



Effect of occupational polychlorinated biphenyls exposure on quality-adjusted life years over time at the HELPcB surveillance program

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Esser A, Gaum PM, Schettgen T, Kraus T, Gube M, and Lang J

Journal

J Toxicol Environ Health A

Summary

This cost analysis examined the longitudinal impact of occupational PCB exposure on health-related quality of life (HRQL) and quality-adjusted life years (QALY) for participants enrolled in the Health Effects in High-Level Exposure to PCB (HELPcB) medical surveillance program. Findings revealed that PCB exerts an influence on QALY, where individuals with a higher PCB exposure show a decline in QALY over time, especially for higher chlorinated PCBs. These results suggest that further investigations are needed to analyze the impact of lower chlorinated PCB congeners on the development of HRQL and QALY to explain the lack of longitudinal findings for these chemicals in the present study.

Population

Participants in the Health Effects in High-Level Exposure to PCB (HELPcB) medical surveillance program

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Chlorinated compounds (polychlorinated biphenyl compounds (PCBs))

Source of Environmental Agents:

- Occupational exposure via a capacitor and transformer recycling company

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Health-related quality of life (HRQL)
- quality-associated life years (QALYs)

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Germany

Models Used:

- Linear calculation model to calculate Quality-Adjusted Life Year (QALY) using Health-Related Quality of Life (HRQL) and Remaining Life Expectancy (RLE)

Methods Used:

- Authors examined the longitudinal impact of PCBs on health-related quality of life (HRQL) and quality-adjusted life years (QALYs) for participants enrolled in the Health Effects in High-Level Exposure to Polychlorinated Biphenyls (HELPCB) medical surveillance program. The authors — 1) included 118 participants for whom a complete data set in three cross-sections at three consecutive years was available; 2) used results from the EQ-5D-3L self-report instrument/questionnaire to determine the HRQL for participants; 3) calculated QALYs for participants using a linear calculation model; and 4) performed statistical analysis (repeated-measurement analysis of covariance) for each PCB congener and each PCB sum variable including potential confounders.

Sources Used:

- Health Effects in High-Level Exposure to PCB (HELPCB) medical surveillance program (Schettgen et al., 2011); EQ-5D-3L self-report instrument via the EuroQol Group (Rabin et al., 2013); Algorithm derived from time trade off (TTO) study (Greiner et al., 2005); Remaining life expectancy values via the mortality table 2010 for Germany (Federal Statistical Office, 2012); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Esser A, Gaum PM, Schettgen T, Kraus T, Gube M, and Lang J. 2015. Effect of occupational polychlorinated biphenyls exposure on quality-adjusted life years over time at the HELPCB surveillance program. *J Toxicol Environ Health A*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Institution for Statutory Accident Insurance and Prevention in the Energy, Textile, Electrical, and Media Industry (BGEM), Cologne, Germany — Grant number 360328

The geographic distribution and economic value of climate change-related ozone health impacts in the United States in 2030

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Fann N, Nolte CG, Dolwick P, Spero TL, Brown AC, Phillips S, and Anenberg S

Journal

J Air Waste Manag Assoc

Summary

This cost-analysis study estimated the influence of near-term climate change on ozone-related health impacts in the continental U.S. and the economic burden of those health impacts. The authors estimated that ozone levels will result in tens to thousands of additional ozone-related premature deaths and illnesses per year, as well as an economic burden of hundreds of millions to tens of billions of U.S. dollars.

Population

Not available

Health Outcomes

- Mortality (premature deaths)
- respiratory outcomes

Environmental Agents

List of Environmental Agents:

- Ozone

Source of Environmental Agents:

- Anthropogenic sources

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Respiratory emergency department visits
- respiratory hospital admissions

Environmental Health Economic Analysis Annotated Bibliography

- cases of acute respiratory symptoms
- lost school days

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Continental United States

Models Used:

- NASA Goddard Institute for Space Studies Model E2
- National Center for Atmospheric Research/Department of Energy Community Earth System Model
- Weather Research and Forecasting Model
- Community Multi-scale Air Quality Model
- GEOS-Chem global chemical transport model
- Benefits Mapping and Analysis Program-Community Edition

Methods Used:

- The authors estimated the influence of near-term climate change on ozone, and the resulting health impacts and economic burden of those health impacts. The authors — 1) used two general circulation models (GCM) driven by different greenhouse gas forcing scenarios to estimate changes in air quality due to climate change; 2) used a weather research and forecasting model to downscale GCM projections to the United States; 3) used Community Multi-scale Air Quality model to assess how climate-driven meteorological changes would impact near-surface ozone levels over continental U.S.; 4) used a health impact function to estimate health impacts associated with near-surface ozone levels; 5) used both cost of illness and willingness to pay measures to estimate the economic value of the health impacts of climate change on air quality; and 6) used value of statistical life to characterize the economic value of ozone-related premature deaths.

Sources Used:

- U.S. EPA estimates of 2030 ozone levels; Regulatory Impact Analysis for the Particulate Matter NAAQS (EPA, 2012); Integrated Climate and Land Use Scenarios (EPA, 2009; Bierwage et al., 2010); Wide Ranging OnLine Data for Epidemiologic Research (CDC Wonder, 2008); U.S. Census Bureau; EPA Science Advisory Board-recommended value of statistical life (EPA Health Effects Subcommittee, 2010); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Fann N, Nolte CG, Dolwick P, Spero TL, Brown AC, Phillips S, and Anenberg S. 2015. The geographic distribution and economic value of climate change-related ozone health impacts in the United States in 2030. J Air Waste Manag Assoc.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

U.S. air quality and health benefits from avoided climate change under greenhouse gas mitigation

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Garcia-Menendez F, Saari RK, Monier E, and Selin NE

Journal

Environ Sci Technol

Summary

The authors evaluated the impact of climate change on U.S. air quality and health in 2050 and 2100 under three greenhouse gas (GHG) emission policy scenarios and performed a cost-benefit analysis to monetize health benefits due to reduced air pollution. When compared to a reference scenario that assumes no GHG mitigation efforts, the authors estimated the value of benefits associated with avoided mortality under one climate policy scenario at \$150 billion and \$1.3 trillion in 2050 and 2100 respectively; and \$180 billion and \$1.4 trillion (in US dollars) under a second, more stringent, policy scenario. These results suggest that increasing climate policy stringency beyond a certain degree may lead to diminishing returns relative to its cost. However, the authors conclude that air quality impacts of climate change are substantial and should be considered by cost-benefit climate policy analyses.

Population

Not available

Health Outcomes

- Mortality (premature deaths)

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone (O₃), particulate matter (PM_{2.5}/fine), which includes fine particulates such as sulfate (SO₄), black carbon, organic aerosol, and ammonium nitrate (NH₄NO₃))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

Environmental Health Economic Analysis Annotated Bibliography

- Cost-benefit analysis (CBA)

Cost Measured:

- Costs of climate policy implementation

Potential Cost Measures: (Not available)

Benefits Measures:

- Mortalities avoided
- years of life gained

Potential Benefits:

- Health benefits stemming from reductions of CO emitted pollutants under greenhouse gas mitigation
- benefits to other sectors, such as ecosystems, infrastructure, and agriculture

Location:

- United States

Models Used:

- Massachusetts Institute of Technology Integrated Global System Model linked to the Community Atmosphere Model (MIT IGSM-CAM)
- Community Atmosphere Model with atmospheric chemistry (CAM-Chem)
- Massachusetts Institute of Technology Emissions Predictions and Policy Analysis (EPPA) model

Methods Used:

- The authors evaluated the impact of climate change on U.S. air quality and health in 2050 and 2100 using a global modeling framework and integrated economic, climate, and air pollution projections. The authors — 1) used earth system and human activity models to generate greenhouse gas emission and climate projections; 2) simulated atmospheric pollution under three greenhouse gas emission policy scenarios; 3) used models to simulate and analyze the climate penalty on air quality across the contiguous United States; 4) estimated change in mortality risk associated with pollutant levels in 2050 and 2100 for each policy scenario; 5) monetized reduced mortality risks using value of a statistical life and years of life saved; and 6) estimated climate policy costs as loss in GDP relative to a no-climate policy scenario in 2050 and 2100.

Sources Used:

- U.S. Environmental Protection Agency, Regulatory Impact Analysis for the Final Revisions to the National Ambient Air Quality Standards for Particulate Matter, Office of Air Quality Planning and Standards (2012); U.S. Environmental Protection Agency, Guidelines for Preparing Economic Analyses, National Center for Environmental Economics (2014); Income, Poverty, and Health Insurance Coverage in the United States: 2005 (U.S. Census Bureau, 2006); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Garcia-Menendez F, Saari RK, Monier E, and Selin NE. 2015. U.S. air quality and health benefits from avoided climate change under greenhouse gas mitigation. Environ Sci Technol.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- U.S. Environmental Protection Agency's Climate Change Division (Cooperative Agreement # XA-83600001-0)

Health impact metrics for air pollution management strategies

Environmental Health Economic Analysis Annotated Bibliography

Details

Review, Research article Cost-benefit analysis (CBA)

Authors

Martenies SE, Wilkins D, and Batterman SA

Journal

Environ Int

Summary

Authors performed a literature review of health impact assessment (HIA) metrics pertaining to air quality management, developed evaluative criteria for selecting and using the metrics, and illustrated the metrics in a Michigan-based case study where PM_{2.5} concentrations were reduced from 10 to 8 g/m³ in an urban area. Results from the case study showed that the total monetized health benefit of the 2 g/m³ change in Wayne County, Michigan exceeded \$1.9 billion annually, and the greatest number of avoided cases occurred for low severity morbidity outcomes such as, asthma exacerbations and minor restricted activity days. The authors concluded that quantitative metrics describing the direction, magnitude, and severity of expected health impacts can help inform decision makers and elevate health concerns to the level of other political and economic drivers into evaluations of projects, programs, and policies. They also made several recommendations for selecting metrics that are appropriate for air quality applications: metrics should be comprehensive, identify the number of people affected for each morbidity and mortality outcome, clearly communicate both direct and indirect impacts, use local data, incorporate outcomes of high public health importance, and represent spatial and temporal dimensions of impacts.

Population

Not available

Health Outcomes

- Mortality (premature and infant mortality)
- respiratory outcomes (asthma exacerbations, pneumonia, COPD)
- cardiovascular outcomes (ischemic heart disease, stroke)
- cancer outcomes (lung, trachea, and bronchus cancers)

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM 2.5/fine))

Source of Environmental Agents:

- Industrial, commercial, area, and mobile emission sources

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Predicted number of cases of mortalities and morbidities attributable to changes in PM2.5 levels
- disability-adjusted life years (DALYs)
- years of life lost (YLL)
- years living with disability (YLD)

Potential Cost Measures:

- Impacts related to other pollutants
- impacts of PM2.5 on outcomes such as cancer and adverse birth outcomes
- impacts of short-term exposure to PM2.5 on mortality outcomes
- time lost to avoidance behaviors (e.g., not participating in recreational activities)

Benefits Measures:

- Avoided cases of premature mortality, all-cause deaths, and cause-specific deaths (COPD, lung, trachea, and bronchus cancers, ischemic heart disease, and stroke)
- avoided cases of asthma exacerbations
- avoided cases of minor restricted activity days
- avoided work loss days
- avoided asthma emergency department visits
- avoided hospitalizations for outcomes related to cardiovascular, pneumonia, COPD, and asthma
- avoided cases of non-fatal myocardial infarction
- avoided DALYs, YLL, and YLD
- emissions-based reductions (i.e., monetized benefits per ton of PM2.5 emitted per year)

Potential Benefits:

- Co-benefits related to other pollutants
- co-benefits of pollution control policies (e.g., transportation policies)

Location:

- Detroit, Michigan, and surrounding county (Wayne County)

Models Used:

- Population Attributable Fraction (PAF) method
- Health impact function (HIF) method

Methods Used:

- Authors evaluated quantitative metrics used in health impact assessments (HIAs) and similar analyses that are relevant to air quality management at the urban and potentially regional scales. The authors — 1) performed a review of literature published between 2011 and 2015 to identify HIA metrics used for both project and policy applications; 2) evaluated and selected HIA quantitative metrics based on explicit criteria; and 3) demonstrated the formulation, use, strengths, and limitations of the

Environmental Health Economic Analysis Annotated Bibliography

selected metrics in a Michigan-based case study that focuses on PM2.5 concentrations being lowered from 10 to 8 g/m³.

Sources Used:

- Population dynamics and air pollution: the impact of demographics on health impact assessment of air pollution (Flachs et al., 2013); Interpreting health statistics for policymaking: the story behind the headlines (Walker et al., 2007); National ambient air quality standards for particulate matter (US EPA, 2013a); Characterizing the PM2.5-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S. (Fann et al., 2012a); Estimating the national public health burden associated with exposure to ambient PM2.5 and ozone (Fann et al., 2012b); An integrated risk function for estimating the global burden of disease attributable to ambient fine particulate matter exposure (Burnett et al., 2014); A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the global burden of disease study 2010 (Lim et al., 2012); National emissions inventory (US EPA, 2012b); Analysis and apportionment of organic carbon and fine particulate matter sources at multiple sites in the Midwestern United States (Buzcu-Guven et al., 2007); Sources of fine urban particulate matter in Detroit, MI (Gildemeister et al., 2007); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Martenies SE, Wilkins D, and Batterman SA. 2015. Health impact metrics for air pollution management strategies. Environ Int.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- R01ES022616, P30ES017885

Other Funding: (Not available)

The economic burden of exposure to secondhand smoke for child and adult never smokers residing in U.S. public housing

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Mason J, Wheeler W, and Brown MJ

Journal

Public Health Rep

Summary

This cost-analysis used large-scale databases and biomarker data to estimate the public health and economic burden of secondhand smoke (SHS) exposure for child and adult non-smokers living in U.S. public housing. The authors estimated that the total annual economic burden of SHS-attributable illness and death of non-smokers in public housing ranged from \$183 million to \$267 million, depending on serum cotinine limit of detection. They concluded that implementing smoke-free policies in all U.S. public housing can improve the health of residents and reduce societal costs.

Population

Adult and child never smokers residing in public housing

Health Outcomes

- Morbidity and mortality associated with: cancer outcomes (lung cancer)
- cardiovascular outcomes (ischemic heart disease)
- respiratory outcomes (asthma, lower respiratory infection – syncytial virus, pneumonia, bronchitis/bronchiolitis)
- birth outcomes (low birth weight)
- sudden infant death syndrome
- otitis media

Environmental Agents

List of Environmental Agents:

- Air pollutants (secondhand smoke)

Source of Environmental Agents:

- Secondhand smoke

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Costs considered in source studies, including direct medical costs (e.g., hospitalizations, physician's visits, medications)
- costs of productivity loss (e.g., caregiver time lost from work or school due to illness)
- nonmedical direct costs

Potential Cost Measures:

- SHS-attributable fire-related and apartment renovation costs
- implementation costs of smoke-free policies
- costs borne by society (e.g., long-term care, copayments, other nonmedical direct expenses)
- intangible cost of SHS-exposure related health effects (e.g., pain and suffering)

Benefits Measures: (Not available)**Potential Benefits:**

- Lower out-of-pocket expenditures for medical care
- lower apartment clean-up costs
- fewer productivity losses for employers and society

Location:

- United States

Models Used: (Not available)**Methods Used:**

- The authors estimated the public health and economic burden of secondhand smoke (SHS) exposure for child and adult never smokers living in U.S. public housing using large-scale databases, including biomarker data. The authors — 1) estimated the public health burden attributable to SHS for health outcomes by calculating a population-attributable fraction using WHO estimates of relative risk; 2) estimated annual societal economic burdens for each health outcome using published estimates for direct medical costs, nonmedical care costs, and the value of lost productivity; and 3) estimated the public health and economic burden for two serum cotinine limits of detection.

Sources Used:

- 2009 National Youth Tobacco Survey; 2010 National Health Interview Survey; National Health and Nutrition Examination Survey (2007-2008, 2009-2010); Second-hand smoke: assessing the burden of disease at national and local levels (Öberg et al./WHO, 2010); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Mason J, Wheeler W, and Brown MJ. 2015. The economic burden of exposure to secondhand smoke for child and adult never smokers residing in U.S. public housing. Public Health Rep.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Application of a cost-benefit analysis model to the use of flame retardants

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Mcnamee MS and Anderson P

Journal

Fire Technol

Summary

This study applied a fire cost-benefit analysis (CBA) model in different scenarios of a 2003-based case study in Sweden comparing television (TV) sets containing/not containing flame retardants. For all tested scenarios, the benefits of a high level of fire performance in a TV set far outweighed the costs associated with obtaining that high level of fire safety, where the net benefit ranged from \$49 to \$1073 million US dollars per year. This study is the first attempt to establish monetary costs and benefits associated with the use of flame retardants in televisions.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Brominated compounds (polybrominated diphenyl ethers (PBDEs, e.g., decaBDE))

Source of Environmental Agents:

- Flame retardants in television (TV) sets

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Calculated incremental costs associated with an increase in fire safety via the fire

Environmental Health Economic Analysis Annotated Bibliography

cost-benefit analysis model by considering the following: cost difference between resins used for TV manufacture

- costs of lives saved
- costs associated with treatment of fire victim injuries
- societal losses and costs associated with fire victim deaths
- cost of flame retardants
- cost of recycling
- value of statistical life (VSL)
- average cost per fire
- cost for house construction
- health costs: costs associated with disposal or inclusion of products in fire

Potential Cost Measures:

- Absolute costs associated with flame or non-flame retarded products, such as: environmental or eco-toxicological costs
- costs of raw materials for production
- costs associated with use
- transport costs
- cost of fire-fighting
- cost of post-fire clean-up
- costs for replacement of destroyed or damaged equipment

Benefits Measures:

- Calculated incremental benefits associated with an increase in fire safety via the fire cost-benefit analysis model by considering the following: lives saved through the avoidance of TV fires
- avoided injuries
- avoided house fires
- avoided TV fires
- capital costs through fires averted

Potential Benefits:

- Absolute benefits associated with flame or non-flame retarded products, such as: environmental or eco-toxicological benefits

Location:

- Sweden, European Union

Models Used:

- Authors developed the fire cost-benefit analysis (CBA) model (which is analogous to the fire life cycle assessment (LCA) model)

Methods Used:

- Authors performed a cost-benefit analysis of effects associated with exposure to flame retardants in TV sets and fires. The authors — 1) developed a fire cost-benefit analysis (CBA) model; 2) applied the fire CBA model to a 2003-based case study comparing cathode ray tube television (CRT TV) sets containing flame retardants in the outer enclosure compared to those that did not; 3) tested nine scenarios for the CRT TV set application of the fire CBA model; and 4) performed several calculations to show the influence of different input parameters on the benefits of house fires saved.

Sources Used:

- Civil Contingencies Agency Incident Database (IDA) (<http://ida.msb.se/ida2#page=a0087>); Televisions by country, CIA World Factbook, Dec. 2003 (http://www.nationmaster.com/graph/med_tel-media-televisions); Swedish Insurance Federation (<http://www.svenskforsakring.se/Huvudmeny/Fakta-Statistik/Statistics-list/>); additional

sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Mcnamee MS and Anderson P. 2015. Application of a cost-benefit analysis model to the use of flame retardants. Fire Technol.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Bromine Science and Environmental Forum (BSEF)

Factors influencing the acquisition and correct and consistent use of the top-lit updraft cookstove in Uganda

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article

Authors

Namagembe A, Muller N, Scott LM, Zwisler G, Johnson M, Arney J, Charron D, and Mugisha E

Journal

J Health Commun

Summary

This study examined the effects of select behavior change interventions on the purchase and use of a top-lit updraft (TLUD) stove in Uganda, and assessed the commercial viability of the stove in the study area. The authors found that community cooking demonstrations, training, and promotion of stove use by village health teams were the most influential factors for purchase, correct, and consistent use of the TLUD, and that access to and cost of processed fuel were the greatest reported barriers. However, commercial viability analyses showed that the TLUD stove would not be commercially viable in Uganda, with or without microfinance. The authors concluded that the community engagement model could help facilitate increased acquisition and use of a lower cost stove technology with similar performance and behavior change barriers.

Population

Households with the top-lit updraft (TLUD) stove; men and women in study communities; village health team members and community sales agents

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents: (Not available)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type: (Not available)

Cost Measured:

- Wholesale cost from manufacturer of top-lit updraft stove
- general, sales, and administrative costs with direct sales efforts
- ongoing operation costs after sales
- opportunity cost to prepare wood
- cost to purchase processed wood

Potential Cost Measures:

- Additional cost to the household of pre-processed wood

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Wakiso district in central Uganda

Models Used:

- AirFOAM framework

Methods Used:

- The authors examined the effects of select behavior change interventions on the purchase and correct and consistent use of a locally fabricated top-lit updraft (TLUD) stove in Uganda and also analyzed the commercial viability of the stove in the study area. The authors — 1) conducted formative research to inform and design behavior change interventions; 2) implemented behavior change interventions (e.g., community cooking demonstrations); 3) collected qualitative and quantitative data to understand effects of interventions on adoption and correct use of the TLUD stove; 4) used a Stove Use Monitoring System with temperature-logging sensors to assess TLUD usage; and 5) conducted commercial viability analysis at the end of the project, which included: a profit-and-loss analysis, analysis of unit sales, analysis of costs incurred, and a breakeven analysis for a scenario including microfinance.

Sources Used:

- Ugandan Bureau of Statistics (2010); Qualitative data collected from men and women in the village and from village health teams; Data on number of stoves sold collected from direct sales agents; Data generated from Stove Use Monitoring System to assess stove usage; Willingness to pay data collected from community; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Namagembe A, Muller N, Scott LM, Zwisler G, Johnson M, Arney J, Charron D, and Mugisha E. 2015. Factors influencing the acquisition and correct and consistent use of the top-lit updraft cookstove in Uganda. J Health Commun.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- United States Agency for International Development under Translating Research into Action, Cooperative Agreement No. GMS-A-00-09-00015-00

Diminishing returns or compounding benefits of air pollution control? The case of NOx and ozone

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Pappin AJ, Mesbah SM, Hakami A, and Schott S

Journal

Environ Sci Technol

Summary

This cost-benefit analysis estimated the marginal benefits (MB) for nitrous oxides (NOx) emitted from mobile and point sources, and characterized these benefits based on estimated ozone-related premature mortality in the United States population. Results showed that nation-wide emission control in the United States significantly increased NOx MBs for all sources. These findings provide economic incentive for higher levels of abatement, and demonstrate a strictly concave damage function and compounding benefits of progressively lower levels of NOx emission. These findings suggest that the traditional perception of a convex damage function and decreasing MB with abatement may not hold true for secondary pollutants such as ozone.

Population

Not available

Health Outcomes

- Mortality

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone (O3), nitrogen oxides (NOx))

Source of Environmental Agents:

- Mobile and point sources

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Environmental Health Economic Analysis Annotated Bibliography

Cost Measured:

- Mortalities cost resulting from acute exposure to ozone

Potential Cost Measures:

- Cost of environmental impacts
- health impacts from other NO_x related air pollutants (NO₂ and inorganic PM)

Benefits Measures:

- Marginal benefits (MB) of averted mortality resulting from reduced short-term (acute) exposure to ozone

Potential Benefits:

- Marginal benefits (MB) of averted mortality resulting from reduced long-term exposure to ozone
- MB of averted morbidity resulting from reduced short-term (acute) exposure to ozone
- MB of nonfatal health impacts of ozone
- MB of environmental impacts of ozone
- impacts of reduced emissions generated within US and resulting public health impacts for other nations

Location:

- United States

Models Used:

- US EPA Community Multiscale Air Quality (CMAQ) model
- Sparse Matrix Operator Kernel Emissions (SMOKE) model
- Weather Research and Forecasting (WRF) model

Methods Used:

- Authors performed an air quality cost-benefit assessment related to emissions control for nitrogen oxides (NO_x) with respect to ozone formation. The authors — 1) estimated marginal benefits (MB) for mobile and point sources using adjoint sensitivity analysis in a regional air quality model (CMAQ); 2) constructed MB curves for 1 ton of emitted NO_x using various US wide emissions abatement scenarios; and 3) reported MBs for 1 ton of NO_x emitted over the 2007 ozone season according to the spatiotemporal distribution of emissions for any given source location.

Sources Used:

- Ozone and short-term mortality in 95 US urban communities, 1987-2000 (Bell et al., 2004); US EPA, Guidelines for preparing economic analyses (2010); Source attribution of health benefits from air pollution abatement in Canada and the United States: an adjoint sensitivity analysis (Pappin et al., 2013); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Pappin AJ, Mesbah SM, Hakami A, and Schott S. 2015. Diminishing returns or compounding benefits of air pollution control? The case of NO_x and ozone. Environ Sci Technol.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

Environmental Health Economic Analysis Annotated Bibliography

- Natural Sciences and Engineering Research Council of Canada

Economic impacts of environmentally attributable childhood health outcomes in the European Union

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Bartlett ES and Trasande L

Journal

European Journal of Public Health

Summary

This report is the first cost analysis of impacts of childhood environmental chemical exposures in the European Union (EU). The researchers estimated the combined environmentally attributable costs of lead exposure, methyl mercury exposure, developmental disabilities, asthma, and cancer to be \$70.9 billion in 2008. Estimation of these costs was important for evaluating the impact of the implementation of the EU's chemical policy (REACH). These findings also highlight the importance of specifically considering the health effects in children when conducting analyses of the costs or benefits of environmental, health, and safety policies.

Population

Children and adolescents (< 18 years)

Health Outcomes

- Lead poisoning
- methyl mercury poisoning
- developmental disabilities (autism spectrum disorder, ADHD, conduct disorders, mental retardation)
- respiratory outcomes (asthma)
- pediatric cancer

Environmental Agents

List of Environmental Agents:

- Environmental pollutants ("chemical substances of human origin in air, food water, and communities")
- metals (lead, methyl mercury)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

Environmental Health Economic Analysis Annotated Bibliography

- Cost analysis (CA)

Cost Measured:

- Direct health care system costs
- costs of rehabilitation
- lost productivity

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- European Union

Models Used:

- Environmentally Attributable Fraction (EAF) model

Methods Used:

- The authors evaluated the economic impacts of childhood environmental chemical exposures in the European Union. The authors — 1) used a cost-of-illness approach to estimate health care system costs; 2) used environmentally attributable fraction (EAF) modeling to estimate the proportion of childhood disease due to environmental exposures; and 3) analyzed data on exposures, disease prevalence, and costs at a country level, and then aggregated costs across EU member states to estimate overall economic impacts within the EU.

Sources Used:

- European Community Health Indicators (European Commission, 2008); Eurostat Harmonized Index of Consumer Prices; Global Burden of Asthma (Global Health Initiative for Asthma); GLOBOCAN database (WHO, 2008); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Bartlett ES and Trasande L. 2014. Economic impacts of environmentally attributable childhood health outcomes in the European Union. *European Journal of Public Health*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Cost of near-roadway and regional air pollution-attributable childhood asthma in Los Angeles County

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Brandt S, Perez L, Kunzli N, Lurmann F, Wilson J, Pastor M, and McConnell R

Journal

J Allergy Clin Immunol

Summary

This cost analysis study estimated the cost of childhood asthma attributable to residential near-roadway air pollution (NRP) exposure, regional ozone (O₃), and nitrogen dioxide (NO₂) in Los Angeles County by developing a novel approach to apportion the costs between these exposures under different pollution scenarios. They estimated that the annual cost of asthma for Los Angeles County in 2007 attributable to O₃ and NO₂ was approximately \$441 million and \$202 million, respectively, and that costs from increased NRP exposure may offset savings from reduced regional air pollution. The authors concluded that disaggregating the effects of regional air pollution and NRP exposure helps clarify the health co-benefits and cost savings that could be achieved by reducing these exposures.

Population

Children (< 17 years)

Health Outcomes

- Respiratory outcomes (asthma, asthma exacerbation-related outcomes such as bronchitis episodes, ear, and sinus infections)

Environmental Agents

List of Environmental Agents:

- Air pollutants (near-roadway air pollution, ozone (O₃), nitrogen dioxide (NO₂))

Source of Environmental Agents:

- Residential near-roadway air pollution, regional ozone (O₃), and nitrogen dioxide (NO₂)

Economic Evaluation / Methods and Source

Environmental Health Economic Analysis Annotated Bibliography

Type:

- Cost analysis (CA)

Cost Measured:

- Costs of hospitalization
- inpatient hospital stays
- emergency room visits
- doctor visits
- asthma inhalers and drugs
- caregiver's time spent traveling, waiting, and receiving care for office visits, ER visits, and hospitalizations
- medication use and treatment for asthma-related comorbidities (e.g., ear and sinus infections)
- school absences
- antibiotics prescriptions

Potential Cost Measures:

- Lower lifetime earnings for caregivers of children with asthma
- costs associated with adult asthma

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Los Angeles County, California

Models Used:

- Yes

Methods Used:

- The authors estimated the cost of childhood asthma attributable to residential near-roadway air pollution, regional ozone, and nitrogen dioxide in Los Angeles County. The authors — 1) used concentration response functions (CRF) to estimate the prevalence of asthma attributable to near-roadway air pollution; 2) integrated results from a study of willingness to pay to reduce the burden of asthma with studies of health care utilization and charges to estimate the costs of an asthma case and exacerbation; and 3) applied those costs to the number of asthma cases and exacerbations due to regional pollution in 2007 and to hypothetical scenarios of a 20% reduction in regional pollution in combination with a 20% reduction or increase in the proportion of families living in proximity to a major roadway relative to 2007 levels.

Sources Used:

- Southern California Children's Health Study (2007); Final 2012 Air Quality Management Plan (South Coast Air Quality Management District, 2013); Healthcare Cost and Utilization Project (Agency for Healthcare Research and Quality, 2011); American Academy of Pediatricians Medicaid Reimbursement Survey 2007/2008; Agency for Healthcare Research and Quality (2004); Epocrates (2010); National Household Travel Survey (U.S. Department of Transportation/Federal Highway Administration, Bureau of Transportation Statistics, and National Highway Traffic Safety Administration, 2009); National Health Statistics Reports (2008) National Hospital Ambulatory Medical Care Survey: 2006 Emergency Department Summary; US Census Bureau (2012); California Health Interview Survey (2009); Health care utilization and cost in children with asthma and selected comorbidities (Grupp-Phelan et al., 2001); Medical Expenditure Panel Survey (2007); Contingent valuation scenarios for chronic illnesses: The case of childhood asthma (Brandt et al., 2012); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Brandt S, Perez L, Kunzli N, Lurmann F, Wilson J, Pastor M, and Mcconnell R. 2014. Cost of near-roadway and regional air pollution-attributable childhood asthma in Los Angeles County. J Allergy Clin Immunol.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- R01ES016535, P01ES011627, P30ES007048, P01ES009581, 5R01ES014447

Other Funding:

- EPA grants: R826708, RD831861, R831845
- South Coast Air Quality Management District
- The Hastings Foundation

Household cooking with solid fuels contributes to ambient PM2.5 air pollution and the burden of disease

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Chafe ZA, Brauer M, Klimont Z, Van Dingenen R, Mehta S, Rao S, Riahi K, Dentener F, and Smith KR

Journal

Environ Health Perspect

Summary

This cost analysis estimated the ill health effects associated with population-wide exposure to ambient PM2.5 caused by household cooking with solid fuels on the basis of the Global Burden of Disease (GBD) 2010 project for the years 1990, 2005, and 2010 in 170 countries. The study authors determined that exposure to ambient PM2.5 caused the loss of 370,000 lives and 9.9 million disability-adjusted life years (DALYs) globally in 2010. These results suggest that efforts to improve ambient air quality, especially in countries within South and East Asia (e.g., India and China, respectively), will be hindered if household cooking conditions are not addressed.

Population

Not available

Health Outcomes

- Mortality

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM 2.5/fine))

Source of Environmental Agents:

- Household cooking with solid fuels

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Deaths
- disability-adjusted life years (DALYs)

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- 170 countries grouped by region

Models Used:

- Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) models were used to calculate proportion of household PM2.5 emissions that comes from cooking
- Fast Scenario Screening Tool for Global Air Quality and Instantaneous Radiative Forcing paired with T5 (TM5-FASST), a global chemical transport model, was used to calculate proportion of ambient PM2.5 that comes from household combustion
- Global burden of disease model was used to calculate ill health resulting from exposure to outdoor PM2.5 air pollution

Methods Used:

- The authors estimated the proportion and concentrations of ambient PM2.5 attributable to household cooking with solid fuels for the years 1990, 2005, and 2010 in 170 countries, and examined ill health associated with exposures to ambient PM2.5. The authors — 1) used the GAINS and TM5-FASST models to estimate the proportion of ambient PM2.5 produced by households; 2) used the GAINS and TM5-FASST models to estimate the proportion of household PM2.5 emissions from cooking with solid fuels; and 3) estimated health effects using global burden of disease data from 2010 on ill health from ambient PM2.5 exposure.

Sources Used:

- Global burden of disease (GBD) 2010 project (IHME 2010); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Chafe ZA, Brauer M, Klimont Z, Van Dingenen R, Mehta S, Rao S, Riahi K, Dentener F, and Smith KR. 2014. Household cooking with solid fuels contributes to ambient PM2.5 air pollution and the burden of disease. Environ Health Perspect.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

QALY as evaluation tool in a health surveillance program

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Esser A, Gube M, Schettgen T, Kraus T, and Lang J

Journal

Int J Hyg Environ Health

Summary

This study assessed whether PCB exposure can be associated with the quality adjusted life years (QALYs) of participants in an occupational exposure surveillance program. The authors found a significant effect of PCB exposure on QALY where PCB exposure reduced health-related quality of life (HRQL) in the remaining lifetime of surveillance program participants. The results supported the use of QALYs to monitor HRQL effects in surveillance programs and suggested that exposure to hazardous substances has an influence on QALYs.

Population

Participants in the Health Effects in High-Level Exposure to PCB (HELPCB) medical surveillance program

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Chlorinated compounds (polychlorinated biphenyls (PCBs))

Source of Environmental Agents:

- Occupational exposure via a capacitor and transformer recycling company

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Quality adjusted life years (QALYs)

Environmental Health Economic Analysis Annotated Bibliography

- health-related quality of life (HRQL)

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Germany

Models Used:

- Linear calculation model to calculate Quality-Adjusted Life Year (QALY) using Health-Related Quality of Life (HRQL) and Remaining Life Expectancy (RLE)
- Complex Number Model as alternate method to calculate QALYs
- Hierarchical linear regression models with control variables to test whether PCB exposure is associated with HRQL and QALYs

Methods Used:

- The authors assessed whether PCB exposure can be associated with the quality adjusted life years (QALYs) of participants in an occupational exposure surveillance program. The authors — 1) determined internal PCB load of program participants using gas chromatography with mass spectrometry in plasma; 2) used a questionnaire to assess health related quality of life (HRQL) and generated an HRQL index value; 3) used a linear model that combined HRQL index value with remaining life expectancy of an individual to calculate QALY; 4) used a Complex Number Model as alternate method to calculate QALYs; and 5) used a hierarchical linear regression model with control variables to assess whether PCB exposure was associated with individual HRQL and QALYs.

Sources Used:

- Remaining life expectancy values via the mortality table 2010 for Germany (Federal Statistical Office, 2012); Biomonitoring data (PCB levels in plasmas) from surveillance program participants (Schettgen et al., 2011); HRQL data from surveillance program participants using EQ-5D-3L self-report tool (Rabin et al., 2013); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Esser A, Gube M, Schettgen T, Kraus T, and Lang J. 2014. QALY as evaluation tool in a health surveillance program. Int J Hyg Environ Health.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Institution for Statutory Accident Insurance and Prevention in the Energy, Textile, Electrical, and Media Industry (BGETEM), Cologne, Germany (unrestricted grant to the UK Hospital Aachen, RWTH Aachen University, grant number360328)

A simulation model of building intervention impacts on indoor environmental quality, pediatric asthma, and costs

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Fabian MP, Adamkiewicz G, Stout NK, Sandel M, and Levy JI

Journal

J Allergy Clin Immunol

Summary

This cost-benefit analysis used a previously developed discrete event simulation model (DEM) of pediatric asthma to estimate differences in healthcare use costs comparing home-based interventions and intervention bundles for a simulated cohort of children in low-income multifamily housing in Boston, Massachusetts. The study authors determined that interventions, such as repairing kitchen exhaust fans and integrated pest management, led to 7% and 12% reductions in serious asthma events, respectively, with one- to three-year payback periods. This work increases the awareness of multi-intervention approaches to control asthma and highlights the cost-benefits of environmental home interventions.

Population

Simulated cohort of one million children living in low-income, multifamily housing consistent with public housing residents

Health Outcomes

- Respiratory outcomes (asthma, lung function)

Environmental Agents

List of Environmental Agents:

- Air pollutants (nitrogen dioxide, particulate matter (PM2.5/fine), indoor allergens (cockroach, mold))

Source of Environmental Agents:

- Sources of indoor air pollution, allergens from pests (cockroaches)

Economic Evaluation / Methods and Source

Environmental Health Economic Analysis Annotated Bibliography

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Healthcare costs related to pediatric asthma (medications/prescriptions)
- healthcare costs related to serious asthma events (e.g., clinic visits, ED visits, hospitalizations)
- asthma symptom days
- medication use
- intervention costs
- energy costs

Potential Cost Measures:

- Lost work days
- missed school days

Benefits Measures:

- Healthcare savings
- reduction of indoor air pollutants and allergen concentrations resulting from interventions
- reduction of pediatric asthma and poor lung function outcomes resulting from interventions
- energy savings

Potential Benefits: (Not available)

Location:

- Boston, Massachusetts

Models Used:

- Simulation models — Discrete event simulation model (DEM) of pediatric asthma
- CONTAM model

Methods Used:

- Authors used a simulated cohort of children to evaluate the impact of building interventions on indoor environmental quality and pediatric asthma healthcare use, and conducted cost comparisons between intervention, healthcare costs, and energy savings. The authors — 1) used a previously developed and evaluated discrete event simulation model (DEM) of pediatric asthma to simulate health outcomes over a range of building interventions; 2) modeled indoor concentrations of four contaminants that potentially affect a child's lung function and asthma status (i.e., nitrogen dioxide, PM2.5, cockroach allergen, and mold); 3) evaluated several candidate interventions for improving indoor environmental conditions, and considered an intervention aimed at reducing energy costs; and 4) tested bundles of interventions that couple weatherization with interventions that can potentially offset indoor environmental effects.

Sources Used:

- 2007/2008 Massachusetts Medicaid Reimbursement Survey (American Academy of Pediatrics, 2008); Medical Expenditure Panel Survey (MEPS) (Barnett et al., 2011); 2006 Agency for Healthcare Research and Quality Healthcare cost and utilization project (Stranges et al., 2008); Medical Care Consumer Price Index (US Department of Labor, 2013); Housing conditions and respiratory health in a Boston public housing community (Brugge et al., 2011); Use of a population-based study to describe the health of Boston public housing residents (Digenis-Bury et al., 2008); Public health and the physical environment in Boston Public Housing: a community-based survey and action agenda (Hynes et al., 2000); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Fabian MP, Adamkiewicz G, Stout NK, Sandel M, and Levy JI. 2014. A simulation model of building intervention impacts on indoor environmental quality, pediatric asthma, and costs. J Allergy Clin Immunol.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- R21ES017522

Other Funding: (Not available)

The human health effects of Florida red tide (FRT) blooms: an expanded analysis

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Hoagland P, Jin D, Beet A, Kirkpatrick B, Reich A, Ullmann S, Fleming LE, and Kirkpatrick G

Journal

Environ Int

Summary

This cost-analysis estimated the human health risks and economic impacts associated with brevetoxin exposure from algal blooms of *Karenia brevis* in six southwest Florida counties. Specifically, these blooms were found to be significantly associated with human health and economic effects in older cohorts (55 years of age). The authors also found that the costs of illness associated with *K. brevis* ranged from \$60,000 to \$700,000 annually, but estimated that these costs could exceed \$1 million per year for severe long lasting bloom events.

Population

Residents and tourists in six southwest Florida counties

Health Outcomes

- Respiratory outcomes
- gastrointestinal outcomes

Environmental Agents

List of Environmental Agents:

- Brevetoxins

Source of Environmental Agents:

- Algal blooms of *Karenia brevis*

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Number of emergency department visits
- number of inpatient hospital admissions

Environmental Health Economic Analysis Annotated Bibliography

- treatment costs for respiratory and digestive illness
- marginal emergency department costs for respiratory and digestive illness
- marginal costs of hospital inpatient admissions for respiratory and digestive illness
- lost income during treatment and recuperation

Potential Cost Measures:

- Non-market costs associated with pain and suffering
- costs of self treatment
- outpatient visits, costs of pharmaceutical utilized outside the emergency department of hospital inpatient environments
- potential morbidities and mortalities from brevetoxin exposures
- losses to local service businesses (e.g., restaurants and hotels)
- increased costs of beach cleanups
- lost recreational opportunities
- reduced fishery yields
- mortalities of passively valued protected species

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Florida southwest or Gulf Coast counties — Hillsborough, Pinellas, Manatee, Sarasota, Charlotte, and Lee County

Models Used:

- Authors developed environmental exposure-response models (time-series, cross-section regression models) using monthly data at the county level to analyze the effects of algal blooms on human health

Methods Used:

- The authors estimated the human health risks and economic impacts in Florida Gulf Coast counties related to exposure to brevetoxins from algal blooms of *Karenia brevis*. The authors — 1) developed exposure-response models to test the effects of *K. brevis* blooms on human health by using data on emergency department visits and hospital admissions, measures of *K. brevis* bloom events, and county level population and tourism data; and 2) used marginal costs of emergency department visits and hospital admissions to estimate costs of illness.

Sources Used:

- Data on emergency department visits and hospital admissions from Florida Agency for Health Care Administration; Harmful algal bloom (HAB) monitoring database (Fish and Wildlife Research Institute, 2013); NOAA harmful algal blooms observing system (National Coastal Data Development Center); Shellfish harvesting area maps (Florida Department of Agriculture and Consumer Services); County level population data from US Census Bureau (2013); County level hotel and motel rental data from Smith Travel Research, Inc. (2013); Income data from Bureau of Economic Analysis (2013); Agency for Healthcare Research and Quality (2103); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Hoagland P, Jin D, Beet A, Kirkpatrick B, Reich A, Ullmann S, Fleming LE, and Kirkpatrick G. 2014. The human health effects of Florida red tide (FRT) blooms: an expanded analysis. Environ Int.
- [Pubmed](#)
- [DOI](#)

Environmental Health Economic Analysis Annotated Bibliography

NIEHS Funding: (Not available)

Other Funding:

- National Science Foundation (NSF/CNH grant no. 1009106)

Household's willingness to pay for arsenic safe drinking water in Bangladesh

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Khan NI, Brouwer R, and Yang H

Journal

J Environ Management

Summary

This study implemented a survey to examine the public willingness to pay (WTP) for arsenic safe drinking water by investing in communal deep tubewells (DTW) across different arsenic-risk zones in areas of rural Bangladesh. Results showed that most survey respondents were willing to pay in principle for a communal DTW to secure access to arsenic safe drinking water; important factors that were found to influence WTP included household income, where respondents lived, awareness of water source contamination, and others. These results are consistent with other studies that have shown that WTP for arsenic safe drinking water increases as the baseline risk exposure levels increase, when controlling for other factors.

Population

Not available

Health Outcomes

- Arsenicosis

Environmental Agents

List of Environmental Agents:

- Metals (arsenic)

Source of Environmental Agents:

- Groundwater, drinking water

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Willingness to pay (WTP) for arsenic safe drinking water
- capital costs
- operation costs
- maintenance costs
- cost of medical treatment
- loss of income

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Bangladesh

Models Used: (Not available)

Methods Used:

- Authors used a double bound discrete choice valuation elicitation approach to estimate the public willingness to pay (WTP) for arsenic safe drinking water by investing in communal deep tubewells (DTW) across different risk zones in rural Bangladesh. The authors — 1) developed an extended questionnaire with contingent valuation questions; 2) collected information about sociodemographics and other factors for households; 3) implemented survey in thirteen villages located in three districts (Comilla, Munshiganj, and Pabna) in Bangladesh following a stratified random sampling procedure for households; and 4) characterized villages at high, medium, or low risk for groundwater arsenic exposure.

Sources Used:

- Value of arsenic-free drinking water to rural households in Bangladesh (Ahmad et al., 2005); A 'natural experiment' approach to contingent valuation of private and public UV health risk reduction strategies in low and high risk countries (Bateman et al., 2005); Environmental Quality Standards for Bangladesh, Government of the Peoples' Republic of Bangladesh (DoE, 1994); Incentive incompatibility and starting point bias in iterative valuation questions (Whitehead, 2002); Incentive incompatibility and starting-point bias in iterative valuation questions: reply (Whitehead, 2004); Constructing Krinsky and Robb Confidence Interval for Mean and Median WTP Using Stata (Jeanty, 2007); Implementation of food frequency questionnaire for the assessment of total dietary arsenic intake in Bangladesh: part B, preliminary findings (Khan et al., 2009); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Khan NI, Brouwer R, and Yang H. 2014. Household's willingness to pay for arsenic safe drinking water in Bangladesh. J Environ Management.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Eawag, Swiss Federal Institute of Aquatic Science and Technology

The global burden of disease for skin, lung, and bladder cancer caused by arsenic in food

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article

Authors

Oberoi S, Barchowsky A, and Wu F

Journal

Cancer Epidemiol Biomarkers Prev

Summary

This quantitative risk assessment study estimated the global burden of disease for bladder, lung, and skin cancers attributable to inorganic arsenic exposures in food. They estimated that each year, 9,129 to 119,176 additional cases of bladder cancer, 11,844 to 121,442 of lung cancer, and 10,729 to 110,015 of skin cancer worldwide are attributable to inorganic arsenic in food. The authors conclude that risk estimates are valuable for informing and supporting policies to reduce the global burden of disease from arsenic exposures in food.

Population

Not available

Health Outcomes

- Cancer outcomes (skin cancer, lung cancer, bladder cancer)

Environmental Agents

List of Environmental Agents:

- Metal (inorganic arsenic)

Source of Environmental Agents:

- Diet

Economic Evaluation / Methods and Source

Type: (Not available)

Cost Measured: (Not available)

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Environmental Health Economic Analysis Annotated Bibliography

Location: (Not available)

Models Used:

- Dose-response model with a linear function of dose and quadratic function of age
- exposure assessment model

Methods Used:

- The authors estimated the global burden of disease for bladder, lung, and skin cancers attributable to inorganic arsenic in food. The authors — 1) established dose response estimates by converting dose response estimates for water exposure to human dose; 2) estimated exposure using data on a common range of arsenic content for food crops grown in different parts of the world and dietary patterns in different parts of the world; 3) multiplied the dose-response slope factor with the estimated range of daily dietary inorganic arsenic exposure to characterize cancer risk; and 4) summed across different populations to estimate the global burden of a particular arsenic-induced cancer.

Sources Used:

- Global Environment Monitoring System-Food Contamination Monitoring and Assessment Programme (GEMS/Food) (World Health Organization 2006); Risk of internal cancers from arsenic in drinking water (Morales et al., 2000); United States Environmental Protection Agency Integrated Risk Information System (IRIS) Arsenic, inorganic (1998); WHO Food Additives Series: 63. Safety evaluation of certain contaminants in food (Joint FAO/WHO Expert Committee on Food Additives, 2011); EFSA panel on contaminants in the food chain: Scientific opinion on arsenic in food (EFSA, 2009); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Oberoi S, Barchowsky A, and Wu F. 2014. The global burden of disease for skin, lung, and bladder cancer caused by arsenic in food. *Cancer Epidemiol Biomarkers Prev.*
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- R01ES0138781

Other Funding:

- WHO Foodborne Disease Burden Epidemiology Group
- National Cancer Institute (R01CA153073)

Hidden cost of U.S. agricultural exports: particulate matter from ammonia emissions

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Paulot F and Jacob DJ

Journal

Environ Sci Technol

Summary

This cost analysis quantified the cost of NH₃ and resulting PM_{2.5} emissions associated with agricultural food exports in the United States. The authors found that NH₃ emissions associated with food export increases the exposure of the U.S. population to PM_{2.5}, and they estimated the valuation of increased premature mortality associated with PM_{2.5} from food export to be \$36 billion per year (in US dollars). These findings suggest that eliminating NH₃ emissions from food export would achieve greater health benefits than the reduction of the National Ambient Air Quality Standards for PM_{2.5} from 15 to 12 g/m³.

Population

Not available

Health Outcomes

- Mortality (premature mortality)

Environmental Agents

List of Environmental Agents:

- Air pollutants (ammonia (NH₃), particulate matter (PM_{2.5}/fine))

Source of Environmental Agents:

- PM_{2.5} and NH₃ emissions via agricultural food exports

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Mortalities

Environmental Health Economic Analysis Annotated Bibliography

- annual health costs of PM2.5 from food export
- direct gross revenue associated with agricultural exports

Potential Cost Measures:

- Other agricultural impacts such as: eutrophication, loss of biodiversity, greenhouse gas emissions from production and transportation

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- United States

Models Used:

- MASAGE model was used to calculate agricultural emissions of NH3
- GEOS-Chem global chemical transport model (CTM) was used to calculate the impact of a change in ammonia emissions on PM2.5

Methods Used:

- The authors quantified the costs of NH3, and resulting PM2.5 emissions, associated with US food export by coupling a model of agricultural sources of NH3 with a chemical transport model. The authors — 1) used a chemical transport model (GEOS-Chem global CTM) to calculate the sensitivity of PM2.5 to NH3 emissions from agricultural exports; 2) used the MASAGE model to calculate agricultural emissions of NH3; 3) used commodity-specific export fraction by weight to estimate the NH3 emissions associated with food export; and 4) estimated the annual health costs of PM2.5 from food export using the willingness to pay (WTP) and value of a statistical life (VSL) method.

Sources Used:

- US Department of Agriculture (USDA) Economic Research Service (2013); Food and Agricultural Organization (FAO) FAOSTAT, Agriculture Organization of the United Nations Statistical Database (2009); US EPA National Emission Inventory (2005); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Paulot F and Jacob DJ. 2014. Hidden cost of U.S. agricultural exports: particulate matter from ammonia emissions. Environ Sci Technol.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Prenatal exposure to airborne polycyclic aromatic hydrocarbons and IQ: Estimated benefit of pollution reduction

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Perera F, Weiland K, Neidell M, and Wang S

Journal

Journal of Public Health Policy

Summary

This study examined the benefits of a modest decrease in PAH exposure to children in New York City, and estimated a \$215 million gain in lifetime earnings due to IQ increase for a single year. These results suggested that a modest reduction in ambient concentrations of PAH is associated with substantial economic benefits as measured by lifetime earnings for exposed children.

Population

Children (0-5 years) — Columbia Center for Children's Environmental Health NYC cohort (low-income, Medicaid recipients)

Health Outcomes

- Neurological/cognitive outcomes (IQ deficits)

Environmental Agents

List of Environmental Agents:

- Air pollutants (Polycyclic aromatic hydrocarbons (PAHs))

Source of Environmental Agents:

- Combustion of fossil fuels and other organic materials

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- IQ deficits/loss associated with PAH exposure

Environmental Health Economic Analysis Annotated Bibliography

Potential Cost Measures:

- Costs of controlling emissions from PAH from diverse sources

Benefits Measures:

- Estimated increase in IQ and related lifetime earnings

Potential Benefits:

- Reduction of asthma and cancer risk

Location:

- New York City, New York (Washington Heights, Harlem, and South Bronx)

Models Used: (Not available)

Methods Used:

- Researchers utilized previous data from the CCCEH cohort study to estimate the increase in IQ and related lifetime earnings in a low-income urban population as a result of reduced ambient PAH concentrations. The researchers — 1) calculated the cost of PAH-related IQ reduction using methods outlined in previous literature (Grosse et al. 2002 and Trasande et al. 2005); 2) estimated the gain in IQ corresponding to the hypothesized reduction in ambient PAH exposure of 0.25 ng/m³; 3) used monitoring data from CCCEH cohort study and city-wide monitoring data to obtain estimates of PAH exposure; and 4) used previous methodologies (Weiland et al. 2011) and selected Medicaid births in NYC which shared basic socioeconomic characteristics of the CCCEH cohort to estimate the size of the population at risk in NYC.

Sources Used:

- Summary of Vital Statistics 2002: NYC Department of Health and Mental Hygiene (Li et al., 2003); Prenatal airborne polycyclic aromatic hydrocarbon exposure and child IQ at age 5 years (Perera et al., 2009); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Perera F, Weiland K, Neidell M, and Wang S. 2014. Prenatal exposure to airborne polycyclic aromatic hydrocarbons and IQ: Estimated benefit of pollution reduction. *Journal of Public Health Policy*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- 5P01ES09600
- 5R01ES08977

Other Funding: (Not available)

Forecast-based interventions can reduce the health and economic burden of wildfires

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA), Cost-effectiveness analysis (CEA)

Authors

Rappold AG, Fann NL, Crooks J, Huang J, Cascio WE, Devlin RB, and Diaz-Sanchez D

Journal

Environ Sci Technol

Summary

This study simulated public health forecast-based interventions using a wildfire smoke episode/case study in rural North Carolina to demonstrate the potential for use of modeled smoke forecasts to reduce the human health burden and estimated the resulting economic benefits of reducing smoke exposures. The authors estimated that the economic benefit of effective interventions exceeded \$1 million in excess emergency department visits for asthma and heart failure, \$2 million in loss of productivity, \$100,000 in respiratory conditions in children, and \$42 million due to excess mortality. They concluded that wildfire smoke forecasts can be used as a tool to protect public health, and have the potential to yield large economic benefit.

Population

Adults (> 18 years); children (7–14 years)

Health Outcomes

- Respiratory outcomes (asthma, acute bronchitis, lower respiratory symptoms, asthma exacerbations, asthma attacks, upper respiratory symptoms in asthmatics)
- cardiovascular outcomes (congestive heart failure, nonfatal heart attacks)
- mortality (premature death)

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM_{2.5}/fine))

Source of Environmental Agents:

- Wildfire smoke

Economic Evaluation / Methods and Source

Environmental Health Economic Analysis Annotated Bibliography

Type:

- Cost-benefit analysis (CBA)
- Cost-effectiveness analysis (CEA)

Cost Measured:

- Costs of emergency department visits and hospital admissions related to asthma and congestive heart failure attributable to smoke-based PM2.5 exposure
- costs of illness (premature deaths, nonfatal heart attacks, chronic cardiovascular conditions, acute bronchitis, lower respiratory symptoms, upper respiratory symptoms, aggravated asthma)
- costs of lost productivity (days of work lost, minor restricted activity days)

Potential Cost Measures:

- Cost of protective measures to mitigate individual smoke exposure (e.g., HEPA filters and personal masks)
- impacts on quality of life

Benefits Measures:

- Avoided healthcare costs from emergency department visits and hospital admissions related to asthma and congestive heart failure attributable to smoke-based PM2.5 exposure
- avoided loss of productivity
- avoided cases of premature mortality attributable to smoke exposure

Potential Benefits: (Not available)

Location:

- 31 counties in eastern North Carolina

Models Used:

- Benefits Mapping and Analysis Program - Community Edition (BenMAP-CE) tool (v0.63)

Methods Used:

- The authors simulated forecast-based interventions using a wildfire smoke episode/case study in rural North Carolina to demonstrate the potential for using modeled smoke forecasts to reduce the human health burden and estimated the resulting economic benefits of reduced smoke exposures. The authors — 1) established a baseline risk model without any intervention to build county level forecast-based interventions; 2) simulated forecast-based intervention scenarios that vary based on the levels of smoke-based PM2.5 used to trigger advisories; 3) simulated three adherence levels for each of the three smoke-based PM2.5 interventions; 4) estimated relative risk of adverse health outcomes for each of the interventions; 5) evaluated the association between asthma and congestive heart failure related to emergency department visits and smoke-based PM2.5 for each intervention; and 6) quantified the economic value of non-avoidance of smoke in these outcomes as well as in a number of general health outcomes.

Sources Used:

- Peat bog wildfire smoke exposure in rural North Carolina is associated with cardiopulmonary emergency department visits assessed through syndromic surveillance (Rappold et al., 2011); NOAA Smoke Forecasting System for the 2008 Evans Road wildfire in North Carolina; North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) (North Carolina Divisions of Public Health, 2010); 2008 Nationwide Emergency Department Sample from the Healthcare Cost and Utilization Project (Agency for Healthcare Research and Quality, 2008); Regulatory impact analysis for the final revisions to the national ambient air quality standards for particulate matter (U.S. EPA); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Rappold AG, Fann NL, Crooks J, Huang J, Cascio WE, Devlin RB, and Diaz-Sanchez D. 2014. Forecast-based interventions can reduce the health and economic burden of wildfires. Environ Sci Technol.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Internal funding by US Environmental Protection Agency

Pesticides and health: a review of evidence on health effects, valuation of risks, and benefit-cost analysis

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost-benefit analysis (CBA)

Authors

Tago D, Andersson H, and Treich N

Journal

Adv Health Econ Health Serv Res

Summary

This review article presented findings on the health effects of pesticide exposure, and preference valuation of health risks related to pesticides. The authors discussed policies related to pesticides, and provided an overview of benefit-cost analyses applied to pesticide regulatory measures. This review highlighted the need to clarify rationale for regulating pesticides, the role of risk perceptions in benefit-cost analysis, and the importance of inter-disciplinary research in this area.

Population

Reviewed publications that examined: 1) individuals with direct exposure to pesticides (e.g., farmers and producers, people who spray pesticides, mix and load pesticides, sow pesticide-seeds, weed and harvest sprayed crops, and clean and dispose of pesticide containers); 2) community members with indirect exposure to pesticides (e.g., farmers' family members and people living in rural areas with intensive use of pesticides); and 3) consumers

Health Outcomes

- Reviewed publications that examined cancer outcomes
- neurological/cognitive outcomes (neurological deficits, children's IQ scores, Parkinson's disease)
- behavioral outcomes (depression, suicides)
- metabolic outcomes (diabetes, body mass index)
- respiratory outcomes (rhinitis, asthma, bronchitis, farmer's lung, wheeze, dyspnea)
- cardiovascular outcomes (myocardial infarction)
- reproductive outcomes (premature/delayed menopause, delayed conception, sperm quality)
- mechanistic outcomes (endocrine performance, women-specific hormonal disorders)
- thyroid dysfunction
- liver outcomes (hepatitis)
- birth outcomes (birth weight, fetal growth)
- other general health outcomes (hearing loss)

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined pesticides (e.g., chlorinated pesticide compounds, organophosphates, insecticides, and fumigants), and pesticide residues

Source of Environmental Agents:

- Reviewed publications that examined agricultural sources of pesticide exposure, and water or food products contaminated with pesticides (e.g., vegetables, fish, seafood, and dairy products)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Reviewed publications that examined preference elicitation to reduce pesticide risks (i.e., individuals' willingness to pay (WTP) to reduce or eliminate pesticides use (e.g., WTP for pesticide-free food products, WTP to reduce or eliminate health risks associated with pesticide exposure)
- indirect costs for farmers such as loss of natural enemies, pesticide resistance, and crop losses
- environmental losses
- costs for monitoring and cleaning pesticide-polluted groundwater
- health costs including those for hospitalization due to poisoning, outpatient-treatment of poisonings, pesticide-related cancers and fatalities

Potential Cost Measures: (Not available)

Benefits Measures:

- Reviewed publications that examined private benefits for farmers (e.g., improved productivity
- self-insurance against pest uncertainty), private benefits for consumers

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors performed a review of existing literature published from 2000 to 2013 to present the following — 1) health effects of pesticide exposure; 2) preference valuation of health risks related to pesticide use; and 3) discussion of policies related to pesticides and difficulties of evaluating them.

Sources Used:

- Agricultural Health Study Cohort data (Alavanja et al., 2003; 2004); Cancer incidence among glyphosate-exposed pesticide applicators in the Agricultural Health Study (De Roos et al., 2005); Depression and pesticide exposures among private pesticide applicators enrolled in the Agricultural Health Study (Beseler et al., 2008); Prevalence of self-reported diabetes and exposure to organochlorine pesticides among Mexican Americans: Hispanic Health and Nutrition Examination Survey, 1982-1984 (Cox et al., 2007); Rhinitis associated with pesticide exposure among commercial pesticide applicators in the Agricultural Health Study (Slager et al., 2009); Pesticide exposure and timing of menopause (Farr et al., 2006); Health impacts of pesticide exposure in a cohort

of outdoor workers (Beard et al., 2003); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Tago D, Andersson H, and Treich N. 2014. Pesticides and health: a review of evidence on health effects, valuation of risks, and benefit-cost analysis. Adv Health Econ Health Serv Res.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding:

- Agence de l'Eau Adour-Garonne (AEAG)
- Institut d'Economie Industrielle (IDEI)

Further limiting bisphenol a in food uses could provide health and economic benefits

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Trasande L

Journal

Health Affairs

Summary

Researchers used a cost-benefit analysis to assess the social costs of childhood obesity and adult coronary heart disease attributable to BPA exposure, and estimated them to be \$2.98 billion in 2008. Results suggested that regulatory action to reduce BPA exposure could result in large health and economic benefits.

Population

Children (12 years); adults (40-74 years)

Health Outcomes

- Cardiovascular outcomes (coronary artery disease)
- metabolic outcomes (obesity/aberrant body weight)

Environmental Agents

List of Environmental Agents:

- Hormonal mimics (bisphenol A (BPA))

Source of Environmental Agents:

- Metal-based food containers
- beverage containers

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Healthcare costs/expenditures associated with additional cases of obesity (during childhood and adulthood)
- healthcare costs/expenditures associated with additional cases of incident coronary heart disease

Environmental Health Economic Analysis Annotated Bibliography

- cost of QALYs lost

Potential Cost Measures:

- Cost for use of alternative lining for containers (e.g., oleoresin) or replacing BPA
- costs for removing BPA from food uses (e.g., costs for premarket testing to rule out toxicity)

Benefits Measures:

- Cases of BPA-attributable childhood obesity prevented
- costs of BPA-associated childhood obesity saved
- cases of BPA-attributable adult coronary heart disease prevented
- costs of BPA-associated adult coronary heart disease saved

Potential Benefits: (Not available)

Location: (Not available)

Models Used:

- Environmentally Attributable Fraction (EAF) model

Methods Used:

- The author quantified the potential social costs of childhood obesity and adult coronary heart disease attributable to BPA exposure in the United States in 2008 and models the potential health and economic benefits associated with replacing BPA in all food uses. The author — 1) quantified both increased rates of coronary heart disease in adults and increases in children's BMIs attributable to BPA exposure; 2) used pre-existing burden of disease cost-estimates to quantify costs from exposure; and 3) used data from previous BPA intervention study to estimate reductions in both disease and costs if BPA was removed from food uses.

Sources Used:

- NHANES (2003-2008); Incidence and prevalence: 2006 chart book on cardiovascular and lung diseases (National Heart, Lung and Blood Institute); Center for Disease Control and Prevention; American Heart Association (Heidenreich et al., 2011; Russell et al., 1998); Nationwide Inpatient Sample and Medical Expenditure Panel Survey; How much should we invest in preventing childhood obesity? (Trasande, 2010); The impact of obesity on health service utilization and costs in childhood (Trasande et al., 2009); Effects of childhood obesity on hospital care and costs (Trasande et al., 2009); Urinary bisphenol A concentration and risk of future coronary artery disease in apparently healthy men and women (Melzer et al., 2012); Consumer Price Index (Bureau of Labor Statistics); A simulation of affordability and effectiveness of childhood obesity interventions (Ma et al., 2011); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Trasande L. 2014. Further limiting bisphenol a in food uses could provide health and economic benefits. Health Affairs.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Healthy homes: in-home environmental asthma intervention in a diverse urban community

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Turcotte DA, Alker H, Chaves E, Gore R, and Woskie S

Journal

Am J Public Health

Summary

This cost-benefit analysis demonstrated that implementing an in-home environmental asthma intervention for the Lowell, Massachusetts community resulted in a significant health improvement from baseline to follow-up. The cost of the interventions (not including personnel) was \$36,240, whereas the estimated savings due to reductions in asthma-related hospitalizations, emergency department visits, and doctor visits over a 4-week assessment period was \$71,162, resulting in an estimated annual savings of about \$821,304. The authors concluded that low-cost, multicomponent interventions decrease all measures of asthma severity and health care utilization in this diverse population of urban children.

Population

Children with asthma (< 15 years)

Health Outcomes

- Respiratory outcomes (asthma attacks, wheeze, rhinitis, eczema, cough, phlegm)

Environmental Agents

List of Environmental Agents:

- Air pollutants (tobacco smoke)
- environmental asthma triggers, such as pests (roaches and mice), mold, dust mites, furry pets, outdoor allergens

Source of Environmental Agents:

- Allergens from pests (roaches and mice), combustion sources, moisture, dust, pets

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Cost of the in-home intervention

Potential Cost Measures: (Not available)

Benefits Measures:

- Savings resulting from reductions in hospitalizations, emergency department visits, and doctor visits

Potential Benefits: (Not available)

Location:

- Lowell, Massachusetts

Models Used: (Not available)

Methods Used:

- The authors evaluated health care cost savings resulting from individualized interventions focused on reducing indoor allergen levels and asthma triggers. The authors — 1) used a questionnaire tool to conduct a pre-intervention health assessment; 2) used a questionnaire and collected floor dust samples to conduct pre-intervention environmental assessment; 3) implemented customized home and education intervention; 4) followed-up 11 to 12 months post-intervention to evaluate impact of the intervention on the child's health; 5) determined reduction in urgent care costs resulting from intervention; 6) analyzed change in medication use pre- and post-intervention using a test of proportion.

Sources Used:

- Data on costs of asthma-related hospitalizations, emergency department visits, and doctor visits from Massachusetts Department of Public Health; Massachusetts Emergency Department Discharge Database (2012)

Economic Evaluation / Methods and Source

Citation:

- Turcotte DA, Alker H, Chaves E, Gore R, and Woskie S. 2014. Healthy homes: in-home environmental asthma intervention in a diverse urban community. Am J Public Health.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- US Department of Housing and Urban Development, Office of Healthy Homes and Lead Hazard Control (grant MALHH0171-8)

Upgrading to cleaner household stoves and reducing chronic obstructive pulmonary disease among women in rural China — a cost-benefit analysis

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Aunan K, Alnes LWH, Berger J, Dong Z, Ma L, Mestl HES, Vennemo H, Wang S, and Zhang W

Journal

Energy for Sustainable Development

Summary

This cost-benefit analysis determined that replacing indoor biomass stoves with cleaner burning stoves in villages of Guizhou Province, China, could potentially avoid 0.6-3.2 annual incidences of COPD per 1000 households with the economic value being greater than the intervention costs. Results suggested that policy interventions to increase access to cleaner burning stoves may provide large net benefits to rural women and their families.

Population

Adults (women 30 years)

Health Outcomes

- Respiratory outcomes (chronic obstructive pulmonary disease (COPD))

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM 2.5/fine))

Source of Environmental Agents:

- Indoor biomass stoves

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Costs for purchase, installation and maintenance of stove (including fuel costs)
- medical treatment expenses

Environmental Health Economic Analysis Annotated Bibliography

Potential Cost Measures: (Not available)

Benefits Measures:

- Treatment expenses saved
- avoided incidence of COPD

Potential Benefits:

- Convenience benefits from improved stoves
- avoided incidence of COPD in men and children

Location:

- Guizhou Province, China

Models Used: (Not available)

Methods Used:

- The authors sought to estimate the costs and benefits among women of replacing current biomass stoves in a rural area of China with second generation improved stoves. The authors — 1) developed hypothetical intervention scenarios for two groups of households (chimney households and no-chimney households); 2) estimated the indoor PM2.5 exposure pre and post-intervention; 3) calculated health benefits of COPD incidences avoided based on change of indoor concentrations of PM2.5 and lung function after replacement of biomass stoves; 4) monetized benefits based on treatment expenses saved and value of statistical life (VSL) formulas; and 5) calculated costs based on direct intervention costs (e.g., costs of installation and maintenance).

Sources Used:

- An assessment of programs to promote improved household stoves in China (Sinton et al. 2004); National Bureau of Statistics (NBS) (2010, 2012); World Bank (2007a, 2007b)

Economic Evaluation / Methods and Source

Citation:

- Aunan K, Alnes LWH, Berger J, Dong Z, Ma L, Mestl HES, Vennemo H, Wang S, and Zhang W. 2013. Upgrading to cleaner household stoves and reducing chronic obstructive pulmonary disease among women in rural China — a cost-benefit analysis. Energy for Sustainable Development.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Cost-consequence analysis of multimodal interventions with environmental components for pediatric asthma in the state of Maryland

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA), Cost-effectiveness analysis (CEA)

Authors

Jassal MS, Diette GB, and Dowdy DW

Journal

Journal of Asthma

Summary

This study estimated the expenditures and savings of environmental interventions for asthma in the state of Maryland. The researchers found that single- and multi-component environmental strategies were cost-saving relative to the standard of care, with home environmental education using non-medical professionals yielding the highest net savings of \$14.1 million. These results lend support for wider deployment of comprehensive management strategies that address environmental determinants of childhood asthma.

Population

Pediatric patients (children and adolescents 18 years)

Health Outcomes

- Respiratory outcomes (asthma)

Environmental Agents

List of Environmental Agents:

- Home-based environmental asthma triggers

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)
- Cost-effectiveness analysis (CEA)

Cost Measured:

- Healthcare costs such as hospitalizations, emergency room visits and asthma-related clinic visits

Environmental Health Economic Analysis Annotated Bibliography

- costs of lost work productivity
- costs of travel incurred during the usage of healthcare services
- educational costs for interventions
- training costs for medical professionals
- costs for follow-up visits (e.g., training supplies and transportation)
- costs for implementation of interventions (e.g., cost of allergen-impermeable covers, pest management, etc.)

Potential Cost Measures:

- Incremental costs of acute and chronic asthma medications
- cost of lost leisure time
- employer friction costs
- quality of life

Benefits Measures:

- Averted healthcare costs and parameters such as hospitalizations, emergency room and clinic/urgent care visits
- averted costs related to lost worker productivity

Potential Benefits:

- Reduction of asthma medication use

Location:

- Maryland

Models Used: (Not available)

Methods Used:

- The authors performed a cost-consequence analysis of environmental strategies for asthma control using data from published studies. The authors — 1) used decision analysis to estimate all incremental costs and benefits, from a societal perspective, of selected environmental strategies for asthma control; 2) determined the appropriate study interventions, by performing a meta-analysis of studies describing environmental strategies for asthma control; 3) constructed a hypothetical study population using data on health encounters in 2009 within the state of Maryland from the 2011 Maryland Asthma Surveillance Report (MASR); and 4) calculated the costs parameters related to asthma and the implementation of the asthma control interventions.

Sources Used:

- Maryland Asthma Control Program, Maryland Asthma Surveillance Report (MASR) (Bankowski et al., 2011); CDC Behavioral Risk Factor Surveillance System (BRFSS); Youth Tobacco Surveys (YTS); Youth Risk Behavior Surveys (YRBS); Ambulatory Care and Hospital Discharge Profiles (Maryland Health Services Cost Review Commission (HSCRC)); Labor Force Statistics from the Current Population Survey (Bureau of Labor Statistics, 2011); Allergy Control Products (Duluth, Georgia, USA); Health Services Cost Review Commission (2012); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Jassal MS, Diette GB, and Dowdy DW. 2013. Cost-consequence analysis of multimodal interventions with environmental components for pediatric asthma in the state of Maryland. *Journal of Asthma*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Cost savings associated with prohibiting smoking in U.S. subsidized housing

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost Analysis (CA)

Authors

King BA, Peck RM, and Babb SD

Journal

Am J Prev Med

Summary

This cost analysis is the first to assess costs that could be averted by prohibiting smoking in U.S. subsidized housing. The authors estimated cost savings would be \$521 million per year, including \$341 million in secondhand smoke-related healthcare expenditures, \$108 million in renovation expenses, and \$72 million in smoking-attributable fire losses. Prohibiting smoking in U.S. public housing alone would yield cost savings of approximately \$154 million per year. These findings suggest that efforts to prohibit smoking in all U.S. subsidized housing would protect health and generate substantial cost savings to society.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (secondhand tobacco smoke)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost Analysis (CA)

Cost Measured:

- Healthcare costs related to secondhand smoke
- costs of renovation of units that permit smoking
- smoking-attributable fire costs

Potential Cost Measures:

- Societal costs associated with smoking
- long-term healthcare costs
- time lost because of illness
- costs associated with investment of money or staff time to implement and enforce smoke free policies

Benefits Measures: (Not available)

Potential Benefits:

- Benefits associated with smokers who quit due to smoke free policies

Location:

- United States (excluding Alaska)

Models Used: (Not available)

Methods Used:

- The authors estimated annual cost savings associated with secondhand-smoke related health care, renovation of units that permit smoking, and smoking-attributable fires in all U.S. subsidized housing. The authors — 1) used residency estimates and previously reported national and state cost estimates for these indicators; 2) applied a price deflator to account for differential costs of living or pricing across states; and 3) performed a sensitivity analysis to develop a range around each cost estimate.

Sources Used:

- National Health Interview Survey (CDC, 2009); Vital signs: current cigarette smoking among adults aged 18 years—U.S. 2009 (CDC 2010); Top 50 States. Cost of living by state (www.top50states.com/cost-of-living-by-state.html); Resident characteristic report as of March 31, 2012 (U.S. Department of Housing and Urban Development); The National Human Activity Pattern Survey (NHAPS): a resource for assessing exposure to environmental pollutants (Klepeis et al., 2001); 2006-2007 tobacco use supplement to the current population survey (National Cancer Institute); How much does secondhand smoke cost a landlord? (Smoke-Free Housing Coalition of Maine); The total cost of fire in the United States (National Fire Protection Association, Fire Analysis and Research Division, 2010); Home structure fires (National Fire Protection Association, Fire Analysis and Research Division, 2010); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- King BA, Peck RM, and Babb SD. 2013. Cost savings associated with prohibiting smoking in U.S. subsidized housing. *Am J Prev Med*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- There were no sources of direct or indirect funding for the reported research.

Optimizing bulk milk dioxin monitoring based on costs and effectiveness

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-effectiveness analysis (CEA)

Authors

Lascano-Alcoser VH, Velthuis AG, Van Der Fels-Klerx HJ, Hoogenboom LA, and Oude Lansink AG

Journal

J Dairy Sci

Summary

Authors developed optimization models and used preselected contamination scenarios to estimate the costs and effectiveness of bulk milk dioxin monitoring in milk trucks as a means of optimizing sampling and pooling monitoring strategies. Results showed that detecting a dioxin incident with a high level of effectiveness is possible, but only at high cost; furthermore, low monitoring budgets are only highly effective when aiming to detect large incidences. These results suggested that taking a higher risk for not detecting the smallest detectable incident significantly reduces monitoring costs. This study developed decision-making models that risk managers of food industries and food safety authorities can use to evaluate the costs and effectiveness of dioxin monitoring in bulk milk. These models can be used to determine the minimum amount of resources required to accomplish a certain level of effectiveness or to calculate the achieved level of effectiveness at a certain monitoring budget.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Chlorinated compounds (polychlorinated dibenzodioxins, polychlorinated dibenzofurans)

Source of Environmental Agents:

- Dairy products (milk)

Economic Evaluation / Methods and Source

Type:

- Cost-effectiveness analysis (CEA)

Cost Measured:

- Monitoring costs (includes costs related to sampling, testing, labor for personnel, materials/equipment, transport, and storage)
- incident costs (includes costs related to tracing the source and concentration of dioxins through sampling and testing of suspected sources of contamination (trucks or farms))
- screening test costs
- confirmatory test costs

Potential Cost Measures:

- Losses of dairy farms or dairy processors related to mitigation strategies emplaced after an incident has been detected, such as cost of destroying contaminated milk
- direct financial costs for implementation of mitigation strategies
- costs of monitoring for government, industries, and consumers

Benefits Measures:

- Reduced monitoring costs
- increased effectiveness of monitoring

Potential Benefits:

- Benefits of monitoring for government, industries, and consumers

Location:

- European Union (hypothetical region (Dutch))

Models Used:

- Authors developed two optimization models using a linear programming methodology — MC optimization model (aimed at minimizing monitoring costs)
- ME optimization model (aimed at maximizing effectiveness of monitoring)

Methods Used:

- The authors estimated the costs and effectiveness of bulk milk dioxin monitoring in milk trucks to optimize sampling and pooling monitoring strategies aimed at detecting at least 1 out of 20,000 contaminated dairy farms at a target dioxin concentration level. The authors — 1) used a linear programming methodology to build two optimization models (MC and ME); 2) used the optimization models to evaluate a bulk milk dioxin monitoring plan in milk trucks covering 20,000 dairy farms located in an area of 40,000 km², and randomly selected milk trucks at each sampling time; and 3) applied the optimization models to 8 preselected contamination scenarios representing different detectable incidents.

Sources Used:

- Results of the monitoring of dioxin level in food and feed (European Food Safety Authority (EFSA), 2010); Animal Health Economics, Principles and Applications, 1st Ed. (Dijkhuizen and Morris, 1997); Kaolinic clay derived PCDD/Fs in the feed chain from a sorting process for potatoes (Hoogenboom et al., 2010); Council Regulation (EC) No 2375/2001 of 29 November 2001 amending Commission Regulation (EC) No 466/2001 setting maximum levels for certain contaminants in foodstuffs (European Commission, 2001c); Commission Recommendation 2006/88/EC of 6 February 2006 on the reduction of the presence of dioxins, furans, and PCBs in feeding stuffs and foodstuffs (European Commission, 2006a); Commission Regulation (EC) no 1883/2006 of 19 December 2006 laying down methods of sampling and analysis for the official control of levels of dioxins

and dioxin-like PCBs in certain foodstuffs (European Commission, 2006b); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Lascano-Alcoser VH, Velthuis AG, Van Der Fels-Klerx HJ, Hoogenboom LA, and Oude Lansink AG. 2013. Optimizing bulk milk dioxin monitoring based on costs and effectiveness. J Dairy Sci.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- RIKILT-Institute of Food Safety, Wageningen University and Research Center, Wageningen, the Netherlands

Co-benefits of global greenhouse gas mitigation for future air quality and human health

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

West JJ, Smith SJ, Silva RA, Naik V, Zhang Y, Adelman Z, Fry MM, Anenberg S, Horowitz LW, and Lamarque JF

Journal

Nat Clim Chang

Summary

This cost-benefit analysis simulated the co-benefits of global greenhouse gas (GHG) reductions on air quality and human health using a global atmospheric model and future scenarios via two mechanisms: 1) reducing co-emitted air pollutants, and 2) slowing climate change. The authors estimated that relative to a reference scenario, global GHG mitigation avoids 0.5 million, 1.3 million, and 2.2 million premature deaths in 2030, 2050, and 2100 respectively, and that global average marginal co-benefits of avoided mortality are \$50–380 (ton CO₂)¹. They concluded that air quality and health co-benefits provide strong additional motivation for transitioning to a low-carbon future.

Population

Adults (> 30 years)

Health Outcomes

- Mortality (premature deaths) due to cardiopulmonary disease, lung cancer, and respiratory outcomes

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone, PM_{2.5})

Source of Environmental Agents:

- Greenhouse gas emissions

Economic Evaluation / Methods and Source

Type:

Environmental Health Economic Analysis Annotated Bibliography

- Cost-benefit analysis (CBA)

Cost Measured:

- Marginal costs of greenhouse gas reductions

Potential Cost Measures: (Not available)

Benefits Measures:

- Avoided mortality

Potential Benefits:

- Avoided cost of air pollution control
- benefits to people younger than 30
- benefits of avoided morbidity outcomes
- ecosystem effects from reduced air pollution
- benefits from reduced indoor air pollution
- benefits from reduced fire and dust as result of slowing climate change

Location: (Not available)

Models Used:

- MOZART-4 global chemical transport model used to simulate ozone and PM2.5 air quality in future scenarios
- AM3 model
- MAGICC climate model

Methods Used:

- The authors estimated the co-benefits of global greenhouse gas (GHG) reductions on air quality and human health. The authors — 1) compared global GHG reductions for two future scenarios: a 'no climate policy' scenario and a second scenario with more aggressive GHG reduction policies; 2) used global atmospheric models to evaluate how these scenarios would affect air quality and human health in 2030, 2050, and 2100; and 3) monetized co-benefits of avoided air pollution mortality using high and low values of a statistical life and compared these values with the marginal costs of GHG reductions.

Sources Used:

- Extended follow-up and spatial analysis of the American Cancer Society study linking particulate air pollution and mortality (Krewski et al., 2009); Projections of global health outcomes from 2005 to 2060 using the International Futures integrated forecasting model (Hughes et al., 2011); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- West JJ, Smith SJ, Silva RA, Naik V, Zhang Y, Adelman Z, Fry MM, Anenberg S, Horowitz LW, and Lamarque JF. 2013. Co-benefits of global greenhouse gas mitigation for future air quality and human health. Nat Clim Chang.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- R21ES022600

Other Funding:

- U.S. Environmental Protection Agency STAR grant #834285
- and the Integrated Assessment Research Program in the U.S. Department of Energy,

Environmental Health Economic Analysis Annotated Bibliography

Office of Science

School buses, diesel emissions, and respiratory health

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Beatty TK and Shimshack JP

Journal

Journal of Health Economics

Summary

This study estimated the benefits of the clean school bus program in Washington state, and determined that school bus retrofits induced statistically significant reductions in bronchitis, asthma, and pneumonia incidence for children and adults with chronic conditions. These results suggested that policies targeting localized air pollution may be particularly cost effective relative to ambient air pollution policies.

Population

At-risk populations with chronic respiratory conditions (children and adults)

Health Outcomes

- Respiratory outcomes (bronchitis, asthma, pneumonia, pleurisy)

Environmental Agents

List of Environmental Agents:

- Air pollutants

Source of Environmental Agents:

- Diesel emissions

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Healthcare costs per inpatient episode of bronchitis, asthma, and pneumonia
- CCV retrofit costs (including parts, labor, and testing) per adopter school district

Potential Cost Measures:

- Indirect costs of school absences, pain and suffering, communicable disease transmission, and long-term welfare effects

Environmental Health Economic Analysis Annotated Bibliography

- Costs related to non-respiratory illnesses, long-term health effects, and health impacts on adults with chronic respiratory conditions

Benefits Measures:

- Reduced and/or avoided healthcare cost

Potential Benefits:

- Benefits calculations related to reduction in costs for non-respiratory illnesses, long-term health effects, suffering considerations, and impacts on adults with chronic respiratory conditions

Location:

- Puget Sound region, Washington

Models Used: (Not available)

Methods Used:

- The authors examined the impact of school bus emissions reductions programs on health outcomes. The authors — 1) performed a large-scale empirical assessment of the health outcomes stemming from school bus retrofit programs for Washington state districts; 2) used standard two-period difference-in-difference approach to examine differential trends in health outcomes for adopter districts and non-adopter districts over time using a regression model; and 3) combined empirical point estimates with cost-of-treatment health valuation estimates and observed retrofit costs to compute benefit-cost assessment of school bus retrofits.

Sources Used:

- Washington State Comprehensive Hospital Abstract Reporting System (CHARS); US Historical Climatology Network; Washington State Department of Ecology; Puget Sound Clean Air Agency; Washington State Department of Health; National Center of Educational Statistics; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Beatty TK and Shimshack JP. 2011. School buses, diesel emissions, and respiratory health. *Journal of Health Economics*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Meeting report: estimating the benefits of reducing hazardous air pollutants — summary of 2009 workshop and future considerations

Environmental Health Economic Analysis Annotated Bibliography

Details

Report Cost-benefit analysis (CBA)

Authors

Gwinn MR, Craig J, Axelrad DA, Cook R, Dockins C, Fann N, Fegley R, Guinnup DE, Helfand G, Hubbell B, Mazur SL, Palma T, Smith RL, Vandenberg J, and Sonawane B.

Journal

Environmental Health Perspectives

Summary

This report summarized the 2009 EPA workshop to evaluate the uncertainties and research needs for many aspects of benefits assessment of reductions in air toxics. Key recommendations provide specific steps in advancing analysis of the benefits from air toxics reductions and suggest some future studies to inform many of the challenges in this field.

Population

Not available

Health Outcomes

- Cancer outcomes
- other serious health outcomes

Environmental Agents

List of Environmental Agents:

- Air pollutants (acrolein)
- other organic compounds (toluene/xylene, benzene/ethyl benzene)
- metals (lead)

Source of Environmental Agents:

- Stationary industrial facilities
- automobiles

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Present value of lifetime loss in earnings per IQ point lost

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used: (Not available)

Sources Used:

- National Ambient Air Quality Standards (NAAQS) (US EPA); National Health and Nutrition Examination Survey (NHANES) (CDC); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Gwinn MR, Craig J, Axelrad DA, Cook R, Dockins C, Fann N, Fegley R, Guinnup DE, Helfand G, Hubbell B, Mazur SL, Palma T, Smith RL, Vandenberg J, and Sonawane B.. 2011. Meeting report: estimating the benefits of reducing hazardous air pollutants — summary of 2009 workshop and future considerations. Environmental Health Perspectives.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Economic value of home-based, multi-trigger, multicomponent interventions with an environmental focus for reducing asthma morbidity a community guide systematic review

Environmental Health Economic Analysis Annotated Bibliography

Details

Review (systematic) Cost-benefit analysis (CBA), Cost-effectiveness analysis (CEA)

Authors

Nurmagambetov TA, Barnett SB, Jacob V, Chattopadhyay SK, Hopkins DP, Crocker DD, Dumitru GG, Kinyota S, and Task Force on Community Preventive Services

Journal

American Journal of Preventive Medicine

Summary

This systematic review identified the effectiveness and economic value of home-based interventions to reduce childhood asthma morbidity. The researchers found that the benefits of interventions with an environmental focus can match or even exceed program costs. Results of this review showed that home-based programs can provide a good value for dollars spent on the interventions.

Population

Nine studies included children and adolescents (< 19 years) with asthma; three studies included participants of all ages with asthma

Health Outcomes

- Reviewed publications that examined — respiratory outcomes (asthma)

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — air pollutants
- indoor allergens

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)
- Cost-effectiveness analysis (CEA)

Cost Measured:

- Reviewed publications that examined program costs (costs of resources required to implement intervention) which varied based on the following factors — home visitor type (e.g., nurse, sanitarian), number of home visits, remediation type (e.g., allergen impermeable pillow covers/mattresses, installation of air filters/dehumidifiers, pest management, repairs), and education content

Potential Cost Measures: (Not available)

Benefits Measures:

- Reviewed publications that examined benefits such as — symptom free asthma days
- averted healthcare utilization
- averted missed school and work days due to illness
- averted productivity losses

Potential Benefits:

- Reduction of indirect costs such as costs related to quality of life and pain/suffering for asthma patients and caregivers

Location:

- Eleven studies in the United States
- two studies in the United Kingdom

Models Used: (Not available)

Methods Used:

- The authors systematically assessed the economic efficiency of home-based, multi-trigger, multi-component interventions with an environmental focus to improve asthma-related morbidity outcomes. The authors — 1) conducted a systematic literature review to retrieve relevant studies; 2) vetted the results using inclusion/exclusion criteria; and 3) analyzed program costs and changes in symptom free days.

Sources Used:

- The Watcombe Housing Study: the short term effect of improving housing conditions on the health of residents (Barton et al., 2007); Housing and health: does installing heating in their homes improve the health of children with asthma? (Somerville et al., 2000); Home environmental intervention in inner-city asthma: a randomized controlled clinical trial (Eggleston, 2005); Reducing environmental triggers of asthma in homes of Minnesota children (Oatman, 2007); The effect of pediatric asthma management program provided by respiratory therapists on patient outcomes and cost (Shelledy, 2005); An evaluation of the asthma intervention of the New York State Healthy Neighborhoods Program (Lin et al., 2004); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Nurmagambetov TA, Barnett SB, Jacob V, Chattopadhyay SK, Hopkins DP, Crocker DD, Dumitru GG, Kinyota S, and Task Force on Community Preventive Services. 2011. Economic value of home-based, multi-trigger, multicomponent interventions with an environmental focus for reducing asthma morbidity a community guide systematic review. American Journal of Preventive Medicine.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Economics of children's environmental health

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost analysis (CA), Cost-benefit analysis (CBA), Cost-effectiveness analysis (CEA)

Authors

Trasande L

Journal

The Mount Sinai Journal of Medicine

Summary

This review article presented a selection of articles that used cost analyses, cost-effectiveness analyses, and cost-benefit analyses, and compared the relative merits of each approach as they apply to children's environmental health. The authors concluded that economic analyses in children's environmental health are highly important to inform public-health policy, and further attention and training in their appropriate use are needed.

Population

Children

Health Outcomes

- Reviewed publications that examined — respiratory outcomes (asthma)
- metabolic outcomes (obesity)
- neurodevelopmental outcomes (mental retardation)

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — metals (lead, methyl mercury)

Source of Environmental Agents:

- Reviewed publications that examined — lead in gasoline
- lead in paint
- mercury from coal-fired power plants

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)
- Cost-benefit analysis (CBA)
- Cost-effectiveness analysis (CEA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Reviewed publications that examined costs related to the following — healthcare expenses
- hospitalizations
- prescription drugs
- outpatient visits and emergency room visits
- lost economic productivity
- QALYs lost
- cost of implementing interventions

Potential Cost Measures: (Not available)

Benefits Measures:

- Reviewed publications that assessed benefits of reducing children's exposure to environmental agents, such as — quality adjusted life years (QALYs) or disability adjusted life years (DALYs) saved/gained
- savings in healthcare expenses and educational costs
- increased economic productivity
- reduced incidence/prevention of illness (e.g., obesity, childhood lead poisoning, mental retardation)

Potential Benefits: (Not available)

Location: (Not available)

Models Used:

- Review described the environmentally attributable fraction (EAF) model

Methods Used:

- This review article compared three types of economic evaluations, described the strengths and weaknesses, and provided examples of each. The authors discussed data sources commonly used in economic health analyses and methodological gaps and issues.

Sources Used:

- Authors recommended several data sources for conducting environmental health economic analyses, such as — NHANES (to quantify environmental exposures); National Health Interview Survey (for disease prevalence and incidence attributable to environmental exposures); Nationwide Inpatient Sample or National Hospital Discharge Survey (to quantify hospitalizations); Nationwide Emergency Department Sample or the National Hospital Ambulatory Medical Care Survey (to quantify emergency room visits); National Ambulatory Medical Care Survey or the Medical Expenditure Panel Survey (to quantify outpatient utilization)

Economic Evaluation / Methods and Source

Citation:

- Trasande L. 2011. Economics of children's environmental health. The Mount Sinai Journal of Medicine.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Reducing the staggering costs of environmental disease in children, estimated at \$76.6 billion in 2008

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Trasande L and Liu Y

Journal

Health Affairs

Summary

This cost analysis found that diseases of environmental origin in US children cost \$76.6 billion in 2008. The authors concluded that to prevent further increases in these costs, efforts are needed to institute premarket testing of new chemicals, conduct toxicity testing on chemicals already in use, reduce lead-based paint hazards, and curb mercury emissions from coal-fired power plants.

Population

Children

Health Outcomes

- Cancer outcomes (childhood cancer)
- respiratory outcomes (asthma)
- neurological/cognitive outcomes (intellectual disability, autism, ADHD, developmental disabilities)
- lead poisoning
- methyl mercury toxicity

Environmental Agents

List of Environmental Agents:

- Environmental pollutants ("chemical substances of human origin in air, food water, and communities")
- metals (lead, methyl mercury)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Medical care costs for lead poisoning
- lost economic productivity due to reduced cognitive ability from lead exposure and methyl mercury toxicity
- intellectual disability costs
- autism costs
- ADHD costs
- economic costs of developmental disabilities
- medical costs of asthma
- work days lost caring for child with asthma
- medical costs for children with malignancies (inpatient emergency room costs, prescription drug costs, outpatient costs)

Potential Cost Measures:

- Medical costs of obesity due to exposure to endocrine-disrupting chemicals
- cardiovascular risks due to perinatal exposure to methyl mercury
- criminal activity due to childhood lead exposure

Benefits Measures: (Not available)

Potential Benefits:

- Economic savings achieved by preventing methyl mercury contamination of fish

Location: (Not available)

Models Used:

- Environmentally Attributable Fraction (EAF) model

Methods Used:

- To update and expand a previous analysis of the costs of environmental disease in children, the study authors multiplied the environmentally attributable fraction by the prevalence or incidence of each condition examined, the population at risk, and the cost per case.

Sources Used:

- US Census Bureau (2008); National Survey of Children's Health (2007-2008); National Health and Nutrition Examination Survey (1999-2004); Medical Expenditure Panel Surveys; Nationwide Inpatient Sample; Nationwide Emergency Department Survey; National Hospital Ambulatory Medical Care Survey; Medical Care Consumer Price Index; National Vital Statistics Reports (2007); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Trasande L and Liu Y. 2011. Reducing the staggering costs of environmental disease in children, estimated at \$76.6 billion in 2008. Health Affairs.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Cost of developmental delay from prenatal exposure to airborne polycyclic aromatic hydrocarbons

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Weiland K, Neidell M, Rauh V, and Perera F

Journal

Journal of Health Care for the Poor and Underserved

Summary

The cost of preschool special education for children with PAH-related cognitive developmental delay was estimated to be over \$13.7 million per birth cohort in New York City, according to this cost analysis. These findings support the role of policies aimed at reducing the level of PAHs in air in order to reduce the health impacts associated with PAH exposure.

Population

Low-income, preschool children in NYC

Health Outcomes

- Neurological/cognitive outcomes (developmental delay)

Environmental Agents

List of Environmental Agents:

- Air pollutants (polycyclic aromatic hydrocarbons (PAH))

Source of Environmental Agents:

- Combustion of fossil fuels and other organic materials

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Annual costs of preschool special education services

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Environmental Health Economic Analysis Annotated Bibliography

Location:

- New York City

Models Used:

- Environmentally Attributable Fraction (EAF) model

Methods Used:

- Researchers used results from CCCEH NYC cohort (low-income women/children in NYC) to compute the rate of developmental delay due to PAH exposure for the NYC Medicaid population. The authors — 1) employed the environmentally attributable fraction method to calculate the costs of developmental delay due to prenatal exposure to PAHs; and 2) estimated the annual costs of PAH-related preschool education services by multiplying the rate of developmental delay by the size of the population at risk from exposure to PAH and the cost per case for preschool education.

Sources Used:

- Effect of prenatal exposure to airborne polycyclic aromatic hydrocarbons on neurodevelopment in the first 3 years of life among inner-city children (Perera et al., 2006); Early childhood outcomes data (New York State Education Department, 2007); New York City Medicaid data (2000); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Weiland K, Neidell M, Rauh V, and Perera F. 2011. Cost of developmental delay from prenatal exposure to airborne polycyclic aromatic hydrocarbons. *Journal of Health Care for the Poor and Underserved*.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Air pollution, health and economic benefits - lessons from 20 years of analysis

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost-benefit analysis (CBA)

Authors

Hall JV, Brajer V, and Lurmann FW

Journal

Ecological Economics

Summary

The authors compared two large-scale air quality benefit assessments that were completed for California's South Coast Air Basin in 1989 and 2008. The authors concluded that there were dramatic improvements in air quality, and dramatic reductions in population exposures to particulate matter and ozone between the two time periods. The authors highlighted the continually evolving health literature, and in contrast, fairly constant real economic unit values assigned to adverse health outcomes.

Population

Adults (18-64 years)

Health Outcomes

- Reviewed publications that examined premature mortality

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — air pollutants (particulate matter (PM10/coarse and PM2.5/fine), ozone)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Reviewed publications that examined costs related to air quality, including — PM-related premature death/mortality (measured using value of a statistical life (VSL))
- ozone-related minor restrictions in activity days (MRADS)

Potential Cost Measures:

- Costs of asthma-related ER visits
- respiratory hospital admissions
- cardiopulmonary hospital admissions
- cardiovascular outcomes
- work days lost

Benefits Measures:

- Reviewed publications that examined benefits of improving air quality, including — reduced incidence of premature mortality
- reduced/averted number of minor restricted activity days
- improved air quality

Potential Benefits: (Not available)

Location:

- South Coast Air Basin in California, USA

Models Used:

- Regional Human Exposure Model (REHEX)
- linear rollback model

Methods Used:

- The authors reviewed and compared two large-scale air quality benefit assessments completed for California's South Coast Air Basin for two different periods, 1989 and 2008. To determine which factors explain the differences in the two air quality assessments, the authors — 1) used an integrated approach to calculate reductions in adverse health outcomes by linking the severity of pollutant exposure of the affected population to the resulting health outcomes; and 2) assigned dollar values to each adverse health outcome/endpoint based on value of a statistical life (VSL).

Sources Used:

- Economic assessment of the health benefits from improvements in air quality in the South Coast Air Basin (Hall et al., 1989); The benefits of meeting federal clean air standards in the South Coast and San Joaquin Air Basins (Hall et al., 2008); Cross-sectional mortality studies and air pollution risk assessment (Evans et al., 1984); Air pollution and morbidity revisited: a specification test (Ostro, 1987); Spatial analysis of air pollution and mortality in Los Angeles (Jerrett et al., 2005); Lung cancer, cardiopulmonary mortality: a further analysis of the Los Angeles student nurses data (Pope et al., 2002); Urban air quality and acute respiratory illness (Portney and Mullahy, 1986); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Hall JV, Brajer V, and Lurmann FW. 2010. Air pollution, health and economic benefits - lessons from 20 years of analysis. Ecological Economics.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

The economic cost of adverse health effects from wildfire-smoke exposure: a review

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost analysis (CA)

Authors

Kochi I, Donovan GH, Champ PA, and Loomis JB

Journal

International Journal of Wildland Fire

Summary

The economic costs of the adverse health impacts associated with wildfire smoke are discussed in this review article. The authors determined that there is a need for better understanding of the association between wildfire smoke and major/minor adverse health outcomes and suggested that quantifying the health-related costs of wildfire-smoke exposure will be an important consideration for wildfire management policy.

Population

Not available

Health Outcomes

- Reviewed publications that examined — morbidity/mortality (premature mortality)
- cardiovascular outcomes (heart failure)
- respiratory outcomes (acute bronchitis, asthma, chronic obstructive pulmonary disease, pneumonia)

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — air pollutants (particulate matter)

Source of Environmental Agents:

- Reviewed publications that examined wildfire smoke

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Reviewed publications that examined economic costs associated with wild-fire smoke exposure, including — healthcare costs (hospital admissions inpatient/outpatient visits,

Environmental Health Economic Analysis Annotated Bibliography

- emergency department visits)
- costs of premature mortality
- number of excess deaths
- morbidity related costs (work days lost, restricted-activity days, minor restricted-activity days)
- self-treatment costs
- other overall costs reviewed included those that were estimated using the willingness to pay (WTP) and cost of illness (COI) method (medical costs, labor loss, averting costs, and utility loss)

Potential Cost Measures:

- Costs of relocating susceptible individuals from smoke-affected areas

Benefits Measures: (Not available)

Potential Benefits:

- The authors mention "prescribed burning" as a technique that would lead to reduction in health costs related to wildfires, reduction in fuel loads, reduction in future PM emissions

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors reviewed and synthesized relevant literature related to health and economic costs of wildfire-smoke exposure. The authors focused on the following — 1) if wildfire-specific epidemiology studies found significant health effects associated with wildfire-smoke exposure; and 2) if the findings in wildfire-specific epidemiology studies are consistent with the findings in conventional PM studies. They then outlined potential reasons/causes for differences in observed health effects from conventional PM and wildfire smoke studies.

Sources Used:

- The economic costs of the use of fire in the Amazon (Cardoso de Mendonca et al., 2004); Indonesia's fires and haze — the cost of catastrophe (Shahwahid and Othman 1999); Smoke episodes emissions characterization and assessment of health risks related to downwind air quality - case study, Thailand (Phonboon et al., 1999); Acute exacerbations of asthma and bushfires (Cooper et al., 1994); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Kochi I, Donovan GH, Champ PA, and Loomis JB. 2010. The economic cost of adverse health effects from wildfire-smoke exposure: a review. International Journal of Wildland Fire.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Cost analysis of impacts of climate change on regional air quality

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Liao KJ, Tagaris E, Russell AG, Amar P, He S, Manomaiphiboon K, and Woo JH

Journal

Journal of the Air & Waste Management Association

Summary

Using a regional air quality model and a technology analysis tool, this cost-benefit analysis assessed the additional emission reductions required and associated costs to offset impacts of climate change on air quality. Overall, an annual cost of \$9.3 billion was estimated for offsetting climate change impacts on air quality in the regions examined. Results suggested that additional emission controls and associated costs for offsetting climate impacts should be considered in developing control strategies for achieving air quality targets in the future.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone, particulate matter (PM_{2.5}/fine))

Source of Environmental Agents:

- Anthropogenic emissions of precursor air pollutants (SO₂, NO_x, VOCs)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Costs of anthropogenic precursor emissions reductions
- costs of offsetting impacts on climate change
- annualized capital costs (calculated by taking into account interest rates, lifetime of the

Environmental Health Economic Analysis Annotated Bibliography

emission control equipment, and capital recovery factors)

- yearly operation and maintenance costs
- implementation costs

Potential Cost Measures:

- Control costs for reductions in primary PM2.5
- interstate transport of precursors

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Six regions of the United States (West region, Central region, Great Lakes region, Northeast region, Mid-Atlantic region, and Southeast region)
- five metropolitan cities within the United States (Atlanta, Chicago, Houston, Los Angeles, New York City)

Models Used:

- The U.S. EPA's Models-3 Air Quality Modeling System—Fifth-Generation NCAR/Penn State Mesoscale Model (MM5)
- Sparse Matrix Operator Kernel Emissions (SMOKE)
- Community Multiscale Air Quality Model (CMAQ)

Methods Used:

- The authors assessed the additional emissions reductions required and associated costs to offset impacts of climate change on air quality. The authors — 1) implemented air quality modeling using current and future emissions scenarios for five metropolitan areas that experience high ozone and PM2.5 levels; and 2) used EPA's control technology analysis tool (AirControlNET) to estimate the costs of emissions reductions of major ozone and PM2.5 precursors.

Sources Used:

- AirControlNET Version 4.1 Documentation Report (E.H. Pechan and Associates, 2006); National Emission Inventory (NEI) (1999); The decoupled direct method for calculating sensitivity coefficients in chemical-kinetics (Dunker, 1984); The decoupled direct method for sensitivity analysis in a three-dimensional air quality model - implementation, accuracy, and efficiency (Dunker et al., 2002); Fast, direct sensitivity analysis of multidimensional photochemical models (Yang et al., 1997); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Liao KJ, Tagaris E, Russell AG, Amar P, He S, Manomaiphiboon K, and Woo JH. 2010. Cost analysis of impacts of climate change on regional air quality. Journal of the Air & Waste Management Association.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Estimates of costs for housing-related interventions to prevent specific illnesses and deaths

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost analysis (CA), Cost-effectiveness analysis (CEA), Cost-benefit analysis (CBA), Cost-utility analysis (CUA)

Authors

Mason J and Brown MJ

Journal

Journal of Public Health Management and Practice

Summary

An overview of economic analyses of housing-related interventions to address asthma, lead poisoning, carbon monoxide poisoning, and radon-related lung cancer was discussed in this review article. The authors stated that understanding both the strengths and limitations of economic evaluations will help decision makers interpret findings appropriately and make informed decisions about how best to allocate limited resources.

Population

Not available

Health Outcomes

- Reviewed publications that examined — respiratory outcomes (asthma)
- cancer outcomes (lung cancer)

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — metals (lead)
- air pollutants (carbon monoxide (CO))
- allergens/irritants
- ionizing radiation (radon gas)

Source of Environmental Agents:

- Reviewed publications that examined — home/residential exposures

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)
- Cost-effectiveness analysis (CEA)
- Cost-benefit analysis (CBA)

Environmental Health Economic Analysis Annotated Bibliography

- Cost-utility analysis (CUA)

Cost Measured:

- Reviewed publications that examined costs related to the following — asthma-related medical/healthcare costs
- missed school days
- productivity losses
- lost lifetime earnings due to premature death
- costs related to environmental/residential exposures to mold/dampness
- costs for medications associated with comorbidities of asthma (e.g., allergic rhinitis)
- costs for asthma-related housing interventions (e.g., home-based interventions, integrated pest management, and reducing exposure to pesticides and allergens)
- lead-poisoning costs (e.g., productivity losses)
- costs related to radon exposure in homes/remediation (e.g., costs of lung cancer, radon mitigation costs, and costs for making new radon-resistant home)

Potential Cost Measures:

- Economic costs and burden of common housing-related injuries
- direct medical costs of lead exposure in homes
- costs associated with the effects of in utero lead exposure (reduced gestational age or lower birth weight) or certain adult adverse outcomes (increases in blood pressure and cardiovascular disease)
- CO poisoning-related fatality costs
- morbidity costs related to CO residential exposure
- costs of CO exposure home interventions (e.g. CO detectors)

Benefits Measures:

- Reviewed publications that examined the following benefits — societal benefits from reduced lead exposures related to productivity gains
- savings in energy costs and higher market values
- benefits of preventing premature death caused by radon-induced lung cancer

Potential Benefits:

- Reduction in costs for ADHD, juvenile delinquency, criminal behavior, and special education as they are associated with lead exposures in young children
- healthcare costs due to extended life expectancy
- delayed lung cancer onset and prevention of nonfatal lung cancer
- benefits to future generations that live in radon high-risk areas

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors performed a review of economic articles on housing interventions, examined salient differences between studies, and discussed pertinent gaps in the literature. They provided an overview of key economic evaluation methods in relation to housing interventions pertaining to housing-related health issues/illness such as asthma, lead, carbon-monoxide poisoning and radon-related lung cancer.

Sources Used:

- Direct and indirect costs of asthma in school-age children (Wang et al., 2005); The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers (Krieger et al., 2005); Effectiveness of an integrated pest management intervention in controlling cockroaches, mice, and allergens in New York City public housing (Kass et al., 2009); Societal benefits of reducing lead exposure (Schwartz, 1994); Exposures to environmental toxicants and attention deficit hyperactivity disorder in US children

Environmental Health Economic Analysis Annotated Bibliography

(Braun et al., 2006); Lung cancer deaths from indoor radon and the cost effectiveness and potential of policies to reduce them (Gray et al., 2010); Consumer Price Index (US Bureau of Labor Statistics); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Mason J and Brown MJ. 2010. Estimates of costs for housing-related interventions to prevent specific illnesses and deaths. Journal of Public Health Management and Practice.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Local air pollution and global climate change: a combined cost-benefit analysis

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Bollen J, Van Der Zwaan B, Brink C, and Eerens H

Journal

Resource and Energy Economics

Summary

This paper reports the first cost-benefit analysis that combines the damages resulting from global climate change and local air pollution. The authors found that the discounted benefits of local air pollution reductions significantly outweigh those of global climate change mitigation. However, the authors called for policies that simultaneously address reducing air pollution and greenhouse gas emissions, as their combination creates an additional climate change bonus.

Population

Not available

Health Outcomes

- Mortality (premature death)

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM2.5/fine))

Source of Environmental Agents:

- Emissions from fossil fuel combustion (electricity/non-electricity sectors)
- greenhouse gas emissions
- CO2 emissions

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Costs for implementing CO2, PM, and greenhouse gas abatement/reduction options or

Environmental Health Economic Analysis Annotated Bibliography

- policies (costs of energy services and consumer goods)
- damages incurred by emissions
- number of premature local air pollution-related deaths
- years of life lost
- costs related to premature death

Potential Cost Measures:

- Costs incurred by the implementation of end-of-pipe measures or the switch from fossil fuels to the use of alternative, cleaner forms of energy

Benefits Measures:

- Net global welfare benefits generated by integrated environmental policies (focused on reduction of air pollution and climate change damages)
- avoided number of premature deaths
- avoided damages from CC and LAP

Potential Benefits: (Not available)

Location: (Not available)

Models Used:

- Modified/expanded version of the Model for Evaluating the Regional Global Effects (MERGE) model of greenhouse gas reduction policies

Methods Used:

- The authors performed a combined cost-benefit analysis of global climate change (GCC) and local air pollution (LAP) to investigate the benefits of technologies and environmental policies that simultaneously address GCC and LAP. The authors — 1) used a modified and expanded version of the MERGE model to estimate the costs and benefits from both GCC and LAP policies in a dynamic and multi-regional context; 2) used the 'Value of a Statistical Life' (VSL) and 'Value Of a Life Year lost' (VOLY) methods to value mortality incurred from PM exposure (Holland et al. 2004); and 3) used data from World Bank (2007) to estimate particulate matter concentrations across different urban and rural populations.

Sources Used:

- WHO (2002, 2004, 2006); The Regional Air Pollution Information and Simulation (RAINS) Model, Interim Report (Amann et al., 2004a); World Bank (2007); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Bollen J, Van Der Zwaan B, Brink C, and Eerens H. 2009. Local air pollution and global climate change: a combined cost-benefit analysis. Resource and Energy Economics.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

The economic cost of environmental factors among North Carolina children living in substandard housing

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Chenoweth D, Estes C, and Lee C

Journal

American Journal of Public Health

Summary

The authors of this cost analysis study determined the cost of exposure to environmental hazards for children living in substandard housing in North Carolina. The costs exceeded \$92 million in 2006 and \$108 million in 2007. These findings suggest that more aggressive policies and funding are needed to reduce the substantial financial impact of childhood illnesses associated with substandard housing in North Carolina.

Population

Children and adolescents in substandard housing (18 years)

Health Outcomes

- Neoplasms
- birth outcomes (congenital birth defects (anencephaly, cleft lip, cleft palate, cleft palate with cleft lip, heart defects, hypospadias, limb reduction, omphalocele, and spina bifida)
- lead or metal poisoning
- neurological/cognitive outcomes (autism, cerebral palsy, mental retardation)
- respiratory outcomes (acute bronchitis, asthma)

Environmental Agents

List of Environmental Agents:

- Metal (lead)
- air pollutants

Source of Environmental Agents:

- Substandard housing conditions

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Medical care treatment
- medications

Potential Cost Measures:

- School days lost
- home modifications
- developmental services
- parental and lifetime wages lost
- premature death
- IQ reduction
- lifetime earnings lost

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- North Carolina

Models Used:

- Environmentally Attributable Fraction (EAF) model within a Proportionate Risk Factor Cost Appraisal (PRFCA) framework

Methods Used:

- The authors quantified the economic cost of selected environmental factors among North Carolina children living in substandard housing. They — 1) estimated direct costs by reviewing various cost analysis approaches by other research and obtaining relevant medical claims and cost data for children with targeted medical conditions; and 2) estimated indirect costs by obtaining data from previous work and applying it to the target population.

Sources Used:

- Medical claims and cost data (Division of Medical Assistance of the North Carolina Department of Health and Human Services, 2006 and 2007); medical claims data from BlueCross BlueShield of North Carolina; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Chenoweth D, Estes C, and Lee C. 2009. The economic cost of environmental factors among North Carolina children living in substandard housing. American Journal of Public Health.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Gould E

Journal

Environmental Health Perspectives

Summary

This cost-benefit analysis of childhood lead poisoning determined that each dollar invested in lead paint hazard control resulted in a return of \$17 - \$221, or a net savings of \$181-269 billion in health care, social, and behavioral costs. Results suggested there are substantial returns to investing in lead hazard control, particularly targeted at early intervention in communities most likely at risk.

Population

Children (6 years)

Health Outcomes

- Neurological/cognitive outcomes (IQ deficits, ADHD)

Environmental Agents

List of Environmental Agents:

- Metal (lead)

Source of Environmental Agents:

- Lead-based paint in housing

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Healthcare costs of screening and treatment (e.g., venipuncture, capillary blood sampling, lead assays, risk assessments/questionnaires, nurse-only visits, physician visits, environmental investigation/hazard removal, oral chelation, and intravenous

Environmental Health Economic Analysis Annotated Bibliography

chelation)

- social/behavioral costs (e.g., criminal activity/crime costs)
- lifetime earnings
- special education costs
- costs of lead-linked ADHD cases
- tax revenue losses
- costs of preventive measures resulting from criminal action

Potential Cost Measures:

- Healthcare costs later in life
- costs related to neonatal mortality
- costs related to community improvement
- lead paint litigation
- indirect costs to criminal activity
- medical diagnostics
- costs of treatment for those with blood lead levels < 10 g/dL
- treatment costs for children who didn't receive immediate treatment for lead poisoning

Benefits Measures:

- Study estimated the benefits of reducing lead-based paint in homes (i.e., household lead-based paint hazard control) relative to the direct/indirect healthcare costs associated with lead exposure (e.g., increased IQ, higher lifetime earnings, tax revenues, reduced spending on special education, and reduced criminal activity)

Potential Benefits:

- Benefits of lead hazard control on property value and energy savings

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The author quantified the social and economic benefits to household lead paint hazard control compared with the investments needed to minimize exposure to these hazards. This research updated estimates of elevated blood lead levels among a cohort of children 6 years of age. The author — 1) compared the composition of children with blood lead levels between 2 and 10 g/dL with the demographic patterns of the entire cohort of children 6 years of age; 2) constructed an upper and lower bound cost-effectiveness of strategies to reduce lead exposure; 3) summed and compared the total benefits and costs of childhood lead level reduction; and 4) estimated the net benefit of lead-based paint hazard control in homes.

Sources Used:

- NHANES (CDC, 2003-2006); National Center for Environmental Health (CDC, 2007a); President's Task Force on Environmental Health Risks and Safety Risks to Children (2000); US Department of Housing and Urban Development (2002); US Census Bureau (2008); Federal Bureau of Investigation (2006); US Bureau of Justice Statistics (2004); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Gould E. 2009. Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control. Environmental Health Perspectives.
- [Pubmed](#)
- [DOI](#)

Environmental Health Economic Analysis Annotated Bibliography

NIEHS Funding: (Not available)

Other Funding: (Not available)

The costs of respiratory illnesses arising from Florida gulf coast *Karenia brevis* blooms

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Hoagland P, Jin D, Polansky LY, Kirkpatrick B, Kirkpatrick G, Fleming LE, Reich A, Watkins SM, Ullmann SG and Backer LC

Journal

Environmental Health Perspectives

Summary

The relationship between *Karenia brevis* algal blooms and the costs of respiratory illness-related visits to emergency departments in Sarasota County, Florida was the focus of this cost–benefit analysis. The authors found that the estimated marginal costs of illness ranged from \$0.5 to \$4 million, depending on bloom severity. Study results suggest blooms of *K. brevis* lead to significant economic impacts.

Population

Not available

Health Outcomes

- Respiratory outcomes (pneumonia, bronchitis (chronic/acute), asthma, upper airway disease)

Environmental Agents

List of Environmental Agents:

- Aerosolized toxicants (brevetoxins)

Source of Environmental Agents:

- Algal blooms of *Karenia brevis*

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Marginal medical costs of emergency department (ED) visits for respiratory ailments due to aerosolized brevetoxins

Environmental Health Economic Analysis Annotated Bibliography

- lost productivity

Potential Cost Measures:

- Other costs of illness (shellfish poisoning)
- costs for accessing primary care physicians, allergists, or pulmonologists, as well as prescriptions and over-the-counter medications
- non-market costs associated with pain and suffering

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Sarasota County, Florida

Models Used:

- Exposure-response model

Methods Used:

- The authors examined the relationship between *K. brevis* blooms and respiratory illness visits to hospital emergency departments and used this relationship to estimate the costs of illness associated with aerosolized brevetoxins. The authors — 1) developed an exposure-response model to express hypotheses about the relationship between respiratory illnesses, harmful algal blooms events, and other potential explanatory variables; 2) compiled total number of daily emergency department visits for respiratory diagnoses from October 2001 - September 2006; and 3) used in situ *K. brevis* cell counts as a proxy for aerosolized brevetoxin concentrations along the coast.

Sources Used:

- ED visits related to respiratory illness (Sarasota Memorial Hospital, 2001-2006); CDC; Sarasota Convention and Visitors Bureau; Florida Agency for Healthcare Administration; US Census Bureau (2008); National Allergy Bureau; MML Pass Weather Station (2009); World Health Organization; National Respiratory and Enteric Virus Surveillance System; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Hoagland P, Jin D, Polansky LY, Kirkpatrick B, Kirkpatrick G, Fleming LE, Reich A, Watkins SM, Ullmann SG and Backer LC. 2009. The costs of respiratory illnesses arising from Florida gulf coast *Karenia brevis* blooms. *Environmental Health Perspectives*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- P50ES12736
- P01ES010594
- P50ES012742

Other Funding: (Not available)

The social costs of childhood lead exposure in the post-lead regulation era

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA), Cost-benefit analysis (CBA)

Authors

Muennig P

Journal

Archives of Pediatrics and Adolescent Medicine

Summary

The authors estimated the benefits that might be realized if all children in the United States had a blood lead level of less than 1 g/dL. This cost–benefit analysis estimated that policy changes to reduce childhood lead exposure would amount to societal benefits of \$50,000 per child annually, and an overall savings of approximately \$1.2 trillion for US society as a whole. The authors concluded that more aggressive programs aimed at reducing childhood lead exposure may produce large social benefits.

Population

Children (6 years)

Health Outcomes

- Neurological/cognitive outcomes (IQ deficits)

Environmental Agents

List of Environmental Agents:

- Metals (lead)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)
- Cost-benefit analysis (CBA)

Cost Measured:

- IQ reduction
- reduced lifetime earnings
- crime costs
- welfare costs

Environmental Health Economic Analysis Annotated Bibliography

- healthcare costs

Potential Cost Measures:

- Costs related to teen pregnancy
- costs related to low-birth weight infants
- costs related to intergenerational transmission of poverty
- costs of child abuse and nonviolent criminal activity

Benefits Measures:

- Increase in high school graduation rates
- quality adjusted life years (QALYs) gained
- increase in lifetime earnings
- reduction in administrative overhead for welfare costs
- reduction in mortality
- reduction in social costs of crime

Potential Benefits: (Not available)

Location: (Not available)

Models Used:

- Markov Model
- mortality models
- Health-Related Quality of Life (HRQL) models

Methods Used:

- The authors — 1) obtained data from published and electronic sources; 2) utilized a Markov model to project lifetime earnings, reduced crime costs, improvements in health, and reduced welfare costs; and 3) selected model inputs using a "levels of evidence" approach with inputs derived from randomized controlled trials given the highest priority.

Sources Used:

- NHANES (1999-2006); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Muennig P. 2009. The social costs of childhood lead exposure in the post-lead regulation era. Archives of Pediatrics and Adolescent Medicine.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

The economic impact of exposure to secondhand smoke in Minnesota

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Waters HR, Foldes SS, Alesci NL and Samet J

Journal

American Journal of Public Health

Summary

This cost analysis study estimated the prevalence and costs of treated medical conditions related to secondhand smoke exposure (e.g., lung cancer and coronary heart disease) in Minnesota and found that the total annual cost of treatment was \$228.7 million. The results presented a strong rationale for regulating smoking in public places and were used to support the passage of Minnesota's Freedom to Breathe Act of 2007.

Population

Nonsmokers — children and adolescents (17 years); adults (18 years +)

Health Outcomes

- Birth outcomes (low birth weight)
- respiratory outcomes (acute lower respiratory illnesses, asthma)
- ear infection
- cancer outcomes (lung cancer)
- cardiovascular outcomes (coronary heart disease)

Environmental Agents

List of Environmental Agents:

- Air pollutants (tobacco smoke)

Source of Environmental Agents:

- Cigarette smoke (secondhand)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Costs related to professional services

Environmental Health Economic Analysis Annotated Bibliography

- inpatient/outpatient hospital services
- laboratory, radiology, and pathology services
- costs of prescribed pharmaceuticals for all assessed outcomes

Potential Cost Measures:

- Medical costs related to sub conditions such as "cough, phlegm, wheeze, and breathlessness among schoolchildren" and "lower level of lung function during childhood" were excluded because they could not be clearly mapped to coded medical conditions with administrative claims data. Medical costs related to SIDS were excluded because the condition leads to immediate mortality instead of treatment. Investigators also excluded costs associated with health conditions the surgeon general identified as having a "suggestive but not sufficient" causal link with exposure to secondhand smoke.

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Minnesota

Models Used:

- Population Attributable Risk (PAR) equation
- Episode Treatment Group methodology (ETG codes)

Methods Used:

- The authors estimated medical treatment costs related to exposure to secondhand tobacco smoke (SHS) in the state of Minnesota. To generate prevalence and cost estimates, the authors — 1) identified health conditions caused by secondhand smoke exposure; 2) determined the prevalence for each condition for Blue Cross members; 3) adjusted the treated prevalence to the state level; 4) determined the number of episodes attributable to secondhand smoke; and 5) determined the cost per episode. The authors used Episode Treatment Group (ETG) codes, applied to administrative claims data from Blue Cross, to identify individuals with an episode, and the average cost per episode, for each of the assessed health conditions for the year 2003.

Sources Used:

- Administrative claims data (Blue Cross Blue Shield of Minnesota); The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General (2006); Current Population Survey (Bureau of Labor Statistics, 2004); Health Insurance Coverage in Minnesota: Trends from 2001-2004 (Minnesota Health Access Survey, 2006); Minnesota Department of Health (2006); Agency for Health Care Research and Quality Procedures in US Hospitals (2003); Minnesota Department of Human Services; Medicare Chart Book (2006); American Cancer Society (2006); Medical Expenditure Panel Survey (MEPS) (2003); US Consumer Price Index for Medical Services (US Department of Labor, 2006); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Waters HR, Foldes SS, Alesci NL and Samet J. 2009. The economic impact of exposure to secondhand smoke in Minnesota. American Journal of Public Health.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Outcomes of a home-based environmental remediation for urban children with asthma

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Bryant-Stephens T and Li Y

Journal

Journal of the National Medical Association

Summary

This study examined the effectiveness of a home-based intervention for reducing environmental asthma triggers, and determined that children experienced fewer asthma-related hospitalizations, emergency room visits, sick visits, and asthma symptoms with the intervention. Study findings suggested that low-cost in-home education and environmental remediation may improve outcomes for asthmatic children, and that lay educators can deliver effective asthma-specific education that results in improved asthma control.

Population

Children and adolescents living in urban areas (2-16 years)

Health Outcomes

- Respiratory outcomes (asthma, asthma symptoms (nighttime/daytime wheezing and coughing))

Environmental Agents

List of Environmental Agents:

- Indoor allergens (cockroach, dust mite)
- air pollutants (tobacco smoke)

Source of Environmental Agents:

- Allergens from pests (cockroaches, rodents)
- cigarette smoke (secondhand smoke)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Asthma-related inpatient hospitalizations (length of hospital stays)
- number of emergency visits related to asthma
- number of sick visits related to asthma
- cost for environmental asthma trigger intervention
- salary for home visitor

Potential Cost Measures: (Not available)

Benefits Measures:

- Reduction in number of inpatient hospitalizations/visits
- reduction in number of asthma-related emergency department visits and sick visits
- reduction in frequency of daytime/nighttime asthma symptoms (wheezing, coughing, etc.)
- reduced reliance on asthma medications (beta-agonists and controller medicines (e.g., albuterol))

Potential Benefits: (Not available)

Location:

- Philadelphia, Pennsylvania

Models Used: (Not available)

Methods Used:

- The authors used a prospective, randomized controlled trial design to study the effectiveness of a low-cost asthma intervention using lay educators to promote control of asthma triggers in the bedrooms of children with asthma. The authors — 1) enrolled patients in the study who received primary care at The Children's Hospital of Philadelphia between 1999 and 2002; 2) randomly assigned patients to either the observation only (OBS) group or the home visitor education and environmental intervention (HVE) group; 3) delivered in-home education visits which covered asthma physiology, asthma trigger avoidance and asthma management and conducted environmental remediation with the caregiver; and 4) monitored groups for 12 months.

Sources Used:

- The authors collected the data used for the study described in this publication. No other existing datasets were used.

Economic Evaluation / Methods and Source

Citation:

- Bryant-Stephens T and Li Y. 2008. Outcomes of a home-based environmental remediation for urban children with asthma. Journal of the National Medical Association.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Economic evaluation of the US Environmental Protection Agency's SunWise Program: sun protection education for young children

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-effectiveness analysis (CEA), Cost-benefit analysis (CBA)

Authors

Kyle JW, Hammitt JK, Lim HW, Geller AC, Hall-Jordan LH, Maibach EW, De Fabo EC, and Wagner MC

Journal

Pediatrics

Summary

This cost-benefit and cost-effectiveness analysis examined the costs, effectiveness, and benefits of the EPA's SunWise program. The researchers estimated that for every dollar invested in the program, \$2 to 4 are potentially saved in medical costs and productivity losses. The findings suggested that it is worthwhile to educate children about sun safety and that small to modest behavioral impacts may result in significant reductions in skin cancer incidence and mortality.

Population

Children and adolescents (5-15 years)

Health Outcomes

- Cancer outcomes (skin cancer, basal cell carcinoma, squamous cell carcinoma, cutaneous malignant melanoma)
- premature death

Environmental Agents

List of Environmental Agents:

- Non-ionizing radiation (UV)

Source of Environmental Agents:

- Sunlight

Economic Evaluation / Methods and Source

Type:

- Cost-effectiveness analysis (CEA)

Environmental Health Economic Analysis Annotated Bibliography

- Cost-benefit analysis (CBA)

Cost Measured:

- Skin cancer cases
- program implementation costs (including the funding amount of the program)

Potential Cost Measures:

- Private costs
- cost of teachers' time spent on SunWise
- community programs or parent influence

Benefits Measures:

- Averted premature deaths
- averted skin cancer cases
- quality adjusted life years (QALYs) saved
- return per dollar spent
- costs averted (equal to the cases averted multiplied by medical and productivity loss cost per case)
- medical care and productivity costs averted

Potential Benefits:

- Impacts of other program components (i.e., SunWise Cities/Communities Program)
- change in impact if students receive SunWise lessons more than once

Location: (Not available)

Models Used:

- Atmospheric and Health Effects Framework Model (AHEF)

Methods Used:

- The authors used standard cost/benefit and cost-effectiveness analysis methods to assess the health and economic benefits of the EPA's SunWise School Program. The authors — 1) measured intervention costs as program costs estimated to be incurred by the US government using three funding scenarios; 2) measured health outcomes as skin cancer cases and premature mortalities averted and QALYs; 3) modeled health outcomes using an effectiveness evaluation of SunWise based on pretest and posttest surveys administered to students who participated in the program and the EPA's peer-reviewed Atmospheric and Health Effects Framework model; 4) measured costs averted as direct medical costs and costs of productivity losses averted as a result of SunWise; and 5) measured net benefits as the difference between costs averted and program costs.

Sources Used:

- National Human Activity Pattern Survey; US Environmental Protection Agency; US Bureau of Labor Statistics; Medicare Current Beneficiary Survey (1999–2000); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Kyle JW, Hammitt JK, Lim HW, Geller AC, Hall-Jordan LH, Maibach EW, De Fabo EC, and Wagner MC. 2008. Economic evaluation of the US Environmental Protection Agency's SunWise Program: sun protection education for young children. *Pediatrics*.
- [Pubmed](#)
- [DOI](#)

Environmental Health Economic Analysis Annotated Bibliography

NIEHS Funding: (Not available)

Other Funding: (Not available)

Monetary benefits of preventing childhood lead poisoning with lead-safe window replacement

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Nevin R, Jacobs DE, Berg M, and Cohen J

Journal

Environmental Research

Summary

The authors used a cost–benefit analysis to quantify the health benefits, costs, market value benefits, and energy savings of lead-safe window replacement and suggested that the intervention would yield net monetary benefits of at least \$67 billion and 15-25% reduction in energy costs. In addition, such a window replacement effort would reduce peak demand for electricity, carbon emissions from power plants, and associated long-term costs of climate change.

Population

Children (1-5 years)

Health Outcomes

- Neurological/cognitive outcomes (IQ deficits, ADHD)

Environmental Agents

List of Environmental Agents:

- Metals (lead)

Source of Environmental Agents:

- Lead-based paint in old windows/window panes

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Cost of lead-safe window replacement

Potential Cost Measures:

Environmental Health Economic Analysis Annotated Bibliography

- Lead paint litigation
- special property maintenance
- stress on parents
- premature mortality/memory loss from lead exposure in childhood
- treatment of dental caries associated with lead exposure
- hearing loss
- liver, kidney and other diseases associated with lead exposure

Benefits Measures:

- Lifetime earnings

Potential Benefits:

- Benefits of avoided healthcare costs associated with neurobehavioral/developmental outcomes (e.g., ADHD, mental retardation)
- benefits of other avoided medical costs of childhood lead exposure (e.g., chelation, follow-up, monitoring, physician visits, etc.)
- benefits of avoided special education
- housing market value benefits
- energy savings (e.g., reduction in peak demand for electricity, carbon emissions from power plants, long-term costs of climate change)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors quantified health benefits, costs, market value benefits, energy savings, and net economic benefits of lead-safe window replacement. The authors — 1) estimated trends in preschool blood lead and blood lead reduction from window replacement from NHANES and NSLAH data; 2) calculated lifetime earnings and other benefits from lead-safe window replacement per resident child in housing units; and 3) calculated lead-safe window replacement costs and energy savings from US Department of Housing and Urban Development data.

Sources Used:

- US EPA (1986, 2003); US Department of Housing and Urban development (1999); NHANES (1999-2002); National Survey of Lead and Allergens in Housing (NSLAH, 1999-2000); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Nevin R, Jacobs DE, Berg M, and Cohen J. 2008. Monetary benefits of preventing childhood lead poisoning with lead-safe window replacement. Environmental Research.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Smoke-free legislation and hospitalizations for acute coronary syndrome

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Pell JP, Haw S, Cobbe S, Newby DE, Pell AC, Fischbacher C, McConnachie A, Pringle S, Murdoch D, Dunn F, Oldroyd K, MacIntyre P, O'Rourke B, and Borland W

Journal

New England Journal of Medicine

Summary

This cost-benefit analysis performed in Scotland, Europe found that the number of hospital admissions for acute coronary syndrome decreased 17% overall and 21% among persons who had never smoked after enactment of smoke-free legislation. Study findings supported the legal treaty for improving public health outlined in the World Health Organization's Framework Convention on Tobacco Control.

Population

Acute coronary syndrome patients — adults (men 55 years, women 65 years)

Health Outcomes

- Cardiovascular outcomes (acute coronary syndrome)

Environmental Agents

List of Environmental Agents:

- Air pollutants (tobacco smoke)

Source of Environmental Agents:

- Cigarette smoke (secondhand)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured: (Not available)

Potential Cost Measures: (Not available)

Benefits Measures:

Environmental Health Economic Analysis Annotated Bibliography

- Reduction in acute coronary syndrome
- related hospital admissions following smoke-free legislation

Potential Benefits: (Not available)

Location:

- Scotland

Models Used: (Not available)

Methods Used:

- The authors compared the number of admissions for acute coronary syndrome (ACS) before and after implementation of national legislation, overall, and according to smoking status. The authors — 1) collected data prospectively on all patients with ACS admitted to nine hospitals during the 10 months before implementation of the smoke-free legislation and during the same 10 months thereafter; 2) obtained case ascertainment for individuals with ACS by performing troponin assays for all patients admitted with chest pain; 3) obtained smoking status and exposure to secondhand smoke by self-reports and confirmed using cotinine assays; and 4) analyzed percentage reduction in the number of admissions, including subgroup analyses according to patients' sex and age group.

Sources Used:

- Acute myocardial infarction: trends in incidence 1996-2005 (NHS National Services Scotland, 2007); Hospital Episodes Statistics (Department of Health, 2007); Deaths: information and statistics (General Register for Scotland, 2007); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Pell JP, Haw S, Cobbe S, Newby DE, Pell AC, Fischbacher C, McConnachie A, Pringle S, Murdoch D, Dunn F, Oldroyd K, MacIntyre P, O'Rourke B, and Borland W. 2008. Smoke-free legislation and hospitalizations for acute coronary syndrome. *New England Journal of Medicine*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

The economic impact of clean indoor air laws

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost-benefit analysis (CBA)

Authors

Eriksen M and Chaloupka F

Journal

CA: A Cancer Journal for Clinicians

Summary

This review article presented evidence that clean indoor air laws are easily implemented, well accepted by the public, reduce nonsmoker exposure to secondhand smoke, and contribute to a reduction in overall cigarette consumption. Economic analyses indicated that clean indoor policies do not have negative economic impacts on the hospitality industry, contrary to fears raised by the tobacco industry.

Population

Not available

Health Outcomes

- Reviewed publications that examined — cancer outcomes (lung cancer, cervical cancer)
- respiratory outcomes (asthma, chronic obstructive pulmonary disease)
- otitis media
- cardiovascular outcomes (coronary heart disease)
- birth outcomes (low birth weight, sudden infant death syndrome)

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — air pollutants (tobacco smoke)

Source of Environmental Agents:

- Reviewed publications that examined — cigarette smoke

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Reviewed publications that examined the following costs — costs and impacts on business/industry revenues (e.g., employment, openings/closings)

Environmental Health Economic Analysis Annotated Bibliography

- costs and impacts on tourism (e.g., retail revenues, hotel revenues, etc.)
- impacts to gaming establishments and businesses

Potential Cost Measures: (Not available)

Benefits Measures:

- Reviewed publications that assessed benefits of clean indoor air laws, such as —
reduced medical costs
- reduced serum cotinine levels in nonsmokers
- reduced cigarette smoking
- protecting nonsmokers from exposure to tobacco smoke

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors reviewed the spread of clean indoor air laws, along with their effects on public health and the scientific evidence of the economic impact of implementation of clean indoor air laws/policies.

Sources Used:

- CDC Third National Report on Human Exposure to Environmental Chemicals (HHS, 2007); Smoke-free laws and secondhand smoke exposure in US non-smoking adults (Pickett et al., 2006); Population based smoking cessation: proceedings of a conference on what works to influence cessation in the general population (NCI, 2000); The guide to community preventive services: tobacco use prevention and control (Task Force on Community Preventive Services, 2001); The guide to community preventive services: what works to promote health? (Task Force on Community Preventive Services, 2005); The effect of ordinances requiring smoke-free restaurants on restaurant sales (Glantz and Smith, 1994); Restaurant employment before and after the New York City Smoke-Free Air Act (Hyland and Cummings, 1999); No association of smoke-free ordinances with profits from bingo and charitable games in Massachusetts (Glantz and Wilson-Loots, 2003); Society of Actuaries (2005); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Eriksen M and Chaloupka F. 2007. The economic impact of clean indoor air laws. CA: A Cancer Journal for Clinicians.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

The economic impact of attention-deficit/hyperactivity disorder in children and adolescents

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost analysis (CA)

Authors

Pelham WE, Foster EM, and Robb JA

Journal

Ambulatory Pediatrics

Summary

The economic impact of attention-deficit/hyperactivity disorder (ADHD) in childhood and adolescence was estimated to be \$14,576 per individual for an annual societal estimate of \$52.4 billion, according to this review article. The results highlighted the public health importance of ADHD, and the authors argued for expansion of and additional research on evidence-based interventions for ADHD.

Population

Children and adolescents (17 years)

Health Outcomes

- Reviewed publications that examined — neurological/cognitive outcomes (ADHD)

Environmental Agents

List of Environmental Agents: (Not available)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Reviewed publications that examined the following costs — healthcare costs (inpatient, outpatient)
- treatment costs (pharmacological treatment costs, psychosocial mental health treatment)
- educational costs (special education services)
- costs related to crime and delinquency (juvenile justice system utilization)

Potential Cost Measures:

Environmental Health Economic Analysis Annotated Bibliography

- Impacts of ADHD children on parental and family function (e.g., distress depression, substance use)
- costs associated with disability/welfare for individuals within ADHD families
- costs associated with substance abuse/use
- costs associated with risky behaviors

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors performed a review of aggregated data from recently published articles that studied the economic costs of ADHD. The authors — 1) selected thirteen studies based on their relevance to the economic costs associated with ADHD; and 2) provided a summed estimate of total ADHD costs across different sectors (e.g., health/mental health, education, crime and delinquency).

Sources Used:

- Utilization and cost of health care services for children with attention-deficit/hyperactivity disorder (Guevera et al., 2001); Use and costs of medical care for children and adolescents with and without attention-deficit/hyperactivity disorder (Leibson et al., 2001); Health care use and costs for children with attention-deficit/hyperactivity disorder — national estimates from the Medical Expenditure Panel Survey (Chan et al., 2002); The attention-deficit hyperactivity disorder paradox — 2. Phenotypic variability in prevalence and cost of comorbidity (Burd et al., 2003a,b); Medical expenditures among children with psychiatric disorders in a Medicaid population (Mandell et al., 2003); Incidence and costs of accidents among attention-deficit/hyperactivity disorder patients (Swensen et al., 2004); Cost-effectiveness of ADHD treatments — findings from the Multimodal Treatment Study of Children with ADHD (Jensen et al., 2005); Consumer Price Index (2005); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Pelham WE, Foster EM, and Robb JA. 2007. The economic impact of attention-deficit/hyperactivity disorder in children and adolescents. *Ambulatory Pediatrics*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

How much disease burden can be prevented by environmental interventions

Environmental Health Economic Analysis Annotated Bibliography

Details

Review

Authors

Prüss-Ustün A and Corvalán C

Journal

Epidemiology

Summary

This commentary described the methods and key findings from a 2006 WHO report that estimated how much of the global burden of disease can be prevented by environmental management. Findings presented within this report suggested that creating healthier environments can prevent approximately one fourth of the disease burden globally in a way that is sustainable, and supported the case that interventions for healthy environments should be an important component of any strategy to improve global public health.

Population

Not available

Health Outcomes

- Reviewed publications that examined — respiratory outcomes (chronic obstructive pulmonary disease, asthma)
- gastrointestinal outcomes (diarrheal diseases)
- cancer outcomes
- neurological/cognitive outcomes (neuropsychiatric disorders)
- cardiovascular outcomes
- musculoskeletal outcomes

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — environmental pollution
- ionizing radiation
- non-ionizing radiation (UV)

Source of Environmental Agents:

- Reviewed publications that examined — air
- water
- soil
- built environment (housing and road design)
- occupation

Economic Evaluation / Methods and Source

Type: (Not available)

Cost Measured: (Not available)

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors briefly describe the methods used in the 2006 WHO Environmental Burden of Disease report. The report — 1) enlarged the scope of previous studies to include most of the risks contained in the environment; 2) systematically reviewed diseases and injuries as to their environmental causes; 3) consulted experts to complete gaps in the evidence to obtain a more comprehensive estimate (using the attributable fraction approach/method) of the potential healthy environments to prevent disease; and 4) limited the environment to only the "reasonably modifiable environment" to improve the policy relevance of results.

Sources Used:

- World Health Report 2004—Changing History (WHO, 2004); Global Burden of Disease Estimates (WHO); Epidemic Update—December 2004 (UNAIDS, WHO, 2004); HIV/AIDS Surveillance Data Base (US Census Bureau, UNAIDS, 2004); ICD-10—International Statistical Classification of Diseases and Related Health Problems, 10th rev, vol 1 (World Health Organization, 1992); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Prüss-Ustün A and Corvalán C. 2007. How much disease burden can be prevented by environmental interventions. *Epidemiology*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Economic costs of childhood diseases and disabilities attributable to environmental contaminants in Washington state, USA

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Davies K

Journal

Ecohealth

Summary

This cost analysis estimated that the costs of childhood diseases and disabilities (asthma, cancer, lead exposure, birth defects, and neurobehavioral disorders) attributable to environmental contaminants equaled \$1.875 billion in 2004 in Washington State. This study argued for the need of an ecosystem approach to human health in which the condition of the environment, in terms of exposures to environmental contaminants, must be addressed using a systemic perspective.

Population

Children and adolescents (18 years)

Health Outcomes

- Cancer Outcomes
- respiratory outcomes (asthma)
- birth outcomes (birth defects)
- neurological/cognitive outcomes (IQ/intelligence deficits)

Environmental Agents

List of Environmental Agents:

- Air pollutants (traffic pollutants)
- metal (lead)

Source of Environmental Agents:

- Outdoor pollution
- vehicle exhaust emissions
- source of lead not available

Economic Evaluation / Methods and Source

Environmental Health Economic Analysis Annotated Bibliography

Type:

- Cost analysis (CA)

Cost Measured:

- Healthcare/medical costs such as hospital care, physician services, prescriptions, inpatient/outpatient charges, radiological services, lab services, and medical treatment
- lost school days and lost productivity
- lost parental wages
- risk of secondary cancer
- effects on IQ
- lost productivity later in life
- lifetime costs associated with decrements in IQ from lead exposure
- costs of developmental services
- cost of special education
- housekeeping expenses

Potential Cost Measures:

- Asthmatic costs due to household allergens, molds, secondhand smoke, infections or climatic conditions
- costs due to metabolic and functional birth defects

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Washington state, USA

Models Used:

- National and State Cost of Illness (COI) models
- environmentally attributable fraction (EAF) model

Methods Used:

- The author estimated the economic costs associated with childhood diseases and disabilities attributable to environmental contaminants in Washington state, USA. The author — 1) based estimates on cost of illness models that included direct healthcare costs and indirect costs; and 2) used an environmentally attributable fraction (EAF) model to quantify the proportions of each disease or disability that could reasonably be attributed to environmental contaminants.

Sources Used:

- US Census Bureau (2000); US Dept. of Labor, Bureau of Labor Statistics (1999); Centers for Disease Control & Prevention (1997 and 2000); Trust for America's Health (2001); US National Academy of Sciences Committee on Developmental Toxicology (2000); Washington State Department of Health and the Washington Asthma Initiative (2005); Washington State Cancer Registry (2004); Washington State Office of Financial Management (2004); Bureau of Economic Analysis; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Davies K. 2006. Economic costs of childhood diseases and disabilities attributable to environmental contaminants in Washington state, USA. Ecohealth.
- **Pubmed:** (Not available)
- [DOI](#)

Environmental Health Economic Analysis Annotated Bibliography

NIEHS Funding: (Not available)

Other Funding: (Not available)

Applying cost analyses to drive policy that protects children - mercury as a case study

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Trasande L, Schechter C, Haynes KA, and Landrigan PJ

Journal

Annals of the New York Academy of Science

Summary

The economic costs of adverse health effects associated with prenatal mercury/methyl mercury exposure were determined using cost analysis. The costs related to diminished intelligence was estimated to be \$8.7 billion annually, and costs of excess mental retardation cases is \$2.0 billion annually. These results suggest that more stringent mercury policy options would prevent thousands of mental retardation cases and save billions of dollars over the next 25 years.

Population

Infants (1 year)

Health Outcomes

- Neurological/cognitive outcomes (IQ deficits, mental retardation)

Environmental Agents

List of Environmental Agents:

- Metals (mercury/methyl mercury)

Source of Environmental Agents:

- Industrial mercury emissions (American coal-fired power plants)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- IQ deficits associated with prenatal mercury exposure
- economic costs associated with IQ deficits
- costs of excess mental retardation (MR) cases

Environmental Health Economic Analysis Annotated Bibliography

- cost of caring for MR children

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits:

- Policies (e.g., EPA's Clean Air Mercury Rule) will likely result in the following benefits — averted cases of mental retardation
- dollars saved/costs averted related to lost economic productivity, special education, and healthcare.

Location: (Not available)

Models Used:

- Environmentally Attributable Fraction (EAF) model
- linear dose-response model used by the National Research Council (NRC) to set reference dose for mercury exposure

Methods Used:

- The authors assessed the impact of industrial mercury emissions on children's health. Using an environmentally attributable fraction (EAF) model, the authors — 1) reviewed the adverse effects of MeHg exposure; 2) estimated the costs of the adverse effects (IQ decrements and mental retardation) and subsequently applied a further fraction to parse out the cost of anthropogenic MeHg exposure resulting from emissions of American electrical generation facilities; 3) used previously published data to obtain estimates about mercury concentrations in women of child-bearing age and mental retardation cases/prevalence in US; and 4) conducted sensitivity analysis with lower bound and upper bounds for estimating the costs to children with estimated cord blood concentrations.

Sources Used:

- NHANES (1999 - 2000); CDC National Vital Statistics System (2004); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Trasande L, Schecther C, Haynes KA, and Landrigan PJ. 2006. Applying cost analyses to drive policy that protects children - mercury as a case study. Annals of the New York Academy of Science.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding:

- P42ES07384-07S1

Other Funding: (Not available)

Economic implications of manganese neurotoxicity

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost analysis (CA)

Authors

Weiss B

Journal

NeuroToxicology

Summary

This review discussed factors to consider for monetizing the economic costs associated with declining capacities in the context of manganese-induced neurodegenerative diseases (e.g., Parkinson's disease). The author suggested that slight elevations in airborne manganese may produce a small but economically significant shift to an earlier onset of neurodegenerative diseases, such as Parkinson's disease.

Population

Not available

Health Outcomes

- Reviewed publications that examined — neurological/cognitive outcomes (Parkinson's disease, other neurodegenerative diseases (Manganism))

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — metal (manganese)

Source of Environmental Agents:

- Reviewed publications that examined — inhaled manganese (hazardous air pollutant)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Reviewed publications that examined — costs associated with Parkinson's disease, such as annual medical costs

Potential Cost Measures:

- Costs of institutionalization

Environmental Health Economic Analysis Annotated Bibliography

- costs related to remedial care and/or education
- decline in functional capacity

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The author reviewed previous literature to analyze how manganese neurotoxicity elevates Parkinson's risk and explored the influence of aging along with the economic implications of these risks.

Sources Used:

- Rate of cell death in Parkinsonism indicates active neuropathological process (McGeer et al., 1988); Ageing and Parkinson's disease: substantia nigra regional selectivity (Fearnley and Lees, 1991); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Weiss B. 2006. Economic implications of manganese neurotoxicity. NeuroToxicology.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding:

- P01ES001247
- P50ES001247
- P30ES001247

Other Funding: (Not available)

Cost-effectiveness of a home-based environmental intervention for inner-city children with asthma

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA), Cost-effectiveness analysis (CEA)

Authors

Kattan M, Stearns SC, Crain EF, Stout JW, Gergen PJ, Evans R 3rd, Visness CM, Gruchalla RS, Morgan WJ, O'Connor GT, Mastin JP, and Mitchell HE

Journal

Journal of Allergy and Clinical Immunology

Summary

The authors of this study calculated the benefits of a home-based environmental remediation for young, asthmatic children. They determined that the intervention, which cost \$1,469 per family, led to a statistically significant reduction in asthma-symptom days, unscheduled clinic visits, and use of beta-agonist inhalers. Findings indicated that the intervention is cost-effective when the aim is to reduce asthma symptom days and the associated costs.

Population

Children (6-11 years) enrolled in the Inner City Asthma Study (ICAS) with moderate-to-severe asthma

Health Outcomes

- Respiratory outcomes (asthma)

Environmental Agents

List of Environmental Agents:

- Air pollutants (tobacco smoke)
- indoor allergens (dust mite, cockroach, mold, pets, rodents)

Source of Environmental Agents:

- Allergens from pests (cockroaches, rodents)
- cigarette smoke (secondhand smoke)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)
- Cost-effectiveness analysis (CEA)

Environmental Health Economic Analysis Annotated Bibliography

Cost Measured:

- Healthcare use costs (scheduled/unscheduled medical visits, emergency department visits, inpatient hospital days, medications/pharmaceutical use)
- costs of the intervention which included skin tests, anti-allergen equipment (e.g., impermeable mattress and pillow covers, HEPA vacuum cleaner, HEPA air cleaner, vent filters)
- salary for environmental counselor
- travel costs
- pest management services

Potential Cost Measures:

- School days lost
- days on which caretaker had to change plans due to child's asthma

Benefits Measures:

- Number of asthma-symptom free days
- reduced healthcare costs

Potential Benefits:

- Reduction in health costs and asthma symptom-free days for other household members

Location:

- Cities within the United States — Boston
- New York City
- Chicago
- Dallas
- Seattle
- Tucson

Models Used: (Not available)

Methods Used:

- The authors used incremental cost-effectiveness ratios (ICER) to assess the cost-effectiveness of a home-based environmental allergen and irritant remediation intervention among inner-city children aged 6-11 years with moderate-to-severe-asthma over a two-year study period.

Sources Used:

- Inner-City Asthma Study (ICAS); National Cooperative Inner-City Asthma Study (NCICAS); Medicaid Reimbursement Survey; American Academy of Pediatrics (2001); The cost-effectiveness of an inner-city asthma intervention for children (Sullivan et al., 2002); Kids Inpatient Database (Hospital Cost and Utilization Project, 2000); Drugs for Asthma (The Medical Letter, Vol. 42, 2000); Drug Topics Red Book (2000); Update and First DataBank Price Alert (2000); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Kattan M, Stearns SC, Crain EF, Stout JW, Gergen PJ, Evans R 3rd, Visness CM, Gruchalla RS, Morgan WJ, O'Connor GT, Mastin JP, and Mitchell HE. 2005. Cost-effectiveness of a home-based environmental intervention for inner-city children with asthma. Journal of Allergy and Clinical Immunology.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

NO_x emissions from large point sources: variability in ozone production, resulting health damages and economic costs

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Mauzerall DL, Sultan B, Kim N, and Bradford DF

Journal

Atmospheric Environment

Summary

This study examined health damages (e.g., mortality and morbidity costs) of ozone produced from nitrogen oxides that are emitted by large point sources in the eastern United States. The results showed that a shift of a unit of nitrogen oxide emissions from one place or time to another could result in large changes in resulting health effects due to ozone formation and exposure. The authors called for development of a system of fees to provide emitters incentives to reduce nitrogen oxides emissions at times and in locations where health damages are greatest.

Population

Not available

Health Outcomes

- Mortality/morbidity
- respiratory outcomes (respiratory morbidity)

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone)

Source of Environmental Agents:

- Ozone produced by NO_x emitted by large, stationary point sources (power plants)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Environmental Health Economic Analysis Annotated Bibliography

Cost Measured:

- Health damages/costs as a result of ozone exposures such as mortality costs (e.g., premature death)
- respiratory morbidity costs (e.g., respiratory hospital admissions)

Potential Cost Measures: (Not available)

Benefits Measures:

- Reductions in adverse health effects as a result of beneficial regulations/cap-and-trade programs that aim to shift fixed amount of NO_x emissions from certain sources (i.e. quantities of ozone that are produced)

Potential Benefits: (Not available)

Location:

- Eastern region of the United States

Models Used:

- Comprehensive Air Quality Model with Extensions (CAMx)

Methods Used:

- The authors described a method for estimating the damages to human health due to exposure to ozone formed as result of nitrogen oxide emissions from individual large stationary sources in the eastern United States. The authors — 1) used a regional atmospheric model of the eastern United States (CAMx) to quantify the variable impact that a fixed quantity of NO_x emitted from individual sources can have on the downwind concentration of surface ozone; and 2) examined the dependence of resulting ozone-related health damages on the size of the exposed population.

Sources Used:

- The benefits and costs of the Clean Air Act (US EPA, 1997, 1999 & 2003); Meta-analysis of time-series studies of air pollution and mortality: update in relation to the use of generalized additive models (Stieb et al., 2003); Gridded Population of the World (GPW), Version 2 (CIESIN et al., 2000); CDC-NCHS (1998 & 2003); Annual Population Estimates by Age Group and Sex, Selected Years from 1990 to 2000 (US Census Bureau, 2000); Epidemiological studies of ozone exposure effects (Thurston and Ito, 1999); Consumer Price Index (US Department of Labor Bureau of Labor Statistics, 2004); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Mauzerall DL, Sultan B, Kim N, and Bradford DF. 2005. NO_x emissions from large point sources: variability in ozone production, resulting health damages and economic costs. Atmospheric Environment.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Public health and economic consequences of methyl mercury toxicity to the developing brain

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Trasande L, Landrigan PJ, and Schechter C

Journal

Environmental Health Perspectives

Summary

The cost of neurodevelopmental impacts (loss of intelligence) from methyl mercury of anthropogenic origin was estimated in this study to be \$8.7 billion annually. Of this total, \$1.3 billion each year was attributable to mercury emissions from American power plants. These data indicated an urgent need on economic grounds for regulatory intervention at the federal level to minimize mercury emissions.

Population

Infants and Children

Health Outcomes

- Neurodevelopmental outcomes (IQ deficit)

Environmental Agents

List of Environmental Agents:

- Metals (methyl mercury)

Source of Environmental Agents:

- American power plants

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Loss of earnings over lifetime due to decreased IQ

Potential Cost Measures:

- Cardiovascular impacts

Environmental Health Economic Analysis Annotated Bibliography

- costs of mercury exposure to children in the first two years of life
- other societal costs beyond decreased lifetime earnings
- non-cognitive impacts (e.g., criminality and antisocial behavior)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used:

- Environmentally Attributable Fraction (EAF) model
- linear dose-response model
- economic forecasting model

Methods Used:

- To assess the costs that may result from exposure of the developing brain to methyl mercury, the authors estimated the economic impact of anthropogenic methyl mercury exposure in the 2000 US birth cohort. The authors — 1) applied the EAF model to assess the neurodevelopmental impacts and costs due to methyl mercury exposure; 2) estimated the costs of the neurodevelopmental impacts and further parsed out the cost of anthropogenic methyl mercury exposure resulting from emissions of American electrical generation facilities; 3) conducted sensitivity analysis using a linear dose response model to set a reference dose for mercury exposure (i.e., to determine the economic costs and impact of lower/upper bounds of methyl mercury exposure on intelligence); and 4) used an economic forecasting model (Schwartz et al., 1995) that was applied to NHANES data on prevalence on mercury exposure in women of childbearing age to estimate the costs associated with IQ loss.

Sources Used:

- Benchmark dose level (BMDL) for cord blood mercury dose concentration (US EPA); Toxicological effects of methyl mercury (NRC, 2000); NHANES (1999-2000); Societal benefits of reducing lead exposure (Schwartz, 1994); American birth cohort data (CDC, 2000); National Marine Fisheries Service (2002); Global Mercury Assessment Report (UNEP, 2002); Mercury Study Report to Congress (US EPA, 1996, 2004); Locating and estimating air emissions from sources of mercury and mercury compounds (US EPA, 1997); National Emissions Inventories for Hazardous Air Pollutants (US EPA, 1999); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Trasande L, Landrigan PJ, and Schecter C. 2005. Public health and economic consequences of methyl mercury toxicity to the developing brain. *Environmental Health Perspectives*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- P42ES07384

Other Funding: (Not available)

Particulate air pollution in urban areas of Shanghai, China: health-based economic assessment

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Kan HD and Chen BH

Journal

Science of the Total Environment

Summary

This cost analysis reported the estimated total economic cost of health impacts due to particulate air pollution in urban areas of Shanghai in 2001 was approximately \$625.40 million US dollars. The results suggested that the impact of particulate air pollution on human health could be substantial in urban Shanghai in physical and economic terms.

Population

Children and adolescents (< 15 years); adults (≥ 15 years)

Health Outcomes

- Mortality/morbidity (premature death)
- cardiovascular outcomes
- respiratory outcomes (chronic/acute bronchitis, asthma)

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM 10/coarse))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Costs associated with premature death
- healthcare costs (respiratory and cardiovascular hospital admissions)
- outpatient visits (internal medicine and pediatrics)
- costs associated with restricted activity days
- costs associated with asthma attacks

Potential Cost Measures:

- Economic costs related to sub-clinical health symptoms

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Shanghai, China

Models Used: (Not available)

Methods Used:

- The authors assessed the health impact of particulate air pollution and estimated its social cost in the urban area of Shanghai. The authors — 1) used concentration-response coefficients derived from other studies to calculate the number of health outcomes attributable to particulate air pollution in urban areas of Shanghai in 2001; and 2) estimated the corresponding economic costs of the health damages based on willingness to pay (WTP), cost of illness (COI), and value of a statistical life (VOSL).

Sources Used:

- A survey on acute respiratory disease (Wang et al., 1994); The benefits and costs of the Clean Air Act 1990 to 2010, Appendix H 21–26 (US EPA, 1999); Willingness to pay for reducing the risk of death by improving air quality: a contingent valuation study in Chongqing, China (Wang et al., 2001); A sample survey and multiple factor analysis on asthma in urban districts of Shanghai (Ling et al., 1996); Shanghai Municipal Bureau of Public Health (2002); China Ministry of Health (1998); Shanghai Municipal Environmental Protection Bureau (2002); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Kan HD and Chen BH. 2004. Particulate air pollution in urban areas of Shanghai, China: health-based economic assessment. *Science of the Total Environment*.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Assessing the health benefits of air pollution reduction for children

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Wong EY, Gohlke J, Griffith WC, Farrow S, and Faustman EM

Journal

Environmental Health Perspectives

Summary

This study estimated that the inclusion of child-specific data on hospitalizations, emergency department visits, school absences and low birth weight would add \$1-2 billion to the predicted cost estimates of decreased morbidity and mortality derived from the US Clean Air Act (CAA). The results highlighted the need for environmental health policy analyses to include improved information for children's health effects.

Population

Children and adolescents (< 18 years)

Health Outcomes

- Mortality (post-neonatal mortality)
- respiratory outcomes (asthma, upper respiratory symptoms, lower respiratory symptoms, shortness of breath, chest tightness, wheeze, acute bronchitis)
- birth outcomes (low birth weight, birth defects (ventricular septal defect))

Environmental Agents

List of Environmental Agents:

- Air Pollutants (ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM10 and PM2.5))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Hospital admissions and emergency department visits

Potential Cost Measures:

Environmental Health Economic Analysis Annotated Bibliography

- Pain and suffering
- lost leisure time

Benefits Measures:

- Reduced cases of post-neonatal mortality
- reduced number of asthma hospitalizations, emergency department visits
- avoided school absences
- reduced number of low birth weight infants

Potential Benefits:

- Benefits of reduced birth defects (e.g., cardiac defects)

Location: (Not available)

Models Used:

- Fast Environmental Regulatory Evaluation Tool (FERET)

Methods Used:

- The authors utilized a meta-analysis approach to assess child-specific health impacts derived from the US Clean Air Act (CAA). The authors — 1) surveyed the peer-reviewed air pollution literature for studies focused exclusively on children or presenting results for children 18 years of age in the US; 2) included 23 original studies examining the association between a considered health effect and an air pollutant; 3) used estimated expected average changes in annual air pollutant concentrations for the entire US on a national level through 2010 based on a previous analysis of the US EPA 1990 - 2010 study (Farrow et al. 2001) to allow comparability with previous studies; 4) estimated a projected 2010 US population 18 years old; and 5) analyzed health impacts using regression coefficients from different studies of the same health outcome that were combined to form a regression coefficient specific to each end point and pollutant.

Sources Used:

- International Classification of Diseases (US DHHS 1991); US Census Bureau (2002); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Wong EY, Gohlke J, Griffith WC, Farrow S, and Faustman EM. 2004. Assessing the health benefits of air pollution reduction for children. Environmental Health Perspectives.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- 1P01ES09601

Other Funding: (Not available)

Fuels for urban transit buses: a cost-effectiveness analysis

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-effectiveness analysis (CEA)

Authors

Cohen JT, Hammitt JK, and Levy JI

Journal

Environmental Science & Technology

Summary

This cost-effectiveness analysis estimated the benefits of alternative transit fuel technologies relative to conventional diesel (CD). The authors found that compressed natural gas (CNG) provided larger health benefits than emission-controlled diesel (ECD) buses, but ECD was more cost-effective than CNG. This study is the first to compute and compare aggregate incremental costs and health benefits for bus propulsion technologies.

Population

Not available

Health Outcomes

- Mortality
- cancer outcomes
- respiratory outcomes (chronic asthma)

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone, nitrogen oxides (NO,NO₂), sulfur dioxide, diesel exhaust)

Source of Environmental Agents:

- Near and far-source exhaust and transit emissions (vehicle operation emissions or upstream emissions)

Economic Evaluation / Methods and Source

Type:

- Cost-effectiveness analysis (CEA)

Cost Measured:

- Resource costs such as vehicle procurement, infrastructure development, and operations (vehicle maintenance, facility maintenance, and fuel)

Environmental Health Economic Analysis Annotated Bibliography

- greenhouse gas emission damages
- health losses (mortality and morbidity) due to environmental exposures measured as quality adjusted life years (QALYs) or health loss estimates

Potential Cost Measures:

- Health impacts/losses due to impact of ultrafine particles
- quality of life impacts of alternative fuel technologies on noise/odor control
- safety risks
- maintenance failure costs
- health risks to those living near bus depots where diesel buses are often left running throughout the night

Benefits Measures:

- Benefits and QALYs saved by the use of alternative transit fuel technologies relative to conventional diesel

Potential Benefits:

- Benefits measures and reductions in costs related to health impacts/losses due to impact of ultrafine particles
- quality of life impacts of alternative fuel technologies on noise/odor control, maintenance, and other health risks

Location: (Not available)

Models Used:

- GREET model

Methods Used:

- The authors analyzed the costs and health benefits associated with the purchase of alternative bus propulsion technologies relative to conventional diesel (CD) engines. The authors — 1) used a series of simplifying assumptions to arrive at first-order estimates for the incremental cost-effectiveness of emission controlled diesel (ECD) and compressed natural gas (CNG) buses relative to CD engines; 2) calculated cost effectiveness using the cost-effectiveness ratio, where the numerator reflects acquisition and operating costs, and the denominator reflects health losses; 3) quantified health impacts using estimated relationships between exposure to particulate matter (PM) and ozone and QALYs lost; 4) evaluated emissions of PM, NO_x, and SO₂ considering mortality risks from primary and secondary PM exposure and mortality and chronic asthma risks from ozone exposure; 5) estimated exposures to PM and ozone using the "intake fraction" parameter; 6) estimated upstream emissions for CD and CNG using the GREET model; and 7) evaluated vehicle operation emissions generated by transit buses using the central business district (CBD) test cycle.

Sources Used:

- Intergovernmental Panel on Climate Change; Transportation Research Board; American Cancer Society (1995); National Morbidity, Mortality, and Air Pollution Study (2000); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Cohen JT, Hammitt JK, and Levy JI. 2003. Fuels for urban transit buses: a cost-effectiveness analysis. Environmental Science & Technology.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Environmental pollutants and disease in American children: estimates of morbidity, mortality, and costs for lead poisoning, asthma, cancer, and developmental disabilities

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Landrigan PJ, Schechter CB, Lipton JM, Fahs MC, and Schwartz J

Journal

Environmental Health Perspectives

Summary

This analysis estimated the economic costs associated with four categories of pediatric illness attributable to environmental factors (lead poisoning, asthma, cancer, and neurodevelopmental conditions) to be an annual total of \$54.9 billion, or 2.8 %, of total U.S. health care costs. This study represented the first comprehensive attempt to estimate the incidence, prevalence, mortality, and costs associated with pediatric disease of toxic environmental origin in the United States.

Population

Children (5 years)

Health Outcomes

- Lead poisoning
- neurobehavioral outcomes
- respiratory outcomes (asthma)
- cancer outcomes (childhood cancer)

Environmental Agents

List of Environmental Agents:

- Metals (lead)
- air pollutants (particulate matter)

Source of Environmental Agents:

- Nonbiologic air pollutants (vehicle exhaust, emissions from stationary sources)
- source not available for metal (lead) exposure

Economic Evaluation / Methods and Source

Environmental Health Economic Analysis Annotated Bibliography

Type:

- Cost analysis (CA)

Cost Measured:

- Medical/healthcare costs (hospital care/hospitalization, physician services, medications, laboratory services)
- costs of long-term care (therapy/rehabilitation)
- indirect costs (lifetime earnings, lost productivity, lost school days, premature deaths, IQ reduction, loss of parental wages)
- investigators also considered effects of cranial irradiation on IQ reduction (treatment for childhood brain cancer)

Potential Cost Measures:

- Costs related to pain, suffering and/or late complications
- costs for outcomes related to tobacco, alcohol or drug abuse

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used:

- Environmentally Attributable Fraction (EAF) model
- economic forecasting model

Methods Used:

- The authors estimated the contribution of environmental pollutants to the incidence, prevalence, mortality, and costs of pediatric disease in American children. The authors — 1) used disease-specific methodologies to estimate the costs for each type of health outcome; 2) estimated costs by calculating the environmentally attributable fraction (EAF) of each type of health outcome, multiplying by the disease rate and population size, and by the cost per case; 3) retrieved data on costs, prevalence, incidence, and morbidity for health outcomes from a variety of relevant sources; and 4) developed EAFs using a modified Delphi technique with a panel of experts.

Sources Used:

- US EPA; Asthma surveillance data (CDC, 1960-1995); Lead poisoning prevalence and blood lead levels data (CDC, 1991-1994); National Health Interview Survey (National Center for Health Statistic, 1994); SEER database (National Cancer Institute, 1995); US Census Bureau (1990-2000); US Bureau of Labor Statistics (1999); Health Care Financing Administration (1995-2000); Pediatric malignancies data (Mount Sinai Medical Center, 1992-1997); Practice Management Information Corporation (1995); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Landrigan PJ, Schechter CB, Lipton JM, Fahs MC, and Schwartz J. 2002. Environmental pollutants and disease in American children: estimates of morbidity, mortality, and costs for lead poisoning, asthma, cancer, and developmental disabilities. *Environmental Health Perspectives*.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Economic evaluation of the benefits of reducing acute cardiorespiratory morbidity associated with air pollution

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Stieb DM, De Civita P, Johnson FR, Manary MP, Anis AH, Beveridge RC, and Judek S

Journal

Environmental Health

Summary

This paper evaluated epidemiological studies estimating the costs and benefits of reducing acute cardiorespiratory morbidity associated with air pollution. The authors determined that decreases in particulate sulfate concentrations in Toronto between 1984 and 1999 resulted in annual benefits of \$1.4 million in relation to reduced emergency department visits and hospital admissions for cardiorespiratory disease. The authors described an approach to estimating the value of avoiding morbidity effects of air pollution that addressed a number of the limitations of the current literature and is applicable to future assessments of the benefits of improving air quality.

Population

Not available

Health Outcomes

- Mortality/morbidity
- cardiorespiratory disease/illness
- respiratory outcomes (asthma, chronic obstructive pulmonary disease, respiratory infections, non-specific respiratory symptoms)
- cardiovascular outcomes (congestive heart failure, cardiac dysrhythmias, myocardial infarction/angina)

Environmental Agents

List of Environmental Agents:

- Air pollutants (sulfates)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Environmental Health Economic Analysis Annotated Bibliography

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Respiratory and cardiac hospital admissions
- hospital utilization costs
- costs of physician visits, medication use, equipment and out-of-pocket expenses
- emergency department visits
- restricted activity days
- asthma symptom days
- acute respiratory symptom days
- cost of productivity losses (e.g., time lost by parents and caregivers)

Potential Cost Measures:

- Reduced work capacity

Benefits Measures:

- Benefits of reduced acute cardiorespiratory morbidity related to air pollution — reduced morbidity
- reduced pain/suffering
- reduced expenditures on mitigation of illness
- reduced risk of lost productivity
- reduced emergency department visits and hospital admissions for cardiorespiratory disease

Potential Benefits: (Not available)

Location:

- Saint John and Toronto, Canada

Models Used:

- Cost of treatment model

Methods Used:

- The authors estimated the benefits of avoiding a variety of acute cardiorespiratory morbidity outcomes related to air pollution. The authors — 1) used empirical data on the duration and severity of cardiorespiratory disease as inputs to complementary models of cost of treatment, lost productivity, and willingness to pay (WTP) to avoid acute cardiorespiratory morbidity outcomes linked to air pollution in epidemiological studies; 2) used a Monte Carlo estimation procedure to propagate uncertainty in key inputs and model parameters; and 3) illustrated application of their approach by examining the benefits associated with reduced cardiorespiratory emergency department visits and hospital admissions attributable to the decline in particulate sulfate concentrations observed in Toronto, Canada from the mid-1980s to the late 1990s.

Sources Used:

- Report of sulphur in gasoline and diesel fuels (Health and Environmental Impact Assessment Panel, 1997); Health and selected socioeconomic characteristics of the family: United States (Collins and LeClere, 1996); Sample design of the National Population Health Survey (Tambay and Catlin, 1995); Associations between ambient particulate sulfate and admissions to Ontario hospitals for cardiac and respiratory diseases (Burnett et al., 1995); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

Environmental Health Economic Analysis Annotated Bibliography

- Stieb DM, De Civita P, Johnson FR, Manary MP, Anis AH, Beveridge RC, and Judek S. 2002. Economic evaluation of the benefits of reducing acute cardiorespiratory morbidity associated with air pollution. Environmental Health.
- [Pubmed](#)
- **DOI:** (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

An economic evaluation of the environmental benefits from pesticide reduction

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Brethour C and Weersink A

Journal

Agricultural Economics

Summary

This study examined the environmental benefits of pesticide risk reduction in Ontario, Canada, and determined that the reduction in external costs associated with changes in pesticide use between 1983 and 1998 was \$188 per household and \$711 million (in US dollars) for the province as a whole. These benefits were largely due to the reduction in the levels of high and moderate-risk pesticides.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Pesticides

Source of Environmental Agents:

- Application of agricultural pesticides

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- External costs of pesticide use (low-risk, moderate-risk, and high-risk)

Potential Cost Measures: (Not available)

Benefits Measures:

Environmental Health Economic Analysis Annotated Bibliography

- Willingness to pay values for reduction in environmental risk incurred by pesticide uses
- values of the changes in environmental risks posed by pesticides

Potential Benefits: (Not available)

Location:

- Ontario, Canada

Models Used: (Not available)

Methods Used:

- The authors evaluated the value of environmental benefits associated with changes in the levels and types of pesticides applied in Ontario agriculture. They used the physical risk assessment approach (Mullen et al. 1997) with an incorporated contingent valuation survey to determine consumers' willingness to pay (CWP) for reductions in pesticide risk to different components of the environment. Using this approach, the authors — 1) identified changes in pesticide risk to the environment; and 2) examined valuation of changes in environmental risk using previous estimates of respondents willingness to pay (WTP) to reduce risk within each environmental category.

Sources Used:

- Survey data from the Ontario Ministry of Agriculture Food and Rural Affairs; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Brethour C and Weersink A. 2001. An economic evaluation of the environmental benefits from pesticide reduction. Agricultural Economics.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Societal costs of exposure to toxic substances: economic and health costs of four case studies that are candidates for environmental causation

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost analysis (CA)

Authors

Muir T and Zegarac M

Journal

Environmental Health Perspectives

Summary

This review article estimated that 10-50% of the social and economic costs of four health outcomes (diabetes, Parkinson's disease, neurodevelopmental effects, and IQ deficits) are environmentally induced. The authors concluded that accounting for the economic and social costs can contribute to a better understanding of the real scope of the many issues raised by polluted environments.

Population

Not available

Health Outcomes

- Reviewed publications that examined — metabolic outcomes (diabetes)
- neurological/cognitive outcomes (Parkinson's disease, IQ deficits, ADHD, autism)
- hypothyroidism

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined persistent toxic substances

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Reviewed publications that examined the following costs — healthcare costs/expenditures (e.g., inpatient, outpatient, nursing home, hospice, home-health provider/assisted living, prescription drugs, treatment/therapy)

Environmental Health Economic Analysis Annotated Bibliography

- costs of disability income subsidies
- lost productivity/earnings
- costs of special education
- costs related to justice system (e.g., juvenile delinquency and prison)
- impacts on lifetime earnings and labor force participation
- social impact costs (e.g., welfare)
- costs of low-weight births

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors reviewed literature to determine the evidence that exposure to environmental agents (particularly persistent toxic substances) are plausible risk factors for the chosen health outcomes. The authors — 1) evaluated literature to assess the extent to which approaches and methodologies to measure economic costs and impacts of the chosen health outcomes are developed; and 2) used primary data sources in cases where no existing studies were found that evaluated costs for the selected effects/outcomes.

Sources Used:

- Economic consequences of diabetes mellitus in the US in 1997 (American Diabetes Association, 1999); US Consumer Price Index (US Census Bureau); Diabetes in Canada: national statistics and opportunities for improved surveillance, prevention and control (Health Canada, 1999); Canadian Consumer Price Index (Ontario Ministry of Finance, 2000); Ontario Ministry of Health (2000); The impact of Parkinson's disease on health status, health expenditures, and productivity: estimates from the National Medical Expenditure Survey (Rubenstein et al., 1997); Parkinson's Action Network: cost of illness and disease severity in a cohort of French patients with Parkinson's disease (LePen et al., 1999); The economic impact of Parkinson's disease: an estimate based on a 3-month prospective analysis (Dodel et al., 1998); In harm's way: toxic threats to child development (Schettler et al., 2000); Canadian Institute of Child Health (2000); Ontario Ministry of Correctional Services (2000); Societal benefits of reducing lead exposure (Schwartz, 1994); Updated estimates of earnings benefits from reduced exposure to children to environmental lead (Salkever, 1995); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Muir T and Zegarac M. 2001. Societal costs of exposure to toxic substances: economic and health costs of four case studies that are candidates for environmental causation. Environmental Health Perspectives.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Health economics of asthma and rhinitis. II. Assessing the value of interventions

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost-effectiveness analysis (CEA)

Authors

Sullivan SD and Weiss KB

Journal

Journal of Allergy and Clinical Immunology

Summary

In this review article, the authors described the elements of comparative economic evaluations for asthma and rhinitis in an attempt to critically evaluate studies from the perspective of one who might use data for decision making. The authors suggested that the quality of economic evidence for asthma and rhinitis is limited, and therefore, the allocation of resources for these diseases will continue to primarily rely on expert opinion rather than evidence-based literature.

Population

Not available

Health Outcomes

- Reviewed publications that examined — respiratory outcomes (asthma, allergic rhinitis)

Environmental Agents

List of Environmental Agents: (Not available)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-effectiveness analysis (CEA)

Cost Measured:

- Reviewed publications that assessed costs associated with asthma and rhinitis, including
 - Healthcare costs (diagnostic testing)
- education costs (special education, asthma patient education)
- productive days lost
- short-stay observation units

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors performed a concise review of studies of both asthma and allergic rhinitis that highlight the utility of economic evaluations for clinical and resource decision making.

Sources Used:

- The cost-effectiveness of budesonide in severe asthmatics aged one to three years (Connett et al., 1993); Efficacy and cost benefit of inhaled corticosteroids in patients considered to have mild asthma in primary care (O'Byrne et al., 1996); Cost-effectiveness of salmeterol/fluticasone propionate combination product 50/250 micrograms twice daily in the treatment of adults and adolescents with asthma (Lundback et al., 2000); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Sullivan SD and Weiss KB. 2001. Health economics of asthma and rhinitis. II. Assessing the value of interventions. Journal of Allergy and Clinical Immunology.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Cost-benefit analysis methods for assessing air pollution control programs in urban environments - a review

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Cost-benefit analysis (CBA)

Authors

Voorhees AS, Sakai R, Araki S, Sato H, and Otsu A

Journal

Environmental Health and Preventive Medicine

Summary

This review article described conceptual approaches that could be useful in analyses of urban air pollution impacts and air pollution prevention policies. The history of cost-benefit analyses (CBA) for air pollution control programs was discussed. The authors identified benefits valuation techniques and approaches for estimating benefits and costs. CBA assumptions and results for several existing analyses of air pollution control in urban areas were presented, and the authors also summarized the importance of CBA in environmental policy studies.

Population

Not available

Health Outcomes

- Reviewed publications that examined — respiratory outcomes (asthma, lower respiratory illness)

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined — Air pollutants (nitrogen oxides (NO_x, NO₂))

Source of Environmental Agents:

- Reviewed publications that examined — air pollution from motor vehicles
- NO_x sources combined
- emissions from stationary sources

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Environmental Health Economic Analysis Annotated Bibliography

Cost Measured:

- Reviewed publications that assessed and described cost measurements related to air pollution impacts, including — private sector costs
- societal costs
- governmental regulatory costs

Potential Cost Measures:

- Addresses limitations in estimating — indirect costs incurred by regulated industries
- indirect macroeconomic costs resulting from regulations

Benefits Measures:

- Reviewed publications that assessed benefits of reducing air pollution, including — human health
- productivity (work output, crop yield, industrial equipment)
- amenity effects (visibility, odor, and noise)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The review article discussed several cost-benefit analysis methods for air pollution impacts.

Sources Used:

- An ex post cost-benefit analysis of the nitrogen dioxide air pollution control program in Tokyo (Voorhees et al., 2000)

Economic Evaluation / Methods and Source

Citation:

- Voorhees AS, Sakai R, Araki S, Sato H, and Otsu A. 2001. Cost-benefit analysis methods for assessing air pollution control programs in urban environments - a review. Environmental Health and Preventive Medicine.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Updated estimates of earnings benefits from reduced exposure of children to environmental lead

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Salkever DS

Journal

Environmental Research

Summary

This reassessment study of the benefits of reducing environmental lead exposure suggested a significant increase in benefits than previously reported. Rapid economic change and additional epidemiological data highlighted the need for regular reassessment of social benefit estimates to ensure that decision makers have up-to-date information when setting priorities for protecting human health and the environment.

Population

Not available

Health Outcomes

- Neurological/cognitive outcomes (IQ deficits)

Environmental Agents

List of Environmental Agents:

- Metal (lead)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Considered costs assessed in a previous study — Societal benefits of reducing lead exposure (Schwartz, 1994)

Potential Cost Measures: (Not available)

Benefits Measures:

Environmental Health Economic Analysis Annotated Bibliography

- Averted effects of lead exposure and IQ loss (effects of enhanced IQ on educational attainment, workforce participation, and earnings)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors made minor extensions to a previous approach (Schwartz et al. 1994) to explicitly estimate the direct effects of IQ on educational attainment and on participation. Three different relationships were estimated using regression techniques — 1) least-squares regression of highest grade on cognitive ability; 2) multiple pro-bit regression of positive earnings on highest grade and cognitive ability; and 3) a least-squares regression, for persons with positive earned income, of the logarithm of earnings on highest grade and cognitive ability. As a measure of cognitive ability, the Armed Forces Qualifying Test percentile score for each respondent was converted to IQ units by assigning a score to each percentile.

Sources Used:

- Educational attainment data (National Longitudinal Survey of Youth, 1979-1990); US Census Bureau (1994); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Salkever DS. 1995. Updated estimates of earnings benefits from reduced exposure of children to environmental lead. Environmental Research.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Societal benefits of reducing lead exposure

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Schwartz J

Journal

Environmental Research

Summary

This study provided an introduction to cost-benefit analysis methods for reducing lead exposure and also presents an example analysis which found that for a 1 µg/dl reduction in blood lead concentrations a society can save \$17 billion a year. The author highlighted major research gaps for cost effective control of lead toxicity, such as a better understanding of low-dose health effects, the molecular basis of lead toxicity, and better measurement techniques for both research and screening.

Population

Not available

Health Outcomes

- Neurological/cognitive outcomes (IQ deficits)
- cardiovascular outcomes (myocardial infarctions, hypertension, stroke)
- mortality
- birth outcomes (low gestational age)

Environmental Agents

List of Environmental Agents:

- Metal (lead)

Source of Environmental Agents:

- Lead-based paint

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Costs related to reduced IQ (reduced lifetime earnings, effect on schooling and educational achievement, special education)

Environmental Health Economic Analysis Annotated Bibliography

- lost wages
- mortality

Potential Cost Measures:

- Effects of lead on growth, balance, hearing, cancer, and metabolic disturbances
- cognitive damage due to prenatal lead exposure
- hyperactivity and attention disorders
- low birth weight

Benefits Measures:

- Reduction in the number of children who require medical attention
- reduced infant mortality
- reduced cardiovascular outcomes such as stroke and hypertension in adults
- reduced medical costs for cardiovascular disease
- increased workplace participation
- increased graduation rates

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The author provided a brief overview of the basic methods and issues involved in calculating the social benefits of lead control policies. The author — 1) discussed a classical approach to derive a theoretical model of the benefits or utility that a person gains from possessions, including health; 2) examined value of lifetime earnings, estimates of the effects of lead on IQ and schooling, and estimates of the effect of IQ on work force participation and wage rates to examine costs of cognitive damage in children; 3) discussed conservative costs of fetal effects of lead from willingness to pay studies; and 4) estimated of health benefits in adults involving blood pressure and cardiovascular disease studies and adapted it to reflect advancements in medical technology.

Sources Used:

- Second National Health and Nutrition Examination Survey from 1976-1980 (NHANES II) (CDC); Blood lead baseline distribution (Agency for Toxic Substances and Disease Registry, 1990); Consumer Price Index; U.S. Department of Education; U.S. Bureau of the Census; 1978 Social Security Survey of Disability and Work (US DHHS, 1981); Office of Technology Assessment; National Medical Care Expenditure Survey (NCHSR, 1981); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Schwartz J. 1994. Societal benefits of reducing lead exposure. Environmental Research.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Valuing the health benefits of clean air

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA), Cost-utility analysis (CUA)

Authors

Hall JV, Winer AM, Kleinman MT, Lurmann FW, Brajer V, and Colome SD

Journal

Science

Summary

An assessment of health effects due to ozone and particulate matter (PM10) suggested that among the 12 million residents of the South Coast Air Basin of California, individuals experienced ozone-related symptoms on an average of up to 17 days each year, and face an increased risk of death in any year of 1/10,000 as a result of elevated PM10 exposure. The estimated annual economic value of avoiding these effects was estimated to be nearly \$10 billion. The authors concluded that attaining air pollution standards may save 1,600 lives a year in the region.

Population

Not available

Health Outcomes

- Mortality
- respiratory outcomes (cough, chest discomfort, sore throat, eye irritation, headaches)

Environmental Agents

List of Environmental Agents:

- Air Pollutants (ozone, particulate matter (PM10/coarse))

Source of Environmental Agents:

- Indoor pollution
- in-vehicle pollution

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)
- Cost-utility analysis (CUA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Minor restricted activity days
- restricted activity days
- economic value of attaining national ambient air quality standards (NAAQS)

Potential Cost Measures: (Not available)

Benefits Measures:

- Lives saved
- reduced symptoms

Potential Benefits:

- Improvements in visibility
- protection of materials or vegetation
- prevention of chronic lung disease
- reduced greenhouse gas
- reduced ecosystem effects

Location:

- South Coast Air Basin in California, USA

Models Used:

- Regional Human Exposure (REHEX) model

Methods Used:

- The authors assessed the health effects due to ozone and particulate matter in the South Coast Air Basin in California. The authors — 1) characterized exposure and dose using the Regional Human Exposure Model which estimates a population's typical indoor, outdoor, and in-vehicle exposures during the day; 2) estimated concentration of exposure to pollutants by corresponding district assigned locations in an ambient air monitoring network for each of nine demographic groups; 3) calculated the statistical value of lives saved; and 4) used three economic measures to value pollution related health effects — cost of illness (CO), willingness to pay (WTP), and willingness to accept (WTA).

Sources Used:

- Air quality monitoring data from the South Coast Air Quality Management District; Effects on human health of pollutants in the South Coast Air Basin (Kleinman et al., 1989); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Hall JV, Winer AM, Kleinman MT, Lurmann FW, Brajer V, and Colome SD. 1992. Valuing the health benefits of clean air. Science.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Controlling urban air pollution: a benefit-cost assessment

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Krupnick AJ and Portney PR

Journal

Science

Summary

This cost-benefit analysis evaluated proposed air quality controls for the US and the Los Angeles metropolitan area, and determined that the costs of proposed new controls were found to exceed the benefits by a considerable margin. Study findings suggested that it may make economic sense to implement air pollution control greatly in some areas and less so in others.

Population

Not available

Health Outcomes

- Mortality/morbidity
- respiratory outcomes (asthma, coughing, shortness of breath)

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone, particulate matter, carbon monoxide (CO), nitrogen oxides (NO_x), sulfur oxides (SO_x), volatile organic compounds (VOCs))

Source of Environmental Agents:

- VOC emissions in nonattainment areas

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Costs for VOC and ozone control/reduction (cost for reducing the volatility of gasoline)
- cost for use of alternative fuels (e.g., methanol) to power fleet vehicles
- costs for the South Coast plan in Los Angeles (costs for application of pollution control

Environmental Health Economic Analysis Annotated Bibliography

technologies

- cost for substitution of less polluting solvents in facilities
- costs for implementation of new controls in electric power plants
- costs for control/reduction of fuel consumption, vehicle usage, and dust blown from roads/parking lots
- costs for programs that aim to eliminate hydrocarbons from solvents, coatings, and motor vehicles

Potential Cost Measures:

- Costs of the South Coast plan to residents (e.g., time losses and inconvenience)
- nonpecuniary costs (e.g., maintenance program costs)

Benefits Measures:

- Acute health benefits associated with reductions in ground level ozone (as a result of controlling VOC emissions), such as — reduced incidence of asthma attacks, coughing, chest discomfort, pain on deep inspiration
- reduced number of days of restricted activity
- reduced acute morbidity
- health benefits associated with the South coast plan, such as — reduced risk of premature mortality, reduced risk of acute morbidity, reduced illness, frequency of respiratory symptoms

Potential Benefits:

- Reduced damage to exposed crops and other vegetation
- reductions in prevalence of chronic illness
- improvements in forests or agricultural output in rural regions that might result from VOC control in urban areas
- reductions in damage to rubber and other products exposed to ozone

Location:

- Urban/metropolitan nonattainment areas in the United States
- Los Angeles, California

Models Used:

- EPA trajectory models (used for predictions of peak ambient concentrations of ozone)
- county-level model (used to determine the acute health benefits associated with estimated reductions in VOC emissions in nonattainment areas)

Methods Used:

- The authors presented point estimates of costs and benefits for proposed efforts of improving air quality (reducing ambient ozone concentrations) at the national level. The authors — 1) used VOC emissions data from the Office of Technology Assessment about predicted air quality changes, EPA trajectory models to predict peak ambient concentrations of ozone, and a county level model to determine the acute health benefits associated with the estimated VOC emission reductions in nonattainment areas; 2) combined area-specific data on air quality improvements and population with dose-response functions based on epidemiologic and clinical studies relating ambient ozone concentrations to various human health effects and estimated the reduced incidence of these health effects accompanying a 35% reduction in VOC, and aggregated these estimates to obtain national estimates; 3) used willingness to pay estimates to convert predicted changes in physical health into economic benefits; and 4) presented point estimates of costs and benefits for proposed efforts of the South Coast air quality plan for Los Angeles.

Sources Used:

- Catching our breath — next steps for reducing urban ozone (Office of Technology Assessment, 1989); Review of the National Ambient Air Quality Standards for Ozone —

Environmental Health Economic Analysis Annotated Bibliography

assessment of scientific and technical information (EPA OAQPS, 1987); Economic impacts of the draft air quality management plan proposed by the South Coast Air Quality Management District (1988); The benefits of air pollution control in California (1986); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Krupnick AJ and Portney PR. 1991. Controlling urban air pollution: a benefit-cost assessment. Science.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Health costs of occupational disease in New York State

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Fahs MC, Markowitz SB, Fischer E, Shapiro J, and Landrigan P

Journal

American Journal of Industrial Medicine

Summary

This cost analysis study of occupational illnesses in New York state estimated the partial economic cost of occupational disease to be approximately \$600 million per year, and the greatest proportion of costs were associated with occupationally induced cancer. Results suggested that analysis of the true costs of occupational disease can help in planning public and private efforts toward prevention.

Population

Adolescents and adults (15 years)

Health Outcomes

- Cancer outcomes (occupational cancer)
- respiratory outcomes (chronic respiratory disease, pneumoconiosis (asbestosis, silicosis, coal workers' pneumoconiosis))
- cardiovascular outcomes (cardiovascular disease)
- kidney outcomes (end stage renal disease)
- cerebrovascular disease

Environmental Agents

List of Environmental Agents: (Not available)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Healthcare costs (hospitalization, physicians' services, nursing home care)
- treatment costs
- future loss earnings (value of the output of workers and retirees suffering premature death or disability)

Potential Cost Measures:

- Costs/wage losses incurred by retirees who are not currently in labor force
- economic costs for market imperfections from inequitable distribution of wages and salaries for certain groups (e.g., women and minorities)
- pain and suffering of all victims and their families

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- New York state

Models Used: (Not available)

Methods Used:

- The authors estimated the total costs of occupational disease in New York State. The authors — 1) used incidence and prevalence statistics, mortality records, and a variety of financial data; and 2) employed two methods of cost accounting strategies applicable to the human capital approach, the incidence method, and the prevalence method, to estimate the costs of four categories of occupational illnesses.

Sources Used: (Not available)

Economic Evaluation / Methods and Source

Citation:

- Fahs MC, Markowitz SB, Fischer E, Shapiro J, and Landrigan P. 1989. Health costs of occupational disease in New York State. American Journal of Industrial Medicine.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Health benefits and costs of filtration interventions that reduce indoor exposure to PM2.5 during wildfires

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Fisk WJ, Chan WR

Journal

Indoor Air

Summary

This cost-benefit analysis estimated the expected health benefits if interventions had improved particle filtration in homes in Southern California during a 10-day period of wildfire smoke exposure in 2003. With interventions in all homes, the central estimates of the economic benefits from avoided respiratory hospitalizations during the wildfire period ranged from \$1 to \$5.8 million, while the economic benefits of reduced mortality ranged from \$75 to \$416 million. Cost effectiveness was improved by implementing interventions in the homes of the elderly.

Population

Portion of analysis examined adults (65 years)

Health Outcomes

- Respiratory outcomes (asthma, bronchitis, bronchiolitis, COPD, pneumonia)
- mortality (premature mortality)

Environmental Agents

List of Environmental Agents:

- Single

Source of Environmental Agents:

- Wildfires

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Cost of interventions (HVAC incremental energy cost, HVAC incremental filter cost, portable filter energy cost, portable filter equipment cost)

Potential Cost Measures: (Not available)

Benefits Measures:

- Prevented respiratory hospital admissions and deaths

Potential Benefits:

- Reduced post-wildfire hospital admissions
- reduced hospital admissions or deaths due to health effects from other wildfire-related air pollutants (e.g., nitrogen oxides and aldehydes)

Location:

- Six-county region in Southern California with substantially increased particle concentrations during wildfires in 2003

Models Used: (Not available)

Methods Used:

- The authors estimated the magnitude of reduced hospital admissions and premature deaths for hypothetical intervention scenarios implemented during a Southern California wildfire in 2003. The authors — 1) used mass balance models, inhalation rate calculations, and published data from the wildfire event to estimate reductions in hospital admissions and premature deaths associated with six intervention types; 2) calculated the economic value of prevented hospital admissions and deaths and the costs of each intervention; and 3) performed these calculations both for the total population of the affected area and a portion of the population 65 years.

Sources Used:

- The relationship of respiratory and cardiovascular hospital admissions to the southern California wildfires of 2003 (Delfino et al., 2009); valuing mortality impacts of smoke exposure from major southern California wildfires (Kochi et al., 2012); County-level population data for 2000 (US Census Bureau); Statistical abstract of the United States - 2012 (US Census Bureau, 2012); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Fisk WJ, Chan WR. 2017. Health benefits and costs of filtration interventions that reduce indoor exposure to PM2.5 during wildfires. Indoor Air.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Funded through interagency agreement DW-89-92337001 between the Indoor Environments Division, Office of Radiation and Indoor Air of the US Environmental Protection Agency (EPA) and the US Department of Energy under contract DE-AC02-05CH11231

The hidden economic burden of air pollution-related morbidity: evidence from the Aphekom project

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Chanel O, Perez L, Künzli N, Medina S, Aphekom group

Journal

Eur J Health Economics

Summary

This cost-benefit analysis compared two methods, a standard health impact assessment (HIA) and a comprehensive HIA, to examine the economic burden that could be avoided by reducing exposure to air pollution. The standard HIA method only accounted for about 6.2 percent [€ 0.55 million (95 percent CI 0–0.95)], of the annual hospitalization burden computed with the comprehensive HIA method [€ 8.81 million (95 percent CI 3–14.4)], and for about 0.15 percent of the overall economic burden of air pollution-related chronic diseases [€ 370 million (95 percent CI 106–592)]. Results suggest that morbidity effects impact the health system more directly and strongly than previously believed.

Population

Children (0-17 years), adults (65 years)

Health Outcomes

- Respiratory outcomes (asthma)
- cardiovascular outcomes (coronary heart disease)

Environmental Agents

List of Environmental Agents:

- Multiple

Source of Environmental Agents:

- Traffic-related pollution, ambient air pollution

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Environmental Health Economic Analysis Annotated Bibliography

Cost Measured:

- Direct health costs (medical resources consumed, drugs, in-patient and outpatient hospitalizations, emergency room stays, and cost of rehabilitation)
- indirect costs (loss of productive work by patient or patient's family)
- intangible costs for patient and his/her friend and family (grief, fear, pain, unhappiness, loss of well-being, and loss of quality of life)

Potential Cost Measures:

- Costs of noise-related health impacts
- costs of asthma attacks, bronchitis episodes, and chronic-disease specific healthcare visits
- costs of health-related related absenteeism
- costs related to disease onset due to other air pollution exposures (near road NO₂, NO, CO, black carbon, elemental carbon)

Benefits Measures:

- Reduced chronic diseases due to lower air pollution exposure

Potential Benefits: (Not available)

Location:

- 10 European cities from six countries

Models Used: (Not available)

Methods Used:

- The authors used a comprehensive health impact exposure (HIA) assessment approach to investigate the full burden of air pollution on asthma in children and coronary heart disease (CHD) in adults over 65 in 10 European cities. The authors — 1) estimated near road traffic-related pollution (NRTP) by combining traffic density information with residential proximity to busy roads; 2) estimated asthma and CHD prevalence and asthma and myocardial infarction hospitalizations using concentration-response functions; 3) used these data to compute current and hypothetical health effects among total city population; 4) assessed direct and indirect costs of health effects with real market prices from cost of illness methods; 5) estimated intangible costs of health effects using willingness to pay; and 6) estimated the economic burden associated with the chronic diseases using annual prevalence costs and cost per exacerbation for OECD countries.

Sources Used:

- Monetary data from World Bank database: World Development Indicators and Global Development Finance (2010); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Chanel O, Perez L, Künzli N, Medina S, Aphekom group. 2016. The hidden economic burden of air pollution-related morbidity: evidence from the Aphekom project. Eur J Health Economics.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Aphekom project co-funded by the European Commission's Programme on Community

Environmental Health Economic Analysis Annotated Bibliography

Action in the Field of Public Health (2003–2008) under Grant Agreement No. 2007105,
and many national and local institutions

Benefit-cost analysis of commercially available activated carbon filters for indoor ozone removal in single-family homes

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Aldred JR, Darling E, Morrison G, Siegel J, Corsi RL

Journal

Indoor Air

Summary

This cost-benefit analysis developed a model to evaluate the potential costs and benefits of using activated carbon filtration of indoor air to reduce ozone exposures. The researchers used the model to predict benefit-to-cost (B/C) ratios for single-family homes in 12 American cities in five different climate zones. The average indoor ozone removal effectiveness ranged from 4 to 20 percent across the 12 cities and the mean predicted B/C ratios were greater than 1.0 in 10 of the 12 cities. The benefits of residential activated carbon filters were greatest in cities with high seasonal ozone and HVAC usage, suggesting the importance of targeting such conditions for activated carbon filter applications.

Population

Not available

Health Outcomes

- Mortality
- respiratory outcomes
- cardiovascular outcomes (dysrhythmia)

Environmental Agents

List of Environmental Agents:

- Single

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Minor restricted activity day
- school loss day
- respiratory hospital admissions
- capital costs for filter (materials and labor)
- energy costs due to the difference in pressure drop between a standard particle filter and an activated carbon filter

Potential Cost Measures:

- Costs associated with the installation and disposal of filters

Benefits Measures:

- Reductions in disability-adjusted life years (DALYs)

Potential Benefits:

- Reductions in secondary organic aerosols and other ozone reaction products (e.g., formaldehyde)

Location:

- 12 U.S. cities (Atlanta, Austin, Buffalo, Chicago, Cincinnati, Houston, Miami, Minneapolis, New York City, Phoenix, Riverside, and Washington D.C.)

Models Used:

- BenMAP - Environmental Benefits Mapping and Analysis Program (US EPA, 2012)
- integrated systems model developed in this study

Methods Used:

- The authors evaluated the potential costs and benefits of ozone control by activated carbon filtration in single-family homes. The authors — 1) developed an integrated systems model to estimate changes in indoor ozone, health incidence, and the benefit-to-cost ratio for ozone control in 12 U.S. cities in five different climate zones; 2) used a Monte Carlo simulation due to uncertainty of model parameters; and 3) evaluated health benefits using disability-adjusted life years (DALYs) and included city-specific age demographics for each simulation.

Sources Used:

- Households and families: 2010 (US Census Bureau, 2012); World Bank Economic Data (World Bank, 2014); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Aldred JR, Darling E, Morrison G, Siegel J, Corsi RL. 2016. Benefit-cost analysis of commercially available activated carbon filters for indoor ozone removal in single-family homes. Indoor Air.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- American Society of Heating, Refrigerating, and Air Conditioning Engineers (RP-1491)
- Walter L. and Reta Mae Moore Graduate Fellowship in Water Resources at the University of Texas at Austin

Environmental Health Economic Analysis Annotated Bibliography

- University of Texas Green Fee Committee
- U.S. Air Force

How much do alternative cookstoves reduce biomass fuel use? Evidence from North India

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Brooks N, Bhojvaid V, Jeuland MA, Lewis JJ, Patange O, and Pattanayak SK

Journal

Resour Energy Econ

Summary

This analysis evaluated how the use of non-traditional stoves (predominantly liquefied petroleum gas (LPG)) affected biomass fuel consumption, time spent cooking on traditional stoves, and time spent collecting biomass fuels for households in Uttar Pradesh and Uttarakhand, India. Non-traditional stove use reduced biomass fuel use by 4.5 kg/day (50 percent), cooking on traditional stoves by about 160 min/day (80 percent), and biomass fuel collection time by 105 min/day (80 percent). Back-of-the-envelope calculations using an existing model of costs and benefits suggested that air quality and environmental benefits from reduced use of biomass fuel use would be worth at least \$1.8/household-month.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Single

Source of Environmental Agents:

- Cookstoves

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Cost of non-traditional stove and fuel
- other costs accounted for in the Jeuland and Pattanayak (2012) cost benefit model

Potential Cost Measures:

- Costs of supply to remote areas

Benefits Measures:

- Reduced biomass fuel consumption
- reduced time spent cooking on traditional stoves
- reduced time spent collecting biomass fuels
- improvements to air quality (averted greenhouse gas emissions)
- environmental benefits (avoided deforestation)
- other benefits accounted for in the Jeuland and Pattanayak (2012) cost benefit model

Potential Benefits:

- Health benefits

Location:

- Two states of northern India (Uttar Pradesh and Uttarakhand)

Models Used: (Not available)

Methods Used:

- The authors examined the relationship between use of non-traditional stoves and three key outcomes related to solid fuel use. The authors – 1) collected data on fuel consumption using a 24-hour fuel measurement exercise; 2) collected data on cooking practices using a larger self-report baseline survey; 3) used Heckman two-step estimator to examine the impact of non-traditional cookstoves on the amount of biomass fuel consumed (in kg/day), time spent cooking on traditional stoves (min/day), and time spent collecting biomass fuels (min/day); and 4) compared Heckman model results to those from propensity score matching and simple Ordinary Least Squares (OLS) estimation approaches.

Sources Used:

- Data about fuel use collected from fuel measurement survey of 1,234 households in northern India during the summer of 2012; self-reported socioeconomic and demographic data from larger sample of over 2,100 households; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Brooks N, Bhojvaid V, Jeuland MA, Lewis JJ, Patange O, and Pattanayak SK. 2016. How much do alternative cookstoves reduce biomass fuel use? Evidence from North India. Resour Energy Econ.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- USAID Translating Research into Action (GHS-A-00-09-00015-00)
- Sanford Masters in Public Policy Program

Air pollution and infant mortality: evidence from the expansion of natural gas infrastructure

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-utility analysis (CUA), cost-benefit analysis (CBA)

Authors

Cesur R, Tekin E, and Ulker A

Journal

The Economic Journal

Summary

This analysis considered the impact of widespread expansion of natural gas services for residential and commercial use on the rate of infant mortality in Turkey. A 1 percent increase in the rate of subscriptions to natural gas services was estimated to result in a 4 percent decline in infant mortality rate, which could translate into approximately 348 infant lives saved in 2011 alone. These findings indicate that the expansion of natural gas infrastructure has resulted in a significant decrease in the rate of infant mortality.

Population

Not available

Health Outcomes

- Mortality (infant mortality)

Environmental Agents

List of Environmental Agents:

- Single

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-utility analysis (CUA)
- cost-benefit analysis (CBA)

Cost Measured: (Not available)

Potential Cost Measures: (Not available)

Benefits Measures:

Environmental Health Economic Analysis Annotated Bibliography

- Lives saved

Potential Benefits: (Not available)

Location:

- Turkey (all 81 provinces)

Models Used: (Not available)

Methods Used:

- The authors examined the impact of widespread adoption of natural gas as a fuel source on infant mortality in Turkey. The authors – 1) estimated a regression model for the impact of the intensity of natural gas on air pollution; 2) used a reduced form binary treatment model to investigate the impact of provincial natural gas adoption on infant mortality; and 3) Performed robustness checks.

Sources Used:

- Natural gas availability data from the Turkish Natural Gas Journal;pProvince population data from the Turkish Statistical Institute (TurkStat) and from the Turkish Ministry of Health; information on the Family Physician Programme from the Ministry of Health; control variable data from TurkStat; infant mortality data from TurkStat and Turkish Census Bureau; air pollution data from Turkish Ministry of Health; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Cesur R, Tekin E, and Ulker A. 2016. Air pollution and infant mortality: evidence from the expansion of natural gas infrastructure. The Economic Journal.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Particulate pollution and the productivity of pear packers

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Chang T, Graff Zivin J, Gross T and Neidell M

Journal

American Economic Journal: Economic Policy

Summary

This analysis examined the effect of outdoor air pollution on the productivity of indoor workers at a pear-packing factory in Northern California. A 10-unit increase in PM_{2.5} reduced worker productivity by approximately 6 percent; these effects occurred at PM levels below national air quality standards. In a nationwide extrapolation, reductions in PM_{2.5} between 1999 and 2008 generated \$19.5 billion in labor cost savings. Findings suggest that outdoor pollution affects the labor productivity of indoor workers, and may be an important determinant of economic growth.

Population

Employees in a pear-packing facility

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM_{2.5}/fine and PM₁₀/coarse), ozone (O₃), carbon monoxide(CO), nitrogen dioxide (NO₂))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Reduced earnings due to presenteeism (reduced on-the-job productivity)

Environmental Health Economic Analysis Annotated Bibliography

Potential Cost Measures:

- Changes in labor supply due to air pollution related sickness (e.g., missed work days, shortened work hours)

Benefits Measures:

- Labor productivity benefits
- total welfare benefits (captured by capitalization into housing prices)

Potential Benefits: (Not available)

Location:

- Northern California

Models Used: (Not available)

Methods Used:

- The authors estimated the effects of fine particulate matter (PM2.5) on worker productivity in a pear-packing facility. The authors — 1) estimated hourly productivity using a hybrid production function which accounted for variable and fixed effects; 2) applied estimated effects to calculate productivity in the manufacturing sector at a national level from changes in PM2.5 across the U.S. from 1999-2008; and 3) quantified total welfare benefits associated with this pollution reduction by using the hedonic price method to study the effect of PM2.5 on housing values.

Sources Used:

- Worker productivity data from payroll records provided by the pear-packing facility for the 2001, 2002, and part of the 2003 packing seasons; weather and pollution data from monitors maintained by the California Air Resources Board; county-level manufacturing earnings data from Bureau of Labor Statistics (2000); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Chang T, Graff Zivin J, Gross T and Neidell M. 2016. Particulate pollution and the productivity of pear packers. American Economic Journal: Economic Policy.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- 1R21ES019670-01

Other Funding:

- The George and Obie Shultz Fund

Female reproductive disorders, diseases, and costs of exposure to endocrine disrupting chemicals in the European Union

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Hunt PA, Sathyanarayana S, Fowler PA, and Trasande L

Journal

J Clin Endocrinol Metab

Summary

This study estimated the combined economic and health care costs for fibroids and endometriosis that are attributable to two specific EDC exposures (DDE and phthalates), respectively, within the European Union in 2010. The authors concluded that these EDC-attributable cases of fibroids and endometriosis were estimated to be 56,700 and 145,000 women, respectively, with total combined economic and health care costs reaching nearly €1.5 billion annually. These findings suggest that DDE and phthalates may contribute substantially to the most common reproductive disorders in women, fibroids and endometriosis, and these public health costs should be considered as the European Union contemplates on proceeding with regulatory action for EDCs.

Population

Young and adult women (15-54 years)

Health Outcomes

- Reproductive outcomes (fibroids, endometriosis)

Environmental Agents

List of Environmental Agents:

- Pesticides (diphenyldichloroethene (DDE))
- hormonal mimics (phthalates)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

Environmental Health Economic Analysis Annotated Bibliography

- Cost analysis (CA)

Cost Measured:

- Direct medical costs per patient
- lost work time or economic productivity associated with disease treatment for fibroids and endometriosis (e.g., costs per case for surgical/radiologic interventions for myomas (fibroids))

Potential Cost Measures:

- Costs related to health damages for fibroids and endometriosis resulting from fetal or periconceptional exposures
- costs related to infertility, gynecological disorders, gravid diseases, or other later onset adulthood diseases (e.g., cancer, autoimmune disorders, gestational diabetes, etc.)
- costs for female reproductive health following exposure to other EDCs (e.g., PAHs)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- European Union

Models Used: (Not available)

Methods Used:

- Researchers applied a conservative approach via an expert panel to calculate the associated combined health care and economic costs attributable to specific EDC exposures within the European Union in 2010. They — 1) selected two exposure-outcome relationships (DDE-attributable fibroids and phthalate-attributable endometriosis) based on the availability of well-conducted observational human studies to assess the effects of the EDCs; 2) evaluated epidemiologic evidence for probability of causation using the Intergovernmental Panel on Climate Change weight-of-evidence characterization; 3) organized reference levels and biomarker data from carefully identified studies within peer-reviewed literature to represent European exposure and approximate burden of disease that occurred in 2010; and 4) estimated cost-of-illness for fibroids and endometriosis using multiple peer-reviewed sources.

Sources Used:

- Birth weight and prenatal exposure to polychlorinated biphenyls (PCBs) and dichlorodiphenyldichloroethylene (DDE): a meta-analysis within 12 European Birth Cohorts (Govarts et al., 2012); First steps toward harmonized human biomonitoring in Europe: demonstration project to perform human biomonitoring on a European scale (Den Hond et al., 2015); Persistent organic pollutants (POPs) and fibroids: results from the ENDO study (Trabert et al., 2015); Bisphenol A and Phthalates and Endometriosis: The Endometriosis: Natural History, Diagnosis and Outcomes Study (Buck Louis et al., 2013); Rate, type, and cost of invasive interventions for uterine myomas in Germany, France, and England (Fernandez et al., 2009); What is the societal burden of endometriosis-associated symptoms? A prospective Belgian study (Klein et al., 2014); Additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Hunt PA, Sathyanarayana S, Fowler PA, and Trasande L. 2016. Female reproductive disorders, diseases, and costs of exposure to endocrine disrupting chemicals in the European Union. *J Clin Endocrinol Metab*.
- [Pubmed](#)

Environmental Health Economic Analysis Annotated Bibliography

- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Endocrine Society
- John Merck Fund
- The Broad Reach Foundation
- Oak Foundation

Particulate matter exposure and preterm birth: estimates of U.S. attributable burden and economic costs

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Trasande L, Malecha P, and Attina TM

Journal

Environ Health Perspect

Summary

This meta-analysis estimated the economic costs of preterm birth attributable to PM2.5 exposure in the United States. The authors determined, across 48 states, that 3.32 percent of all preterm births in 2010 were attributable to PM2.5 exposure, and reported a combined estimate of \$5.09 billion for preterm-birth related costs for medical care and lost economic productivity. They also determined that the PM2.5 attributable fraction of preterm birth was highest in urban counties. These results suggest that PM2.5 exposure may contribute substantially to the burden and costs of preterm birth in the United States, and considerable health and economic benefits may be achieved through environmental regulatory interventions that reduce PM2.5 exposure in pregnancy.

Population

Pregnant women and their children

Health Outcomes

- Birth outcomes (preterm birth)

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM 2.5/fine))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Medical care costs for treatment of preterm birth-associated medical conditions in the first 5 years of life
- medical care costs for treatment of preterm-birth associated with medical conditions after the first 5 years of life due to preterm birth-associated developmental disability
- lost economic productivity (due to reduced cognitive potential)
- preterm birth-associated IQ deficits or loss

Potential Cost Measures:

- Direct and indirect costs related to maternal health, stillbirths, and birth defects that may be associated with PM2.5 exposure

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- United States

Models Used:

- Environmentally Attributable Fraction (EAF) model

Methods Used:

- Authors performed a meta-analysis to estimate the burden of preterm birth in the United States, and the economic costs attributable to PM2.5 exposure (as a proxy for outdoor air pollution) in 2010. The authors — 1) obtained daily averages of PM2.5 in 2008 for all ZIP codes in the United States as modeled by EPA; 2) estimated deciles of PM2.5 exposure for each county in 2008; 3) used data from different studies to contribute to estimates for preterm birth associated with prenatal PM2.5 exposure; 4) obtained county-level preterm birth rates for 2010 from the CDC WONDER database; 5) calculated the corresponding odds ratios for each decile of exposure above the lowest decile; 6) computed the attributable fraction of preterm birth for outdoor air pollution for each decile; and 7) estimated PM2.5-attributable direct (medical treatment costs) and indirect costs (lost economic productivity) associated with preterm birth.

Sources Used:

- Data on daily averages of PM2.5 in 2008 for ZIP codes in the U.S. (U.S. EPA, 2014); CDC WONDER database for county-level preterm birth rates for 2010 in the U.S. (CDC, 2014a); U.S. Census data (U.S. Census Bureau, 2010); Medical Care Consumer Price Index (U.S. Department of Labor, Bureau of Labor Statistics, 2014); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Trasande L, Malecha P, and Attina TM. 2016. Particulate matter exposure and preterm birth: estimates of U.S. attributable burden and economic costs. Environ Health Perspect.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Economic implications of mercury exposure in the context of the global mercury treaty: Hair mercury levels and estimated lost economic productivity in selected developing countries

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Trasande L, Digangi J, Evers DC, Petrlik J, Buck DG, Samanek J, Beeler B, Turnquist MA, and Regan K

Journal

J Environ Manage

Summary

This study reported the economic costs related to mercury exposure for subpopulations near sites located within 15 developing and transitioning countries. The authors estimated that a total of \$77.4 million in lost economic productivity assuming a 1 ppm reference level, and \$130 million if no reference level was used. The authors concluded that significant mercury exposures occur in developing and transition country communities near sources named in the Minamata Convention on Mercury, and their estimates suggest that a large economic burden could be avoided by timely implementation of measures to prevent mercury exposures.

Population

Adults (18 years)

Health Outcomes

- Neurological/cognitive outcomes

Environmental Agents

List of Environmental Agents:

- Metals (mercury)

Source of Environmental Agents:

- Anthropogenic sources (chlor-alkali plants, artisanal small-scale gold mining, coal-fired power plants, waste incineration, non-ferrous metal smelting, cement plants), wastes, contaminated sites, global deposition

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Economic costs associated with IQ points lost (e.g., lost economic productivity)
- indirect economic costs due to diminished educational achievements and reduced labor force participation
- DALY losses due to intellectual disability

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Developing and transition countries (15 sites) that have communities near mercury sources named in the Minamata Convention on Mercury: Albania, Bangladesh, Belarus, Cameroon, Cook Islands, India, Indonesia, Kenya, Mexico, Nepal, Russia, Sri Lanka, Tanzania, Thailand, and Uruguay

Models Used: (Not available)

Methods Used:

- Authors estimated the economic costs related to mercury exposure for subpopulations near sites located within 15 developing and transitioning countries that are most likely to benefit from implementation of the global mercury treaty (Minamata Convention on Mercury). The authors — 1) used mercury sources listed in the Minamata Convention as a guide for selection of the sites; 2) developed a standardized hair sampling protocol for all selected countries to ensure samples were collected in a uniform fashion; 3) calculated log-transformed mercury concentrations across samples collected from each location; 4) used a linear dose-response relationship that previously identified a 0.18 decrement per ppm increase in hair mercury to estimate IQ losses for each location; and 5) estimated the corresponding increases in intellectual disability and lost Disability-Adjusted Life Years (DALYs) for each location.

Sources Used:

- Data on mercury sources and sites listed within the Minamata Convention on Mercury (United Nations Environment Programme, 2013a); Dose-response relationship of prenatal mercury exposure and IQ: an integrative analysis of epidemiologic data (Axelrad et al., 2007); World Bank data (World Bank, 2014); Census data for Albania (Albania, 2011); Census data for Bangladesh (Bangladesh 2011a, 2011b); Census data for Belarus (Belarus, 2011); Census data for Cameroon (Cameroon, 2011); Census data for Cook Islands (Cook Islands, 2011); Census data for India (India, 2011); Census data for Indonesia (Indonesia, 2011); Census data for Kenya (Kenya, 2011); Census data for Mexico (Mexico, 2011a, 2011b, 2011c); Census data for Nepal (Nepal, 2011); Census data for Russia (Russia, 2011a, 2011b); Census data for Sri Lanka (Sri Lanka, 2011); Census data for Tanzania (Tanzania, 2011a, 2011b); Census data for Thailand (Thailand, 2011); Census data for Uruguay (Uruguay, 2011); Global Burden of Disease (WHO, 2008); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Trasande L, Digangi J, Evers DC, Petrlik J, Buck DG, Samanek J, Beeler B, Turnquist MA, and Regan K. 2016. Economic implications of mercury exposure in the context of the global mercury treaty: Hair mercury levels and estimated lost economic productivity in

Environmental Health Economic Analysis Annotated Bibliography

selected developing countries. J Environ Manage.

- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Environment Protection Agency of Sweden (HGFREE2011, HGFREE2012)
- Federal Office for the Environment of Switzerland (K21-20775)
- IPEN
- Gelfond Fund (Gelfond Fund 2012 to DC Evers)

The attributable annual health costs of U.S. occupational lead poisoning

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Levin R

Journal

Int J Occupational Environ Health

Summary

This study examined the attributable annual societal costs of health damages associated with occupational lead exposure in U.S. workers. Results from the analysis revealed direct medical costs of \$141 million (2014 US dollars) per year for 16 categories of health endpoints, and a combined amount of \$392 million for direct and indirect costs (2014 US dollars) per year for the 10,000 or more U.S. workers with high occupational lead exposures. These results suggest reducing allowable occupational lead limits could produce annual societal benefits of almost \$40,000 per highly exposed worker.

Population

Adults (U.S. resident and non-resident workers, age not specified)

Health Outcomes

- Cardiovascular outcomes (hypertension, myocardial infarctions)
- musculoskeletal outcomes (muscular pain)
- neurological/cognitive outcomes (ocular disorder, depression, nervous system disorder, pain disorder, dementia)
- reproductive outcomes (male fertility damages, female fertility damages)
- birth outcomes (preterm birth)
- kidney outcomes (end stage renal disease (ESRD), chronic kidney disease)
- cancer outcomes (lung cancer)
- mortality/morbidity

Environmental Agents

List of Environmental Agents:

- Metals (lead)

Source of Environmental Agents:

- Occupational

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Direct medical costs associated with diagnosis, treatment, rehabilitation, and accommodation, including medical and other care provided at the work place, in a medical facility, or at home for all specified health outcomes of interest (health unit, equipment, transportation, out-of-pocket expenditures, etc.)
- indirect costs associated with productivity, personal time loss for the individual (including the family) and employer, and specialized consumer products related to all conditions/outcomes of interest (lost work, costs)

Potential Cost Measures:

- Costs related to health damages associated with other outcomes, such as cognitive and hearing decrements, or metabolic changes
- valuation for pain, suffering, decreased quality of life, and similar others
- costs associated with the suffering of family members and psychological hardships

Benefits Measures: (Not available)**Potential Benefits:** (Not available)**Location:**

- United States

Models Used:

- Author developed simple algorithms to monetize direct medical and indirect (productivity) damages associated with high lead exposures.

Methods Used:

- The author estimated the attributable annual societal costs of health damages associated with occupationally lead-exposed U.S. workers, and developed methods for fuller valuation of health damages. The author — 1) used blood lead data collected through the National Institute of Occupational Safety and Health Adult Blood Lead Epidemiology and Surveillance (ABLES) program to estimate the number of U.S. occupationally lead-exposed workers; 2) used published literature and a COI or human capital approach to value health damages, which includes direct and indirect cost categories, and converted costs to 2014\$; and 3) used effect slopes to calculate the number of workers suffering specific health damages, assuming blood lead levels will be reduced to 30 µg/dL.

Sources Used:

- Adult Blood Lead Epidemiology and Surveillance (ABLES) Program (NIOSH, 2015); Elevated blood lead levels among employed adults - United States, 1994-2012 (Alarcon, 2015); Guidelines in preparing economic analyses (EPA, National Center for Environmental Economics, Office of Policy, 2014); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Levin R. 2016. The attributable annual health costs of U.S. occupational lead poisoning. Int J Occupational Environ Health.
- [Pubmed](#)
- [DOI](#)

Environmental Health Economic Analysis Annotated Bibliography

NIEHS Funding: (Not available)

Other Funding: (Not available)

Economic evaluation of the air pollution effect on public health in China's 74 cities

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Li L, Lei Y, Pan D, Yu C, and Si, C.

Journal

Springerplus

Summary

This study used the willingness to pay method to evaluate the health-related economic loss caused by air pollution exposure in China's 74 cities using the latest available data regarding PM10 and SO2 exposure from January 2015 to June 2015, and by establishing lowest and highest limit scenarios. Results showed that in the lowest and highest limit scenario, the health-related economic loss caused by PM10 and SO2 represented 1.63 and 2.32 percent of the GDP, respectively. For a single city, in the lowest and highest limit scenarios, the highest health-related economic loss caused by PM10 and SO2 were observed in Chongqing. The authors propose the following as ways to reduce the health-related economic loss caused by air pollution in China: use of improved energy structure, use of advanced production processes, control of urban population growth, and adoption of the emissions trading system.

Population

Not available

Health Outcomes

- Mortality (premature deaths)
- respiratory outcomes (respiratory symptoms, lower respiratory tract infections, asthma, childhood asthma, chronic bronchitis)
- chest discomfort

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM 10/ultrafine), sulfur dioxide (SO2))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Environmental Health Economic Analysis Annotated Bibliography

Type:

- Cost analysis (CA)

Cost Measured:

- Health-related economic loss associated with premature death, respiratory outcomes, and hospitalizations caused by air pollution exposure

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- China (74 cities)

Models Used: (Not available)

Methods Used:

- The authors evaluated the economic loss associated with public health effects caused by exposure to PM10 and SO2 for 74 cities in China. They — 1) performed a literature review to determine research progress on economic loss and public health impacts caused by air pollution, and to determine what methods are used to evaluate the economic loss associated with public health effects caused by air pollution; 2) obtained environmental data of the 74 cities during the period from January 2015 to June 2015, as well as population and GDP data for the cities; 3) used a previously reported dose-response relationship to establish the relationship between PM10 and SO2 concentrations and their public health effects; and 4) Used the willingness to pay method to calculate the health-related economic loss associated with public health effects caused by exposure to the air pollutants of interest.

Sources Used:

- Sector allocation of emissions and damages in clearing the air: the health and economic damages of air pollution in China (Ho and Jorgenson, 2007); China's National Environmental Monitoring Centre data (2013a, 2013b, 2015a, 2015b, 2015c, 2015d, 2015e, 2015f); The people's number and GDP ranking in 74 cities in the first half of 2015 (Askcinet, 2015); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Li L, Lei Y, Pan D, Yu C, and Si, C.. 2016. Economic evaluation of the air pollution effect on public health in China's 74 cities. Springerplus.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- National Natural Science Foundation of China (Grant No. 71173200)
- Development and Research Center of China Geological Survey (Grant Nos. 1212011220302, 12120114056601)
- Key Laboratory of Carrying Capacity Assessment for Resource and Environment, Ministry of Land and Resources (Grant No. CCA2015.08)

Impact of climate conditions on occupational health and related economic losses: a new feature of global and urban health in the context of climate change

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Kjellstrom, T.

Journal

Asia Pac J Public Health

Summary

This study calculated the loss of work capacity due to heat exposure for 21 global regions at baseline (1960-1989) and future periods (2030 and 2050). By combining heat exposure data and estimates of economic consequences, the authors demonstrated the vulnerability of low- and middle-income countries to heat stress. Furthermore, they demonstrated that the annual cost of reduced labor productivity at country level in 2030 can be several percent of GDP. These results suggest an urgent need for effective climate change adaptation and mitigation policies and preventive actions in all countries.

Population

Indoor and outdoor workers

Health Outcomes

- Heat stress

Environmental Agents

List of Environmental Agents:

- Extreme weather/climate change (heat)

Source of Environmental Agents:

- Work-related heat exposure

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Lost economic output, work capacity, and labor productivity

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- 21 global regions, with a specific focus on Asia

Models Used: (Not available)

Methods Used:

- The authors presented examples on estimates of lost economic output due to occupational heat stress, focusing on countries in Asia. They — 1) calculated heat data using Wet Bulb Globe Temperature (WBGT) for different months and years; 2) used detailed regional and national data from the Climate Vulnerability Monitor (2012) report to calculate annual losses as a result of lost work hours, and these projections were used to calculate lost work capacity (reduced labor productivity); 3) used the global Hothaps program to gather produce estimates of heat conditions and trends; 4) mapped results from the Hothaps program to depict spatial distribution of workplace heat stress; and 5) calculated the loss of work capacity due to heat exposure for 21 global regions at baseline (1960-1989) and future periods (2030 and 2050).

Sources Used:

- Hothaps-Soft program (www.ClimateCHIP.org); The "Hothaps" program for assessment of climate change impacts on occupational health and productivity: an invitation to carry out field studies (Kjellstrom et al., 2009); Climate Vulnerability Monitor (DARA, 2012); US National Oceanic Atmospheric Administration (NOAA) publicly available data; Climate Research Unit data (University of East Anglia, UK); Hot environments: estimation of the heat stress on working man, based on the WBGT-Index (International Standards Organization, 1989); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Kjellstrom, T.. 2016. Impact of climate conditions on occupational health and related economic losses: a new feature of global and urban health in the context of climate change. Asia Pac J Public Health.
- [Pubmed](#)
- DOI: (Not available)

NIEHS Funding: (Not available)

Other Funding:

- Australian National University
- Umea University (Sweden)
- Tromso University (Norway)
- Pufendorf Institute, Lund University (Sweden)

Shore power for vessels calling at U.S. ports: benefits and costs

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Vaishnav P, Fischbeck PS, Morgan MG, and Corbett JJ

Journal

Environ Sci Technol

Summary

This study used two integrated assessment models to quantify the benefits of reducing air pollutant emissions (NO_x, SO₂, PM_{2.5}, and CO₂), that would occur if shore power were used by U.S. cargo and cruise ships in port. Researchers found, depending on the social costs of pollution assumed, an air quality benefit of \$70-150 million per year could be achieved by retrofitting one quarter to two-thirds of all vessels that call at U.S. ports. They concluded that such a benefit could be produced at no net cost to society, but would require many ships to be quipped to receive shore power. These results suggest that policy makers could produce a net societal gain by implementing incentives and mandates to encourage a shift toward shore power.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (nitrous oxide (NO_x), sulfur dioxide (SO₂), particulate matter (PM 2.5/fine), carbon dioxide (CO₂))

Source of Environmental Agents:

- Hoteling emissions generated from ships in port

Economic Evaluation / Methods and Source

Type:

Environmental Health Economic Analysis Annotated Bibliography

- Cost-benefit analysis (CBA)

Cost Measured:

- Cost to ship owners for retrofitting U.S. vessels to accept shore power
- cost to U.S. ports of extending or expanding the power distribution network

Potential Cost Measures:

- Cost to ship owners for retrofitting non-U.S. vessels to accept shore power
- cost to non-U.S. ports of extending or expanding the power distribution network

Benefits Measures:

- Monetary benefits for ship owners
- environmental benefits as a result of reduced air pollutant emissions per kilowatt hour via shore power use

Potential Benefits: (Not available)

Location:

- United States

Models Used:

- Air Pollution Emission Experiments and Policy analysis (APEEP) model
- Estimating Air Pollution Impacts Using Regression (EASIUR) method with the Comprehensive Air-Quality model with extensions (CAMx)

Methods Used:

- Researchers used two integrated assessment models to quantify the benefits of reducing the emissions of air pollutants (NO_x, SO₂, PM_{2.5}, and CO₂) that would occur if shore power were used by cruise and cargo ships in port. They — 1) obtained data on cargo vessels (July 2013 to December 2014), port information for vessels, as well as information on cruise and port ships; 2) defined the costs and benefits of using shore power in mathematical equations; 3) obtained the value in dollars (per ton) for emitting pollutants (NO_x, SO₂, and PM_{2.5}) using the APEEP and CAMx models; 4) conducted analysis assuming social costs obtained from both models; and 5) solved mixed-integer linear problems twice for each type of vessel, assuming the social costs of pollutants derived from APEEP and EASIUR.

Sources Used:

- Fleetmon vessel traffic report for 20 U.S. ports (Fleetmon, JAKOTA Cruise Systems, 2015); Cold ironing cost effectiveness study (<http://www.polb.com/civica/filebank/blobdload.asp?BlobID=7718>); Applications of environmental valuation for determining externality costs (Matthews et al. 2000); Measuring the damages of air pollution in the United States (Muller et al., 2007); Evaluation of air quality impacts on society: Methods and application (Heo, 2015); Reduced-form modeling of public health impacts of inorganic PM_{2.5} and precursor emissions (Heo et al., submitted for review); Linking policy to statistical uncertainty in air pollution damages (Muller et al., 2011); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Vaishnav P, Fischbeck PS, Morgan MG, and Corbett JJ. 2016. Shore power for vessels calling at U.S. ports: benefits and costs. Environ Sci Technol.
- [Pubmed](#)
- [DOI](#)

Environmental Health Economic Analysis Annotated Bibliography

NIEHS Funding: (Not available)

Other Funding:

- Center for Climate and Energy Decision Making (SES-0949710)
- Academic Funds through the Department of Engineering and Public Policy from the CIT Dean's Office

Air pollution and procyclical mortality

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Heutel G and Ruhm CJ

Journal

Journal of the Association of Environmental and Resource Economists

Summary

Prior research shows that levels of air pollution fluctuate with the rise and fall of economic conditions, and this study is the first to investigate if these changes are associated with fluctuations in mortality rates. Investigators used a panel dataset to analyze the relationship between air pollutant levels (carbon monoxide, PM10, and ozone), county-level mortality rates (overall, age-, and cause-specific), and county-level unemployment rates between 1982 and 2009. They found a significant positive correlation between pollution concentrations and mortality rates after controlling for demographic variables and state-by-year fixed effects. Consistent with previous research, they also found a negative correlation between county unemployment and mortality rates after controlling for the appropriate variables. Addition of the three air pollutants to the statistical model attenuated the predicted unemployment rate effect by about 17 percent, consistent with a substantial role for air pollution. This attenuation is significant at the 10 percent level or better but is insubstantial in models that include linear time trends. Finally, carbon monoxide concentrations were estimated to be more important than PM10 or ozone concentrations. These results support the possibility that changes in pollution levels explain a portion of the observed procyclical variation in deaths.

Population

Eight age groups: infants (0-1 year), children and young adults (1-19 years); young and middle-aged adults (20-44 years); older adults (45-54 years); elderly (55-64 years, 65-74 years, 75-84 years, and 85 years)

Health Outcomes

- Mortality (cause- and age-specific mortality due to a variety of diseases/outcomes including respiratory diseases, cardiovascular diseases, acute myocardial infarction (heart attack), ischemic heart disease, cerebrovascular disease (stroke), cancer, accidents (total, vehicular, and nonvehicle), suicide, and homicide)

Environmental Agents

List of Environmental Agents:

- Air pollutants (carbon monoxide (CO), particulate matter (PM10/coarse), ozone (O3))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Procyclical fluctuation in mortality rates
- county-level overall, age-specific, and cause-specific mortality rates
- county-level unemployment rates (as a proxy for macroeconomic conditions)

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- United States

Models Used: (Not available)

Methods Used:

- The authors investigated how air pollutants fluctuate with macroeconomic conditions and whether these variations help to explain observed fluctuations in mortality rates between the years of 1982 and 2009. They — 1) combined county-level data on overall, cause-specific, and age-specific mortality with county-level measures of ambient concentrations for three types of air pollutants (carbon monoxide, PM10, and ozone) and unemployment rates and 2) analyzed the relationship between macroeconomic conditions, air pollution, and mortality rates using regression techniques and panel data methods to control for demographic and pollution variables as well as state-by-year fixed effects.

Sources Used:

- Pollution levels from EPA's Air Quality System (AQS) database (<http://www.epa.gov/air/data/>); unemployment rates from the U.S. Department of Labor's Local Area Unemployment Statistics (LAUS) database (<http://www.bls.gov/lau/lauov.htm>); mortality rates from the CDC's Compressed Mortality Files (CMF) (http://www.cdc.gov/nchs/data_accerss/cmf.htm); population estimates from the Surveillance Epidemiology and End Results (SEER) program of the National Cancer Institute (<http://www.seer.cancer.gov/data>); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Heutel G and Ruhm CJ. 2016. Air pollution and procyclical mortality. Journal of the Association of Environmental and Resource Economists.
- [Pubmed](#)
- DOI: (Not available)

Environmental Health Economic Analysis Annotated Bibliography

NIEHS Funding: (Not available)

Other Funding:

- University of Virginia Bankard Fund

Near-roadway air pollution and coronary heart disease: burden of disease and potential impact of a greenhouse gas reduction strategy in Southern California

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-utility analysis (CUA), cost-benefit analysis (CBA)

Authors

Ghosh R, Lurmann F, Perez L, Penfold B, Brandt S, Wilson J, Milet M, Kunzli N, and Mcconnell R

Journal

Environ Health Perspect

Summary

The authors assessed the burden of coronary heart disease (CHD) attributable to near-roadway air pollution (NRAP) relative to PM2.5 for 2008 and also estimated the CHD burden under a 2035 greenhouse gas reduction scenario in California. In 2008, an estimated 1,300 CHD deaths (6.8 percent of the total) were attributable to traffic density and 430 deaths (2.4 percent) to residential proximity to a major road. In 2035, the numbers of estimated CHD deaths and hospitalizations attributable to traffic density are anticipated to increase due to population aging, however this number was much smaller when the authors used the 2008 population age distribution. Results suggest that a large burden of preventable CHD mortality is attributable to NRAP and is likely to increase even with decreasing exposure by 2035 due to vulnerability of an aging population.

Population

Adults (45 years)

Health Outcomes

- Cardiovascular outcomes (coronary heart disease)
- mortality (cause-specific related to coronary heart disease)

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM2.5/fine), near-roadway air pollution (NRAP), elemental carbon (EC))

Source of Environmental Agents:

- Near-roadway air pollution, residential traffic density, proximity to a major road

Economic Evaluation / Methods and Source

Type:

- Cost-utility analysis (CUA)
- cost-benefit analysis (CBA)

Cost Measured:

- Coronary heart disease (CHD) hospitalization rates
- death counts related to coronary heart disease
- CHD population attributable fraction (PAF) due to residential proximity to major roadways

Potential Cost Measures: (Not available)

Benefits Measures:

- Prevented CHD mortality
- reduced CHD hospitalizations

Potential Benefits:

- Decreased burden of stroke and COPD in elderly populations
- decreased burden of asthma exacerbation in children
- other health co-benefits of greenhouse gas reduction

Location:

- California's South Coast Air Basin (comprising the southern part of Los Angeles County, western portions of Riverside and San Bernardino counties, and all of Orange County)

Models Used:

- SCAG Regional Travel Demand Model
- Community Multiscale Air Quality model, version 4.7.1
- Weather Research and Forecasting model version 3.3
- Caline4

Methods Used:

- The authors assessed the burden of coronary heart disease (CHD) attributable to near-roadway air pollution (NRAP) relative to PM_{2.5} in Southern California. The authors — 1) used published concentration response functions (CRF) to estimate the CHD population attributable fraction (PAF) due to residential traffic density, proximity to major roadways, and to background levels of air pollution; 2) used the PAF and cause-specific mortality and hospitalization rates to estimate the CHD attributable number for 2008; and 3) used a hypothetical population scenario to estimate the health co-benefits under a California regulation that will reduce greenhouse gas emissions by 16% in 2035.

Sources Used:

- Total population, household, land use, and real estate data for 2008 were acquired from the Southern California Association of Governments; 2010 U.S. Census tract data; State and County Population Projections - Race/Ethnicity and 5-Year Age Groups, 2010–2060 (California Department of Finance, 2013); mortality and hospitalization data for 2008 from California Department of Public Health; South Coast Air Quality Monitoring District's Air Quality Management Plan (SCAQMD, 2013); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

Environmental Health Economic Analysis Annotated Bibliography

- Ghosh R, Lurmann F, Perez L, Penfold B, Brandt S, Wilson J, Milet M, Kunzli N, and Mcconnell R. 2016. Near-roadway air pollution and coronary heart disease: burden of disease and potential impact of a greenhouse gas reduction strategy in Southern California. Environ Health Perspect.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- P01ES022845, P01ES011627, P30ES007048, R01ES016535

Other Funding:

- U.S. Environmental Protection Agency (RD83544101)
- Hastings Foundation (Pasadena, California)
- the study was partially supported by funds from an air quality violations settlement agreement between the South Coast Air Quality Management District, a California state regulatory agency, and BP (British Petroleum)

Public health costs of primary PM2.5 and inorganic PM2.5 precursor emissions in the United States

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Heo J, Adams PJ, and Gao HO

Journal

Environ Sci Technol

Summary

The authors developed a reduced-form model to estimate marginal social costs and intake fractions for inert primary PM2.5, SO2, NOx, and NH3 in the U.S. Emission-weighted seasonal averages were estimated at \$88,000130,000/ton PM2.5, \$14,00024,000/ton SO2, \$3,80014,000/ton NOx, and \$23,00066,000/ton NH3. The aggregate social costs for year 2005 emissions were estimated at \$1.0 trillion dollars. The authors model allows for updates as emissions inventories and chemical transport model improve, enhancing the potential to link policy research to up-to-date atmospheric science.

Population

Not available

Health Outcomes

- Mortality (premature deaths)

Environmental Agents

List of Environmental Agents:

- Air pollutants (inert primary particulate matter (PM2.5/fine, mainly elemental carbon), and precursors that form PM2.5 (sulfur dioxide (SO2), nitrogen oxides (NOx), ammonia (NH3)))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Marginal social costs

Environmental Health Economic Analysis Annotated Bibliography

- aggregate public health costs

Potential Cost Measures:

- Costs due to primary and secondary organic PM2.5

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- 100 randomly selected locations in the United States

Models Used:

- Estimating Air Quality Social Impacts Using Regression (EASIUR) model

Methods Used:

- The authors used a built reduced-form model to estimate marginal and aggregate public health costs for four major inorganic air pollutants in the United States. The authors — 1) employed a method that they developed, the Estimating Air Quality Social Impacts Using Regression (EASIUR) model, to estimate air quality changes, social costs, and intake fractions from marginal emissions at 100 randomly selected locations in the U.S.; 2) used tagged chemical transport model (CTM) simulations to build a large dataset of air quality public health costs from marginal emissions in the U.S.; 3) used an average plume method to estimate population exposure; and 4) estimated social costs for 11 emissions categories.

Sources Used:

- 2005 emissions and meteorological input data developed for U.S. EPA regulatory impact analysis (EPA-HQ-OAR-2009-0491 and EPA-HQ-OAR-2009-0491) (EPA, 2011); 2005 population data developed for the CAMx grid; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Heo J, Adams PJ, and Gao HO. 2016. Public health costs of primary PM2.5 and inorganic PM2.5 precursor emissions in the United States. Environ Sci Technol.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Center for Climate and Energy Decision Making (SES-0949710)

Airports, air pollution, and contemporaneous health

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Schlenker W and Walker WR

Journal

The Review of Economic Studies

Summary

This study used a novel framework to estimate the contemporaneous health effects and external health costs associated with air pollution generated by local airport runway congestion in California. Study findings showed that daily variation in airport congestion significantly impacted the health of local residents, and this effect was largely driven by carbon monoxide (CO) exposure. A one standard deviation increase in daily pollution levels led to an additional \$1 million in hospital costs for respiratory and heart-related hospital admissions for the 6 million individuals living within 10 km of the 12 largest airports in California; these effects are largest for infants and the elderly. The reported health effects occurred at levels of CO exposure far below existing EPA mandates, and these results suggest lowering the existing CO standard could create sizeable morbidity benefits.

Population

All residents living near 12 major airports in California, and two major subpopulations of these residents: children (5 years) and older adults (65 years)

Health Outcomes

- Respiratory outcomes (asthma, acute respiratory illness, other respiratory illness)
- morbidity outcomes
- cardiovascular outcomes (heart-related problems)

Environmental Agents

List of Environmental Agents:

- Air pollutants (carbon monoxide (CO), nitrous oxide (NO₂), ozone (O₃))

Source of Environmental Agents:

- Local airport runway congestion

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Local hospital admissions (inpatient and emergency room visits)

Potential Cost Measures:

- Costs due to the long-term, cumulative effect of pollution on health
- costs of health effects for individuals living more than 10km from an airport
- non-hospital cost of illness (e.g., primary care visit, prescription medicines, lost work days)
- marginal willingness to pay to avoid treatment

Benefits Measures: (Not available)**Potential Benefits:** (Not available)**Location:**

- California

Models Used: (Not available)**Methods Used:**

- The authors developed a novel framework to estimate the link between ground level airport congestion, local air pollution levels, and contemporaneous health effects (hospitalization rates) for major airports in California. They — 1) focused their analyses on populations and areas within 10km of the 12 major airports; 2) constructed a daily congestion measure for each of the 12 major airports in California by aggregating the combined taxi time of all airplanes at an airport; 3) constructed daily measures of air pollution (CO, NO₂, and O₃) surrounding airports using a specific air pollution monitoring network/database; 4) used temperature, precipitation, and wind data in their analyses to control for direct effects of weather on health, and to leverage the quasi-experimental features of wind direction and wind speed in distribution airport pollution from airports; and 5) measured health effects using hospital discharge and emergency room data for hospitals in California.

Sources Used:

- Air carriers: T-100 domestic segment US carriers data (Bureau of Transportation Statistics, 2008); monitoring network data maintained by the California Air Resource Board (CARB); Caution, drivers! Children present: traffic, pollution, and infant health (Knittel et al., 2011); Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change (Schlenker and Roberts, 2009); Climate change and birth weight (Deschênes et al., 2009); Bureau of Transportation Statistics (BTS) Airline On-Time Performance Database; National Climatic Data (National Oceanic and Atmospheric Administration (NOAA)); California Emergency Department & Ambulatory Surgery data set (2005-2007); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Schlenker W and Walker WR. 2016. Airports, air pollution, and contemporaneous health. The Review of Economic Studies.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Robert Wood Johnson Foundation

The effect of future ambient air pollution on human premature mortality to 2100 using output from the ACCMIP model ensemble

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Silva RA, West JJ, Lamarque JF, Shindell DT, Collins WJ, Dalsoren S, Faluvegi G, Folberth G, Horowitz LW, Nagashima T, Naik V, Rumbold ST, Sudo K, Takemura T, Bergmann D, Cameron-Smith P, Cionni I, Doherty RM, Eyring V, Josse B, Mackenzie IA, Plummer D, Righi M, Stevenson DS, Strode S, Szopa S, and Zengast G

Journal

Atmos Chem Phys

Summary

This study quantified the human premature mortality impacts of future ambient air pollution in years 2030, 2050, and 2100, using Representative Concentration Pathway (RCP) emission scenarios. Due to projected reductions in emissions, PM_{2.5} concentrations were shown to decrease relative to 2000 in all RCP scenarios, and were associated with avoided premature mortality, particularly in 2100. The global mortality burden of ozone markedly increased from 382,000 deaths per year in 2000 to between 1.09 and 2.36 million deaths per year in 2100, across RCPs, mostly due to the effect of increases in population and baseline mortality rates. Trends in future air-pollution related mortality were found to vary regionally across scenarios, reflecting assumptions for economic growth and air pollution control specific to each RCP and region. The authors conclude that the assumed link between economic development and air pollution control in the RCPs requires new and stronger regulations around the world, as well as new control technologies, for the air pollution decreases in the RCPs to be realized.

Population

Adults (25 years)

Health Outcomes

- Mortality (cause-specific mortality due to a variety of diseases, including chronic respiratory diseases, ischemic heart disease, cerebrovascular disease, COPD, and lung cancer)

Environmental Agents

List of Environmental Agents:

- Air pollutants (particulate matter (PM 2.5/fine), ozone (O3))

Source of Environmental Agents:

- Anthropogenic and biomass burning emissions, natural emissions (biogenic volatile organic compounds, ocean emissions, soil and lightning NOx)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Premature mortality associated with ambient air pollution
- global mortality burden of ozone and PM2.5 exposure

Potential Cost Measures:

- Air pollutant effects on morbidity

Benefits Measures:

- Avoided premature mortality associated with ambient air pollution

Potential Benefits: (Not available)

Location: (Not available)

Models Used:

- Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP) ensemble, Integrated Exposure-Response (IER) model for health impacts of PM2.5

Methods Used:

- The authors used modeled ozone and PM2.5 concentrations from the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP) ensemble, along with projections of future population and baseline mortality rates, to quantify the human premature mortality impacts of future ambient air pollution in years 2030, 2050, and 2100. They — 1) obtained hourly and monthly output data for ozone and PM2.5 from the ACCMIP ensemble simulations for a base year (2000) and for future projections under four Representative Concentration Pathway (RCP) scenarios; 2) applied a health impact function to estimate future air-pollution-related cause specific premature mortality associated with exposure to ozone and PM2.5 ambient air pollution; 3) calculated changes in premature mortality by applying the change in pollutant concentrations in each future year (2030, 2050, and 2100) relative to year 2000 concentrations; 4) gridded country-level population projections for 2030, 2050, and 2100 using ArcGIS 10.2 processing tools; 5) estimated the number of deaths per 5-year age group per country using the country level population; and 6) estimated the global mortality burden of ozone and PM2.5 in 2000 and future periods relative to preindustrial 1850 concentrations.

Sources Used:

- Global premature mortality due to anthropogenic outdoor air pollution and the contribution of past climate change (Silva et al., 2013); The Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP): overview and description of models, simulations and climate diagnostics (Lamarque et al. 2013); Tropospheric ozone changes, radiative forcing and attribution to emissions in the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP) (Stevenson et al. 2013); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Silva RA, West JJ, Lamarque JF, Shindell DT, Collins WJ, Dalsoren S, Faluvegi G, Folberth G, Horowitz LW, Nagashima T, Naik V, Rumbold ST, Sudo K, Takemura T, Bergmann D, Cameron-Smith P, Cionni I, Doherty RM, Eyring V, Josse B, Mackenzie IA, Plummer D, Righi M, Stevenson DS, Strode S, Szopa S, and Zengast G. 2016. The effect of future ambient air pollution on human premature mortality to 2100 using output from the ACCMIP model ensemble. Atmos Chem Phys.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- 1R21ES022600-01

Other Funding:

- Portuguese Foundation for Science and Technology
- dissertation completion fellowship from the graduate school at UNC Chapel Hill

Co-benefits of global and regional greenhouse gas mitigation for US air quality in 2050

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Zhang YQ, Bowden JH, Adelman Z, Naik V, Horowitz LW, Smith SJ, and West JJ

Journal

Atmos Chem Phys

Summary

This study used a systematic approach to quantify the co-benefits from both the global and regional greenhouse gas (GHG) mitigation for regional air quality over the United States at fine resolution in 2050, building on scenarios and findings from a 2013 global co-benefits study. The authors found that the total co-benefits of global GHG mitigation from the RCP4.5 scenario compared with its reference were estimated to be higher in the eastern U.S. than the west for PM_{2.5}, while for ozone, the total co-benefits were more uniform. Reductions in co-emitted air pollutants had a much greater influence on both PM_{2.5} (96 percent of the total co-benefits) and ozone (89 percent of the total) than co-benefits achieved via slowing climate change. Furthermore, GHG mitigation from foreign countries contributes more to the U.S. ozone reduction (76 percent of the total) than that from domestic GHG mitigation only (24 percent); and for PM_{2.5}, the benefits of domestic GHG control are greater (74 percent of total). The authors conclude that the U.S. can gain significantly greater domestic air quality co-benefits by engaging with other nations to control GHGs.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone, particulate matter (PM 2.5/fine))

Source of Environmental Agents:

- Greenhouse gas emissions

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured: (Not available)

Potential Cost Measures: (Not available)

Benefits Measures:

- Co-benefits from global and domestic greenhouse gas (GHG) mitigation
- seasonal and spatial patterns of future air quality changes as a result of GHG mitigation
- emission benefits
- air quality benefits from global and domestic greenhouse gas (GHG) mitigation (e.g., reduced co-emitted air pollutants, slowing climate change and its influence on air quality)

Potential Benefits: (Not available)

Location:

- United States (nine regions in the contiguous U.S.)

Models Used:

- Weather Research and Forecasting (WRF) model
- Sparse Matrix Operator Kernel Emissions (SMOKE) program
- Community Multiscale Air Quality Model (CMAQ)
- Model of Ozone And Related Chemical Tracers, version 4, (MOZART-4)
- chemical transport models (CTMs)

Methods Used:

- The authors build on scenarios from a previous global co-benefits study (West et al., 2013, or WEST2013) to examine the co-benefits of both global and regional greenhouse gas (GHG) mitigation for U.S. air quality in 2050 at fine resolution. They — 1) used a comprehensive modeling framework for their downscaling processes, including a regional climate model (Weather Research and Forecasting model), to dynamically downscale the global climate to the contiguous United States; 2) used an emissions processing program (Sparse Matrix Operator Kernel Emissions) to directly process the global anthropogenic emissions to the regional scale; 3) created dynamical boundary conditions from the global co-benefit outputs for the regional chemical transport model; 4) quantified the total co-benefits of global GHG mitigation for U.S. air quality for both PM_{2.5} and O₃; 5) separated the co-benefits into the two mechanisms analyzed by WEST2013 (i.e., co-benefits from reductions in co-emitted air pollutants and co-benefits from slowing climate change and its influence on air quality; 6) quantified the co-benefits from domestic GHG mitigation versus the co-benefits from those of foreign countries' reductions; and 7) presented the co-benefits from global and domestic GHG mitigation for nine U.S. regions.

Sources Used:

- Co-benefits of global greenhouse gas mitigation for future air quality and human health (West et al., 2013); A time-split nonhydrostatic atmospheric model for weather research and forecasting applications (Skamarock and Klemp, 2008); Emission inventory development and processing for the Seasonal Model for Regional Air Quality (SM-RAQ) project (Houyoux et al., 2000); Review of the governing equations, computational algorithms, and other components of the Models-3 Community Multiscale Air Quality (CMAQ) Modeling System (Byun and Schere, 2006); US National Emissions Inventory (NEI); Representative Concentration Pathway (RCP) datasets (REF and RCP4.5 scenarios); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Zhang YQ, Bowden JH, Adelman Z, Naik V, Horowitz LW, Smith SJ, and West JJ. 2016. Co-benefits of global and regional greenhouse gas mitigation for US air quality in 2050. Atmos Chem Phys.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- 1R21ES022600

Other Funding:

- U.S. EPA STAR grant number 834285

World Health Organization estimates of the global and regional disease burden of four foodborne chemical toxins, 2010: a data synthesis

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA), Cost-utility analysis (CUA)

Authors

Gibb H, Devleeschauwer B, Bolger PM, Wu F, Ezendam J, Cliff J, Zeilmaker M, Verger P, Pitt J, Baines J, Adegoke G, Afshari R, Liu Y, Bokkers B, Van Loveren H, Mengelers M, Brandon E, Havelaar AH, Bellinger D

Journal

F1000Res

Summary

This cost analysis estimated the global and regional burden of disease from four foodborne chemicals: aflatoxin, cyanide in cassava, peanut allergen, and dioxin. These four agents were estimated to be associated with 339,000 illnesses (95 percent UI: 186,000–1,239,000); 20,000 deaths (95 percent UI: 8,000–52,000); and 1,012,000 disability adjusted life years (DALYs) (95 percent UI: 562,000–2,822,000) in the year 2010. These results show that chemicals in the food supply can have a significant impact on the global burden of disease, particularly in low- and middle-income countries.

Population

Not available

Health Outcomes

- Cancer outcomes (liver cancer), Neurological/cognitive outcomes (Konzo), Immune outcomes (allergic response), Reproductive outcomes (reduced fertility), Thyroid dysfunction (hypothyroidism)

Environmental Agents

List of Environmental Agents:

- Natural toxicants (cyanide in cassava), Allergen (peanut allergen), Mycotoxins (aflatoxin), Chlorinated compounds (dioxin)

Source of Environmental Agents:

- Food

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)
- Cost-utility analysis (CUA)

Cost Measured:

- Disability adjusted life years (DALYs)

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors estimated the burden of disease for four foodborne chemicals: aflatoxin, cyanide in cassava, peanut allergen, and dioxin. The authors — 1) conducted a systematic literature review for each chemical to develop age- and sex-specific disease incidence and mortality estimates due to these chemicals; and 2) used these estimates to calculate the number of cases, deaths, and disability adjusted life years (DALYs) for each chemical.

Sources Used:

- Incidence and prevalence estimates of cassava cyanide-induced diseases (WHO/FERG report, 2011); Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010 (Lancet, 2012); Parameters needed to estimate the global burden of peanut allergy: systematic literature review (Ezendam et al. 2012); International Agency for Research on Cancer. GLOBOCAN 2012: Estimated Cancer Incidence, Mortality, and Prevalence Worldwide in 2012 (WHO, 2012); Human exposure to POPs across the globe: POPs levels and human health implication: results of the WHO/UNEP human milk survey (UNEP, 2013); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Gibb H, Devleeschauwer B, Bolger PM, Wu F, Ezendam J, Cliff J, Zeilmaker M, Verger P, Pitt J, Baines J, Adegoke G, Afshari R, Liu Y, Bokkers B, Van Loveren H, Mengelers M, Brandon E, Havelaar AH, Bellinger D. 2015. World Health Organization estimates of the global and regional disease burden of four foodborne chemical toxins, 2010: a data synthesis. F1000Res.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- WHO
- National Institute for Public Health and the Environment (Netherlands)
- Ministry of Public Health, Welfare, and Sport (Netherlands)

Environmental health risks and housing values: evidence from more than 1600 toxic plant openings and closings

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Currie J, Davis L Greenstone M, and Walker R

Journal

Am Econ Rev

Summary

This cost-benefit analysis examined the external costs of industrial plants that emit toxic pollutants on housing values and birth outcomes in five US States. The authors found that: 1) toxic air pollutants affect ambient air quality within only one mile of plants; 2) plant openings lead to 11 percent declines in housing values within 0.5 miles or loss of about \$4.25 million for these houses; and 3) the incidence of low birthweight increased by 3% within 1 mile of operating industrial plants. Reliable measures of these different costs and benefits can help policymakers efficiently make siting decisions.

Population

Not available

Health Outcomes

- Birth outcomes (low birthweight)

Environmental Agents

List of Environmental Agents:

- Air pollutants

Source of Environmental Agents:

- Industrial plants

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Lost housing values

Potential Cost Measures:

- Effects of criteria pollutants (particulates, ozone) which may harm human health over a broad geographic area
- impacts on non-residential property

Benefits Measures:

- Local economic benefits of a plant opening (e.g., jobs, increased wages)

Potential Benefits: (Not available)

Location:

- Texas, New Jersey, Pennsylvania, Michigan, Florida

Models Used: (Not available)

Methods Used:

- The authors used a partial equilibrium model to compare housing values and birth outcomes in areas near a toxic plant to those in slightly further away in five U.S. states. The authors — 1) merged data on toxic emissions, housing transactions, infant health, and plant opening and closing dates; 2) used a difference-in-difference strategy to characterize the transport of toxic emissions; 3) employed an econometric regression model to examine effects of plant openings and closings on housing values, exploring effects of plant and community characteristics; and 4) examined the relationship between infant health outcomes and distance from a plant, controlling for maternal characteristics using a two-step, group-level estimator.

Sources Used:

- Toxic Release Inventory (TRI) to identify plants emitting airborne toxic pollutants (US EPA); Longitudinal Business Database to determine plant open/close date (US Census Bureau); Standard Statistical Establishment List to obtain plant names and addresses (US Census Bureau); county registrar websites for housing transaction data; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Currie J, Davis L, Greenstone M, and Walker R. 2015. Environmental health risks and housing values: evidence from more than 1600 toxic plant openings and closings. *Am Econ Rev*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- John D. and Catherine T. MacArthur Foundation
- US EPA (RE: 83479301-0)

What do we know about short- and long-term effects of early-life exposure to pollution?

Environmental Health Economic Analysis Annotated Bibliography

Details

Review Review of many types of economic evaluations

Authors

Currie J, Graff Zivin J, Mullins J, and Neidell M

Journal

Annual Review of Resource Economics

Summary

The authors reviewed the economic literature on the short- and long-term effects of early-life exposure to pollution. The literature provided both direct and indirect evidence that early-childhood exposure to pollution significantly affected later-life outcomes. The authors suggested that given the potentially long-lasting consequences from early exposure to pollution, the marginal returns to pollution control may be particularly high.

Population

Reviewed publications that examined early childhood, late childhood, and adulthood

Health Outcomes

- Reviewed publications that examined birth outcomes (low birth weight
- gestational age), Mortality (infant mortality), Respiratory outcomes (asthma)

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined air pollutants (carbon monoxide (CO)
- particulate matter (PM10/coarse)
- sulfur dioxide (SO₂)
- ozone
- lead), radiation

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Review of many types of economic evaluations

Cost Measured:

- Reviewed publications that examined costs related to educational attainment, test

Environmental Health Economic Analysis Annotated Bibliography

scores, school absence, decreased IQ, childhood hospitalizations, hospitalizations due to respiratory conditions (e.g., infection or asthma), and earnings

Potential Cost Measures: (Not available)

Benefits Measures:

- Reviewed publications that examined benefits related to increased high school graduation rates, test scores, and adult earnings due to reduced pollution levels

Potential Benefits: (Not available)

Location: (Not available)

Models Used: (Not available)

Methods Used:

- The authors reviewed the economic literature on the short- and long-term effects of early-life exposure to pollution. The authors — 1) developed a conceptual model that links pollution exposure and birth outcomes to health and human capital later in life; and 2) provided a structured reviewed of the literature, focusing on how early-life exposure to pollution affects outcomes in early childhood, late childhood, and adulthood.

Sources Used:

- Chernobyl's subclinical legacy: prenatal exposure to radioactive fallout and school outcomes in Sweden (Almond et al., 2009); Gray matters: pollution and human capital formation (Bharadwaj et al., 2013); This is only a test? Long-run impacts of prenatal exposure to radioactive downfall from nuclear weapon testing (Black et al., 2013); Air pollution and infant health: What can we learn from California's recent experience? (Currie and Neidell, 2005); The impact of air pollution on infant mortality: evidence from geographic variation in pollution shocks induced by a recession (Chay and Greenstone, 2003); Do current levels of air pollution kill? The impact of air pollution on population mortality in England (Janke et al., (2009); Information, avoidance behavior, and health: the effect of ozone on asthma hospitalizations (Neidell, 2009); External health costs of a steel mill (Ransom and Pope, 1995); The impact of air pollution on cognitive performance and human capital formation (Lavy et al., 2012); Childhood lead and academic performance in Massachusetts (Reyes, 2011); Air pollution and academic performance: evidence from California schools (Zweig et al., 2009); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Currie J, Graff Zivin J, Mullins J, and Neidell M. 2014. What do we know about short- and long-term effects of early-life exposure to pollution?. Annual Review of Resource Economics.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Getting cars off the road: the cost-effectiveness of an episodic pollution control program

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-effectiveness analysis (CEA)

Authors

Cropper ML, Jiang Y, Alberini A and Baur P

Journal

Environmental and Resource Economics

Summary

This cost-effective analysis compared the cost of an episodic vehicle permit scheme that requires people to buy permits to drive on high ozone days with the cost of year-round ozone control in the Washington DC metropolitan area. At a low permit price (\$75), the program would reduce VOCs by 39-50 tons and NOx by 33-42 tons on a high-ozone day. The cost per ozone season of achieving these reductions is approximately \$9 million (2008 USD), compared to \$70.4 million annually for the cost of a year-round control program that meets the same reductions as the episodic program. Results suggest that an episodic program could be a cost-effective way of reducing ozone precursors on high ozone days.

Population

Adults (18 years)

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone (O3))
- Volatile organic compounds (VOCs)
- Nitrous oxides (NOx)

Source of Environmental Agents:

- Mobile sources (vehicles)

Economic Evaluation / Methods and Source

Type:

- Cost-effectiveness analysis (CEA)

Cost Measured:

- Cost of purchasing a permit
- cost per ton of emissions reduced

Potential Cost Measures: (Not available)**Benefits Measures:** (Not available)**Potential Benefits:** (Not available)**Location:**

- Washington DC metropolitan area

Models Used: (Not available)**Methods Used:**

- The authors examined the cost-effectiveness of an episodic pollution control program that requires people to purchase permits to drive on days when ozone levels are high. The authors — 1) surveyed over 1,300 commuters in the Washington D.C. Metropolitan Area to determine household characteristics and willingness to pay for a permit; 2) applied survey results to an econometric model and random effects probit model to estimate permit demand and effects of price on permit demand; 3) used probability of purchasing a permit to predict number of cars removed from the road and cost of the permit program; 4) estimated emission reductions using number of vehicles removed and average daily tailpipe emissions; and 5) used the random effects probit model to estimate the cost of the program with less than full compliance.

Sources Used:

- Data from a survey of 1,383 Washington metropolitan area commuters used to evaluate the episodic ozone control program (survey conducted January - March of 2008 by SRBI International); vehicle ownership by household from 2000 U.S. Census data; number of passenger vehicles in Washington D.C. area from National Capital Region Transpiration Planning board (2006); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Cropper ML, Jiang Y, Alberini A and Baur P. 2014. Getting cars off the road: the cost-effectiveness of an episodic pollution control program. Environmental and Resource Economics.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)**Other Funding:** (Not available)

Temperature, human health, and adaptation: a review of the empirical literature

Environmental Health Economic Analysis Annotated Bibliography

Details

Review

Authors

Deschnes, O

Journal

Energy Economics

Summary

This empirical review examined the determinants and effects of adaptation on human health in response to extreme weather and climate events, with a narrowed focus on health impacts and adaptation driven by exposure to extreme temperatures. The author concluded that most existing studies found that temperature extremes lead to significant reductions in health, generally measured by excess mortality, and available evidence indicates that adaptation is both economically important and contributes to reducing mortality attributable to temperature extremes. Findings from this review offer broader implications for policy and areas for future research. It is important to develop estimates for countries where economies are more weather-dependent or where current temperatures are higher than in the United States. Due to the lack of infrastructure and limited economic resources in these countries, identifying feasible and life-preserving adaptations is especially important. Additionally, there is a pressing need for developing databases and research designs to study additional forms of adaptation in the United States and elsewhere.

Population

Not available

Health Outcomes

- Reviewed publications that examined mortality (all-cause and cause-specific mortality (cardiovascular disease and respiratory disease))

Environmental Agents

List of Environmental Agents:

- Reviewed publications that examined extreme weather/climate change (extreme temperatures)

Source of Environmental Agents:

- Reviewed publications that examined global climate change

Economic Evaluation / Methods and Source

Type: (Not available)

Cost Measured:

- Reviewed publications that examined adaptation strategies and their role in reducing the health impacts of climate change (household and community level adaptation)
- adaptation measures
- temperature exposure variables
- mortality counts (all-cause and all-age)
- hospital admission records

Potential Cost Measures:

- Reviewed publications that examined health-related welfare losses due to morbidity rates, chronic disease, and quality of life

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location: (Not available)

Models Used:

- Becker-Grossman economic health production model

Methods Used:

- The author performed a review of existing literature to examine the relationship between health outcomes, temperature, and adaptation to temperature extremes. The author — 1) presented the conceptual and methodological issues associated with the measurement of the effect of temperature extremes on health, and the role of adaptation in muting these effects; 2) derived the implications of a simple version of the Becker-Grossman economic model of health production in the presence of adaptation, which highlights a key tradeoff between health production and costly adaptation; 3) presented a review of relevant economic literature, as well as the public health and epidemiology literature; and 4) concluded with a discussion on the remaining gaps in the empirical literature, the implications of currently available evidence for assessments of the potential health impacts of global climate change, and guidelines for improving the current Integrated Assessment Model (IAM) literature that seeks to incorporate human health and adaptation in its framework.

Sources Used:

- Impacts, adaptation, and vulnerability (International Panel on Climate Change Working Group II, 2007); Days of haze: environmental information disclosure and intertemporal avoidance behavior (Graff-Zivin and Neidell, 2009); Relationships between weather and myocardial infarction: a biometeorological approach (Morabito et al., 2005); Has the impact of heat waves on mortality changed in France since the European heat wave of summer 2003? A study of the 2006 heat wave (Fouillet et al., 2008); Temperature and cardiovascular deaths in the U.S. elderly (Barnett, 2007); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Deschnes, O. 2014. Temperature, human health, and adaptation: a review of the

Environmental Health Economic Analysis Annotated Bibliography

empirical literature. Energy Economics.

- **Pubmed:** (Not available)

- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Sacred cars? Cost-effective regulation of stationary and nonstationary pollution sources

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Fowle M, Knittel CR, and Wolfram C

Journal

American Economic Journal: Economic Policy

Summary

The authors compared the marginal costs of abating NO_x emissions from power plants to the marginal costs of abating NO_x emissions from passenger vehicles. The marginal cost of reducing NO_x from power plants was more than double the marginal cost of abating NO_x emissions from passenger vehicles. The authors estimated that the total costs of achieving the NO_x emissions reductions mandated by the point and mobile source programs could be reduced by 6 percent (or \$1.6 billion) through more efficient regulatory coordination. These results highlight the potential gains from improved regulatory coordination across sectors.

Population

Not available

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (nitrous oxides (NO_x))

Source of Environmental Agents:

- Mobile (vehicles) and stationary sources (coal-fired power plants)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Point source costs: capital, installation, and operating costs of pollution control

Environmental Health Economic Analysis Annotated Bibliography

- technologies
- cost of emissions permits
- mobile source costs: increased vehicle costs
- engineering costs
- certification costs

Potential Cost Measures:

- Costs associated with regulatory distortions and optimization error in electricity sector estimates
- costs of steps to reduce vehicle emissions beyond regulation guidelines
- reduced demand from consumers

Benefits Measures: (Not available)

Potential Benefits:

- Avoided damages due to reduced emissions
- co-benefits from reductions in other mobile source pollutants (sulfur and particulate matter)
- reduced emissions from nonroad diesel vehicles
- benefits of fuel desulfurization regulation

Location:

- United States

Models Used:

- EPA's Integrated Planning Model (2003), MOBILE5 model
- MOBILE6, Air Pollution Emissions Experiments and Policy (APEEP) model

Methods Used:

- The authors compared the marginal costs of abating NOx emissions from power plants to the marginal costs of abating NOx emissions from passenger vehicles. The authors — 1) constructed estimates of NOx marginal abatement costs for power plants using detailed unit-level engineering data; 2) constructed estimates for light-duty car and truck NOx abatement costs based on existing engineering analyses; and 3) compared abatement costs between point and mobile sources.

Sources Used:

- Unit- and plant-level data from the Electric Power Research Institute (EPRI) software; data from EPA's Regulatory Impact Analyses (RIA); data from field testing of available pollution control technologies; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Fowlie M, Knittel CR, and Wolfram C. 2012. Sacred cars? Cost-effective regulation of stationary and nonstationary pollution sources. *American Economic Journal: Economic Policy*.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

The impact of pollution on worker productivity

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Zivin JG and Neidell M

Journal

The American Economic Review

Summary

This study analyzed and reported the impact of ozone pollution on worker productivity for a cohort of agricultural workers employed by a large farm in the Central Valley of California. Investigators found that a 10 ppb decrease in average ozone levels increases worker productivity by 5.5 percent. Furthermore, they determined that impacts on worker productivity became statistically significant at 42-46 ppb, a concentration well below federal ozone air quality standards of 75 ppb. This study is the first to rigorously assess effects of the environment on worker productivity, and results indicate that ozone, even at levels below current air quality standards in most of the world, has significant negative impacts on worker productivity. Authors suggest that strengthening of regulations on ozone pollution would yield additional benefits with avoided exposure.

Population

Agricultural workers (male and female) employed by a large farm

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone (O3))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

Environmental Health Economic Analysis Annotated Bibliography

- Worker productivity

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Central Valley, California

Models Used: (Not available)

Methods Used:

- The authors analyzed the impact of ozone pollution on worker productivity for a cohort of agricultural workers. They — 1) derived data on daily worker productivity from an electronic payroll system used by a large farm in the Central Valley of California (1600 workers over the course of 155 days); 2) obtained environmental and air quality data conducted the analysis of ozone effects on worker productivity at the daily level; 3) merged the worker data with environmental conditions based on readings from air quality and meteorology stations in the California air monitoring network; and 4) used regression models to relate mean ozone concentrations (during the typical workday) to worker productivity.

Sources Used:

- Air quality and meteorological information system (California EPA, California Air Resources Board, 2012); Orange Enterprises (OE) payroll collection data from the Payroll Employee Tracking (PET) Tiger software system (worker dataset); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Zivin JG and Neidell M. 2012. The impact of pollution on worker productivity. The American Economic Review.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding:

- R21ES019670

Other Funding:

- Property and Environment Research Center
- Institute for Social and Economic Research and Policy

Pollution, health, and avoidance behavior: evidence from the Ports of Los Angeles

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Moretti E and Neidell M

Journal

Journal of Human Resources

Summary

This cost analysis study estimated the short-term health effects of ozone between the years 1993 and 2000 using daily data on boat traffic at ports in the Los Angeles area as an instrumental variable of ozone exposure. Upon merging several datasets on daily air pollution and health effects and applying a conceptual framework of equations, investigators estimated that ozone causes at least \$44 million in annual costs in Los Angeles from respiratory-related hospitalizations along and that the cost of avoidance behavior is at least \$11 million per year. Although these estimates cover a wide range, they are at least as large as the medical and wage expenditures based on a cost of illness analysis, suggesting considerable costs from this nonmarket behavior.

Population

Four age groups: infants and young children (0-5 years); children and adolescents (6-14 years), young adults and older adults (15-64 years), and elderly (64 years)

Health Outcomes

- Respiratory outcomes (pneumonia, bronchitis, asthma, and other respiratory illnesses)

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone (O3))

Source of Environmental Agents:

- Emissions from boat traffic in ports

Economic Evaluation / Methods and Source

Type:

Environmental Health Economic Analysis Annotated Bibliography

- Cost analysis (CA)

Cost Measured:

- Respiratory-related emergency department visits
- willingness to pay (WTP) to reduce ozone levels
- costs of avoidance behavior from ozone-related hospitalizations

Potential Cost Measures:

- Costs related to other short-term effects of ozone that do not result in hospitalizations
- costs related to long-term effects of ozone

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- Los Angeles and Long Beach, California

Models Used: (Not available)

Methods Used:

- The authors estimated the short-term effects of ozone on health accounting for avoidance behavior, confounding factors, and measurement error, and provided estimates of the welfare effects and costs of avoidance behavior from ozone-related hospitalizations in the Los Angeles area. They — 1) obtained daily data from the marine exchange of southern California on boat arrivals and departures into the port of Los Angeles, and used boat traffic as an instrumental variable for ozone levels; 2) obtained health data from respiratory-related emergency department visits from the California Hospital Discharge Data (CHDD) for specific age groups; 3) obtained daily pollution data maintained by the California Air Resources Board; 4) obtained weather data from the National Climatic Data Center; 5) merged datasets together at the daily level by zip code for the months of April-October for the years 1993-2000 for all zip codes in the South Coast Air Quality Management District (SCAQMD); and 6) used a conceptual framework with mathematical equations to estimate the health effects of ozone.

Sources Used:

- Air quality data from the South Coast Air Quality Management District (SCAQMD); California Hospital Discharge Data (CHDD) on respiratory-related emergency department visits for specific age groups; California Air Resources Board daily pollution data; data on boat traffic from the marine exchange of southern California; data on weather from the National Climatic Data Center; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Moretti E and Neidell M. 2011. Pollution, health, and avoidance behavior: evidence from the Ports of Los Angeles. Journal of Human Resources.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Does pollution increase school absences?

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Currie J, Hanushek EA, Kahn EM, Neidell M, and Rivkin SG

Journal

The Review of Economics and Statistics

Summary

The authors examined the effects of carbon monoxide (CO), ozone, and particulate matter concentrations on school absences from 1996-2001 in 39 of the largest school districts in Texas. They found that high CO levels, even when below regulatory thresholds set by the EPA, significantly increased absences. In highly polluted areas, reductions in the number of days with high CO concentrations reduced absences by 0.8 percentage points. Results suggest that lowering CO levels may yield economically significant health benefits.

Population

School children (1st through 8th grade)

Health Outcomes

- Not available

Environmental Agents

List of Environmental Agents:

- Air pollutants (carbon monoxide (CO)), Ozone (O3), Particulate matter (PM10/coarse))

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Missed school days

Potential Cost Measures: (Not available)

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Environmental Health Economic Analysis Annotated Bibliography

Location:

- 39 of the largest school districts in Texas

Models Used: (Not available)

Methods Used:

- The authors examined the effects of air pollution on school absences in 39 of the largest school districts in Texas. The authors — 1) merged administrative school-level panel data with pollution monitor data; 2) employed in a difference-in-difference-in differences (DDD) which held school, year, and attendance period characteristics constant and also controlled for precipitation and temperature; and 3) compared DDD results to ordinary least squares estimates.

Sources Used:

- School absence data for 1996-2001 (The Texas Schools Project, University of Texas, Dallas); air pollution data from Texas Commission on Environmental Quality (TCEQ) monitors; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Currie J, Hanushek EA, Kahn EM, Neidell M, and Rivkin SG. 2009. Does pollution increase school absences?. The Review of Economics and Statistics.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding: (Not available)

Child mental health and human capital accumulation: the case of ADHD

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost analysis (CA)

Authors

Currie J and Stabile M

Journal

Journal of Health Economics

Summary

The authors examined the effects of ADHD on child human capital outcomes, including grade repetition, mathematics scores, reading scores, special education, and delinquency, using data from the Canadian National longitudinal Survey of Children and Youth, and the American National Longitudinal Survey of Youth. They found that children with symptoms of hyperactivity suffered large negative consequences in terms of their test scores and schooling attainment. Furthermore, hyperactivity was a more important determinant of reduced human capital accumulation than chronic physical health problems, like asthma.

Population

Children and adolescents (4-11 years)

Health Outcomes

- Neurological/cognitive outcomes (ADHD)

Environmental Agents

List of Environmental Agents: (Not available)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost analysis (CA)

Cost Measured:

- Child's human capital accumulation captured using the following measures: grade repetition, mathematics scores, reading scores, special education, and delinquency

Potential Cost Measures: (Not available)

Environmental Health Economic Analysis Annotated Bibliography

Benefits Measures: (Not available)

Potential Benefits: (Not available)

Location:

- United States and Canada

Models Used: (Not available)

Methods Used:

- The authors examined the effects of ADHD on child human capital outcomes using data from the Canadian National Longitudinal Survey of Children and Youth and the American National Longitudinal Survey of Youth. The authors — 1) generated hyperactivity scores using results from surveys administered to the children, their parents, and their teachers; 2) estimated ordinary least squares (OLS) models of the relationship between hyperactivity scores in 1994 and child human capital outcomes in 1998, controlling for a wide range of other potentially confounding variables, such as maternal health status; 3) estimated sibling fixed effects models to control for omitted variables bias; 4) estimated OLS models to examine how ADHD outcomes are mediated by income; and 5) compared outcomes of ADHD to those of chronic health problems, such as asthma.

Sources Used:

- Canadian National Longitudinal Survey of Children and Youth; American National Longitudinal Survey of Youth; results from hyperactivity surveys given to children and their parents and teachers; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Currie J and Stabile M. 2006. Child mental health and human capital accumulation: the case of ADHD. Journal of Health Economics.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Social Science and Humanities Research Council of Canada

Air pollution and infant health: what can we learn from California's recent experience?

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Currie J and Neidell M

Journal

Quarterly Journal of Economics

Summary

The authors examined the impact of ozone, carbon monoxide (CO), and particulate matter (PM10) on infant health in California over the 1990s. Reductions in CO during this time period were estimated to save approximately 1,000 infant lives in California. This reduction in infant deaths due to reduced air pollution was valued at \$1.6 – \$4.8 billion.

Population

Infants (26 weeks gestation)

Health Outcomes

- Mortality (infant death, fetal death), Birth outcomes (low birth weight)

Environmental Agents

List of Environmental Agents:

- Air pollutants (ozone (O3)), Carbon monoxide (CO), Particulate matter (PM10/coarse)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Infant deaths
- infant mortality rates

Potential Cost Measures:

- Willingness to pay for pollution reduction
- costs of reducing pollution

Benefits Measures:

Environmental Health Economic Analysis Annotated Bibliography

- Value of infant lives saved due to pollution reduction

Potential Benefits:

- Benefits of pollution abatement (e.g., effects of pollution levels on housing prices)

Location:

- California

Models Used: (Not available)

Methods Used:

- The authors examined the impact of air pollution on infant health in California over the 1990s. The authors — 1) developed a flexible, discrete-time, hazard model to estimate probability of infant death due to air pollution; 2) used case-control sampling to reduce the number of observations; and 3) developed models to estimate the probability of fetal death and low birth weight to investigate the effects of prenatal exposure.

Sources Used:

- Air pollution data from California Environmental Protection Agency's air monitoring stations; weather data from National Climatic Data Center TD3200; infant death data from California Birth Cohort files for 1989-2000; additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Currie J and Neidell M. 2005. Air pollution and infant health: what can we learn from California's recent experience?. Quarterly Journal of Economics.
- [Pubmed](#)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Princeton's Center for Health and Well-Being
- University of Chicago's Center for Integrating Statistical and Environmental Science

An assessment of the benefits of air pollution control: the case of infant health

Environmental Health Economic Analysis Annotated Bibliography

Details

Research article Cost-benefit analysis (CBA)

Authors

Joyce TJ, Grossman M, and Goldman F

Journal

Journal of Urban Economics

Summary

This study estimated the impact of five criteria air pollutants (carbon monoxide, lead, sulfur dioxide, particulates, and nitrogen dioxide) on race-specific neonatal mortality rates across heavily populated counties within the United States in 1977. Results showed that carbon monoxide and total suspended particulates have the most consistently negative impacts on early infant survival. However, when all five pollutants were employed as regressors, sulfur dioxide was the only significant predictor of neonatal mortality. Furthermore, the authors' calculations of a collective marginal willingness to pay estimate (for white and black women) based on declines in sulfur dioxide levels totaled an upper bound estimate of \$1.09 billion and a lower bound estimate of \$54 million in 1977. The authors suggest that the main contribution of this study is that these estimates were obtained from a well-specified behavioral model of the production of health, which was estimated with the appropriate simultaneous equation techniques.

Population

Not available

Health Outcomes

- Mortality (race-specific neonatal mortality)

Environmental Agents

List of Environmental Agents:

- Air pollutants (nitrogen dioxide (NO₂), carbon monoxide (CO), lead (Pb), sulfur dioxide (SO₂), total suspended particulates)

Source of Environmental Agents: (Not available)

Economic Evaluation / Methods and Source

Type:

- Cost-benefit analysis (CBA)

Cost Measured:

- Marginal willingness to pay for declines in air pollutant levels
- marginal cost of prenatal care
- marginal cost of neonatal intensive care
- race-specific neonatal mortality rates

Potential Cost Measures:

- Indirect costs of neonatal intensive care

Benefits Measures:

- Increases in neonatal survival rates as a results of decreased air pollutant levels (specifically sulfur dioxide (SO₂))

Potential Benefits: (Not available)**Location:**

- United States (677 most populated counties in the country in 1970)

Models Used: (Not available)**Methods Used:**

- Researchers measured the impact of air pollution on race-specific neonatal mortality rates (deaths within the first 27 days of life per thousand live births) across heavily populated counties within the United States in 1977. They — 1) obtained population variables from a dataset that pertains to the 677 most populated counties of the United States; 2) obtained air pollution variables and raw data on the criteria air pollutants of interest (CO, Pb, SO₂, particulates, and NO₂) from EPA's Storage and Retrieval of Aerometric Data (SAROAD); 3) used an algorithm to calculate county-specific estimates of the air pollutants; 4) fitted equations on race-specific neonatal mortality using a two-stage least-squares procedure; and 5) calculated the marginal willingness to pay for declines in SO₂ that result in increases in neonatal survival rates.

Sources Used:

- Behavior of mothers as inputs to child health: determinants of birth weight, gestation, and rate of fetal growth (Rosenzweig et al., 1982); Consumer demand and household production: the relationship between fertility and child mortality (Rosenzweig and Schultz, 1983); Education and household production of child health (Rosenzweig and Schultz, 1981); Estimating a household production function: heterogeneity, the demand for health inputs, and their effects on birth weight (Rosenzweig and Schultz, 1983); Determinants of neonatal mortality rates in the US: a reduced form model (Gorman and Grossman, 1985); EPA's Storage and Retrieval of Aerometric Data (SAROAD); additional sources cited in publication

Economic Evaluation / Methods and Source

Citation:

- Joyce TJ, Grossman M, and Goldman F. 1989. An assessment of the benefits of air pollution control: the case of infant health. *Journal of Urban Economics*.
- **Pubmed:** (Not available)
- [DOI](#)

NIEHS Funding: (Not available)

Other Funding:

- Cooperative agreement with the U.S. Environmental Protection Agency (CR 811041)

