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Aphekom

Improving Knowledge and Communication for Decision Making on Air Pollution and Health in Europe

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

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Background and Aims

As part of the Aphekom project we reviewed the existing literature on air pollution intervention studies. Our objective was to identify different types of interventions, both legislative and coincidental and evaluation approaches used to assess their effects on health. The work presented here gives an overview of the 20 most relevant, published studies that summarizes the health impact of changes in air quality due to interventions. Intervention studies play an important role in supporting and complementing scientific validation of results of epidemiological non-intervention studies linking air pollution and health.

Methods

Intervention studies published in English from the 1960's up to January 2011 were considered for inclusion.

Where interventions were examined by numerous studies, only the main, most representative and/or most recent studies were included.

The selection was based on a systematic search of Pubmed, Google Scholar, ISI Web of Knowledge[SM] and Science Direct.

Discussion

Methods and findings varied considerably and hence limit the scope to directly compare results from the different studies.

Opportunities to assess the full extent/all aspects of an intervention are not always given as this is dependent on available funding, data availability, etc.

Overall this review showed that the majority of the interventions, irrespective of their nature, have been successful at reducing air pollution levels

It has also shown that there is consistent published evidence that a number of these interventions have been associated with health benefits, mostly by way of reduced cardiovascular or respiratory mortality and/or morbidity.

In the majority of reviewed interventions the observed decrease in mortality exceeded the expected predicted figures which were based on observations from European multicity studies.

Conclusions

There is consistent evidence that decreased air pollution levels following an intervention resulted in health benefits for the assessed population. This provides an informed scientific basis for decision and policy makers.

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Contact & Project Information

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

Aphekom General Brochure http://aphekom.org/c/document_library/get_file?uuid=5532fafa-921f-4ab1-9ed9-c0148f7da36a&groupId=10347

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	Intervention	Investigator	Pollutant	Health outcome	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 → ↓ ~50% in PM_{10} winter levels Reopening → Hospital admissions for children x3 → for adults ↑ ~ 44% with 24-hr PM_{10} >150µg/m^3
		Pope *et al.*, 1992	PM_{10}	Mortality	Closure → ↓ ~15µg/m^3 in PM_{10} levels → simultaneous 3.2% ↓ in average daily deaths
	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
	European Air Emission Policies	EEA Report No. 8/2011	CO, $PM_{2.5}$, NO_x, O_3, SO_2	Years of life lost using country specific baseline incidences	• Air quality and public health improved in 32 EEA member-states with variation btw the countries • However, not all possible improvements yet achieved
	Reduction of fuel sulphur content in Hong Kong	Hedley *et al.*, 2002	PM_{10}, SO_4RSP, 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 larger 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 non-asthma acute care events in children 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
		Peel *et al.*, 2009	CO, PM_{10}, NO_2, NO_x, O_3, SO_2	Cardio-respiratory ED visits in Olympic period compared to baseline years	• Little or no ↓ in ER visits during the Olympic period • ↑ in ER visits for COPD • Results sensitive to choice of analytical model
	2008 Summer Olympic Games in Beijing, China	Li *et al.*, 2010	$PM_{2.5}$, O_3, SO_2, NO_2, CO	Daily outpatient asthma visits of adults at Chaoyang Hospital (07.–09.2008)	• Significant ↓ in asthma visits during Olympic period • ↑ 10 µg/m^3 of $PM_{2.5}$ and ↑ 10ppb of O_3 found to be associated with ↑2% and ↑4.4% in asthma outpatient visits
		Huang *et al.*, ISEE Abstract, 2009	$PM_{2.5}$, PM_{10}, NO_2, BC	24-hr ECG monitoring data from 43 elderly (summer 2007 and 2008)	Significant ↓ of the root mean square of successive inter beat intervals (-2.47%) and of the high frequency (-3.15%) in association ↓$PM_{2.5}$
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}
		Tonne *et al.*, 2010	NO_x	Cardio-respiratory hospital admissions in Greater London (2001-2004)	• Significant association btw. ↓NO_x and ↓admissions only for bronchiolitis • Substantial spatial dependence in the data
	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

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