Air Quality literature review

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Air pollution and health effects

**Brunekreef B. (2007) Health effects of air pollution observed in cohort studies in Europe.** *Journal of Exposure Science & Environmental Epidemiology; 17: s61-65*

In recent years, several studies in Europe have associated within-city contrasts in air pollution with various health end points including mortality in cohort studies of adults, and respiratory morbidity in cross-sectional and cohort studies of children. Many of these studies have used NO$_2$ contrasts as the primary exposure variable, which raises the issue of whether such associations are uniquely found for NO$_2$ *per se*, or whether NO$_2$ acts as a surrogate for a complex mixture of combustion pollutants primarily derived from vehicular traffic. Exposure assessment in these studies has been based on dispersion modelling, on data from routine monitoring networks, on stochastic models developed from dedicated spatially resolved monitoring, or some combination of these. The results of a number of recent European studies are discussed.


This is a strategic review of children's susceptibility to ambient fine particles and characteristics of infant and children which underlie their increased susceptibility to PM. The authors found ambient fine PM is associated with intra-uterine growth retardation, infant mortality; it is associated with impaired lung function and increased respiratory symptoms, particularly in asthmatics.


This document presents the results of a survey of experts developed and conducted as part of the WHO “Health risks of air pollution in Europe – HRAPIE” project. The survey’s objective was to assess and document the views of expert stakeholders regarding “evidence of new emerging issues on risks to health from air pollution, either related to specific source categories, specific gaseous pollutants or specific components of particulate matter. The main findings are that the majority of respondents identified “road traffic”, “space heating and air conditioning” and “shipping” as the top emission sources and felt that fine and ultrafine particles are the greatest concern in relation to health effects.


Recent epidemiological research suggests that near road traffic-related pollution may cause chronic disease, as well as exacerbation of related pathologies, implying that the entire "chronic disease progression" should be attributed to air pollution, no matter what the proximate cause was. The researchers estimated the burden of childhood asthma attributable to air pollution in 10 European cities by calculating the number of cases of 1) asthma caused by near road traffic-related pollution, and 2) acute asthma events related to urban air pollution levels. They then expanded their approach to include coronary heart diseases in adults.
Air pollution and respiratory disease

Short-term exposure to air pollution has been associated with exacerbation of chronic obstructive pulmonary disease (COPD), whereas the role of long-term exposures on the development of COPD is not yet fully understood. The authors assessed the effect of exposure to traffic-related air pollution over 35 years on the incidence of COPD in a prospective cohort study. They found that long-term exposure to traffic-related air pollution may contribute to the development of COPD with possibly enhanced susceptibility in people with diabetes and asthma.

In this Series paper, the authors discuss the effects of particulate matter (PM), gaseous pollutants (ozone, nitrogen dioxide, and sulphur dioxide), and mixed traffic-related air pollution. They focus on clinical studies, both epidemiological and experimental, published in the previous 5 years.

Epidemiological and toxicological research continues to support a link between urban air pollution and an increased incidence and/or severity of airway disease. Not only do we have strong epidemiological evidence of a relationship between air pollution and exacerbation of asthma and respiratory morbidity and mortality in patients with chronic obstructive pulmonary disease (COPD), but recent studies, particularly in urban areas, have suggested a role for pollutants in the development of both asthma and COPD.

Specific characteristics of particulate matter (PM) responsible for associations with respiratory health observed in epidemiological studies are not well established. High correlations among, and differential measurement errors of, individual components contribute to this uncertainty. The authors investigated which characteristics of PM have the most consistent associations with acute changes in respiratory function in healthy volunteers.

1.1. By age-groups

1.1.1. Child
Health effects of ambient air pollution were studied in three groups of schoolchildren living in areas (suburban, urban and urban-traffic) with different air pollution levels in Eskişehir, Turkey. Significant
association between ambient ozone concentrations and impaired lung function (for an increase of 10 μg m(-3)) was found only for girls for the summer season evaluation [OR = 1.11 (95 % CI 1.03-1.19)]. No association was found for boys and for the winter season evaluation.


The authors determined the spatial relationship between the distance from a major roadway and clinical, physiologic and inflammatory features of asthma in a highly characterized sample of asthmatic children 6-17 years of age across a wide range of severities. They hypothesized that a closer residential proximity to a major roadway would be associated with increased respiratory symptoms, altered pulmonary function and a greater magnitude of airway and systemic inflammation. Asthmatic children living in closer proximity to a major roadway had an increased frequency of wheezing associated with increased medication requirements and more hospitalizations even after controlling for potential confounders.


Air pollution is a widespread health problem associated with respiratory symptoms. Continuous exposure monitoring was performed to estimate alveolar and tracheobronchial dose, measured as deposited surface area, for 103 children and to evaluate the long-term effects of exposure to airborne particles through spirometry, skin prick tests and measurement of exhaled nitric oxide (eNO). The mean daily alveolar deposited surface area dose received by children was 1.35 × 10^3 mm^2. The lowest and highest particle number concentrations were found during sleeping and eating time. A significant negative association was found between changes in pulmonary function tests and individual dose estimates. Significant differences were found for asthmatics, children with allergic rhinitis and sensitive to allergens compared to healthy subjects for eNO. Variation is a child's activity over time appeared to have a strong impact on respiratory outcomes, which indicates that personal monitoring is vital for assessing the expected health effects of exposure to particles.


Acute respiratory infections are common in children below 5 years and recent studies suggest a possible link with air pollution. In this study, this study investigated the association between ambient nitrogen oxides (NOx) and bronchitis or upper airway inflammation. The results demonstrate an association between NOx and respiratory infections that are sufficiently severe to come to medical attention. The evidence, if causal, can be of public health concern because acute respiratory illnesses are common in preschool children.

In this study the authors aimed to investigate the frequency of respiratory health symptoms among high school students attending schools at industrial, urban and rural areas in a Turkish city. Chronic pulmonary disease, tightness in the chest and morning cough were higher among students in the industrial zone where nitrogen dioxide and ozone levels were also highest.


Few studies have examined associations between air pollution and emergency room (ER) visits for wheezing, and even fewer for gastroenteric illness. These researchers conducted a multicity analysis of the relationship between air pollution and ER visits for wheezing and gastroenteric disorder in children 0-2 years of age. CO and SO(2) were most strongly associated with wheezing, with a 2.7% increase [95% confidence interval (CI), 0.5-4.9] for a 1.04-microg/m(3) increase in 7-day average CO and a 3.4% (95% CI, 1.5-5.3) increase for an 8.0-microg/m(3) increase in SO(2). Air pollution is associated with triggering of wheezing and gastroenteric disorders in children 0-2 years of age.

1.1.2. Adult

Lindgren A, Bjork J, Stroh E, Jakobsson K. (2010) Adult asthma and traffic exposure at residential address, workplace address, and self-reported daily time outdoor in traffic. A two-stage case-control study. BMC Public Health, 10 (716)

Most epidemiologic studies use traffic at residential address as a surrogate for total traffic exposure when investigating effects of traffic on respiratory health. This study used GIS (Geographical Information Systems) to estimate traffic exposure, not only on residential, but also on workplace address, in addition to survey questions on time spent in traffic during commuting or other daily activities. The aim was to investigate 1) if there is an association between traffic exposure and prevalence of adult asthma and asthma symptoms, and 2) if so, does this association become stronger using more complete traffic exposure information.


Air pollution from road traffic is a serious health hazard, and people with preexisting respiratory disease may be at increased risk. The authors investigated the effects of short-term exposure to diesel traffic in people with asthma in an urban, roadside environment. 60 adults with either mild or moderate asthma participated in a randomized, crossover study. Each participant walked for 2 hours along a London street (Oxford Street) and, on a separate occasion, through a nearby park (Hyde Park). The authors performed detailed real-time exposure, physiological, and immunologic measurements. Our observations serve as a demonstration and explanation of the epidemiologic evidence that associates the degree of traffic exposure with lung function in asthma.

A case-control study was employed to investigate the relationship between atmospheric pollution and emergency hospital attendance for respiratory causes among adult and elderly patients resident in Turin in the period 1997 – 1999. A significant association was found between the increase in emergency hospital attendance for respiratory causes and exposure to sulfur dioxide, total suspended particulate and carbon monoxide in Turin during the study period. This easy to use and manage case-control study produced results in line with those reported for other Italian and European cities.


This paper demonstrates association of short-term variation in pollution and health outcomes within the same geographical area for a typical urban setting in the northern part of the UK from time series analysis. It utilises publicly available datasets for regulated air pollutants (PM₁₀, NO₂, SO₂, CO and O₃), meteorology and respiratory hospital admissions (and mortality) between April 2002 and December 2005 to estimate the respiratory health effect of pollution exposure, mainly in the elderly. The results show that PM₁₀ and O₃ are positively associated with respiratory hospital admissions in the elderly, specifically in the age group 70-79.
Air pollution and cardiovascular disease

There is growing evidence of a distinct set of freshly-emitted air pollutants downwind from major highways, motorways and freeways that include elevated levels of ultrafine particulates (UFP), black carbon (BC), oxides of nitrogen (NOx), and carbon monoxide (CO). The paper reviewed studies that described measurement of near-highway air pollutants, and epidemiologic studies of cardiac and pulmonary outcomes as they relate to exposure to these pollutants and/or proximity to highways. The authors concluded that those most susceptible to serious health effects from air pollution may be those who live very near major regional transportation routes.

The aim of this paper was to study the effect of long term exposure to airborne pollutants on the incidence of acute coronary events in 11 cohorts participating in the European Study of Cohorts for Air Pollution Effects (ESCAPE). Modelled concentrations of particulate matter <2.5 μm (PM$_{2.5}$), 2.5-10 μm (PM$_{coarse}$), and <10 μm (PM$_{10}$) in aerodynamic diameter, soot (PM$_{2.5}$ absorbance), nitrogen oxides, and traffic exposure at the home address based on measurements of air pollution conducted in 2008-12. The authors concluded that long term exposure to particulate matter is associated with incidence of coronary events, and this association persists at levels of exposure below the current European limit values.

This study was undertaken to determine whether there was a correlation between fine particles (PM2.5) levels and hospital admissions for myocardial infarction (MI) in Taipei, Taiwan. Hospital admissions for MI and ambient air pollution data for Taipei were obtained for the period 2006-2010. For the single-pollutant model (without adjustment for other pollutants), increased numbers of MI admissions were significantly associated with higher PM2.5 levels both on warm days (>23°C) and on cool days (<23°C).

The objective of this study was to assess and quantify the association between short-term exposure to major air pollutants (ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter ≤10 μm [PM$_{10}$] and ≤2.5 μm [PM$_{2.5}$] in diameter) on MI risk. All the main air pollutants, with the exception of ozone, were significantly associated with an increase in MI risk.

The researchers compared triggers of myocardial infarction at an individual and population level. In view of both the magnitude of the risk and the prevalence in the population, air pollution is an important trigger of myocardial infarction, it is of similar magnitude (PAF 5—7%) as other well accepted triggers such as physical exertion, alcohol, and coffee. The work shows that ever-present small risks might have considerable public health relevance.


Recent interest has developed in understanding the health effects attributable to different components of particulate matter. This review evaluates the effects of black carbon (BC) on cardiovascular disease in individuals with pre-existing disease using evidence from epidemiologic and experimental studies. Evidence across studies suggested ambient BC is associated with changes in subclinical cardiovascular health effects in individuals with diabetes and coronary artery disease (CAD). Limited evidence demonstrated that chronic respiratory disease does not modify the effect of BC on cardiovascular health.


Air pollutant levels have been widely associated with increased hospitalizations and mortality from cardiovascular disease. In this study, the authors focused on pollutant levels and triggering of acute myocardial infarction (AMI). Data on AMI hospitalizations, air quality, and meteorologic conditions were collected in 6 urban areas of Tuscany (central Italy) during 2002-2005. More susceptible subgroups were elderly persons (age ≥75 years), females, and older patients with hypertension and chronic obstructive pulmonary disease.


The aim of this study was to investigate the association between long-term residential exposure to air pollution from traffic and the risk of nonfatal and fatal myocardial infarction. Long-term exposure to traffic-generated air pollution is associated with fatal myocardial infarction but not with nonfatal infarction.


The aim of this paper was to examine the association of air pollution with the occurrence of OHCA. Larger studies suggested that an increased risk of OHCA with air pollution exposure from PM$_{2.5}$ and ozone.
Air pollution and mortality


All peer-reviewed papers with quantitative results from time series and panel studies of ambient air pollution published up to 2006 were obtained. Estimates of effects were extracted and standardized for meta-analysis. Meta-analyses were done for all pollutant/outcome/diagnosis/age groups for which there were 4 or more estimates. While the evidence was fairly similar for the various pollutants, there were some variations in the level of evidence between them and between various outcomes. Overall, we consider that our results largely support the position that ambient air pollution is a hazard to health. However, the inconsistencies and difficulties in interpreting the evidence must also be acknowledged.


The Committee on the Medical Effects of Air Pollutants (COMEAP) produced in 2001 a report on the long-term effects of particulate air pollution on mortality. Research in this field has progressed rapidly since then and COMEAP present in this report a summary of the new evidence and quantitative estimates of the impact of the long-term effects of particulate pollution on mortality. Long term exposure to sulphur dioxide, nitrogen dioxide, carbon monoxide and ozone on mortality is thought to be weaker than that regarding particles.


During the 1980s the Republic of Ireland experienced repeated severe pollution episodes. This study explores and compares the effectiveness of sequential 1990, 1995 and 1998 bans in reducing community air pollution and improving public health. The bans were associated with reductions in respiratory mortality but no detectable improvement in cardiovascular mortality. The changes in hospital admissions for respiratory and cardiovascular disease were supportive of these findings but cannot be considered confirming.


Short-term increases in particulate air pollution are linked with increased daily mortality and morbidity. Socioeconomic status (SES) is a determinant of overall health. This paper investigated whether social class is an effect modifier of the PM(10) (particulate matter with diameter <10 micron)-daily mortality association, and possible mechanisms for this effect modification. The results confirm previous suggestions of a stronger effect of particulate air pollution among people in
low social class. Given the uneven geographical distributions of social deprivation and traffic emissions in Rome, the most likely explanation is a differential burden of chronic health conditions conferring a greater susceptibility to less advantaged people.


A time-series study was conducted to ascertain the short-term effects of different-sized airborne particulate matter (PM) on daily respiratory and cardiovascular cause-specific mortality in winter and summer, among subjects aged over 75 years in Madrid. The results indicated an association between coarser PM fractions (PM10 and PM10-2.5) and respiratory-specific mortality on the one hand, and between PM2.5 and cardiovascular-specific mortality on the other. While the risk of mortality due to exposure to particulate matter was greater in summer than in winter, this difference was statistically significant solely for total organic-cause mortality.
Further reading


This statistical release covers annual average concentrations in the UK of two pollutants thought to have the greatest health impacts: particulate matter and ozone. The statistical release also covers the number of days when air pollution was ‘moderate or higher’. The indicator is intended to provide a summary measure of air pollutants that affect health.


This document provides an overview and outline of the UK Government and devolved administrations’ ambient (outdoor) air quality policy. It sets out a way forward for work and planning on air quality issues, details objectives to be achieved, and proposes measures to be considered further to help reach them. The strategy is based on a thorough and detailed analysis of estimating reductions in emissions and concentrations from existing policies and proposed new policy measures, and quantification and valuation of benefits and estimated costs (the analysis is set out in more detail in Volume 2 of the strategy and the updated Third Report by the Interdepartmental Group on Costs and Benefits (IGCB).


Literature review of research on air pollution and health impacts. The paper discusses strengths and limitations of previous research.


For several decades, environmental changes have impacted the health of Europeans. Over the last two decades, the environment has become increasingly more complex. Today, the links between health and environment have never been so evident and the time to act is here and now. In this report the European Public Health Association highlight what has been done so far and who has been active at European level in the field of environment and health. At the end of the report, we formulate some conclusions in our strategic four pillars.


Air pollution EIRs: air quality and air pollution in London in the last 2 years to April 2014, including copies of minutes of Secretary of State’s meetings with the Mayor of London and copies of correspondence between them.
A national transport, health and environment action plan (NTHEAP) is a key tool and mechanism for developing sustainable and healthy transport in a country. NTHEAPs provide a comprehensive and intersectoral way of planning and implementing transport, environment and health action at the national level. This manual was developed to guide NTHEAP development at the country level. It proposes four phases: planning, development, implementation and evaluation.

Equity Action – Air pollution