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 impacts on health. The work presented here gives an overview of the 20 most relevant, published studies that summarize the health impacts 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™ 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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Aphekom General Brochure

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Intervention
Investigator
Pollutant
Health outcome
Main Findings
Copper smelter strike in the U.S.
Pope et al., 2007
SO2
Mortality counts (1960 – 1975)
• Decrease in mortality of 2.5%
Closure and reopening of a steel mill in Utah (U.S.)
Pope et al., 1989
PM10
Closure → ~ 50% in PM10 winter levels
Reopening → Hospital admissions for childr x3
for adults ~ 44% with 24-hr PM10 >150µg/m3
PM10
Mortality
Closure → ~ 15mg/m3 in PM10, levels → ~3.2% in average daily deaths
German reunification 1990
Peters et al., 2009
PM10, SO2, NOx, CO, UFP
• No clear association btw. all cause mortality or specific-cause mortality and PM10, SO2, or SO4,
Associations btw. daily mortality and UFP, NOx, CO and O3 (lag 3 or 4)
Sugitan et al., 2006
TSPs
1991 East Germany
TSP↑, 6-year-olds worse LF than urban
1991 to 1992, difference in LF in and TSP concentration vanished simultaneously

European Air Emission Policies
EEA Report No B2011
CO, PM10, NOx, SO2
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
PM10, PM2.5, SO2, NOx, SO3, NO3
Air quality and public health improved in 32 EEA member-
states with variation btw the countries
However, not all possible improvements yet achieved
Wong et al., 1998
SO2
Consistent downward trend for bronchial responsiveness in both districts, but larger reductions in more polluted district
1998 Summer Olympic Games in Atlanta, Georgia, U.S.
Friedman et al., 2001
CO, PM10, SO2, NOx, O3
Daily asthma and non-asthma acute care events in children 4 weeks prior and during after Olympics
Little or no difference in ER visits during the Olympic period
Little or no difference in ER visits for COPD
Results sensitive to choice of analytical method
2008 Summer Olympic Games in Beijing, China
Peat et al., 2009
CO, PM10, NOx, SO2, O3
Cardio-respiratory ED visits in Olympic period compared with baseline years
• Little or no in ER visits during the Olympic period
• Little or no difference in ER visits for COPD
• Results sensitive to choice of analytical method
Li et al., 2010
CO, PM10, NOx, SO2, O3
Air quality and public health improved in 32 EEA member-
states with variation btw the countries
However, not all possible improvements yet achieved

The London Congestion Charging Scheme
Tonnes et al., 2008
PM10, NOx
• Reductions (levels reductions 1.2% - 3.6% of NOx, 0.8% of PM10, 1.0% of CO) per 100,000 population 28 years Greater for London, 183 years within CZZ; YLG2003 only Byttes for Greater Outer
Outside: 0.4% of NOx, 0.1% of PM10
Tonnes et al., 2010
NOx
• Significant association btw. NOx and mortality
• Substantial spatial dependency in the data

The Stockholm Congestion Charging Trial
Johansson et al., 2008
PM10, NOx, CO
Residents of Stockholm comparing with and without the CCSTF for 2006
• Reductions levels in city centre in CZZ - 10.0% for NOx, 7.6% for PM10
• Greater Stockholm: -5.3% for NOx, -3.8% for PM10
• 206 YLG per 100,000 people for Greater Stockholm over a 10-year period

The Irish coal ban
Clancy et al., 2002
BS, SO2
• BS by ~70%, SO2 by 44%

Goodman et al., 2009
BS, SO2
Daily BS and SO2 for the sequential bans in 11 cities
• BS by ~70%, SO2 by 44%

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Residential Wood Burning Regulations in S.J. Valley, Ca., U.S.
Rich et al., 2009
BS, SO2
• Weekly decreases in cause specific mortality

Lighthall et al., 2009
PM2.5
Mortality and morbidity in Bakersfield and Fresno/Clovis (2000-2006)
• Annual PM2.5 < 40 µg/m³ was significantly lower in Bakersfield and Fresno/Clovis

Air pollution intervention Studies in different geographical regions
Leisman et al., 2006
Multiple studies in one interventions
Interventions with the highest positive economic NPVs all different: household level, majority of the industry based interventions had negative NPV

Annual PM2.5 < 40 µg/m³ was significantly lower in Bakersfield and Fresno/Clovis

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