Aphekom- A Literature Review on Air Pollution Interventions and their Impact on Public Health

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Background to this work

The work presented here is a review of the scientific literature on interventions, both legislative and coincidental which have resulted in reductions in air pollution, and accumulates the evidence for health benefits associated with these events.

The work has been conducted as part of Work Package 6 of the EU-funded Aphekom project that includes the development of innovative methods to: i) analyse the decrease in air pollution levels following implementation of a European regulation, ii) to follow the evolution of health risks over time, iii) to track related effect modifiers, and iv) to quantify monetary costs of health impacts of the implemented regulation.
The Aphekom project aims to improve knowledge and communication for decision making on air pollution and health in Europe.

Introduction

Short- and long-term effects of air pollution have found to be linked to mortality and morbidity in numerous epidemiological studies as a contributing factor in a number of multi-factorial disease patterns, such as respiratory and cardiovascular diseases.

Intervention\accountability studies play an important role in supporting scientific validation of the results of non-intervention studies, because they allow a direct examination of the hypothesized cause-effect relationship. Some of these "interventions" are not interventions in the truest sense of the word, but may be side effects attributable to political or economic changes or other societal changes.

This literature review gives a summarized overview on a collection of existing intervention\ accountability studies, spanning a variety of approaches regarding the kind of the intervention and evaluation methods and their subsequent health impacts.

Conclusions

This review has shown that air pollution interventions have been successful at reducing air pollution levels. It has also shown that there is significant published evidence that most of these interventions have been associated with health benefits, mostly by way of reduced cardiovascular or respiratory mortality and or morbidity. This provides an informed scientific basis for decision and policy makers.

Contact & Project Information

Aphekom tackles air pollution in Europe. WHO Newsletter No. 42, Dec. 2008, p. 14-15, Berlin, Germany.

Aphekom General Brochure (order: a.bienvenu@invs.sante.fr), Saint-Maurice, France.

Co-funded by the European Commission's Programme on Community Action in the Field of Public Health (2003-2008) under Grant Agreement number 2007105, and by the many institutions that have dedicated resources to the fulfillment of this city-based project.

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	Intervention	Investigator	Pollutant	Study Population	Main Findings
Large Industrial Emission Sources	**Copper smelter strike in the U.S., 1960's**	Pope *et al.*, 2007	SO_2	Mortality counts (1960 – 1975)	• Decrease in mortality of 2.5%
	Closure and reopening of a steel mill in Utah (U.S.)	Pope, 1989	PM_{10}	Respiratory hospital admissions (1985 - 1988)	Closure → PM_{10} winter levels were ~ ½ Reopening → Hospital admissions for children x3 → for adults ↑ ~ 44% with 24-hr PM_{10} >150µg/m³ Regression analysis: Strong correlation btw. admissions and PM_{10}
	German reunification 1990	Peters *et al.*, 2009	$PM_{2.5}$, PM_{10}, SO_2, NO_2, CO, O_3, UFP	Daily mortality counts (1990 - 2002)	• No clear association btw. all-cause mortality or specific-cause mortality and $PM_{2.5}$, PM_{10}, or SO_2; • Association btw. daily mortality and UFP, NO_2, CO and O_3 (lag 3 or 4)
		Suguri *et al.*, 2006	TSPs	Lung function (LF) in children (age 5 - 7) in 9 German cities (1991 – 2000)	1991 East Germany: TSP ↑↑, 6-year-olds worse LF than West 1991 to 1997: difference in LF and in TSP concentration vanished simultaneously
		Frye *et al.*, 2003	TSP, SO_2	LF of schoolchildren (age 11–14) in 3 East German communities (1992 - 1999)	• Drastic overtime ↓of TSP and SO_2 levels • ↑ of FVC (significant) and FEV_1 (not significant) • ↓ in bronchitic symptoms and bronchitis
	Reduction of fuel sulphur content in Hong Kong	Hedley *et al.*, 2002	PM_{10}, SO_4,RSP, NO_2, O_3, SO_2	Monthly mortality data (all-cause, cardio-respiratory, neoplasmic and other) (1985 – 1995)	• ↓SO_2 levels ~50% citywide • ↓annual all-cause mortality by 2.1%, respiratory by 3.9% and cardiovascular by 2.0%; • estimated gain in life expectancy 20 days for women, 41 days for men
		Wong *et al.*, 1998	SO_2	Bronchial responsiveness in children (age9-12) in 2 city districts (1990 – 1992)	Consistent downward trend for bronchial responsiveness in both districts, but bigger reductions in more polluted district
Olympic Games	**1996 Summer Olympic Games in Atlanta, Georgia, U.S.**	Friedman *et al.*, 2001	CO, PM_{10} ,NO_2, O_3, SO_2	Daily asthma and of non-asthma acute care events in children (age 1-16) in Atlanta 4 weeks prior, during and after Olympics	• ↓of 13% for O_3 levels, 18.5% for CO, 16.1% for PM_{10}, 6.8% for NO_2; ↑ of 22.1% of SO_2 • significant ↓ of asthma emergency care visits and hospitalisations by 41.6% in Medicaid database
	2008 Summer Olympic Games in Beijing, China	Wang *et al.*, 2009	$PM_{2.5}$, CO, BC, UFP	Not applicable	Emissions during Olympics : • light duty gasoline vehicle: ↓33% CO, ↓ 47% BC, ↓78% UFP • heavy-duty diesel vehicles: UFP by 67%; mean BC ↓ 74% on traffic control days
		Wang and Xie, 2009	PM_{10}, CO, NO_2, O_3	Not applicable	↓ 28% of PM_{10}, ↓19.3% CO, ↓12.3%NO_2; ↑ 25.2% of O_3
Traffic Related Initiatives	**The London Congestion Charging Scheme**	Tonne *et al.*, 2008	PM_{10}, NO_2	All-cause mortality counts of Greater London city residents 2001–2003)	In CCZ: ↑↑Reductions levels: ↓ 2.3% of NO_x, ↓ 0.8% of PM_{10}; YLG_{NO2} per 100,000 population 26 years for Greater London, 183 years within CCZ; YLG_{PM10} only 8years for Greater London Outside: ↓ 0.4% of NO_x, ↓ 0.1% of PM_{10}
	The Stockholm Congestion Charging Trial	Johansson et al., 2008	PM_{10}, NO, NO_2, CO	Residents of Stockholm comparing with and without the CCST for 2006	↑↑Reductions levels in city centre in CCZ: -10.0% for NO_x, -7.6% for PM_{10} ; Greater Stockholm: -5.3% for NO_x , -3.8% for PM_{10}; 206 YLG per 100,000 people for Greater Stockholm over a 10-year period
Domestic Emission Sources	**The Irish coal ban**	Clancy *et al.*, 2002	BS , SO_2	Mortality counts in Dublin: non-trauma, respiratory, cardiovascular (1984 - 1996)	↓ BS by ~70%, ↓SO_2 by 34% ↓ non-trauma death rates by 5.7%, ↓ respiratory by 15.5%, ↓ cardiovascular by 10.3%
		Goodman *et al.*, 2009	BS, SO_2	Daily BS and SO_2 for the sequential bans in 11 cities	↓ BS in all centres post-ban (-45 to -70%) largest in winter; no clear pattern in SO_2 changes
		Rich *et al.*, Abstract, 2009	BS, SO_2	Weekly cause-specific mortality rates in County Cork (1981 - 2004)	• ↓BS by -49%, but ↑ 24% of SO_2 • ↓total mortality by 7%, ↓respiratory by 8%, ↓cardiovascular by13%
	Residential Wood Burning Regulations in S.J. Valley, Ca., U.S.	Lighthall *et al.*, 2009	$PM_{2.5}$	Mortality and morbidity in Bakersfield and Fresno/Clovis (2000-2006)	Annual ↓ $PM_{2.5}$ in 4 post-rule winters: Fresno/Clovis -13.63%, Bakersfield -12.94% annual mortality costs savings: $367.5 - 430.6 M in F./C., $189.1 - 239.9 M in Bakersfield; morbidity costs savings: $11 - 26.6 M in F./C., $5.7 - 14.1 M in Bakersfield
	Air pollution Intervention Studies in South Africa	Leiman *et al.*, 2006	Multiple studies in one	Varies btw. the 26 different interventions	Interventions with the highest positive economic NPVs all household based; majority of the industry based interventions had negative NPV
Indoor	**Workplace smoke-free laws**	Goodman *et al.*, 2009	Review of multiple studies	Varies btw. studies	Consistently observed association of smoking bans at workplaces and health benefits for workers and the general population regarding respiratory and cardiovascular health ,especially for AMI