

The Framingham Heart Study

American epidemic

Pourquoi l'athérosclérose ?

The Framingham Heart Study

1948-2011

- ✓ Hérité
- ✓ Cholestérol
- ✓ Hypertension
- ✓ Diabète
- ✓ Tabac
- ✓ Obésité
- ✓ Sédentarité
- ✓ Stress

Pourquoi l'athérosclérose ?

La maladie cardiaque
est rare chez l'animal

Pourquoi l'athérosclérose ?

La maladie cardiaque
était rare chez l'humain

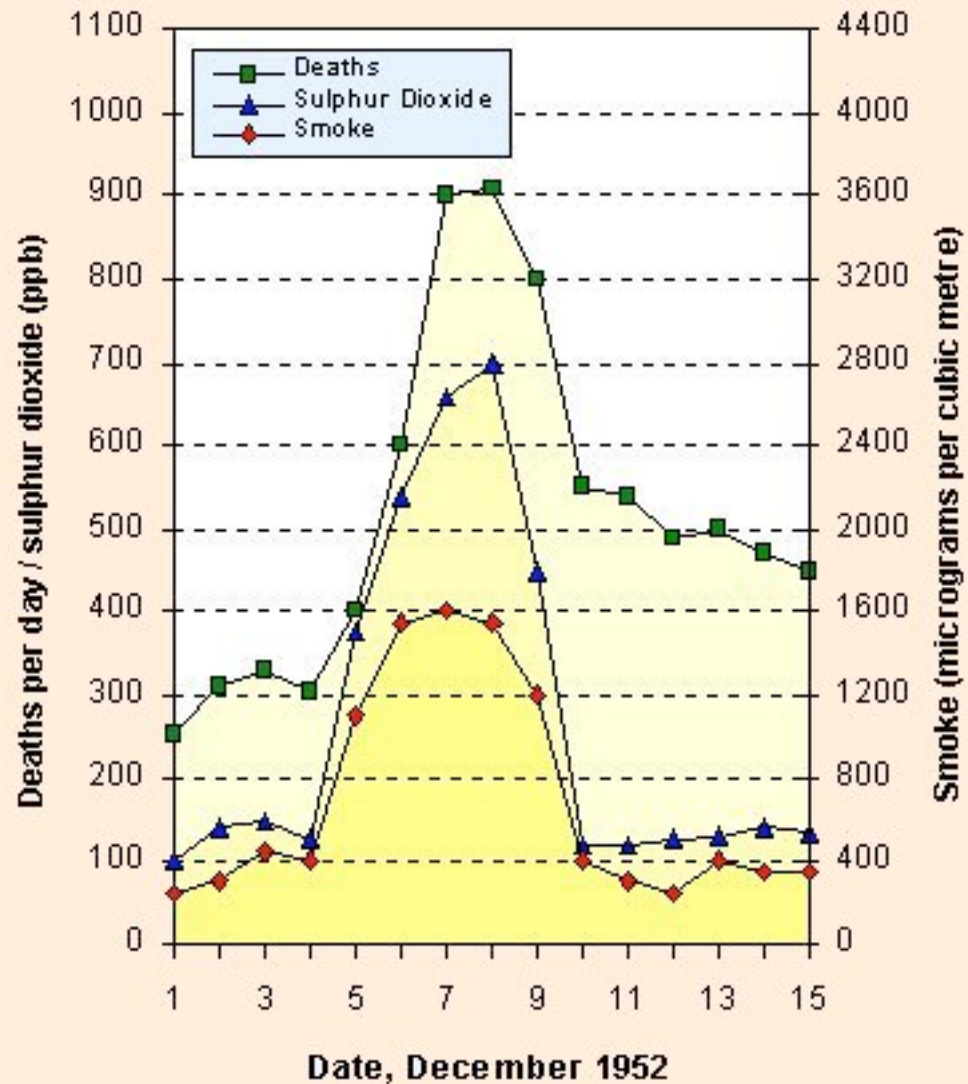
Pourquoi l'athérosclérose ?

La maladie cardiaque
explose lors des
révolutions industrielles

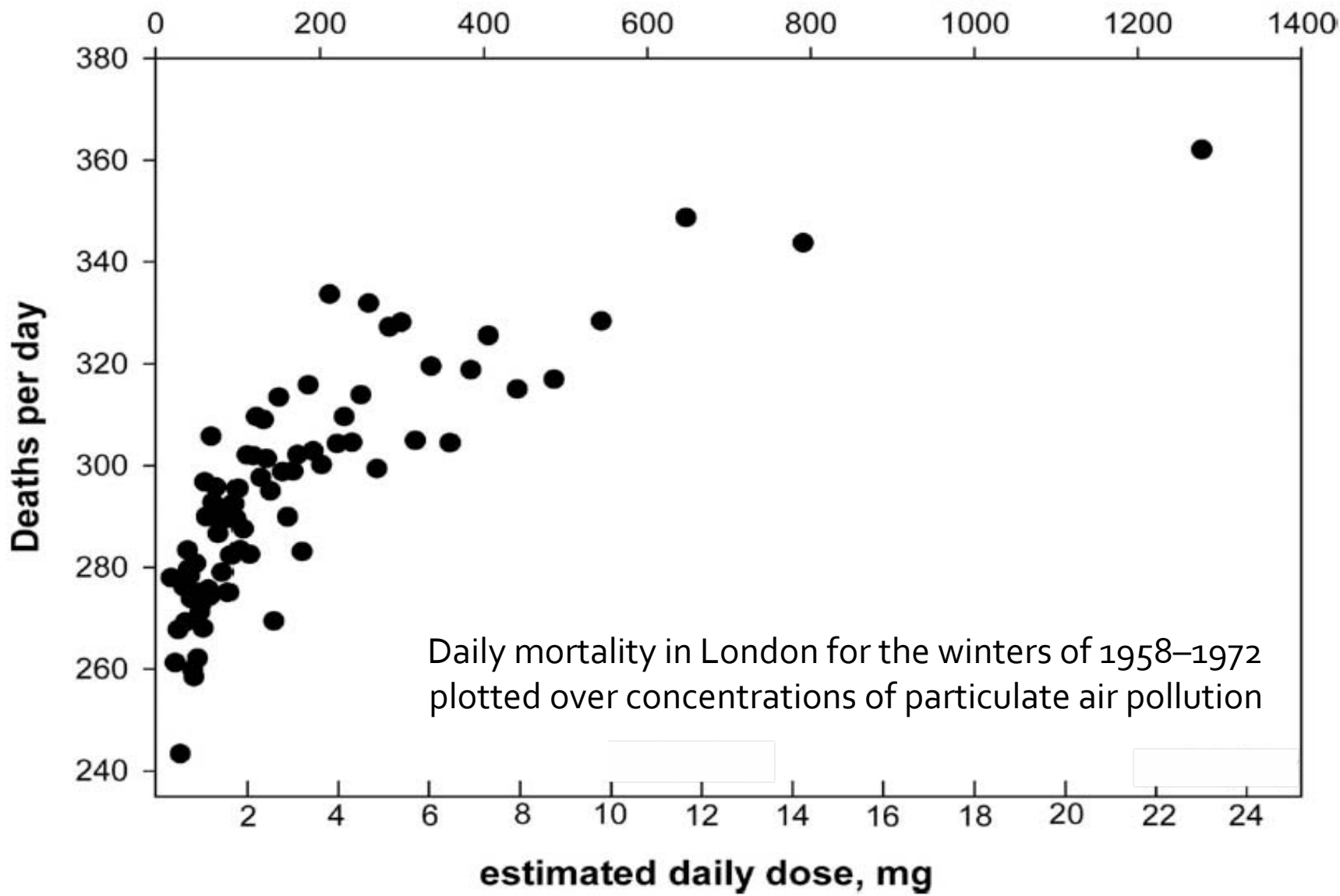
Great London Smog, décembre 1952



"Great London Smog » : 12 000 décès excédentaires



British Smoke concentrations, $\mu\text{g}/\text{m}^3$



The New England Journal of Medicine

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Number 24

AN ASSOCIATION BETWEEN AIR POLLUTION AND MORTALITY IN SIX U.S. CITIES

DOUGLAS W. DOCKERY, Sc.D., C. ARDEN POPE III, Ph.D., XIPING XU, M.D., Ph.D.,
JOHN D. SPENGLER, Ph.D., JAMES H. WARE, Ph.D., MARTHA E. FAY, M.P.H.,
BENJAMIN G. FERRIS, JR., M.D., AND FRANK E. SPEIZER, M.D.

Abstract Background. Recent studies have reported associations between particulate air pollution and daily mortality rates. Population-based, cross-sectional studies of metropolitan areas in the United States have also found associations between particulate air pollution and annual mortality rates, but these studies have been criticized, in part because they did not directly control for cigarette smoking and other health risks.

Methods. In this prospective cohort study, we estimated the effects of air pollution on mortality, while controlling for individual risk factors. Survival analysis, including Cox proportional-hazards regression modeling, was conducted with data from a 14-to-16-year mortality follow-up of 8111 adults in six U.S. cities.

Results. Mortality rates were most strongly associated with cigarette smoking. After adjusting for smoking and

other risk factors, we observed statistically significant and robust associations between air pollution and mortality. The adjusted mortality-rate ratio for the most polluted of the cities as compared with the least polluted was 1.26 (95 percent confidence interval, 1.08 to 1.47). Air pollution was positively associated with death from lung cancer and cardiopulmonary disease but not with death from other causes considered together. Mortality was most strongly associated with air pollution with fine particulates, including sulfates.

Conclusions. Although the effects of other, unmeasured risk factors cannot be excluded with certainty, these results suggest that fine-particulate air pollution, or a more complex pollution mixture associated with fine particulate matter, contributes to excess mortality in certain U.S. cities. (N Engl J Med 1993;329:1753-9.)

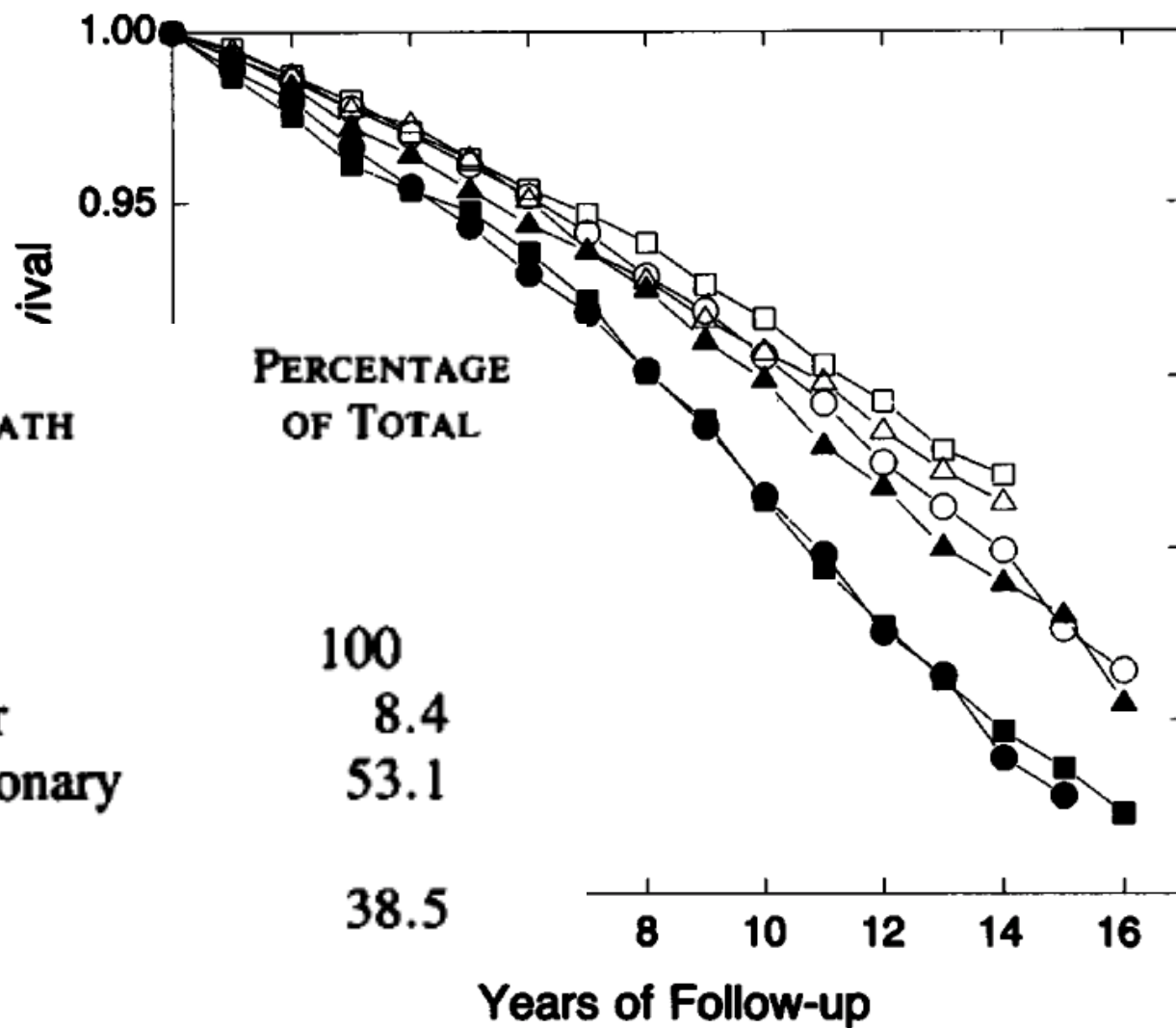


Figure 2. Crude Probability of Survival in the Six Cities, According to Years of Follow-up.

Nos échanges avec l'environnement

Interface solide/ liquide/ gaz

- Ce qu'on mange
 - Ce qu'on boit
 - Ce qu'on respire
- 1 kilo
 - 2 kilos
 - 20 kilos

Révolution industrielle

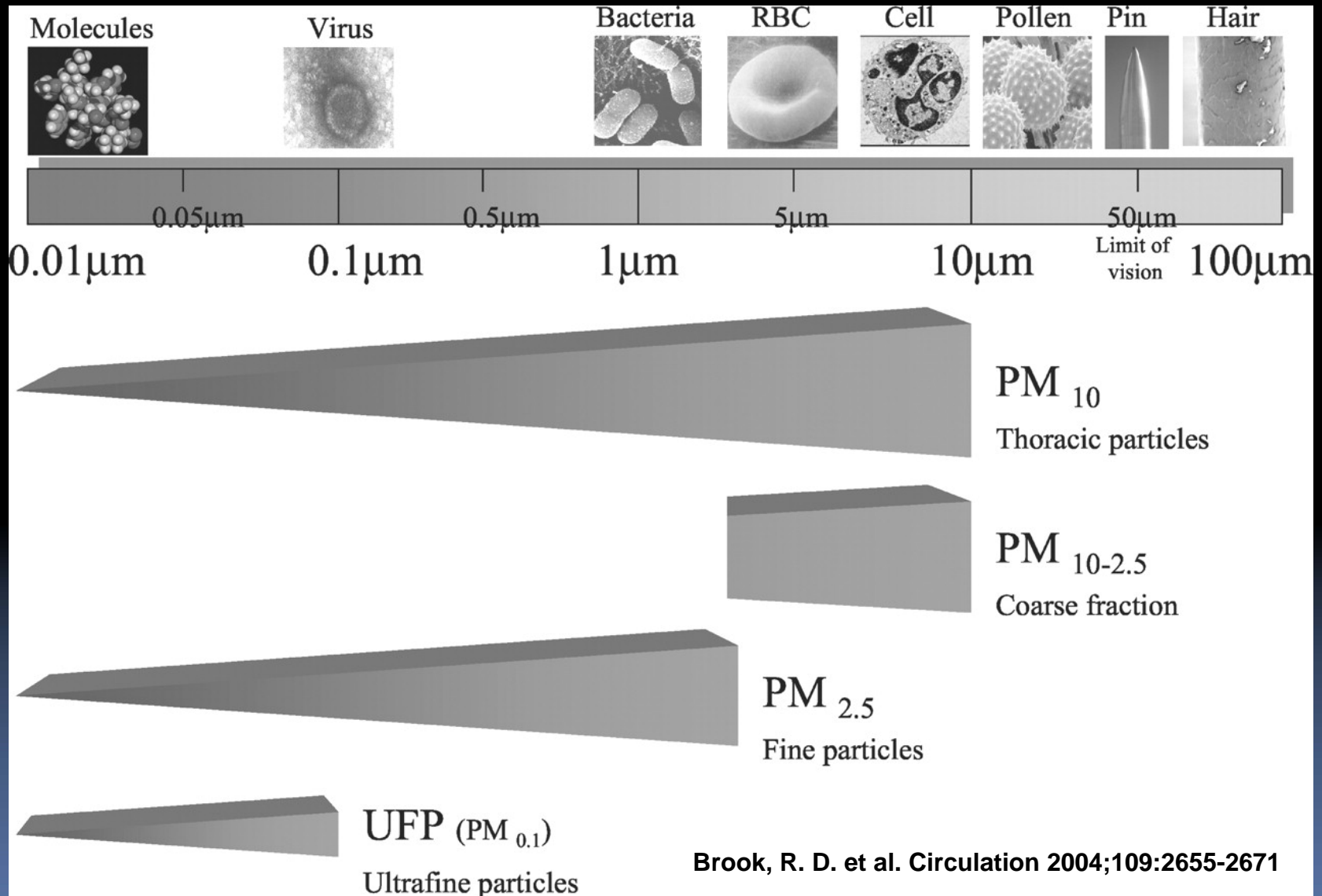
■ Nano-agresseurs alimentaires

- Sel
- Sirop fructose-glucose
- Gras trans
- Acide phosphorique
- Pesticides

■ Nano-agresseurs aériens

- CO
- NO₂, SO₂
- Particules fines
- COV
- Ozone
- Plomb

Particules fines des combustibles fossiles



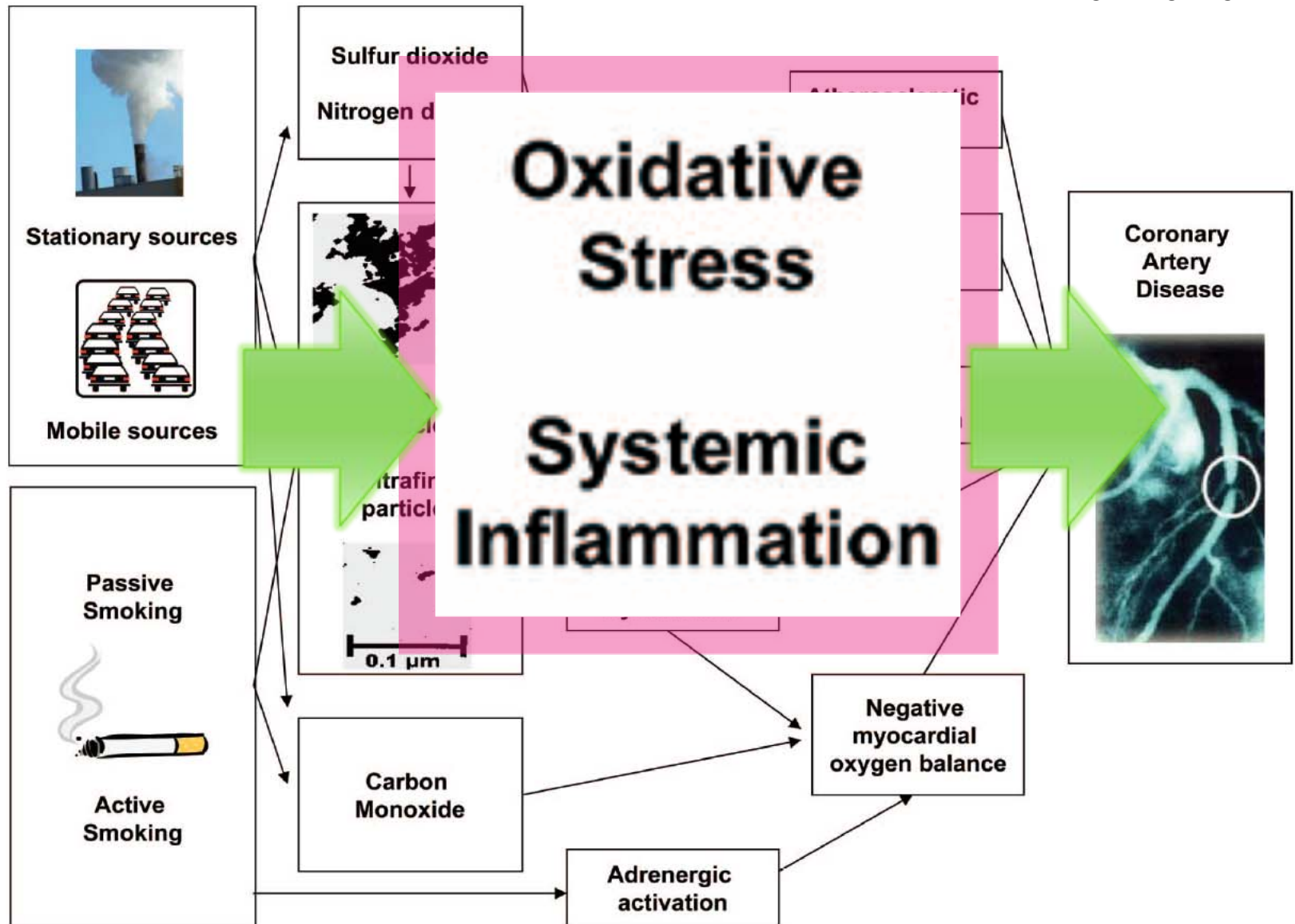
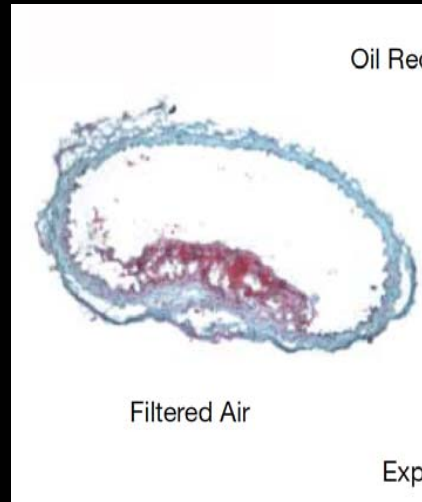


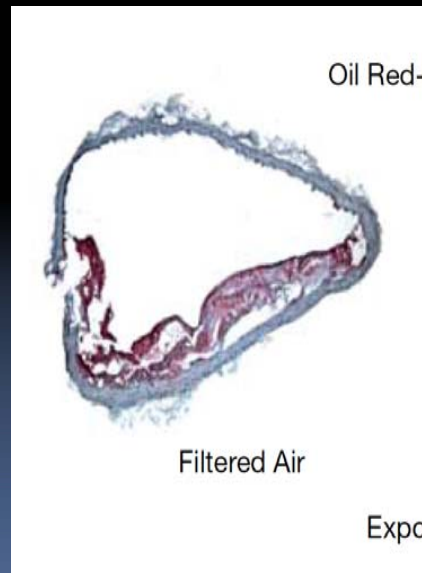
Figure. Overview on pathomechanism linking ambient air pollution,⁴ secondhand smoke,⁷ and active smoking to acute coronary syndromes.

Air filtré

Diète normale



Diète grasse



Long-term Air Pollution Exposure and Acceleration of Atherosclerosis and Vascular Inflammation in an Animal Model. JAMA 2005. 294: 3003-3010

Plus de 500 publications scientifiques nous apprennent que

- Plus le taux de polluants monte, plus monte le taux de
 - Calcifications artérielles
 - Thrombophlébites
 - Arythmies malignes et mort subites
 - Infarctus aigus
 - AVC
 - Hausse de complications diabétiques

Pollution et maladie cardiaque



Residential Exposure to Traffic Is Associated With Coronary Atherosclerosis
B. Hoffmann, S. Moebus, S. Möhlenkamp, A. Stang, N. Lehmann, N. Dragano, A. Schmermund, M. Memmesheimer, K. Mann, R. Erbel, K.-H. Jöckel and for the Heinz Nixdorf Recall Study Investigative Group

Circulation 2007;116;489-496; originally published online Jul 16, 2007;

DOI: 10.1161/CIRCULATIONAHA.107.693622

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- Allemagne (Rhur) 00-03 **4494 personnes**
 - Plus on vit près d'une voie polluée, plus on augmente le dépôt de calcium dans les artères
 - **Hausse de 63 % de calcifications** à moins de 50 m

Pollution et maladie cardiaque

THE LANCET

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ARTICLES

Ⓜ Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study

Gerard Hoek, Bert Brunekreef, Sandra Goldbohm, Paul Fischer, Piet A van den Brandt

- Hollande 86-94 **4492 personnes**
 - Plus on vit près d'une voie routière polluée, plus on augmente la mortalité CV
 - **Hausse de 95 %** à moins de 50 m

Pollution et maladie cardiaque

Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION

Increased Particulate Air Pollution and the Triggering of Myocardial Infarction

Annette Peters, Douglas W. Dockery, James E. Muller and Murray A. Mittleman

Circulation 2001;103:2810-2815

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1524-4539

- Boston 95-96 **772 infarctus**
 - Pic de pollution: déclencheur d'infarctus
 - **Hausse de 48 %** dans l'heure
 - **Hausse de 69%** dans les 24 heures

Pollution et maladie cardiaque

The **NEW ENGLAND**
JOURNAL of MEDICINE

Exposure to Traffic and the Onset of Myocardial Infarction

Annette Peters, Ph.D., Stephanie von Klot, M.P.H., Margit Heier, M.D.,
Ines Trentinaglia, B.S., Allmut Hörmann, M.S., H. Erich Wichmann, M.D., Ph.D., and Hannelore Löwel, M.D.,
for the Cooperative Health Research in the Region of Augsburg Study Group

- Augsburg 99-01 **700 infarctus**
 - Exposition au trafic urbain lourd augmente le risque d'infarctus
 - **Hausse de 292 %** dans l'heure de l'exposition

Pollution et maladie cardiaque



Effects of air pollution on the incidence of myocardial infarction

K Bhaskaran, S Hajat, A Haines, et al.

Heart 2009 95: 1746-1759 originally published online July 26, 2009
doi: 10.1136/hrt.2009.175018

- 26 articles liant polluants et infarctus aigus
 - 19 en aigu
 - 7 en chronique
- Hausse de 10 $\mu\text{g}/\text{m}^3$ $\text{PM}_{2,5}$ entraîne une hausse de 5-17 % d'infarctus

Pollution/Hospitalisation MCAS



Long-Term Exposure to Traffic-Related Air Pollution and the Risk of Coronary Heart Disease Hospitalization and Mortality

Wen Qi Gan, Mieke Koehoorn, Hugh W. Davies, Paul A. Demers, Lillian Tamburic, and Michael Brauer

- Vancouver
 - 450 000 sujets 1994-2002
 - Hausse de 0,75 $\mu\text{g}/\text{m}^3$ PM :
 - Hausse de 3% hospitalisation MCAS
 - Hausse de 6 % de mortalité CV

Pollution et arythmies malignes



Association of Air Pollution with Increased Incidence of Ventricular Tachyarrhythmias Recorded by Implanted Cardioverter Defibrillators

Douglas W. Dockery,^{1,2} Heike Luttmann-Gibson,¹ David Q. Rich,¹ Mark S. Link,³ Murray A. Mittleman,^{4,5} Diane R. Gold,^{1,2} Petros Koutrakis,¹ Joel D. Schwartz,^{1,2} and Richard L. Verrier^{1,5}

¹Department of Environmental Health, Harvard School of Public Health, Boston, Massachusetts, USA; ²Channing Laboratory, Brigham and Women's Hospital and Harvard Medical School, Boston, Massachusetts, USA; ³New England Medical Center, Tufts University, Boston, Massachusetts, USA; ⁴Department of Epidemiology, Harvard School of Public Health, Boston, Massachusetts, USA; ⁵Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, USA

- Boston 1995-2002 **203 pts/défibrillateur**
 - **Hausse de 60% de tachycardie ventriculaire** dans les 3 jours suivant un pic de pollution

Pollution et arythmies malignes



Driving and Implantable Cardioverter-Defibrillator Shocks for Ventricular Arrhythmias

Results From the TOVA Study

- Étude TOVA **1,188 pts/défib** 31 villes
 - Dans l'heure suivant une sortie en automobile: **deux fois plus** de décharges de défibrillateurs pour arythmies malignes.

Pollution et AVC

Stroke

JOURNAL OF THE AMERICAN HEART ASSOCIATION

**Associations of Fine and Ultrafine Particulate Air Pollution With Stroke
Mortality in an Area of Low Air Pollution Levels**

Jaana Kettunen, Timo Lanki, Pekka Tiittanen, Pasi P. Aalto, Tarja Koskentalo,
Markku Kulmala, Veikko Salomaa and Juha Pekkanen

Stroke 2007;38:918-922; originally published online Feb 15, 2007;

DOI: 10.1161/01.STR.0000257999.49706.3b

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Copyright © 2007 American Heart Association. All rights reserved. Print ISSN: 0039-2499. Online

ISSN: 1524-4628

- Helsinki / 1 million d'habitants
- 1998 à 2004 / 3265 décès par AVC
- Une élévation d'un quartile de FP et de CO entraîne dans les 24 heures une **hausse de 8.5 %** d'AVC mortels

Pollution et démence



ORIGINAL INVESTIGATION

Exposure to Particulate Air Pollution and Cognitive Decline in Older Women

Jennifer Weuve, MPH, ScD; Robin C. Puetz, MPH, PhD; Joel Schwartz, PhD; Jeff D. Yanosky, MS, ScD; Francine Laden, MS, ScD; Francine Grodstein, ScD

Background: Chronic exposure to particulate air pollution may accelerate cognitive decline in older adults, although data on this association are limited. Our objective was to examine long-term exposure to particulate matter (PM) air pollution, both coarse (PM 2.5-10 μm in diameter [PM_{2.5-10}]) and fine (PM <2.5 μm in diameter [PM_{2.5}]), in relation to cognitive decline.

ing tests of general cognition, verbal memory, category fluency, working memory, and attention.

Results: Higher levels of long-term exposure to both PM_{2.5-10} and PM_{2.5} were associated with significantly faster cognitive decline. Two-year decline on a global score was 0.020 (95% CI, -0.032 to -0.008) standard units worse per 10 $\mu\text{g}/\text{m}^3$ increment in PM_{2.5-10} exposure and 0.018

- Chaque hausse de 10 $\mu\text{g}/\text{m}^3$ de particules fines:
 - Baisse de 2 % du score mental
 - Équivalent à un vieillissement cérébral de 2 ans

Modèle cardio- environnemental

- Taux de pollution d'une ville =
 - Taux de mortalité/morbidité cardiovasculaire

COST OF POLLUTION IN CHINA

ECONOMIC ESTIMATES OF PHYSICAL DAMAGES



THE WORLD BANK



THE GOVERNMENT OF THE
PEOPLE'S REPUBLIC OF CHINA

L'air tue 2 millions de personnes par année

Mise à jour le lundi 26 septembre 2011 à 14 h 40 HAE

Commenter 10



3



1



Recommander 64

Partager



(archives)

Les maladies causées par la pollution de l'air tuent chaque année au moins deux millions de personnes dans le monde, montre un rapport de l'Organisation mondiale de la santé (OMS).



ORGANISATION FOR ECONOMIC
CO-OPERATION AND DEVELOPMENT

ORGANISATION DE COOPÉRATION ET
DE DÉVELOPPEMENT ÉCONOMIQUES



BETTER POLICIES FOR BETTER LIVES

DES POLITIQUES MEILLEURES POUR UNE VIE MEILLEURE

OECD ENVIRONMENTAL OUTLOOK TO 2050:
The Consequences of Inaction
Key Facts and Figures

OCDE 2010-2050



Pollution de l'air

- Hausse de 360 % PM 2,5
- Hausse de 90 % SO₂
- Hausse de 50 % NO_x

Exposition humaine

- 2% population urbaine: <20 µg/m³ PM 2,5 (« bon »)
- 70 % urbains BRIICS exposés à > 70 µg/m³ (toxique)

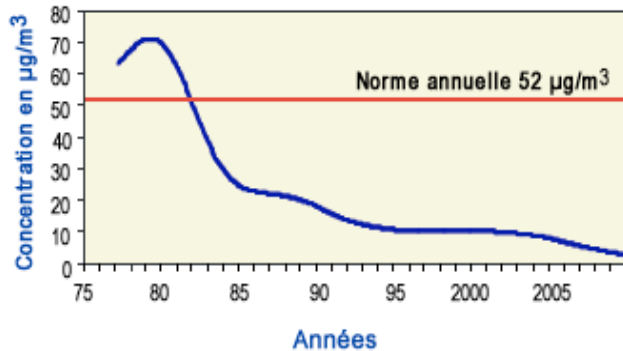
Air : Impact santé (cardiovasculaire et pulmonaire)

- 1^{ère} cause de † prématurés
- Particules fines
 - Hausse de 1 M à 3,6 M †
- Ozone au sol :
 - Hausse de 380 000 à 800 000 †

Montréal 1980-2009 RSQA

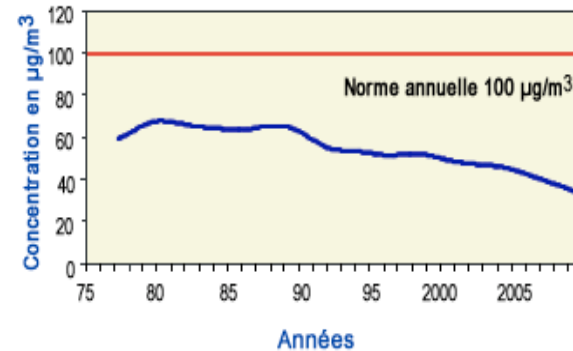
Dioxyde de soufre (SO₂)

Station 061, Montréal (centre-ville)



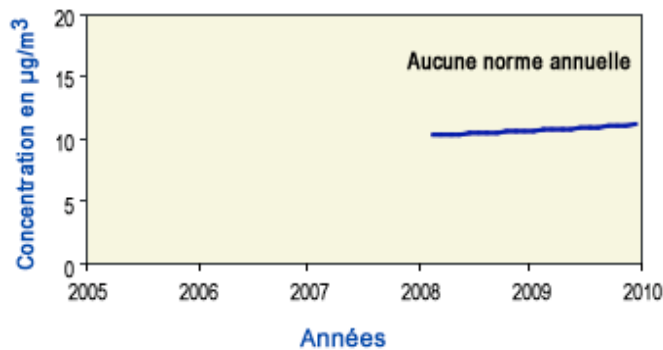
Dioxyde d'azote (NO₂)

Station 061, Montréal (centre-ville)



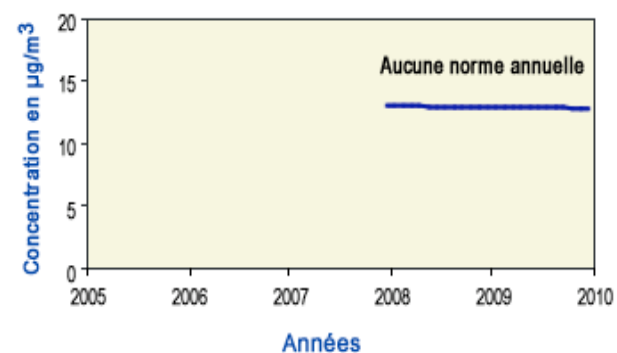
Particules respirables (PM_{2,5})

Station 066, Aéroport de Montréal

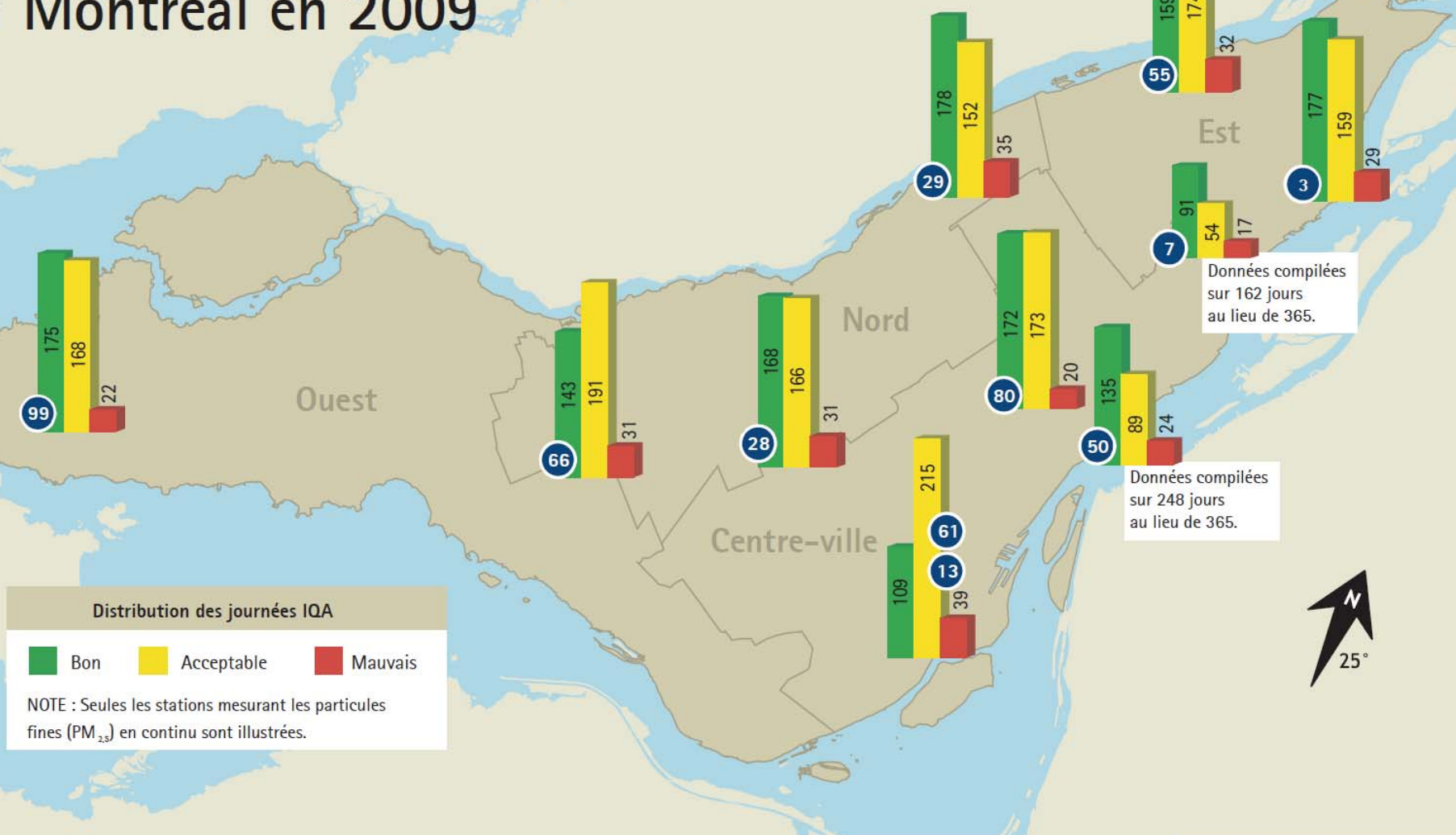


Particules respirables (PM_{2,5})

Station 013, Montréal (centre-ville)



Indice de la qualité de l'air (IQA) à Montréal en 2009





ORIGINAL INVESTIGATION

Ambient Air Pollution and the Risk of Acute Ischemic Stroke

Gregory A. Wellenius, ScD; Mary R. Burger, MD; Brent A. Coull, PhD; Joel Schwartz, PhD; Helen H. Suh, ScD; Petros Koutrakis, PhD; Gottfried Schlaug, MD, MPH; Diane R. Gold, MD, MPH; Murray A. Mittleman, MD, DrPH

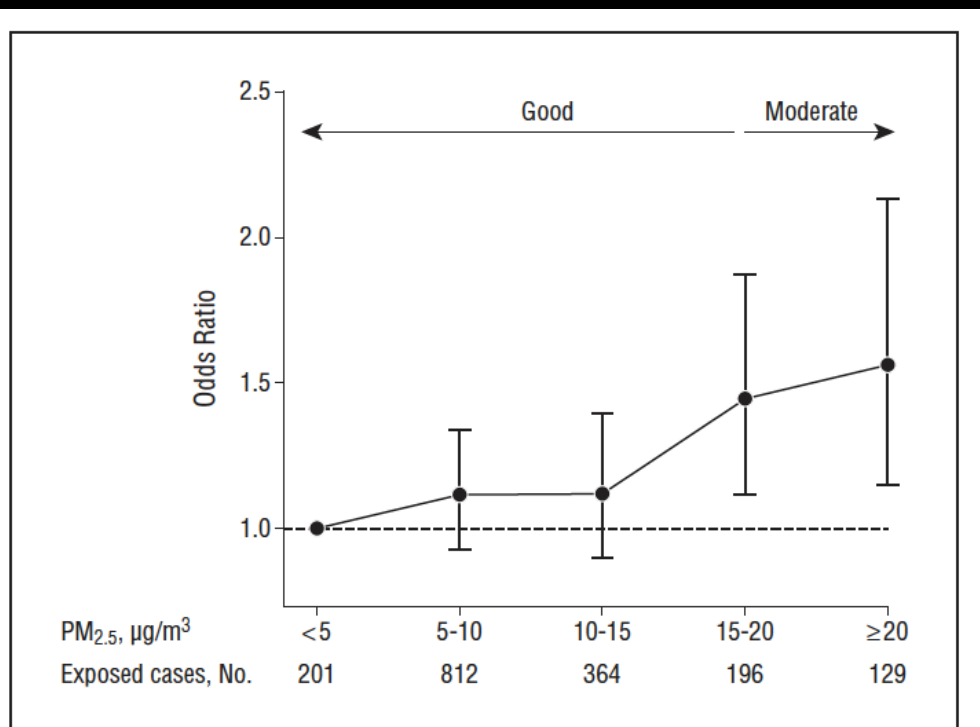
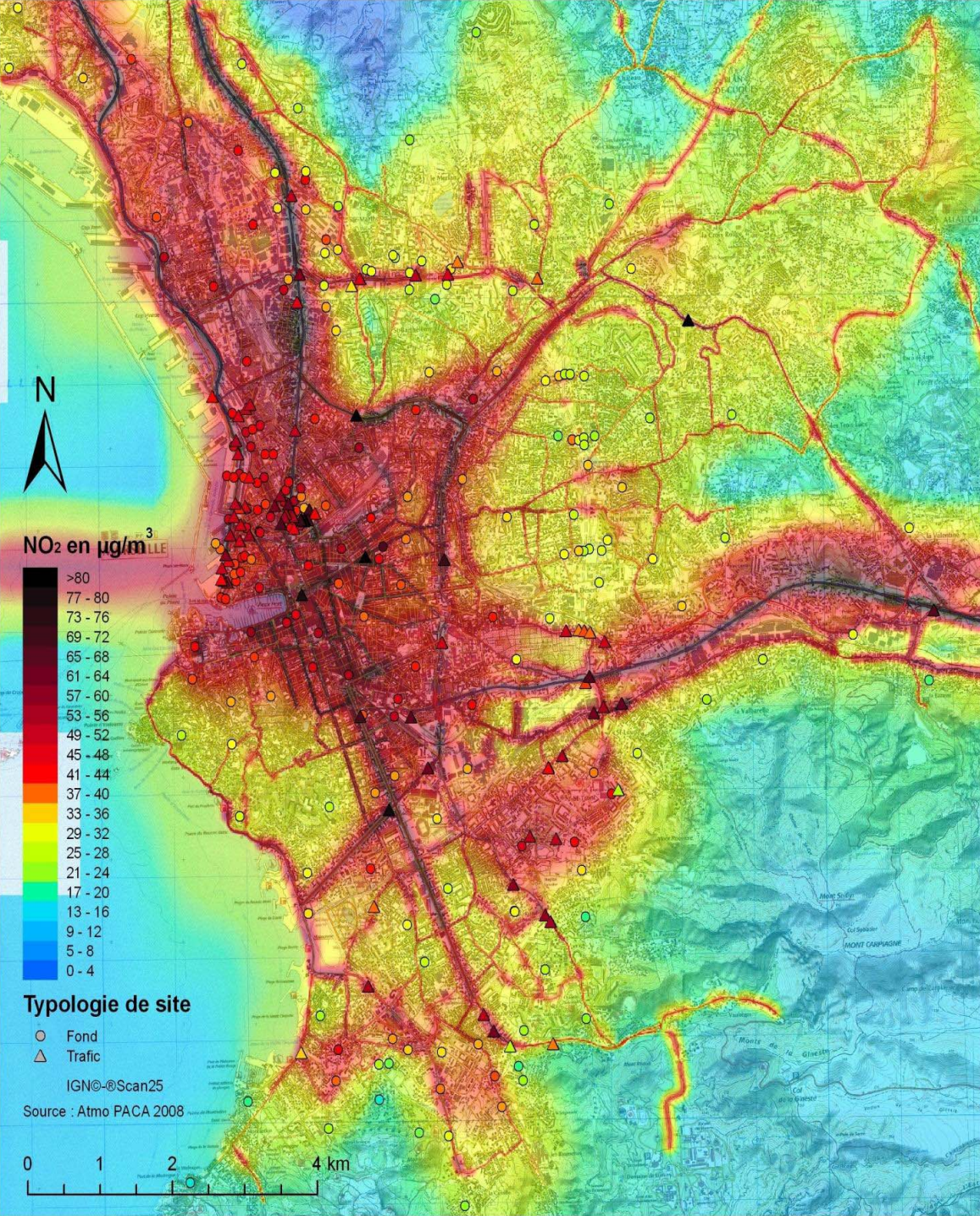


Figure 1. Odds ratio of ischemic stroke onset for US Environmental Protection Agency categories (*good* and *moderate*) of mean ambient fine particulate matter air pollution (PM_{2.5}) levels in the 24 hours preceding stroke onset. Error bars indicate 95% CIs.



Emission de NO₂ à Marseille

Émission de NO₂ à Paris



Concentrations moyenne en NO₂ à Paris en 2009

Impact de la pollution au Canada

- 5 à 11 000 décès cardiovasculaires/an
- 33 à 67 000 hospitalisations CV
- 1,5 millions de jours d'hospitalisation CV
- 9,1 milliards de dollars

David R.Boyd, Stephen J. Genuis
Envir. Research, 2008, 106:240-249.

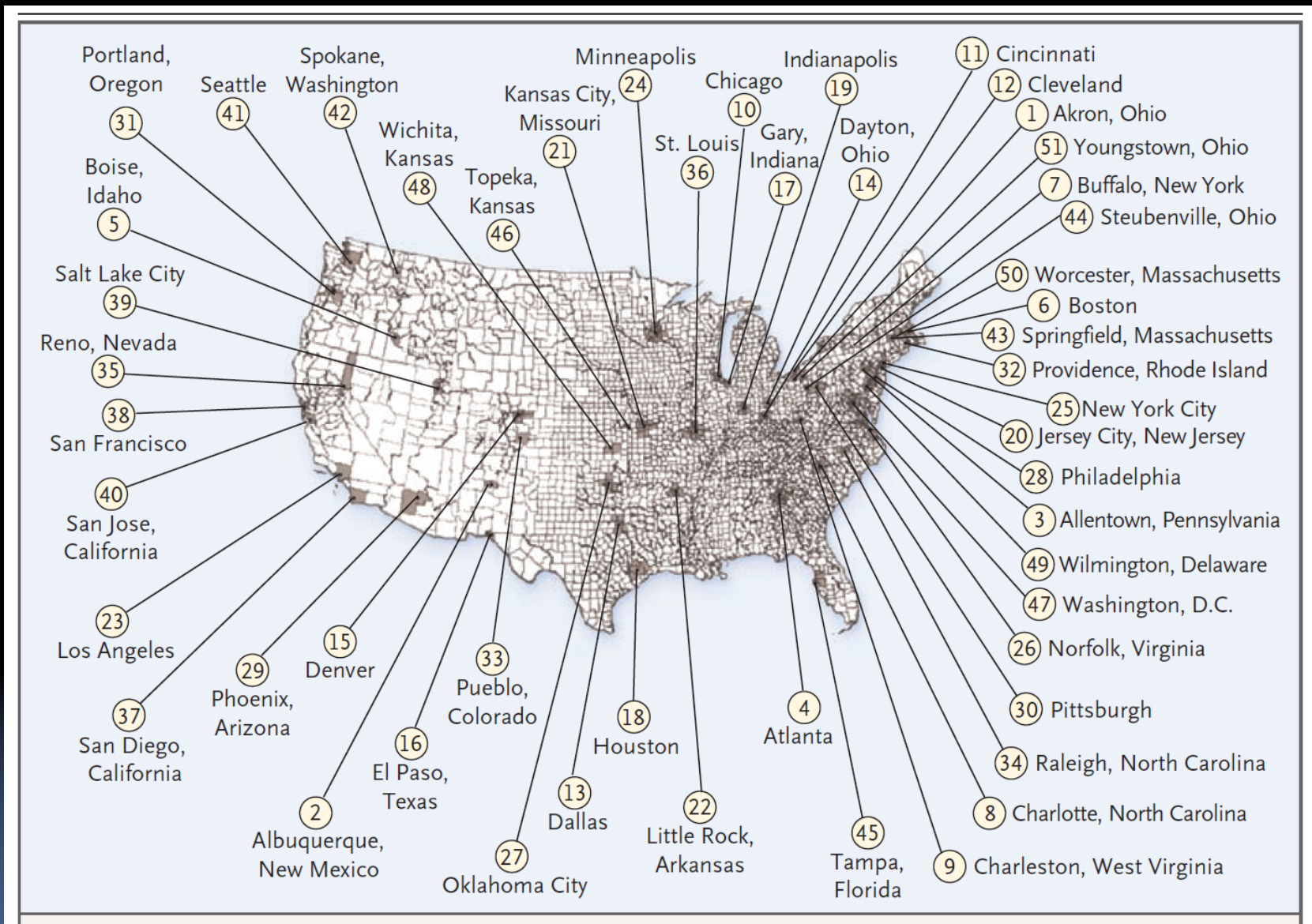
Public health importance of triggers of myocardial infarction: a comparative risk assessment

Tim S Nawrot, Laura Perez, Nino Künzli, Elke Munters, Benoit Nemery

« Our study confirms previous reports and indicates that the magnitude of pollution health effects may be larger than previously recognized.

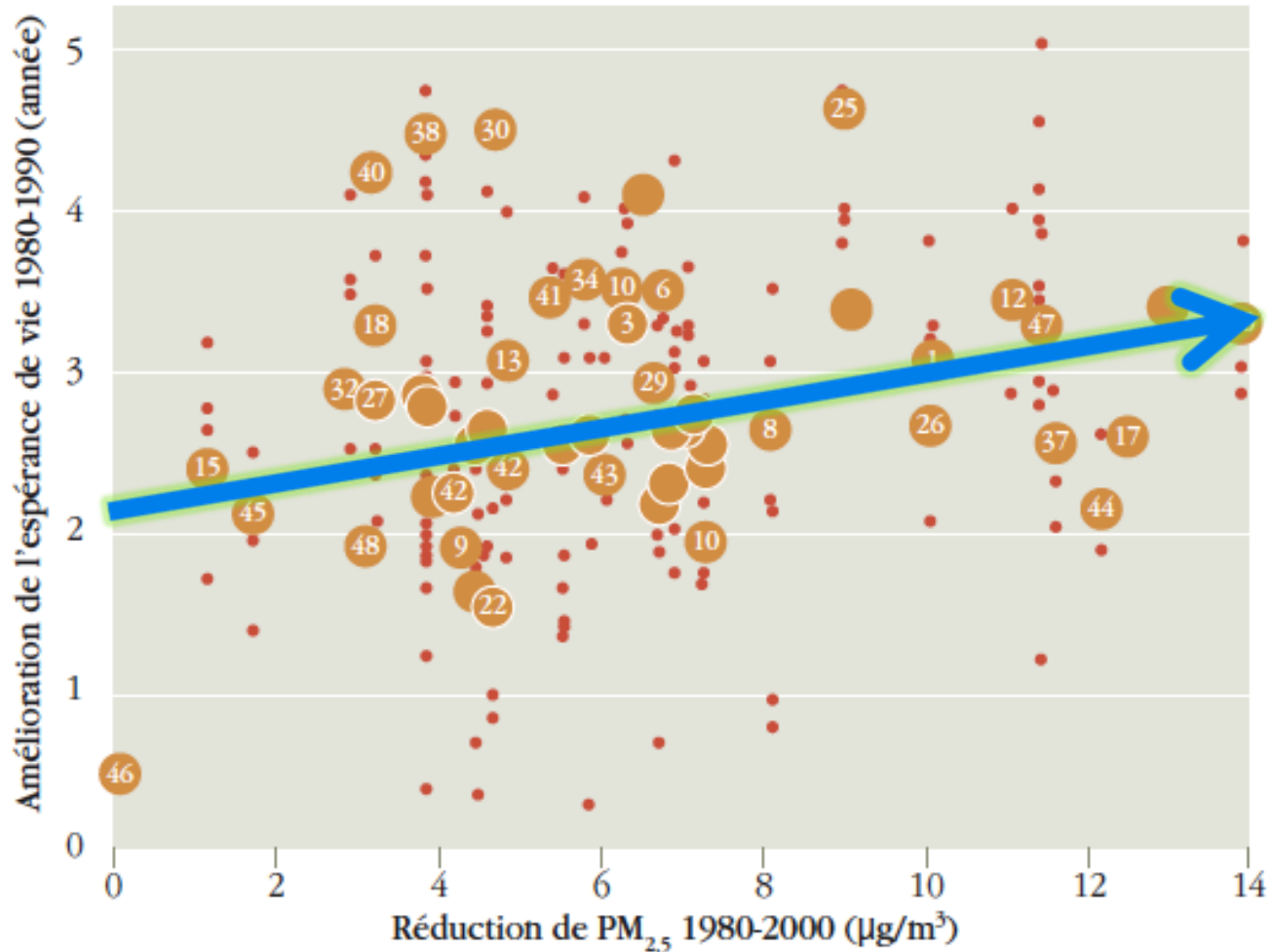
These results suggest that efforts to limit long-term exposure to fine particulate pollution are warranted. »

Les bonnes nouvelles



Fine-particulate air pollution and life expectancy in the United States .
 C. Arden Pope III, Majid Ezzati et Douglas W. Dockery.
New England Journal of Medicine 2009 360 : 376-86.

Amélioration de l'espérance de vie en fonction de la baisse des particules fines



Fine-particulate air pollution and life expectancy in the United States .
C. Arden Pope III, Majid Ezzati et Douglas W. Dockery.
New England Journal of Medicine 2009 360 : 376-86.

Si une Cité élimine

Dans la nourriture

- ✓ High Fructose Corn Syrup
- ✓ Gras trans
- ✓ Excès de sel
- ✓ Acide phosphorique

Dans l'air

- ✓ Particules fines
- ✓ SO₂ - NO₂
- ✓ CO - COV
- ✓ Ozone

Cette cité peut s'attendre à
une diminution de 25 à 75 % de la
prévalence de la maladie vasculaire

Cardiologie clinique
Cardiologie d'intervention
Cardiologie préventive

Cardiologie environnementale: Prescription verte



HUMANITÉ et
BIODIVERSITÉ



m^F
MÉDECINS
FRANCOPHONES
DU CANADA

» Après tout, la maladie coronarienne était peu fréquente avant 1830. Pourquoi ne pourrait-elle pas le redevenir en 2050 ? C'est le défi auquel nous faisons tous face. «



Dr Salim Yusuf
Cardiologue et épidémiologiste
McMaster University, Hamilton, Ontario



Chaire de cardiologie environnementale