National Institute of Environmental Health Sciences

Environmental Health Economic Analysis Annotated Bibliography

Introduction

The NIEHS Annotated Environmental Health Economic Analysis Bibliography is a resource for environmental health researchers who are looking to learn about economic analyses and incorporate them into their research. This list summarizes key attributes from almost 70 environmental health science articles that include economic analyses. Researchers can search by exposures studied, health outcomes analyzed, economic analysis methods used, and economic data cited. Full references to the articles are provided.

This document contains information from selected publications, mostly from the US, that address environmental health and include an economic analysis component. The bibliography is not comprehensive – articles were curated to select those most in line with current NIEHS funded research. We plan to update these resources periodically. To nominate an article for review, contact: EHEA@niehs.nih.gov.

Suggested Citation:
NIEHS (National Institute of Environmental Health Sciences). 2022. Environmental Health Economic Analysis Annotated Bibliography. Available: www.niehs.nih.gov/EHEAcitation

Coding Details

Peer-reviewed articles were identified from calendar years 1989-2021 in the following databases:

- Easy DANS archives
- Econlit
- Google Scholar
- NBER Database
- PubMed
- Scopus
- Science.gov
- Web of Science

Using the following key words:

- Burden
- *Cost benefit (cost benefit analysis, cost analyses, etc.)
- *Cost effective (cost effective analysis, cost utilities, cost measure etc.)
- *Economic (economic analysis, economic evaluation, economic impacts, etc.)
- QALY

Combined with environmental pollutant* OR environmental pollution OR environmental health OR air pollution OR air pollutant* OR mercury OR lead (Pb) or metal OR BPA OR pesticide* OR phthalate OR PCB OR cookstove (and other relevant exposures).

Response options for each of the coded categories are listed below.

Article Type

- Research article
- Review
- Commentary
- Report/white paper

Type of Economic Evlauation

- Cost analysis
- Cost-effectiveness analysis
- Cost-utility analysis
- Cost-benefit analysis

General Information

- Study specific population
- Environmental agents
- Health outcomes
- Location/Region specificity

Methodology and Analysis

- Models Used
- Models Used (Links or References)
- Methods Used

Economic Measures/Variables for Costs and Benefits

- Costs Measures/Variables Measured
- Potential Cost Measures/Variable Measures
- Benefits Measures/Benefits Variables
- Potential Benefits Measures/Benefits Variables

Data Sources, Funding, and Summaries

- Sources of Data
- NIEHS Funding
- Summaries

National Institute of Environmental Health Sciences

Index of Topics

This index provides page numbers for key methods, exposures and outcomes that may be of interest to readers.

Index of Topics *(continued)*

Health Outcomes

National Institute of Environmental Health Sciences

Health costs of occupational disease in New York State

Article #1

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)

Costs 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

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

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 16 4

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/2610214

DOI: http://dx.doi.org/1002/ajim.4700160409

NIEHS Funding: Not Available

Other Funding: Not Available

Controlling urban air pollution: a benefit-cost assessment Article #2

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 (NOx), sulfur oxides (SOx), volatile organic compounds (VOCs))

Source of Environmental Agents: VOC emissions in nonattainment areas

Economic Evaluation / Methods and Source

Type: Cost-benefit analysis (CBA)

Costs 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 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 — 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.

Citation: Krupnick AJ and Portney PR 1991 Controlling urban air pollution: a benefit-cost assessment Science 252 5005

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/1902322

DOI: Not Available

Other Funding: Not Available

Valuing the health benefits of clean air — Article #3

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)

Costs Measured: 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.

Citation: Hall JV, Winer AM, Kleinman MT, Lurmann FW, Brajer V, and Colome SD 1992 Valuing the health benefits of clean air Science 255 5046

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/1536006

DOI: Not Available

NIEHS Funding: Not Available

Other Funding: Not Available

Societal benefits of reducing lead exposure — Article #4

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)

Costs Measured: Costs related to reduced IQ (reduced lifetime earnings, effect on schooling and educational achievement, special education); 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.

Citation: Schwartz J 1994 Societal benefits of reducing lead exposure Environmental Research 66 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/8013434

DOI: http://dx.doi.org/10.1006/enrs.1994.1048

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #5

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)

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

Potential Cost Measures: Not Available

Benefits Measures: 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.

Citation: Salkever DS 1995 Updated estimates of earnings benefits from reduced exposure of children to environmental lead Environmental Research 70 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/8603652

DOI: http://dx.doi.org/10.1006/enrs.1995.1038

NIEHS Funding: Not Available

Other Funding: Not Available

An economic evaluation of the environmental benefits from pesticide reduction

Article #6

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)

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

Potential Cost Measures: Not Available

Benefits Measures: 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 respondent’s 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.

Citation: Brethour C and Weersink A 2001 An economic evaluation of the environmental benefits from pesticide reduction Agricultural Economics 25

Pubmed: Not Available

DOI: http://dx.doi.org/10.1111/j.1574-0862.2001.tb00202.x

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

Article #7

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)

Costs 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); 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.

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 109 Suppl 6

Pubmed: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1240624/

DOI: Not Available

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #8

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)

Costs 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.

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 107 2

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/11174182

DOI: http://dx.doi.org/10.1067/mai.2001.112851

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #9

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 (NOx, NO2))

Source of Environmental Agents: Reviewed publications that examined — air pollution from motor vehicles; NOx sources combined; emissions from stationary sources

Economic Evaluation / Methods and Source

Type: Cost-benefit analysis (CBA)

Costs 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).

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 6 2

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/21432239

DOI: http://dx.doi.org/10.1007/BF02897948

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

Article #10

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

Type: Cost analysis (CA)

Costs 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.

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 110 7

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/12117650

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

Article #11

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

Type: Cost-benefit analysis (CBA)

Costs 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.

Citation: 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 1 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/12537591

DOI: Not Available

NIEHS Funding: Not Available

Other Funding: Not Available

Fuels for urban transit buses: a cost-effectiveness analysis Article #12

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)

Costs Measured: Resource costs such as vehicle procurement, infrastructure development, and operations (vehicle maintenance, facility maintenance, and fuel); 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, NOx, 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.

Citation: Cohen JT, Hammitt JK, and Levy JI 2003 Fuels for urban transit buses: a cost-effectiveness analysis Environmental Science & Technology 37 8

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/12731827

DOI: http://dx.doi.org/10.1021/es0205030

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #13

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)

Costs 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.

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 332 1-3

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/15081739

DOI: http://dx.doi.org/10.1016/j.scitoenv.2003.09.010

NIEHS Funding: Not Available

Other Funding: Not Available

Assessing the health benefits of air pollution reduction for children

Article #14

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)

Costs Measured: Hospital admissions and emergency department visits

Potential Cost Measures: 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.

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 112 2

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/14754578

DOI: http://dx.doi.org/10.1289/ehp.6299

NIEHS Funding: 1P01ES09601

Other Funding: Not Available

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

Article #15

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)

Costs 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.

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 116 5

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/16275376

DOI: http://dx.doi.org/10.1016/j.jaci.2005.07.032

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #16

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 NOx emitted by large, stationary point sources (power plants)

Economic Evaluation / Methods and Source

Type: Cost analysis (CA)

Costs 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 NOx 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 NOx 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.

Citation: Mauzerall DL, Sultan B, Kim N, and Bradford DF 2005 NOx emissions from large point sources: variability in ozone production, resulting health damages and economic costs Atmospheric Environment 39

Pubmed: Not Available

DOI: http://dx.doi.org/10.1016/j.atmosenv.2004.12.041

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #17

Details	Research article	Cost analysis (CA)

Authors Trasande L, Landrigan PJ, and Schecter 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)

Costs Measured: Loss of earnings over lifetime due to decreased IQ

Potential Cost Measures: Cardiovascular impacts; 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.

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 113 5

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/15866768

DOI: http://dx.doi.org/10.1289/ehp.7743

NIEHS Funding: P42ES07384

Other Funding: Not Available

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

Article #18

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

Type: Cost analysis (CA)

Costs 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.

Citation: Davies K 2006 Economic costs of childhood diseases and disabilities attributable to environmental contaminants in Washington state, USA Ecohealth 3 2

Pubmed: Not Available

DOI: http://dx.doi.org/10.1007/s10393-006-0020-1

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #19

Details	Research article	Cost analysis (CA)

Authors Trasande L, Schecther 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)

Costs Measured: IQ deficits associated with prenatal mercury exposure; economic costs associated with IQ deficits; costs of excess mental retardation (MR) cases; cost of caring for MR children

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Policies (e.g., EPAs 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.

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 1076

Pubmed: Not Available

DOI: http://dx.doi.org/10.1196/annals.1371.034

NIEHS Funding: P42ES07384-07S1

Other Funding: Not Available

Economic implications of manganese neurotoxicity Article #20

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 (Manganese))

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)

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

Potential Cost Measures: Costs of institutionalization; 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.

Citation: Weiss B 2006 Economic implications of manganese neurotoxicity NeuroToxicology 27 3

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/15936082

DOI: Not Available

NIEHS Funding: P01ES001247; P50ES001247; P30ES001247

Other Funding: Not Available

The economic impact of clean indoor air laws — Article #21

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)

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

Citation: Eriksen M and Chaloupka F 2007 The economic impact of clean indoor air laws CA: A Cancer Journal for Clinicians 57 6

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/17989131

DOI: http://dx.doi.org/10.3322/CA.57.6.367

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #22

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)

Costs 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: 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.

Citation: Pelham WE, Foster EM, and Robb JA 2007 The economic impact of attention-deficit/hyperactivity disorder in children and adolescents Ambulatory Pediatrics 7 Suppl 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/17261491

DOI: http://dx.doi.org/10.1016/j.ambp.2006.08.002

NIEHS Funding: Not Available

Other Funding: Not Available

How much disease burden can be prevented by environmental interventions

Article #23

Details	Review	Not Available

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

Costs 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.

Citation: Prüss-Ustün A and Corvalán C 2007 How much disease burden can be prevented by environmental interventions Epidemiology 18 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/16971860

DOI: http://dx.doi.org/10.1097/01.ede.0000239647.26389.80

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #24

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)

Costs 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.

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 100 3

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/18390024

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

Article #25

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); Mortality (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), Cost-benefit analysis (CBA)

Costs 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.

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 121 5

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/18450850

DOI: http://dx.doi.org/10.1542/peds.2007-1400

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #26

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/windowpanes

Economic Evaluation / Methods and Source

Type: Cost-benefit analysis (CBA)

Costs Measured: Cost of lead-safe window replacement

Potential Cost Measures: 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.

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 106 3

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/17961540

DOI: http://dx.doi.org/10.1016/j.envres.2007.09.003

NIEHS Funding: Not Available

Other Funding: Not Available

Smoke-free legislation and hospitalizations for acute coronary syndrome

Article #27

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)

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: 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.

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 359 5

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DOI: http://dx.doi.org/10.1056/NEJMsa0706740

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #28

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)

Costs Measured: Costs for implementing CO2, PM, and greenhouse gas abatement/reduction options or 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.

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 31

Pubmed: Not Available

DOI: http://dx.doi.org/10.1016/j.reseneeco.2009.03.001

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #29

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)

Costs 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.

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 99 Suppl 3

Pubmed: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2774188/

DOI: http://dx.doi.org/10.2105/AJPH.2008.141671

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #30

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)

Costs 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 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 μg/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 µg/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.

Citation: Gould E 2009 Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control Environmental Health Perspectives 117 7

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/19654928

DOI: http://dx.doi.org/10.1289/ehp.0800408

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #31

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)

Costs Measured: Marginal medical costs of emergency department (ED) visits for respiratory ailments due to aerosolized brevetoxins; 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.

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 117 8

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/19672403

DOI: http://dx.doi.org/10.1289/ehp.0900645

NIEHS Funding: P50ES12736; P01ES010594; P50ES012742

Other Funding: Not Available

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

Article #32

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 μg/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)

Costs Measured: IQ reduction; reduced lifetime earnings; crime costs; welfare costs; 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.

Citation: Muennig P 2009 The social costs of childhood lead exposure in the post-lead regulation era Archives of Pediatrics and Adolescent Medicine 163 9

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/19736339

DOI: http://dx.doi.org/10.1001/archpediatrics.2009.128

NIEHS Funding: Not Available

Other Funding: Not Available

The economic impact of exposure to secondhand smoke in Minnesota

Article #33

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)

Costs Measured: Costs related to professional services; 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.

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 99 4

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/19197082

DOI: http://www.ncbi.nlm.nih.gov/pubmed/19197082

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #34

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)

Costs 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.

Citation: Hall JV, Brajer V, and Lurmann FW 2010 Air pollution, health and economic benefits - lessons from 20 years of analysis Ecological Economics 69 12

Pubmed: Not Available

DOI: http://dx.doi.org/10.1016/j.ecolecon.2010.08.003

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #35

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)

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

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 19

Pubmed: Not Available

DOI: http://dx.doi.org/10.1071/WF09077

NIEHS Funding: Not Available

Other Funding: Not Available

Cost analysis of impacts of climate change on regional air quality Article #36

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 (PM2.5/fine))

Source of Environmental Agents: Anthropogenic emissions of precursor air pollutants (SO2, NOx, VOCs)

Economic Evaluation / Methods and Source

Type: Cost analysis (CA)

Costs 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 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.

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 60 2

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/20222532

DOI: http://dx.doi.org/10.3155/1047-3289.60.2.195

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #37

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), Cost-utility analysis (CUA)

Costs 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 (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.

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 16 Suppl 5

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/20689380

DOI: http://dx.doi.org/10.1097/PHH.0b013e3181e28b2e

NIEHS Funding: Not Available

Other Funding: Not Available

School buses, diesel emissions, and respiratory health — Article #38

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)

Costs 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; 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.

Citation: Beatty TK and Shimshack JP 2011 School buses, diesel emissions, and respiratory health Journal of Health Economics 30 5

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/21741102

DOI: http://dx.doi.org/10.1016/j.jhealeco.2011.05.017

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

Article #39

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)

Costs Measured: 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.

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 119 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/20920952

DOI: http://dx.doi.org/10.1289/ehp.1002468

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

Article #40

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)

Costs 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.

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 41 2 Suppl 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/21767734

DOI: http://dx.doi.org/10.1016/j.amepre.2011.05.011

NIEHS Funding: Not Available

Other Funding: Not Available

Economics of children's environmental health — Article #41

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)

Costs Measured: 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

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).

Citation: Trasande L 2011 Economics of children's environmental health The Mount Sinai Journal of Medicine 78 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/21259266

DOI: http://dx.doi.org/10.1002/msj.20234

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #42

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)

Costs Measured: 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.

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 30 5

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/21543421

DOI: http://dx.doi.org/10.1377/hlthaff.2010.1239

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #43

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)

Costs Measured: Annual costs of preschool special education services

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

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 Medicaid data (2000); additional sources cited in publication.

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 22 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/21317525

DOI: http://dx.doi.org/10.1353/hpu.2011.0012

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #44

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)

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

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).

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 17 5

Pubmed: Not Available

DOI: http://dx.doi.org/10.1016/j.esd.2013.06.002

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

Article #45

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)

Costs Measured: Healthcare costs such as hospitalizations, emergency room visits and asthma-related clinic visits; 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.

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 50 6

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/23614791

DOI: http://dx.doi.org/10.3109/02770903.2013.792351

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #46

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)

Costs 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.

Citation: King BA, Peck RM, and Babb SD 2013 Cost savings associated with prohibiting smoking in U.S. subsidized housing Am J Prev Med 44 6

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/23683981

DOI: http://dx.doi.org/10.1016/j.amepre.2013.01.024

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

Article #47

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)

Costs 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.

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 96 7

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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

Article #48

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, PM2.5)

Source of Environmental Agents: Greenhouse gas emissions

Economic Evaluation / Methods and Source

Type: Cost-benefit analysis (CBA)

Costs Measured: Marginal costs of greenhouse gas reductions

Potential Cost Measures: Not Available

Benefits Measures: Avoided mortality

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.

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 3 10

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/24926321

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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, Office of Science

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

Article #49

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: Cost analysis (CA)

Costs 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.

Citation: Bartlett ES and Trasande L 2014 Economic impacts of environmentally attributable childhood health outcomes in the European Union European Journal of Public Health 24 1

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/23748596

DOI: http://dx.doi.org/10.1093/eurpub/ckt063

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #50

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 brochitis 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

Type: Cost analysis (CA)

Costs 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.

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 134 5

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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

Article #51

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)

Costs 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.

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 122 12

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DOI: http://dx.doi.org/10.1289/ehp.1206340

NIEHS Funding: Not Available

Other Funding: Not Available

QALY as evaluation tool in a health surveillance program Article #52

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)

Costs Measured: Quality adjusted life years (QALYs); 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.

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 217 3-Feb

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/24054544

DOI: http://dx.doi.org/10.1016/j.ijheh.2013.07.014

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

Article #53

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

Type: Cost-benefit analysis (CBA)

Costs 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.

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 133 1

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DOI: http://dx.doi.org/10.1016/j.jaci.2013.06.003

NIEHS Funding: R21ES017522

Other Funding: Not Available

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

Article #54

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)

Costs Measured: Number of emergency department visits; number of inpatient hospital admissions; 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.

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 68

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/24727069

DOI: http://dx.doi.org/10.1016/j.envint.2014.03.016

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

Article #55

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)

Costs Measured: 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.

Citation: Khan NI, Brouwer R, and Yang H 2014 Household's willingness to pay for arsenic safe drinking water in Bangladesh J Environ Management 143

Pubmed: Not Available

DOI: http://dx.doi.org/10.1016/j.jenvman.2014.04.018

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

Article #56

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

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

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.

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 23 7

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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

Article #57

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 PM2.5 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 PM2.5, and they estimated the valuation of increased premature mortality associated with PM2.5 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 PM2.5 from 15 to 12 μg/m-3.

Population Not Available

Health Outcomes

Mortality (premature mortality)

Environmental Agents

List of Environmental Agents: Air pollutants (ammonia (NH3), particulate matter (PM2.5/fine))

Source of Environmental Agents: PM2.5 and NH3 emissions via agricultural food exports

Economic Evaluation / Methods and Source

Type: Cost analysis (CA)

Costs Measured: Mortalities; 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.

Citation: Paulot F and Jacob DJ 2014 Hidden cost of U.S. agricultural exports: particulate matter from ammonia emissions Environ Sci Technol 48 2

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/24370064

DOI: http://dx.doi.org/10.1021/es4034793

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #58

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)

Costs Measured: IQ deficits/loss associated with PAH exposure

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 o 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.

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: http://www.ncbi.nlm.nih.gov/pubmed/24804951

DOI: http://dx.doi.org/10.1057/jphp.2014.14

NIEHS Funding: 5P01ES09600; 5R01ES08977

Other Funding: Not Available

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

Article #59

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 (PM2.5/fine))

Source of Environmental Agents: Wildfire smoke

Economic Evaluation / Methods and Source

Type: Cost-benefit analysis (CBA), Cost-effectiveness analysis (CEA)

Costs 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.

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 48 18

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DOI: http://dx.doi.org/10.1021/es5012725

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

Article #60

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)

Costs 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.

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 24

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/25244910

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

Article #61

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)

Costs 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; 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.

Citation: Trasande L 2014 Further limiting bisphenol a in food uses could provide health and economic benefits Health Affairs 33 2

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/24452104

DOI: http://dx.doi.org/10.1377/hlthaff.2013.0686

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #62

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)

Costs 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).

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 104 4

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/24524511

DOI: http://dx.doi.org/10.2105/ajph.2013.301695

NIEHS Funding: Not Available

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

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

Article #63

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)

Costs 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.

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 78 2

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/25424621

DOI: http://dx.doi.org/10.1080/15287394.2014.946165

NIEHS Funding: Not Available

Other Funding: Institution for Statutory Accident Insurance and Prevention in the Energy, Textile, Electrical, and Media Industry (BGETEM), Cologne, Germany — Grant number 360328

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

Article #64

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)

Costs Measured: Respiratory emergency department visits; respiratory hospital admissions; 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-Chemic 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.

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 65 5

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/25947315

DOI: http://dx.doi.org/10.1080/10962247.2014.996270

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #65

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 (PM2.5/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: Cost-benefit analysis (CBA)

Costs 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 coemitted 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, GuidePolic Analysis (EPPA) model.

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 49 13

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/26053628

DOI: http://dx.doi.org/10.1021/acs.est.5b01324

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 Article #66

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 PM2.5 concentrations were reduced from 10 to 8 μg/m3 in an urban area. Results from the case study showed that the total monetized health benefit of the 2 μg/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)

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

Citation: Martenies SE, Wilkins D, and Batterman SA 2015 Health impact metrics for air pollution management strategies Environ Int 85

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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

Article #67

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)

Costs 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.

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 130 3

Pubmed: http://www.ncbi.nlm.nih.gov/pubmed/25931627

DOI: Not Available

NIEHS Funding: Not Available

Other Funding: Not Available

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

Article #68

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)

Costs Measured: Calculated incremental costs associated with an increase in fire safety via the fire 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.

Citation: Mcnamee MS and Anderson P 2015 Application of a cost-benefit analysis model to the use of flame retardants Fire Technol 51 1

Pubmed: Not Available

DOI: http://dx.doi.org/10.1007/s10694-014-0402-9

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

Article #69

Details	Research article	Not Available

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

Costs 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.

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 0

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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

Article #70

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)

Costs Measured: Mortalities cost resulting from acute exposure to ozone

Potential Cost Measures: Cost of environmental impacts; health impacts from other NOx related air pollutants (NO2 and inorganic PM)

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

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 (NOx) 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 NOx using various US wide emissions abatement scenarios; and 3) reported MBs for 1 ton of NOx

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.

Citation: Pappin AJ, Mesbah SM, Hakami A, and Schott S 2015 Diminishing returns or compounding benefits of air pollution control? The case of NOx and ozone Environ Sci Technol 49 16

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NIEHS Funding: Not Available

Other Funding: Natural Sciences and Engineering Research Council of Canada

Defining the Human Envirome: An Omics Approach for Assessing the Environmental Risk of Cardiovascular Disease.

Article #71

Details	Review	Not Available

Authors: Riggs D, Yeager R, Bhatnagar A

Journal: Circulation research

Summary: The authors critically reviewed the current state of research on cardiovascular health with the lens of the envirome. The authors explained the current knowledge of cadiovascular health as a baseline, then explored multiple avenues for cross disiplenary research optortunities. The authors discussed the built environment, the social environment, the personal environmental, and then the envirome as a whole in relation technilogical advances and omics analyses. This review provides a starting point for addressing these complex multidisiplenary cardiovasular avenues in future research.

Population: Not Available

Health Outcomes

Reviewed publications that examined — cardiovascular disease

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Reviewed publications that examined — built environment; agricultural and industrial activities; pollutants and contaminants

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Not Available

Potential Cost Measures: Reviewed publications that examined — cost of exposure to environmental factors that contribute to cardiovascular disease

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Not Available

Models Used: Envirome Model (article presents a hierarchical model of the envirome, defined by 3 consecutively nested domains, consisting of natural, social, and personal environments)

Methods Used: The authors performed a review of existing literature to examine the current state of research on cardiovascular health with the lens of the envirome. The authors — 1) explained the current knowledge of cadiovascular health as a baseline; 2) explored the built environment, the social environment, the personal environmental, and 3) the envirome as a whole in relation technilogical advances and omics analyses.

Sources Used: Global burden of disease (GBD) estimates (Gakidou et al., 2016); PREDIMED trial (Estruch et al., 2018); Normalized Difference Vegetation Index (NDVI) (James et al., 2016. James et al., 2015); NASA TEMPO satellite (Chance et al., 2013); Global assessment of nutritional status (Detsky et al., 1987); Jackson Heart Study (Sims et al., 2009. Sims et al., 2016. Okhomina et al., 2018); Metropolitan and neighborhood scales in relation to adverse outcomes (Kershaw et al., 2015. Friedman et al., 2015); Ecosystem modeling (Aguilera et al., 2011. Uusitalo L. 2007); Life course approach (Ben-Shlomo et al., 2002. Kuh et al., 2004); Environment-Wide Association Studies (EWAS) (Patel et al., 2010); Additional sources sited in the publication.

Citation: Riggs, Daniel W;Yeager, Ray A;Bhatnagar, Aruni Defining the Human Envirome: An Omics Approach for Assessing the Environmental Risk of Cardiovascular Disease. Circulation research 122

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Other Funding: P50HL120163, U54HL120163, R01HL120746, R01HL055477

Established and Emerging Environmental Contributors to Disparities in Asthma and Chronic Obstructive Pulmonary Disease.

Article #72

Details	Review	Cost analysis (CA)

Authors: Levy J, Quirós-Alcalá L, Fabian, P, Basra, K, Hansel, N

Journal: Current epidemiology reports

Summary: In this review article, the authors examine the available literature regarding distinctive socioeconomic and racial/ethnic disparies and their impact on the development of multiple respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). The authors found that there is substantial literature that supprts the hypothesis that environmental exposures due to socioeconmic status and/or ethnictiy/race are greatly contributing to the disparity in chronic lung diseases. Further research is needed to understand the exposure to and health implcations of multiple environmental stressors on these groups.

Population: Reviewed publications that examined under-represented ethnic/racial groups and low SES groups

Health Outcomes

Reviewed publications that examined — respiratory diseases (asthma, chronic obstructive pulmonary disease (COPD))

Environmental Agents

List of Environmental Agents: Reviewed publications that examined — particulate matter, nitrogen dioxide, psychosocial stress, and pesticides

Source of Environmental Agents: Reviewed publications that examined — home environment and neighborhood environment

Economic Evaluation/Methods and Sources

Type: Cost analysis (CA)

Costs Measured: Reviewed publications that examined — health cost of disproportionate environmental exposures on racial/ethnic disparities and people with lower socioeconomic status

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 review of existing literature to examine the relationship between environmental stressors and respiratory disease. The authors used two seperate literature searches in PubMed. The first literature search used the keywords, housing, nitrogen dioxide, air pollution, mold or environmental tobacco smoke, stress, allergen, temperature, noise, pesticide in addition to asthma or COPD. The second literature search was limited to articles published since 2013 and used the keywords green space, crime and violence in addition to asthma, COPD or respitatory disease.

Sources Used: Urban Environment and Childhood Asthma (URECA) study (O'Connor et al.,2017); Population Based Cohort study (Sbihi et al., 2017); Residential Segregation and Racial gaps in childhood asthma study (Alexander et al., 2017); PubMed; Additional sources cited in the publication.

Citation: Levy, Jonathan I;Quirós-Alcalá, Lesliam;Fabian, M Patricia;Basra, Komal;Hansel, Nadia N Established and Emerging Environmental Contributors to Disparities in Asthma and Chronic Obstructive Pulmonary Disease. Current epidemiology reports 5

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Other Funding: P50MD010428, K01HL138124, P50MD010431

Urban HEART Detroit: a Tool To Better Understand and Address Health Equity Gaps in the City.

Article #73

Details	Research article	Cost analysis (CA)

Authors: Mehdipanah R, Schulz A, Israel B, Gamboa C, Rowe Z, Khan M, Allen A

Journal: Journal of urban health : bulletin of the New York Academy of Medicine

Summary: This paper describes the process of adopting and implementing the Urban HEART tool for Detroit, Michigan. The six steps of Urban HEART were implemented by a community-based participatory research partnership made up of community-based organizations, health service providers, and researchers based in academic institutions. The authors examined how principles of CBPR influenced the implementation of the tool. Urban HEART tool involves six steps: building an inclusive team; defining local indicators and benchmarks indicative of social determinants of health equity; assembling relevant and valid data with which to assess those indicators; generating evidence; assessing and prioritizing health equity gaps and gradients; and identifying the best response to health equity issues identified in the previous steps. The evidence generated is in the form of a matrix that allows assessment of indicators at the relevant geographic units, using the data collected. For the health equity matrix, 15 indicators were chosen within the Urban HEART five policy domains (physical environment and infrastructure, social and human development, economics, governance, and population health). This project provides pilot data and a foundation for expanding Urban HEART to other areas. Urban HEART Detroit is an ongoing effort.

Population: Not Available

Health Outcomes

Asthma; cardiovascular disease; psychological distress

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost analysis (CA)

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Promoting health equity in Detriot

Location: Detriot, Michigan

Models Used: Urban Health Equity Assessment Response Tool (Urban HEART); Community-based participatory research (CBPR)

Methods Used: The authors examined how Community Based Participatory Research (CBPR) Principles influenced Urban HEART as well as the process of adopting and implementing this tool in Detroit, Michigan to achieve health equity.

Sources Used: Urban HEART tool (WHO, 2010); Most data came from the American Community Survey (ACS), a yearly survey conducted by the U.S. Census Bureau (Bureau UC, 2016); The National Air Toxics Assessment from 2011 was used to attain broad estimates of diesel PM exposures (US EPA O, 2011); Average percent of population that died per year from 2009 to 2013 was obtained from the Michigan Department of Health and Human Services (MDHHS), using 5-year estimates (2009–2013) (Veinot et al., 2016); Additional sources cited in the publication.

Citation: Mehdipanah, R;Schulz, A J;Israel, B A;Gamboa, C;Rowe, Z;Khan, M;Allen, A Urban HEART Detroit: a Tool To Better Understand and Address Health Equity Gaps in the City. Journal of urban health : bulletin of the New York Academy of Medicine 95

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NIEHS Funding: R01ES022616, P30ES017885

Other Funding: R24MD001619

Does Economic Strengthening Improve Viral Suppression Among Adolescents Living with HIV? Results From a Cluster Randomized Trial in Uganda.

Article #74

Details	Research article	Cost-effectiveness analysis (CEA)

Authors: Bermudez L, Ssewamala F, Neilands T, Lu L, Jennings L, Nakigozi G, Mellins C, McKay M, Mukasa M

Journal: AIDS and behavior

Summary: This study examined the ART adherence of adolecents with HIV in southern Uganda when applying the multi-component economic empowerment intervention, Suubi + Adherence. The authors tracked HIV viral load as an indicator of ART adherence in the control group and the group that received ecomonic education. The authors found that the viral load surpression increased in patients who received the economic empowerment intervention, as well as the individuals self reported savings amount increasing.

Population: Adolescents living with HIV in Southern Uganda

Health Outcomes

HIV

Environmental Agents

List of Environmental Agents: Virus

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-effectiveness analysis (CEA)

Costs Measured: Self reported savings

Potential Cost Measures: Not Available

Benefits Measures: Increased HIV viral load supression

Potential Benefits: Not Available

Location: Southern Uganda

Models Used: Subsequent covariate-adjusted mixed effects models

Methods Used: The authors — 1) calculated the difference in savings amount between the baseline standard of care with provided bulstered standard of care in adolecents with HIV, participants who received bulstered care were provided with finanical education regarding ART; 2) studied the amount of HIV viral load available in the patients control arm versus the arm that received intervention; and 3) used viral load suppression to track adherence to ART.

Sources Used: The Suubi + Adherence, longitudinal, cluster randomized trial; HIV prevalence rate of 10.6% (The Republic of Uganda, 2014); Additional sources cited in the publication.

Citation: Bermudez, Laura Gauer;Ssewamala, Fred M;Neilands, Torsten B;Lu, Lily;Jennings, Larissa;Nakigozi, Gertrude;Mellins, Claude A;McKay, Mary;Mukasa, Miriam Does Economic Strengthening Improve Viral Suppression Among Adolescents Living with HIV? Results From a Cluster Randomized Trial in Uganda. AIDS and behavior 22

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NIEHS Funding: Not Available

Other Funding: R01HD074949, K01MH107310, P30AI094189, U19MH110001, R25MH067127

Impact of individual and neighborhood factors on socioeconomic disparities in localized and advanced prostate cancer risk.

Article #75

Details	Research article	Cost-utility analysis (CUA)

Authors: DeRouen M, Schupp C, Yang, J, Koo, J, Hertz A, Shariff-Marco S, Cockburn M, Nelson D, Ingles S, Cheng, I, John E, Gomez S

Journal: Cancer causes & control : CCC

Summary: This population-based case-control study combines interview and secondary data, including specific social and built environment factors, to explore potential mediators of socio-economic status disparities in prostate cancer risk. The authors interviewed NHW men in the San Francisco Bay area using a structured questionnaire and the social and built aspects of each participants neighborhood were measured useing ArcGIS. Using statistical analysis, the authors examinded individual-level covariates and specific social and built environment factors to assess the extent to which these factors were associated with odds of localized or advanced prostate cancer. The study found that neighborhood socio-economic status affects prostate cancer risk.

Population: AA (non-Hispanic) and NHW men

Health Outcomes

Prostate cancer

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Neighborhood environments and built environment

Economic Evaluation/Methods and Sources

Type: Cost-utility analysis (CUA)

Costs Measured: Socio-economic status of neighborhoods

Potential Cost Measures: Not Available

Benefits Measures: Decreased risk of prostate cancer

Potential Benefits: Not Available

Location: San Fransico, California

Models Used: Multivariable logistic regression models

Methods Used: The authors — 1) conducted In-person interviews in English by trained interviewers at the participants' home using a structured questionnaire that asked about socio-demographic background, medical history, family history of cancer (first degree relative), lifestyle factors, and self reported education level; 2) geocoded residential address to latitude/longitude coordinates and then assigned to a 2000 census block group; 3) measured the social and built aspects of each neighborhood using ArcGIS; and 4) examinded individual-level covariates and specific social and built environment factors using statistical analysis to assess the extent to which these factors were associated with odds of localized or advanced prostate cancer.

Sources Used: Greater Bay Area Cancer Registry, which participates in the National Cancer Institute's (NCI's) Surveillance, Epidemiology, and End Results (SEER) Program and the California Cancer Registry (CCR); Texas A&M Geocode (Goldburg, 2009); ArcGIS (ArcGIS, 2011); Retail Food Environment Index (RFEI) and the Restaurant Environment Index (REI); Additional sources cited in the publication.

Citation: DeRouen, Mindy C;Schupp, Clayton W;Yang, Juan;Koo, Jocelyn;Hertz, Andrew;Shariff-Marco, Salma;Cockburn, Myles;Nelson, David O;Ingles, Sue A;Cheng, Iona;John, Esther M;Gomez, Scarlett L Impact of individual and neighborhood factors on socioeconomic disparities in localized and advanced prostate cancer risk. Cancer causes & control : CCC 29

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NIEHS Funding: Not Available

Other Funding: U58DP003862

Exploring the Health and Spatial Equity Implications of the New York City Bike Share System.

Article #76

Details	Research article	Cost-benefit analysis (CBA)

Authors: Babagoli M, Kaufman T, Noyes P, Sheffield P

Journal: Journal of transport & health

Summary: This cost-benefit analysis compares the NYC Citi Bike station distribution by census tract poverty during the system's 2013 launch and after the 2015 geographic expansion through a health equity lens. Using the World Health Organization's Health Economic Assessment Tool (HEAT), the author estimated an increase from two to three premature deaths prevented and an increased annual economic benefit from $18,800,000 to $28,300,000 associated with Citi Bike use. Their findings underscore the potential for even greater benefits with increased spatial access in higher-poverty neighborhoods and communities of color and highlight the importance of the built environment in shaping health and the need for a health equity lens to consider the social and political processes that perpetuate inequities.

Population: Low SES communities, minorities

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-benefit analysis (CBA)

Costs Measured: Inceased wealth in impoverished communities

Potential Cost Measures: Not Available

Benefits Measures: Decrease in premature deaths

Potential Benefits: Increase access to transportation

Location: New York, New York

Models Used: World Health Organization's Health Economic Assessment Tool (HEAT); U.S. Census

Methods Used: The authors — 1) compared the Citi Bike station distribution by census tract poverty during the system's 2013 launch and after the 2015 geographic expansion; and 2) applied the World Health Organization's Health Economic Assessment Tool (HEAT) to estimate the benefit of cycling associated with annual Citi Bike members for two 12-month time periods and analyzed change of the benefit over time.

Sources Used: World Health Organization's Health Economic Assessment Tool (HEAT) (Kahlmeier et al., 2017); Neighborhood poverty rates (Toprani et al., 2013); Citi Bike data (NYC Bike Share, 2017. Citi Bike, 2017); Additional sources cited in the publication.

Citation: Babagoli, Masih A;Kaufman, Tanya K;Noyes, Philip;Sheffield, Perry E Exploring the Health and Spatial Equity Implications of the New York City Bike Share System. Journal of transport & health 13

Pubmed: https://pubmed.ncbi.nlm.nih.gov/32832380/

DOI: https://doi.org/10.1016/j.jth.2019.04.003

NIEHS Funding: K23ES024127, P30ES023515

Other Funding: Not Available

Metal Toxicity Links to Alzheimer's Disease and Neuroinflammation.

Article #77

Details	Review	Not Available

Authors: Huat T, Camats-Perna J, Newcombe E, Valmas N, Kitazawa M, Medeiros R

Journal: Journal of molecular biology

Summary: In this review article, the authors explore how essential and non-essential metals affect brain physiology and immunity, as well as their roles in the accumulation of toxic Alzheimer's disease (AD) proteinaceous species (i.e., β-amyloid and tau). The authors reviewed studies that validate the disruption of immune-related pathways as an important mechanism of toxicity by which metals can contribute to AD. They explored research on iron, copper, zinc, manganese, lead, aluminum, and cadmium. Evidence strongly supports that disruption in the homeostasis of essential metals and the accumulation of non-essential metals disturb the cellular metabolism, antioxidant defense, and immune responses, leading to the onset and progression of AD.

Population: Not Available

Health Outcomes

Reviewed publications that examined — Alzheimer's disease (AD)

Environmental Agents

List of Environmental Agents: Reviewed publications that examined — metals (iron, copper, zinc, manganese, lead, aluminum, and cadmium)

Source of Environmental Agents: Reviewed publications that examined — anthropogenic activities

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Not Available

Models Used: Mouse model

Methods Used: The authors performed a review of existing literature to examine research related to 6 metals and their relation to brain physiology, immunity, and their roles in the accumulation of toxic AD proteinaceous species. Metals studied were iron, copper, zinc, manganese, lead, aluminum, and cadmium.

Sources Used: Mouse models (Xian-Hui et al., 2015. Kitazawa et al., 2009. Sparks et al., 2006. Sparks et al., 2003. Yu et a., 2015); United Nations, Department of Economic and Social Affairs, Population Division (2017); Lifestyle factors also affect an individual's risk of developing AD (Livingston et al., 2017); Reduced levels of LRP-1 further impair the transcytotic clearance of Aβ and exacerbate neuroinflammation (Newcombe et al., 2018); Additional sources cited in the publication.

Citation: Huat, Tee Jong;Camats-Perna, Judith;Newcombe, Estella A;Valmas, Nicholas;Kitazawa, Masashi;Medeiros, Rodrigo Metal Toxicity Links to Alzheimer's Disease and Neuroinflammation. Journal of molecular biology 431

Pubmed: https://pubmed.ncbi.nlm.nih.gov/30664867/

DOI: https://doi.org/10.1016/j.jmb.2019.01.018

NIEHS Funding: R01ES024331

Other Funding: Not Available

Neighborhood Environment and Health of Injured Urban Black Men.

Article #78

Details	Research article	Cost-utility analysis (CUA)

Authors: Palumbo A, Wiebe D, Kassam-Adams N, Richmond T

Journal: Journal of racial and ethnic health disparities

Summary: This research article analysed the contribution of area-level characteristics and individual-level perceptions of neighborhood environment to the mental and physical health of recently injured, urban black males as an important step towards understanding factors that contribute to health in this vulnerable population. The authors analyzed data from 486 black, adult males in Philadelphia admitted to a trauma center with injury between January 2013 and February 2017. The authors conducted factor analysis to identify neighborhood characteristics, then estimated odds of poor physical or mental health, accounting for spatial correlation of participants. The authors found both area-level and individual-level measures were associated with health, perhaps operating through different mechanisms, but individual experiences may not be easily extrapolated from area-level data.

Population: Injured black adult males

Health Outcomes

Physical trauma; mental health

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Neighborhood environments

Economic Evaluation/Methods and Sources

Type: Cost-utility analysis (CUA)

Costs Measured: Socioeconomic factors, neighborhood poverty, area-level spending, income

Potential Cost Measures: Not Available

Benefits Measures: Physical health and mental health

Potential Benefits: Not Available

Location: Philadelphia, Pennsylvania

Models Used: MPlus version 7 statistical analysis; logistic regression modelling; area-level neighborhood predictors model; individual-level neighborhood predictors model; all neighborhood variables model; all neighborhood variables + confounders model; selected neighborhood variables + confounders model

Methods Used: The authors — 1) analyzed data from 486 black, adult males in Philadelphia admitted to a trauma center with injury between January 2013 and February 2017; and 2) conducted factor analysis to identify neighborhood characteristics, then estimated odds of poor physical or mental health, accounting for spatial correlation of participants. Area-level measures of social, economic, and built environments were obtained from multiple sources. At enrollment, participants answered questions about neighborhood environment and self-reported physical and mental health 30 days before injury.

Sources Used: 2010 Census (U.S. Census Bureau, 2015); the American Community Survey (ACS 5-year estimates) (ACS, 2010); Health spending, Insurance spending, Prescription spending, Medicare spending, Housing spending Additional sources cited in the publication (ESRI, 2013); Additional sources cited in the publication.

Citation: Palumbo, Aimee J;Wiebe, Douglas J;Kassam-Adams, Nancy;Richmond, Therese S Neighborhood Environment and Health of Injured Urban Black Men. Journal of racial and ethnic health disparities 6

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31250370/

DOI: https://doi.org/10.1007/s40615-019-00609-5

NIEHS Funding: R49CE002474, P30ES013508

Other Funding: R01NR013503

Neurocognitive impact of metal exposure and social stressors among schoolchildren in Taranto, Italy.

Article #79

Details	Research article	Cost analysis (CA)

Authors: Lucchini R, Guazzetti S, Renzetti S, Conversano M, Cagna G, Fedrighi C, Giorgino A, Peli M, Placidi D, Zoni S, Forte G, Majorani C, Pino A, Senofonte O, Petrucci F

Journal: Environmental health : a global access science source

Summary: This research article studied the impact co-exposure to metal and socio-economic stressors has on children aged 6-12 years old. The authors collected hair, blood, and urine samples to test metal concentrations. They also collected socioeconomic information and performed the Wechsler Intelligence Scale for Children (WISC) and the Cambridge Neuropsychological Test Automated Battery (CANTAB) to test for cognitive outcomes. When the data was collected, the authors ran linear mixed models to assess the association between metal exposure, socio-economic status, and neurocognitive outcomes. They found that subjects with higher socio-economic status showed better neurocognitive scores compared to thier lower SES counterparts. Significant correlation between metal exposure and SES was also observed.

Population: Children aged 6-12 years residing at incremental distance from industrial emissions

Health Outcomes

Reduced cognitive abilities

Environmental Agents

List of Environmental Agents: Metals (arsenic, cadmium, manganese, mercury, lead, and selenium)

Source of Environmental Agents: Adverse home and family environment

Economic Evaluation/Methods and Sources

Type: Cost analysis (CA)

Costs Measured: Decrease in intellectual abilities due to co-exposure of metals and socio-economic stressors

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Taranto, Italy

Models Used: Linear regression models; generalized additive models (GAMS); non-parametric Kruskal Wallis rank-sum test

Methods Used: The authors — 1) collected whole blood, urine and hair to measure metals; 2) administered an individual assessment of sociodemographic and lifestyle information; 3) collected information about the home environment through the Home Observation for Measurement of the Environment (HOME) Questionnaire; and 4) once all of the information was collected, generalized additive models (GAMs) were used to assses the data.

Sources Used: Wechsler Intelligence Scale for Children (WISC); Environmental Agency (ARPA) of the Puglia Region (Valutazione del Danno Sanitario, 2012); Cambridge Neuropyschological Test Automated Battery (CANTAB, 2015); Home Observation for Measurement of the Environment (HOME) questionnaire (Bradley et al., 1998); The WHO MONICA project (Cesana et al., 1995); German Environmental Survey (GerES IV)(Schulz et al., 2009); US National Health and Nutrition Examination Survey (NHAMES, 2017); Additional sources cited in the publication.

Citation: Lucchini, Roberto G;Guazzetti, Stefano;Renzetti, Stefano;Conversano, Michele;Cagna, Giuseppa;Fedrighi, Chiara;Giorgino, Augusto;Peli, Marco;Placidi, Donatella;Zoni, Silvia;Forte, Giovanni;Majorani, Costanza;Pino, Anna;Senofonte, Oreste;Petrucci, Francesco;Alimonti, Alessandro Neurocognitive impact of metal exposure and social stressors among schoolchildren in Taranto, Italy. Environmental health : a global access science source 18

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31324194/

DOI: https://doi.org/10.1186/s12940-019-0505-3

NIEHS Funding: R01ES019222, R56ES019222

Other Funding: Not Available

The Effect of Dioxin Contamination and Remediation on Property Values.

Article #80

Details	Research article	Cost analysis (CA)

Authors: Zwickle A, Cox J, Zhuang J, Hamm J, Upham B, Chung M, Cruz S, Dearing J

Journal: International journal of environmental research and public health

Summary: This research article conducted a multilevel, longitundinal analysis to understand the effects of contamination and remediation on property values in Midland, Michigan. The authors created a model to test the different parameters including whether the property had been remediated or not and the actual amount of dioxin. The article found that the continuous measure of dioxin in the soil had a negative effect on the property value, decreasing $9 for every 1 ppt of dioxin. However, there was no difference in the decrease of property value between remediated and un-remediated properties.

Population: Homeowners in Midland, Michigan

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Dioxins

Source of Environmental Agents: Incineration of contaminated waste and the discharge of contaminated water

Economic Evaluation/Methods and Sources

Type: Cost analysis (CA)

Costs Measured: Effects of Dioxin exposure on property values

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Midland, Michigan, United states

Models Used: Unconditional growth model; longitundinal, multilevel model

Methods Used: The authors — 1) used SPSS software to create a longitudinal multilevel model to assess home values over an 18 year period; 2) they began with an unconditional growth model to determine the intraclass correlation (ICC); 3) once the baseline model was created, they tested it with three different values. The first two were whether the property had been remediated or not. The last one was the actual amount of dioxin in parts per trillion found in the soil of each property.

Sources Used: Public Dow Report (2014); Parcel map obtained from the Midland County Geographic Information Systems (GIS) office; Property assessment data from BS&A Software. The data used were received as a part of the ASSESSING.NET software (version 10.1.19). Additional sources cited in the publication.

Citation: Zwickle, Adam;Cox, Jeffrey G;Zhuang, Jie;Hamm, Joseph A;Upham, Brad L;Chung, Minwoong;Cruz, Shannon;Dearing, James W The Effect of Dioxin Contamination and Remediation on Property Values. International journal of environmental research and public health 16

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31618820/

DOI: https://doi.org/10.3390/ijerph16203900

NIEHS Funding: P42ES004911

Other Funding: Not Available

Using Google Street View to examine associations between built environment characteristics and U.S. health outcomes.

Article #81

Details	Research article	Cost-utility analysis (CUA)

Authors: Nguyen Q, Khanna S, Dwivedi P, Huang D, Huang Y, Tasdizen T, Brunisholz K, Li F, Gorman W, Nguyen T, Jiang C

Journal: Preventive medicine reports

Summary: This research article uses Google Street View images and computer vision to understand the correlation between constructed indicators of urban development and county-level chronic disease. The authors used regression models to estimate these associations. This study suggests that indicators of built environments may be connected with lower chronic disease and decreased premature mortality but there is a modest increase in excessive drinking. This study points out the need for more equity in health resources across the country.

Population: Not Available

Health Outcomes

Obesity; diabetes; premature mortality

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Built environment

Economic Evaluation/Methods and Sources

Type: Cost-utility analysis (CUA)

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Increasing neighborhood built environments can increase public health

Potential Benefits: Not Available

Location: United States

Models Used: Regression models; PostgreSQL

Methods Used: The authors — 1) used national road network data to create a database representative of all street intersections in the US, which included latitude and longitude coordinates; 2) used Google Street View Application Programming Interface (API) to obtain images of the intersections; 3) ran all 16,171,605 images through image data processing to detect pre-defined items such as highways, rural areas and grasslands; 4) used ArcGIS Desktop software to create choropleth maps; and 5) pulling health data from the US Census and county wide censuses, the authors created linear regression models to accociate chronic diseases, premature mortality, and other health outcomes with the built environment.

Sources Used: Google Street View (GSV) API from December 15, 2017- May 14, 2018 images; 2017 Census Topologically Integrated Geographic Encoding and Referencing data set; US Census; 2018 County health rankings; National Vital Statistics system (2014-2016); 2014 Behavioral Risk Fsctor Surveillance System (BRFSS); Disease Control and Prevention's (CDC) 500 Cities project; 2016 U.S. Census TIGER/Line Shapefiles; 2010-2014 American Community Survey; Additional sources cited in the publication.

Citation: Nguyen, Quynh C;Khanna, Sahil;Dwivedi, Pallavi;Huang, Dina;Huang, Yuru;Tasdizen, Tolga;Brunisholz, Kimberly D;Li, Feifei;Gorman, Wyatt;Nguyen, Thu T;Jiang, Chengsheng Using Google Street View to examine associations between built environment characteristics and U.S. health outcomes. Preventive medicine reports 14

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31061781/

DOI: https://doi.org/10.1016/j.pmedr.2019.100859

NIEHS Funding: K01ES025433

Other Funding: K99MD012615, P2CHD041041, UL1TR002538, R01LM012849

Cross-Sectional Associations of Neighborhood Perception, Physical Activity, and Sedentary Time in Community-Dwelling, Socioeconomically Diverse Adults.

Article #82

Details	Research article	Cost analysis (CA)

Authors: Claudel S, Shiroma E, Harris T, Mode N, Ahuja C, Zonderman A, Evans M, Powell-Wiley T

Journal: Frontiers in public health

Summary: This article researches the relationship between perceived neighborhood environment, physical activity/sedentary time as well as race, sex and SES. The methods used included determing thier neighborhood perception score (NPS) through a questionnaire completed by HANDLS participants. The authors coded self-reported Likert scale response to the Baecke Physical Activity Questionnaire to understand physical activity (PA). To understand sedentary time (ST), they used data measured from an ActiGraph GT3X+ accelerometer. They than ran a multivariate linear regression model to evaluate the influence of NPS on PA, LTPA, non-sedentary time, and ST. This research found a postive correlation between neighborhood perception and physical activity/sedentary time, but no significant interactions with race, sex and SES. It also found no relationship between perceived neighborhood crime and increased ST. Further research is needed to understand individuals' motivations and how the social environment mediates the decision-making process.

Population: Participants from the Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) cohort

Health Outcomes

Obesity

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Neighborhood environments

Economic Evaluation/Methods and Sources

Type: Cost analysis (CA)

Costs Measured: Perceived socioeconomic status effects on sedentary/active lifestyles

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Increased physical activity decreases obesity-related health risks

Location: Baltimore City, Maryland

Models Used: Linear regression models

Methods Used: The authors — 1) determined neighborhood perception score (NPS) through a questionnaire completed by HANDLS participants, the questionnaire contained questions on neighborhood accessibility, neighborhood disorder, neighborhood social conscience, neighborhood social cohesion, disorder and neighborhood crime; 2) the authors coded self-reported Likert scale response to the Baecke Physical Activity Questionnaire to understand physical activity (PA); 3) to understand sedentary time (ST) they used data measured from an ActiGraph GT3X+ accelerometer; and 4)hey then ran a multivariate linear regression model to evaluate the influence of NPS on PA, LTPA, non-sedentary time, and ST.

Sources Used: Self-reported neighborhood perception (Likert-scale questions); Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study (Evans et al., 2010); Baecke Physical Activity Questionnaire (Baecke et al., 1982); 2012-2016 American Community Survey data (Mode et al., 2016); Additional sources cited in the publication.

Citation: Claudel, Sophie E;Shiroma, Eric J;Harris, Tamara B;Mode, Nicolle A;Ahuja, Chaarushi;Zonderman, Alan B;Evans, Michele K;Powell-Wiley, Tiffany M Cross-Sectional Associations of Neighborhood Perception, Physical Activity, and Sedentary Time in Community-Dwelling, Socioeconomically Diverse Adults. Frontiers in public health 7

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31572702/

DOI: https://doi.org/10.3389/fpubh.2019.00256

NIEHS Funding: Not Available

Other Funding: ZIAAG000513, ZIAHL006148

Do Neighborhoods Matter? A Systematic Review of Modifiable Risk Factors for Obesity among Low Socio-Economic Status Black and Hispanic Children.

Article #83

Details	Review	Not Available

Authors: Johnson, K, Showell N, Flessa S, Janssen M, Reid N, Cheskin L, Thornton R

Journal: Childhood obesity (Print)

Summary: The authors critically reviewed 24 studies investigating relationships between empirically measured neighborhood characteristics and obesity risk factors among urban, low socioeconomic status (SES), Black and Hispanic children. The authors found that BMI may be related to living in a lower-income neighborhood or convenience store access but found that body of evidence relating neighborhood exposures and obesity risk factors among urban, low SES Black and Hispanic children is limited.

Population: Reviewed publications that examined low SES communities, minorities, urban, low socioeconomic status Black and Hispanic children

Health Outcomes

Reviewed publications that examined — obesity

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Reviewed publications that examined — neighborhood environments

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Reviewed publications that examined — socioeconomic effects on obesity risk

Potential Cost Measures: Not Available

Benefits Measures: Reviewed publications that examined — increased research in minority population to reduce the risk of obesity

Potential Benefits: Not Available

Location: Not Available

Models Used: RefWorks Database

Methods Used: The authors performed a review of exisitng literature to examine studies published from 1993 through early 2017 from PubMed, SCOPUS, Web of Science, and Sociological Abstracts databases investigating relationships between empirically measured neighborhood characteristics and obesity risk factors in the populations of interest. Databases were last searched on May 8, 2018. Initial analysis took place during 2014 and was completed during 2017. The authors extracted data on study population, design, and associations between neighborhood characteristics and obesity risk factors.

Sources Used: PubMed, SCOPUS, Web of Science, and Sociological Abstracts databases; Additional sources cited in the publication.

Citation: Johnson, Katherine Abowd;Showell, Nakiya N;Flessa, Sarah;Janssen, Melissa;Reid, Natalie;Cheskin, Lawrence J;Thornton, Rachel L J Do Neighborhoods Matter? A Systematic Review of Modifiable Risk Factors for Obesity among Low Socio-Economic Status Black and Hispanic Children. Childhood obesity (Print) 15

Pubmed: https://pubmed.ncbi.nlm.nih.gov/30565954/

DOI: https://doi.org/10.1089/chi.2018.0044

NIEHS Funding: Not Available

Other Funding: P50HL105187, K23HL121250, KL2TR001077

The Health and economic effects of light rail lines: design, methods, and protocol for a natural experiment.

Article #84

Details	Research article	Cost-benefit analysis (CBA)

Authors: Frank, L, Kuntz J, Chapman J, Fox E, Dickerson J, Meenan R, Saelens B, Young D, Boone-Heinonen J, Fortmann S

Journal: BMC public health

Summary: The Rails & Health study is an ongoing research study that will provide information that documents how a new transportation option can alter PA, health, and health care costs over time. The study is prospectively following 3036 adults exposed to the new light rail transit (LRT) line in Portland, Oregon and a similar cohort of 4386 adults who do not live close to the new line. The authors collect Individual-level outcomes and covariates from the electronic medical records at Kaiser Permanente Northwest and from interviews. The Rails & Health study will provide urban planners, transportation engineers, health practitioners, developers, and decision makers with critical information needed to document how transit investments impact population health and related costs.

Population: Not Available

Health Outcomes

Chronic disease indicators; obesity

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-benefit analysis (CBA)

Costs Measured: Effects of opening a new LRT line on health care costs

Potential Cost Measures: Not Available

Benefits Measures: Provide urban planners, transportation engineers, health practitioners, developers, and decision makers with critical information needed to document how transit investments impact population health and related costs

Potential Benefits: Not Available

Location: Portland, Oregand

Models Used: Structural Equation Modeling; Standardized Medical Care Costing Model; Microscale Audit of Pedestrian Landscape (MAPS)

Methods Used: This is an ongoing study that uses data from Kaiser Permanente Northwest (KPNW) members medical records following the opening of a new light rail transit (LRT) line in Portland, Oregon. Individual-level outcomes and covariates are extracted from the electronic medical record at KPNW, including member demographics and comorbidities, blood pressure, body mass index, lipids, glycosylated hemoglobin, and health care utilization and costs. In addition, participants are surveyed about additional demographics, travel patterns, physical activity (PA), and perceived neighborhood walkability. The authors will use statistical analyses to examine the effects of opening a new LRT line on chronic disease indicators, health care utilization, and health care costs and to evaluate the degree to which observed effects of the LRT line on health measures and costs are mediated by changes in total and transportation-associated PA.

Sources Used: Kaiser Permanente Northwest (KPNW) (Kaiser Permanente Center for Health Research, 2009); General Transit Feed Specification Data Exchange (http://transitfeeds.com); Microscale Audit of Pedestrian Landscape (MAPS) (Cain et al., 2018); Additional sources cited in the publication.

Citation: Frank, Lawrence D;Kuntz, Jennifer L;Chapman, James E;Fox, Eric H;Dickerson, John F;Meenan, Richard T;Saelens, Brian E;Young, Deborah R;Boone-Heinonen, Janne;Fortmann, Stephen P The Health and economic effects of light rail lines: design, methods, and protocol for a natural experiment. BMC public health 19

Pubmed: https://pubmed.ncbi.nlm.nih.gov/30770737/

DOI: https://doi.org/10.1186/s12889-019-6518-6

NIEHS Funding: Not Available

Other Funding: R01DK103385

Unraveling Race, Socioeconomic Factors, and Geographical Context in the Heterogeneity of Lupus Mortality in the United States.

Article #85

Details	Research article	Cost analysis (CA)

Authors: Falasinnu T, Chaichian Y, Palaniappan L, Simard J

Journal: ACR open rheumatology

Summary: The authors of this study combined race-geographical combinations of the US population known as the "Eight Americas" from National Vital Statistics and US Census data to statistically examine whether social environment attenuates racial disparities in Systemic lupus erythematosus-related mortality. The authors concluded that the average annual mortality rates were highest among blacks in three race-geographical contexts: average-income blacks, southern low-income blacks, and high-risk urban blacks and lowest among nonblacks living in average-income settings. The authors findings suggest that race may transcend SES and geographical parameters as a key determinant of SLE-related mortality.

Population: The Eight Americas

Health Outcomes

Systemic lupus erythematosus (SLE)

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost analysis (CA)

Costs Measured: Socioecomonic effects on racial disparities in Systemic lupus erythematosus-related mortality

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: United States

Models Used: Logistic regression models

Methods Used: The authors combined race-geographical combinations of the US population known as the “Eight Americas” from National Vital Statistics and US Census data to statistically examine whether social environment attenuates racial disparities in Systemic lupus erythematosus-related mortality.

Sources Used: National Vital Statistics and US Census data; National Center for Health Statistics Multiple Cause of Death (MCOD) database; Additional sources cited in the publication.

Citation: Falasinnu, Titilola;Chaichian, Yashaar;Palaniappan, Latha;Simard, Julia F Unraveling Race, Socioeconomic Factors, and Geographical Context in the Heterogeneity of Lupus Mortality in the United States. ACR open rheumatology 1

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31777791/

DOI: Not Available

NIEHS Funding: Not Available

Other Funding: K24HL150476

Environmental stress and socioeconomic status: Does parent and adolescent stress influence executive functioning in urban youth?

Article #86

Details	Research article	Not Available

Authors: Mance, G, Grant K, Roberts D, Carter J, Turek C, Adam E, Thorpe R

Journal: Journal of prevention & intervention in the community

Summary: This research study utilized another ongoing study to test for mediating and moderating processes in the relationship between stressors and developmental outcomes among a diverse sample of urban adolescents. Data from 267 adolescents and parents who reported as Black/African American or White/Caucasian were analyzed for this study. Self-report questionnaires were completed by adolescent and parent informants independently. Parent level of education, job description, income, and home address were considered in calculating "Family SES Score." The authors found that adolescent stress was positively associated with executive function skills of emotional control, shifting, and inhibition. Adolescent stress was also found to be positively associated with parent stress, school grade, and adolescent age.

Population: Grade students attending racially and socioeconomically diverse schools

Health Outcomes

Stress

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Socioeconomic effects on adolecent stress

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Chicago, Illinois

Models Used: Hollingshead's Four Factor Index of Social Status coding; Behavior Rating Inventory Function – Self Report (BRIEF-SF)

Methods Used: Data from 267 adolescents and parents who reported as Black/African American or White/Caucasian were analyzed for this study.. All adolescents attended one of three public schools chosen for their diverse student enrollment. Self-report questionnaires were completed by adolescent and parent informants independently. Parent level of education, job description, income, and home address were considered in calculating "Family SES Score."

Sources Used: Data came from a larger study examining the relationship between stressful life experiences and developmental psychopathology among 402 racially, ethnically, and socioeconomically diverse adolescents, aged 11–17, residing in a large Midwestern city; Bronfenbernner's ecological systems theory (Bronfenbrenner, 1979); Social stress in the urban environment is thought to underlie the risk for negative psychological outcomes (Lederbogen et al., 2011); Hollingshead's Four Factor Index of Social Status coding (Adams et al., 2011); Additional sources cited in the publication.

Citation: Mance, GiShawn A;Grant, Kathryn E;Roberts, Debra;Carter, Jocelyn;Turek, Carolyn;Adam, Emma;Thorpe, Roland J Environmental stress and socioeconomic status: Does parent and adolescent stress influence executive functioning in urban youth? Journal of prevention & intervention in the community 47

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31169069/

DOI: https://doi.org/10.1080/10852352.2019.1617386

NIEHS Funding: Not Available

Other Funding: R21AA021073

Estimating the Combined Effects of Natural and Built Environmental Exposures on Birthweight among Urban Residents in Massachusetts.

Article #87

Details	Research article	Cost analysis (CA)

Authors: Yitshak-Sade M, Fabian P, Lane K, Hart J, Schwartz J, Laden F, James P, Fong K, Kloog I, Zanobetti A

Journal: International journal of environmental research and public health

Summary: This research study compared Massachusetts birth registry data to exposure to PM 2.5, temperature, greeness, walkability index, nighttime noise, and socioeconomic environment to understand their effects on birthweight. The authors observed lower birthweights in infants born to women with higher temperature exposures during pregnancy, living in areas with less greenness and higher noise, living in more walkable areas, and in areas with more of the low income population.

Population: Singleton live births of mothers who resided in urban census block-groups and delivered in Massachusetts between 2001 and 2011

Health Outcomes

Birthweight

Environmental Agents

List of Environmental Agents: Fine particulate matter (PM2.5); temperature; greenness

Source of Environmental Agents: Built environment

Economic Evaluation/Methods and Sources

Type: Cost analysis (CA)

Costs Measured: Socioeconomic effects on birthweight

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Massachusetts, United States

Models Used: Elastic-net regression model; multivariate model; out-of-sample tenfold cross-validation; Spearman correlation tests; linear regression models; Weighted Quantile Sum (WQS) regression; single exposure model

Methods Used: The authors — 1) used the Massachusetts birth registry data to collect singleton live births for the years of 2001-2011, data included the newborn's birthweight in grams and sociodemographic and clinical characteristics; and 2) examined exposure to PM 2.5, temperature, greeness, walkability index, nighttime noise, and socioeconomic environment using statstical analysis.

Sources Used: Massachusetts birth registry; 2010 Census urban and rural classification; Massachusetts Department of Public Health; Environmental Protection Agency (EPA); National Climatic Data Center (NCDC); monthly remote sensing data from the MODIS satellites; Environmental Protection Agency (EPA) Smart Location Database; Measures of Local Segregation for Monitoring Health Inequities by Local Health Departments (Krieger et al., 2017); Additional sources cited in the publication.

Citation: Yitshak-Sade, Maayan;Fabian, M Patricia;Lane, Kevin J;Hart, Jaime E;Schwartz, Joel D;Laden, Francine;James, Peter;Fong, Kelvin C;Kloog, Itai;Zanobetti, Antonella Estimating the Combined Effects of Natural and Built Environmental Exposures on Birthweight among Urban Residents in Massachusetts. International journal of environmental research and public health 17

Pubmed: https://pubmed.ncbi.nlm.nih.gov/33260804/

DOI: https://doi.org/10.3390/ijerph17238805

NIEHS Funding: R01ES024332, P30ES000002

Other Funding: P50MD010428

Food environment near schools and body weight-A systematic review of associations by race/ethnicity, gender, grade, and socio-economic factors.

Article #88

Details	Review	Not Available

Authors: Matsuzaki M, Sánchez B, Acosta ME, Botkin J, Sanchez-Vaznaugh E

Journal: Obesity reviews : an official journal of the International Association for the Study of Obesity

Summary: This review article examined the association between food environments near schools and childhood obesity by demographic and socioeconomic factors. The studies in this review found generally positive associations between fast food outlets near schools and obesity among Latino, White, and African American children.

Population: Not Available

Health Outcomes

Reviewed publications that examined — childhood obesity

Environmental Agents

List of Environmental Agents: Reviewed publications that examined — food environments

Source of Environmental Agents: Reviewed publications that examined — built environment

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Reviewed publications that examined — socioeconomic effects on childhood obesity

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 review of existing literature to examine association between food environments near schools and obesity by demographic and socioeconomic factors. The authors used PubMed and Scopus databases.

Sources Used: PubMed and Scopus databases; Additional sources cited in the publication.

Citation: Matsuzaki, Mika;Sánchez, Brisa N;Acosta, Maria Elena;Botkin, Jillian;Sanchez-Vaznaugh, Emma V Food environment near schools and body weight-A systematic review of associations by race/ethnicity, gender, grade, and socio-economic factors. Obesity reviews : an official journal of the International Association for the Study of Obesity 21

Pubmed: https://pubmed.ncbi.nlm.nih.gov/32026567/

DOI: https://doi.org/10.1111/obr.12997

NIEHS Funding: P01ES022844

Other Funding: R01HL131610, K01HL115471, R01HL136718

Genetic and environmental influences on human height from infancy through adulthood at different levels of parental education.

Article #89

Details	Research article	Cost-effectiveness analysis (CEA)

Authors: Jelenkovic A, Sund R, Yokoyama Y, Latvala A, Sugawara M, Tanaka M, Matsumoto S, Freitas D, Maia JA, Knafo-Noam A, Mankuta D, Abramson L, Ji F, Ning F, Pang Z, Rebato E, Saudino K, Cutler T, Hopper J, Ullemar V, Almqvist C, Magnusson P, Cozen W, Hwang A, Mack T, Nelson T, Whitfield K, Sung J, Kim J, Lee J, Lee S, Llewellyn C, Fisher A, Medda E, Nisticò L, Toccaceli V, Baker L, Tuvblad C, Corley R, Huibregtse B, Derom C, Vlietinck R, Loos R, Burt A, Klump K, Silberg J, Maes H, Krueger R, McGue M, Pahlen S, Gatz M, Butler D, Harris J, Brandt I, Nilsen T, Harden P, Tucker-Drob E, Franz C, Kremen W, Lyons M, Lichtenstein P, Bartels M, Beijsterveldt C, Willemsen G, Öncel S, Aliev F, Jeong H, Hur Y, Turkheimer E, Boomsma D, Sørensen T, Kaprio J, Silventoinen K

Journal: Scientific reports

Summary: This research article uses twin data from 29 cohorts to statistically analyze the effects of socioeconomic environment on ones height. The authors found no solid evidence to support their hypothesis.

Population: Twins

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-effectiveness analysis (CEA)

Costs Measured: Socioeconomic effects on height

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Not Available

Models Used: Stata statistical software; variance decomposition modeling; random-effects meta-regression analysis; linear regression models

Methods Used: The authors used twin data from several cohorts to statistically analyze socioeconomic effects on height.

Sources Used: CODATwins project; Australian Twin Registry; Korean Twin-Family Register, Ochanomizu University Twin Project, Qingdao Twin Registry of Children, South Korea Twin Registry, West Japan Twins and Higher Order Multiple Births Registry; Child and Adolescent Twin Study in Sweden, East Flanders Prospective Twin Survey, FinnTwin12, FinnTwin16, Gemini, Italian Twin Registry, Norwegian Twin Registry, Portugal Twin Cohort, TCHAD-study, Turkish Twin Study, Young Netherlands Twin Registry; Longitudinal Israeli Study of Twins; Boston University Twin Project, California Twin Program, Carolina African American Twin Study of Aging, Colorado Twin Registry, Michigan Twins Project, Mid Atlantic Twin Registry, Minnesota Twin Registry, NAS-NRC Study, University of Southern California Twin Study, Texas Twin Project, Vietnam Era Twin Registry; Additional sources cited in the publication.

Citation: Jelenkovic, Aline;Sund, Reijo;Yokoyama, Yoshie;Latvala, Antti;Sugawara, Masumi;Tanaka, Mami;Matsumoto, Satoko;Freitas, Duarte L;Maia, José Antonio;Knafo-Noam, Ariel;Mankuta, David;Abramson, Lior;Ji, Fuling;Ning, Feng;Pang, Zengchang;Rebato, Esther;Saudino, Kimberly J;Cutler, Tessa L;Hopper, John L;Ullemar, Vilhelmina;Almqvist, Catarina;Magnusson, Patrik K E;Cozen, Wendy;Hwang, Amie E;Mack, Thomas M;Nelson, Tracy L;Whitfield, Keith E;Sung, Joohon;Kim, Jina;Lee, Jooyeon;Lee, Sooji;Llewellyn, Clare H;Fisher, Abigail;Medda, Emanuela;Nisticò, Lorenza;Toccaceli, Virgilia;Baker, Laura A;Tuvblad, Catherine;Corley, Robin P;Huibregtse, Brooke M;Derom, Catherine A;Vlietinck, Robert F;Loos, Ruth J F;Burt, S Alexandra;Klump, Kelly L;Silberg, Judy L;Maes, Hermine H;Krueger, Robert F;McGue, Matt;Pahlen, Shandell;Gatz, Margaret;Butler, David A;Harris, Jennifer R;Brandt, Ingunn;Nilsen, Thomas S;Harden, K Paige;Tucker-Drob, Elliot M;Franz, Carol E;Kremen, William S;Lyons, Michael J;Lichtenstein, Paul;Bartels, Meike;Beijsterveldt, Catharina E M van;Willemsen, Gonneke;Öncel, Sevgi Y;Aliev, Fazil;Jeong, Hoe-Uk;Hur, Yoon-Mi;Turkheimer, Eric;Boomsma, Dorret I;Sørensen, Thorkild I A;Kaprio, Jaakko;Silventoinen, Karri Genetic and environmental influences on human height from infancy through adulthood at different levels of parental education. Scientific reports 10

Pubmed: https://pubmed.ncbi.nlm.nih.gov/32409744/

DOI: https://doi.org/10.1038/s41598-020-64883-8

NIEHS Funding: R01ES015150

Other Funding: T32DA017637, R21MH070542, R21AG039572, R01AA009203, K05AA000145, R01AA012502, R01AG018384, R01AG018386, R01MH092377, R01MH062375, R03MH063851, R01MH081813, R01HD066040, R01MH058354, R01AG022982, R21AA023322, P60DA011015, R01AG050595, R01AG013662, R01HD068

Hotspots of childhood obesity in a large metropolitan area: does neighbourhood social and built environment play a part?

Article #90

Details	Research article	Cost analysis (CA)

Authors: Ribeiro, Ana Isabel;Santos, Ana Cristina;Vieira, Verónica M;Barros, Henrique

Journal: International journal of epidemiology

Summary: The authors of this research article used data from the Generation XXI cohort to georeference childhood obesity levels in Portugal. The authors found that neighborhood socioeconmic deprevation and greater availability to fast-food resturants were linked to increased prevalence of obesity.

Population: 7-year old children from Generation XXI cohort

Health Outcomes

Childhood obesity

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Built environment

Economic Evaluation/Methods and Sources

Type: Cost analysis (CA)

Costs Measured: Socioeconomic effects on childhood obesity

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Porto Metropolitan Area (municipalities of Porto, Gondomar, Matosinhos, Valongo, Maia, Vila Nova de Gaia), Northern Portugal

Models Used: Generalized additive models (GAMs)

Methods Used: The authors — 1) used the Generation XXI cohort data to collect weight and address data; and 2) used ARC GIS and Google Maps to georeference the data and used statistical analyses to determine relation between childhood obesity and built environment.

Sources Used: Generation XXI (G21) (Larson, et al., 2013); ArcGIS Online World Geocoding Service and Google Earth (Ribeiro et al, 2014); Additional sources cited in the publication.

Citation: Ribeiro, Ana Isabel;Santos, Ana Cristina;Vieira, Verónica M;Barros, Henrique Hotspots of childhood obesity in a large metropolitan area: does neighbourhood social and built environment play a part? International journal of epidemiology 49

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31603208/

DOI: https://doi.org/10.1093/ije/dyz205

NIEHS Funding: P42ES007381

Other Funding: Not Available

Racial Capitalism Within Public Health-How Occupational Settings Drive COVID-19 Disparities.

Article #91

Details	Commentary	Not Available

Authors: McClure E, Vasudevan P, Bailey Z, Patel, S, Robinson W

Journal: American journal of epidemiology

Summary: This commentary examines the structural and systemic challenges that contribute to racial disparities in health, specifically with the Covid-19 pandemic. This paper uses stories to illustrate where industry has contributed to the outbreak and review how they exemplify racial capitalism. This paper addresses the need for public health professionals to critically evaluate the populations helped and hurt by understanding structural determinants of health in etiological evaluation.

Population: Not Available

Health Outcomes

COVID-19; Hearing loss

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: United States

Models Used: Not Available

Methods Used: The authors used existing literature to examine and critique the structural and systemic challenges that contribute to racial disparities in health.

Sources Used: NHANES; NIOSH; OSHA; WHO; CDC; Additional sources cited in the publication.

Citation: McClure, Elizabeth S;Vasudevan, Pavithra;Bailey, Zinzi;Patel, Snehal;Robinson, Whitney R Racial Capitalism Within Public Health-How Occupational Settings Drive COVID-19 Disparities. American journal of epidemiology 189

Pubmed: https://pubmed.ncbi.nlm.nih.gov/32619007/

DOI: https://doi.org/10.1093/aje/kwaa126

NIEHS Funding: T32ES007018

Other Funding: P2CHD050924, T32HD007168

Spatial predictive properties of built environment characteristics assessed by drop-and-spin virtual neighborhood auditing.

Article #92

Details	Research article	Not Available

Authors: Plascak J, Schootman M, Rundle A, Xing C, Llanos A, Stroup A, Mooney S

Journal: International journal of health geographics

Summary: The authors used a point-based virtual neighborhood audit method to spatially autocorrelate built environment and compared it to a virtual neighborhood that was audited by trained professionals. The authors found that the spatially autocorrelated audit items were well-predicted using regression Kriging spatial models and that predicted responses to neighborhood physical disorder-related items correlated strongly with one another, especially within the areas of racial-ethnic compostion, socioeconomic indicators, and residential mobility.

Population: Not Available

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Built environment

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Essex County, New Jersey

Models Used: Nested semivariograms and regression Kriging; Receiver Operator Curve (ROC) Area Under the Curve (AUC); isostropic, Gaussian kernel; nonparametric, spatially varying probability surfaces; semivariograms of deviance residuals; Local Ordinary Kriging (OK); root mean squared prediction error (RMSPE)

Methods Used: The authors — 1) conducted a virtual visual audit of Essex County, New Jersey and surrounding areas, looking at the built environment characteristics on non-highway streets; and 2) compared spatial properties prediction to what their auditors found using statistical analysis.

Sources Used: Google Street View (GSV); CANVAS virtual audit tool (Bader et al., 2015); Census; Additional sources cited in the publication.

Citation: Plascak, Jesse J;Schootman, Mario;Rundle, Andrew G;Xing, Cathleen;Llanos, Adana A M;Stroup, Antoinette M;Mooney, Stephen J Spatial predictive properties of built environment characteristics assessed by drop-and-spin virtual neighborhood auditing. International journal of health geographics 19

Pubmed: https://pubmed.ncbi.nlm.nih.gov/32471502/

DOI: https://doi.org/10.1186/s12942-020-00213-5

NIEHS Funding: P30ES005022

Other Funding: R01HD087460, K07CA222158, P30CA072720, P2CHD058486, K99LM012868

Water borrowing is consistently practiced globally and is associated with water-related system failures across diverse environments.

Article #93

Details	Research article	Cost-benefit analysis (CBA)

Authors: Rosinger A, Brewis A, Wutich A, Jepson W, Staddon C, Stoler J, Young S

Journal: Global environmental change : human and policy dimensions

Summary: The authors used data from the Household Water InSecurity Experiences to statistically analyze how widespread the need for water borrowing is, the need for water borrowing, and how perceived socioeconomic status plays a role in water borrowing. The authors found that water borrowing occurs globally, unmet water needs result in water borrowing, and water borrowing is most common among households that reported the lowest perceived socioecomonic status.

Population: Those knowledgable about their household water situation

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Water

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-benefit analysis (CBA)

Costs Measured: Socioecomonic effects on the need to borrow water

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Sub-Saharan Africa, the Middle East, Central/South America, and Asia

Models Used: Multilevel mixed-effect logistic regression models; two-level, mixed-effect logistic regression models; Spearman's rank correlations

Methods Used: The authors — 1) used data from the Household Water InSecurity Experiences study to estimate prevalence of water borrowing practices using a household water insecurity score; and 2) statistically compared how self-perceived socioeconomic status correlated to the need to borrow water, how prevalent borrowing water is worldwide, and if returning water to the lender is expected.

Sources Used: Household Water InSecurity Experience (HWISE) (Young Et Al., 2019); WHO and UNICEF; 2017.; Additional sources cited in the publication.

Citation: Rosinger, Asher Y;Brewis, Alexandra;Wutich, Amber;Jepson, Wendy;Staddon, Chad;Stoler, Justin;Young, Sera L; Water borrowing is consistently practiced globally and is associated with water-related system failures across diverse environments. Global environmental change : human and policy dimensions 64

Pubmed: https://pubmed.ncbi.nlm.nih.gov/33071475/

DOI: https://doi.org/10.1016/j.gloenvcha.2020.102148

NIEHS Funding: R01ES019841

Other Funding: R21MH108444, K01MH098902

A Mixed Method Study to Inform the Implementation and Expansion of Pop-Up Parks for Economic, Behavioral, and Social Benefits.

Details	Research article	Cost-benefit analysis (CBA)

Authors: Winter S, Sheats J, Salvo D, Banda J, Quinn J, Rivera BR, King A

Journal: Journal of urban health : bulletin of the New York Academy of Medicine

Summary: This mixed method study use quantitative and qualitative data to further understand how pop-up parks contribued to economic, behavioral and social benefits. The results showed that the pop-up parks were highly successful and contribued to increased foot traffic, increased physical activity, increased interest in local businesses, and increased social interactions. This study was predominantly white and affluent so the results may not be generalizable to other socioeconomically disadvantaged neighborhoods.

Population: Stakeholders in Los Altos, California's downtown business district

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-benefit analysis (CBA)

Costs Measured: Not Available

Potential Cost Measures: Increased foot traffic to business boardering pop-up parks, increases in property values

Benefits Measures: Not Available

Potential Benefits: Increased physical activity, improvements in mental health, increases in social interactions, improvements to the environment

Location: Los Altos, California

Models Used: Logistic regression analysis

Methods Used: The authors — 1) partnered with an investment company and the city of Los Altos, California to study the benefits of pop-up park installations.; 2) collected data relating to the amount the pop-up park was used, and how its presence affected the business boarding the pop-up park; and 3) evaluated the data based on the individual criteria of each source, for example using statistics to analyze the quantitive data.

Sources Used: System for Observing Play and Recreation in Communities (SOPARC) (McKenzie et al., 2006); Park User Intercept Surveys; Stanford Healthy Neighborhood Discovery Tool (King et al., 2016); On-Line Survey Data Collected by Locally Owned Investment Company; Local Business Owner/ Manager Survey; Direct Observation of Business Foot Traffic; Sales Tax Data Collected by City Government; Key Informant Interviews; Additional sources cited in the publication.

Citation: Winter, Sandra J;Sheats, Jylana L;Salvo, Deborah;Banda, Jorge A;Quinn, Jennifer;Rivera, Brooke Ray;King, Abby C A Mixed Method Study to Inform the Implementation and Expansion of Pop-Up Parks for Economic, Behavioral, and Social Benefits. Journal of urban health : bulletin of the New York Academy of Medicine 97

Pubmed: https://pubmed.ncbi.nlm.nih.gov/32613496/

DOI: https://doi.org/10.1007/s11524-020-00434-w

NIEHS Funding: Not Available

Other Funding: T32HL007034, P30DK092950, P20CA217199, UL1RR025744, R01CA211048, UL1TR003142

Childhood maltreatment and lead levels in middle adulthood: A prospective examination of the roles of individual socio-economic and neighborhood characteristics.

Article #95

Details	Research article	Not Available

Authors: Carpi A, Nikulina V, Li X, Widom CS

Journal: PloS one

Summary: This research study seeks to understand the relationship between childhood maltreatment and exposure to household lead pollution as an adult. The authors matched maltreated children with non-abused children, accounting for identify factors and SES, and followed them into adulthood. The authors interviewed the study paticipants and collected dust lead samples from the homes and blood lead samples from the participant periodically. Data was statistically analyzed to determine the correlation between maltreatment in childhood to levels of lead exposure in mid-adulthood. The study found that maltreatment experienced by children predicts the level of lead present in their home environment, three decades later, in middle adulthood.

Population: Abused and neglected children in the county juvenile (family) or adult criminal courts of a Midwestern metropolitan area

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Lead

Source of Environmental Agents: Gasoline; household paint; household dust

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Not Available

Models Used: T-tests for continuous variables and Pearson's chi-square tests for categorical variables; exploratory factor analyses (EFA); oblique rotation and Ordinary Least Squares (OLS); structural equation models (SEM); Lavaan (latent variable analysis) with R to test for mediation

Methods Used: The authors — 1) matched abused and neglected children with non-abused and non-neglected children accounting for age, sex, race/ethnicity, and family SES, the pairs were followed into adulthood; 2) interviewed the study participants four times, during the interviews, the field interviewers collected dust samples and a nurse collected blood samples; and 3) conducted statistical analyses to determine any correlations between abuse, SES, and lead exposure.

Sources Used: Data collected as part of a large prospective cohort design study (Leventhal, 1982. Schulsinger et al., 1981. Widom, 1989); Census Tract data; Additional sources cited in the publication.

Citation: Carpi, Anthony;Nikulina, Valentina;Li, Xuechen;Widom, Cathy Spatz Childhood maltreatment and lead levels in middle adulthood: A prospective examination of the roles of individual socio-economic and neighborhood characteristics. PloS one 15

Pubmed: https://pubmed.ncbi.nlm.nih.gov/33232365/

DOI: https://doi.org/10.1371/journal.pone.0240683

NIEHS Funding: Not Available

Other Funding: SC2GM125547

Geospatial Analysis of Individual and Community-Level Socioeconomic Factors Impacting SARS-CoV-2 Prevalence and Outcomes.

Article #96

Details	Research article	Not Available

Authors: Cromer S, Lakhani C, Wexler D, Burnett-Bowie S, Udler M, Patel C

Journal: medRxiv : the preprint server for health sciences

Summary: This research study seeks to understand the the socioeconomic factors that contirbuted to the SARS-CoV-2 disproportionate effects on racial and ethnic minority communities. The study group included participants that tested positive for SARS-CoV-2 from Feburary to June 2020. Participants addresses were geocoded to latitude and longitiude to assign census tracts. The research found that infection and hospitalization rates but not death rates are related to census-tract level socioeconomic characteristics, specifically lower educational attainment, and higher household crowding and occupancy.

Population: Adults tested for SARS-COV-2 between Feburary 1 and June 21, 2020

Health Outcomes

Covid-19

Environmental Agents

List of Environmental Agents: Virus

Source of Environmental Agents: Home environment

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Socioeconomic effects on hospitalization rates of SARS-CoV-2 infection

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Massachusetts, United States

Models Used: Logistic Mixed model; linear mixed model; base-plus model; full multivariable model

Methods Used: The authors — 1) geocoded results from adults tested for SARS-CoV-2 between February 1 and June 21, 2020 to a census tract based on their address, and 2) data was then entered into a logistic mixed model.

Sources Used: Electronic medical record (EMR) of Mass General Brigham (NGB); 2014-2018 American Community Survey; Additional sources cited in the publication.

Citation: Cromer, Sara J;Lakhani, Chirag M;Wexler, Deborah J;Burnett-Bowie, Sherri-Ann M;Udler, Miriam;Patel, Chirag J Geospatial Analysis of Individual and Community-Level Socioeconomic Factors Impacting SARS-CoV-2 Prevalence and Outcomes. medRxiv : the preprint server for health sciences

Pubmed: https://pubmed.ncbi.nlm.nih.gov/33024982/

DOI: https://doi.org/10.1101/2020.09.30.20201830

NIEHS Funding: Not Available

Other Funding: T32DK110919, T32DK007028

The Role of Social, Economic, and Physical Environmental Factors in Care Planning for Home Health Care Recipients.

Article #97

Details	Research article	Not Available

Authors: Irani E, Hirschman K, Cacchione P, Bowles K

Journal: Research in gerontological nursing

Summary: This research study seeks to explore and understand the nonclinical factors that home health nurses evaluate and how they make decisions based on social, economic, and environmental factors. The authors conducted semi-structured interviews with 20 visiting nurses. Three nonclinical factor themes emerged: social support, home environment and neighborhood, and finances and insurance barriers. Furher research and guidance is needed to address the social determinants of health across the care continuum.

Population: Large urban home health agencies and their residents

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Mid-Atlantic region, United States

Models Used: Ecological models, CAPABLE (Community Aging in Place—Advancing Better Living for Elders), Patient-Driven Groupings Model

Methods Used: The authors — 1) used face-to-face semi-structured interviews with 20 visiting nurses, the nurses were recruited using an e-mail announcement that was sent by research coordinators and nurse managers from each of the participating agencies; and 2) analzyed the interview reponses using conventional content analysis.

Sources Used: Semi-structured interviews with 20 visting nurses from three home health agenices; Additional sources sited in publication.

Citation: Irani, Elliane;Hirschman, Karen B;Cacchione, Pamela Z;Bowles, Kathryn H The Role of Social, Economic, and Physical Environmental Factors in Care Planning for Home Health Care Recipients. Research in gerontological nursing 13

Pubmed: https://pubmed.ncbi.nlm.nih.gov/31834411/

DOI: https://doi.org/10.3928/19404921-20191210-01

NIEHS Funding: Not Available

Other Funding: T32NR015433

Environmental parameters associated with incidence and transmission of pathogenic Vibrio spp.

Article #98

Details	Review	Not Available

Authors: Brumfield K, Usmani M, Chen K, Gangwar M, Jutla A, Huq A, Colwell R

Journal: Environmental microbiology

Summary: In this review, the focus was on environmental parameters associated with incidence and distribution of clinically relevant Vibrio spp. and their role in disease transmission. In addition, molecular methods designed for detection and enumeration proved useful for predictive modeling and are described, namely in the context of prediction of environmental conditions favourable to Vibrio spp., hence human health risk.

Population: Not Available

Health Outcomes

Reviewed pubications that examined — cholera; gastroenteritis; septicemia; and other extra-intestinal infections

Environmental Agents

List of Environmental Agents: Reviewed publications that examined — bacteria

Source of Environmental Agents: Reviewed pubications that examined — aquatic ecosystems

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: United States

Models Used: Risk prediction models; National Centers for Coastal Ocean Science (NCCOS) probability model; hydroclimatic risk model

Methods Used: Not Available

Sources Used: Not Available

Citation: Brumfield, Kyle D;Usmani, Moiz;Chen, Kristine M;Gangwar, Mayank;Jutla, Antarpreet S;Huq, Anwar;Colwell, Rita R Environmental parameters associated with incidence and transmission of pathogenic Vibrio spp. Environmental microbiology 23

Pubmed: https://pubmed.ncbi.nlm.nih.gov/34390611/

DOI: https://doi.org/10.1111/1462-2920.15716

NIEHS Funding: R01ES030317

Other Funding: Not Available

Impact of paternal education on epigenetic ageing in adolescence and mid-adulthood: a multi-cohort study in the USA and Mexico.

Article #99

Details	Research article	Cost-utility analysis (CUA)

Authors: Joyce, B, Gao T, Koss K, Zheng Y, Cardenas A, Heiss J, Just A, Zhang K, van Horn L, Allen N, Greenland P, Cohen S, Gordon-Larsen P, Mitchell C, McLanahan S, Schneper L, Notterman D

Journal: International journal of epidemiology

Summary: In this study, authors examined three USA-based and one Mexico-based cohorts to examine the biological mechanism that drives the influence of both parental and neighbourhood socio-economic status (SES) on health via epigenetic age acceleration (EAA). EAA was associated with paternal education in CARDIA and FFCWS. The authors found stronger associations for some paternal education categories among white adults, men and women. These findings suggested that EAA captures epigenetic impacts of paternal education independently of personal SES later in life.

Population: Participants from the CARDIA cohort

Health Outcomes

Epigenetic age acceleration

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-utility analysis (CUA)

Costs Measured: Not Available

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Urban sites in the United States

Models Used: Hannum's EAA

Methods Used: The authors used Pearson’s correlation coefficients to assess potential collinearity; linear regression to separately model Hannum’s EAA on each SES variable in CARDIA, followed by mutually adjusted models for all personal, parental or neighbourhood SES measures; and generalized estimating equations.

Sources Used: Data from CARDIA, FFCWS, Project Viva, and PROGRESS cohorts.; Hannum's ESS (Horvath et al., 2016); Additional sources cited in the publication.

Citation: Joyce, Brian T;Gao, Tao;Koss, Kalsea;Zheng, Yinan;Cardenas, Andres;Heiss, Jonathan;Just, Allan;Zhang, Kai;van Horn, Linda;Allen, Norrina Bai;Greenland, Philip;Cohen, Sheldon;Gordon-Larsen, Penny;Mitchell, Colter;McLanahan, Sara;Schneper, Lisa;Notterman, Daniel;Rifas-Shiman, Sheryl L;Oken, Emily;Hivert, Marie-France;Wright, Robert;Baccarelli, Andrea;Lloyd-Jones, Donald;Hou, Lifang Impact of paternal education on epigenetic ageing in adolescence and mid-adulthood: a multi-cohort study in the USA and Mexico. International journal of epidemiology

Pubmed: https://pubmed.ncbi.nlm.nih.gov/34534313/

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NIEHS Funding: K23ES022242, R24ES028522, R01ES013744, R01ES014930, K99ES020346, P42ES016454, R01ES020268, T32ES007069

Other Funding: UG3OD023286, R01HD039135, R01HD076592, R01HL111108, R01HD040421, R01NR013945, R01HD036916, R01AI102960, R01HD034568

Assessing the roles of demographic, social, economic, environmental, health-related, and political factors on risk of osteoporosis diagnosis among older adults.

Article #100

Details	Research article	Cost-utility analysis (CUA)

Authors: Gough Courtney M, Quintero Y, Godde K

Journal: Archives of osteoporosis

Summary: The authors demonstrated that inflammation from prolonged stress did not cause changes to bone health through inflammation but instead impacted access to health care, social inequalities, and overall health, which in turn impacted bone health. The study provided a comprehensive assessment of how determinants of health across demographic, psychological, mobility-related, health, environmental, and economic domains are associated with the diagnosis of osteoporosis and tested three hypotheses: (1) a diverse set of variables across domains will predict osteoporosis, (2) chronic inflammation as a result of stress (represented by high-sensitivity C-reactive protein) will not be associated with osteoporosis, and (3) the model developed will have high accuracy in predicting osteoporosis.

Population: Participants from the 2012 - 2016 waves of the Health and Retirement Study

Health Outcomes

Osteoporosis

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-utility analysis (CUA)

Costs Measured: Demographic, psychological, mobility-related, health, environmental, and economic domains

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Not Available

Models Used: Cox proportional hazards models

Methods Used: The authors used a Cox proportional hazards model of osteoporosis diagnoses. The authors used — 1) logistic regression; and 2)k-nearest Neighbors Discriminant Analysis to assess predictive accuracy.

Sources Used: Data from 14,792 and 13,169 participants (depending on model) in the 2012–2016 waves of the Health and Retirement Study, including the Biomarker Study, the Contextual Data Resource (Vable et al., 2017); Additional sources cited in the publication.

Citation: Gough Courtney, Margaret;Quintero, Yadira;Godde, K Assessing the roles of demographic, social, economic, environmental, health-related, and political factors on risk of osteoporosis diagnosis among older adults. Archives of osteoporosis 16

Pubmed: https://pubmed.ncbi.nlm.nih.gov/34817704/

DOI: https://doi.org/10.1007/s11657-021-01042-0

NIEHS Funding: Not Available

Other Funding: R15AG063330, P01AG017625, R21AG045625

Association of Retail Environment and Neighborhood Socioeconomic Status with Mortality among Community-dwelling Older Adults in the US: Cardiovascular Health Study.

Article #101

Details	Research article	Cost-utility analysis (CUA)

Authors: Zhang K, Lovasi G, Odden M, Michael Y, Newman A, Arnold A, Kim DH, Wu C

Journal: The journals of gerontology. Series A, Biological sciences and medical sciences

Summary: Authors evaluated the association of neighborhood components with 5-year mortality. They also examined the interactions between neighborhood components and sex and race. They found that communities' economic status but not facilities in communities was associated with mortality among older adults.

Population: 4379 community-dwelling adults 65 years or older from the Cardiovascular Health Study

Health Outcomes

Mortality

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Neighborhood environments and built environment

Economic Evaluation/Methods and Sources

Type: Cost-utility analysis (CUA)

Costs Measured: Education, income, neighborhood components

Potential Cost Measures: Not Available

Benefits Measures: Reduced mortality

Potential Benefits: Age, sex, race, marital status, body mass index, smoking status, disability, coronary heart disease, diabetes, other health outcomes; physical environmental measures like the PM2.5 concentrations, activity spaces using GPS; specific types of facilities/es

Location: North Carolina, California, Maryland, Pennsylvania, United States

Models Used: Cox proportional hazards models

Methods Used: The authors — 1) used a Cox model to evaluate the association of neighborhood components with 5-year mortality; and 2) used 2-sample t-test to compare continuous variables and chi-squared test to compare categorical variables; heatmap to inspect the correlation matrix of all included neighborhood environmental variables; principal component analysis (PCA) to reduce the 48 neighborhood environmental variables into a smaller set of principal components.

Sources Used: Cardiovascular Health Study; National Establishment Time Series (NETS) Database; Longitudinal Tract Database; Additional sources cited in the publication.

Citation: Zhang, Kehan;Lovasi, Gina S;Odden, Michelle C;Michael, Yvonne L;Newman, Anne B;Arnold, Alice M;Kim, Dae Hyun;Wu, Chenkai Association of Retail Environment and Neighborhood Socioeconomic Status with Mortality among Community-dwelling Older Adults in the US: Cardiovascular Health Study. The journals of gerontology. Series A, Biological sciences and medical sciences

Pubmed: https://pubmed.ncbi.nlm.nih.gov/34669918/

DOI: https://doi.org/10.1093/gerona/glab319

NIEHS Funding: Not Available

Other Funding: R01AG049970

Priorities and Indicators for Economic Evaluation of Built Environment Interventions to Promote Physical Activity.

Article #102

Details	Research article	Not Available

Authors: Cradock A, Buchner D, Zaganjor H, Thomas J, Sallis J, Rose K, Meehan L, Lawson M, Lavinghouze R, Fenton M, Devlin H, Carlson S, Bhattacharya, T, Fulton J

Journal: Journal of physical activity & health

Summary: In this study, authors engaged experts to identify a set of key economic indicators useful for evaluation, research, and public health practice. Experts identified 73 economic indicators, then used a 5-point scale to rate them on three properties: measurement quality, feasibility of use by a community, and influence on community decision-making. The 10 highest-rated "key" indicators were walkability score, residential vacancy rate, housing affordability, property tax revenue, retail sales per square foot, number of small businesses, vehicle miles traveled per capita, employment, air quality, and life expectancy.

Population: Not Available

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Built environment

Economic Evaluation/Methods and Sources

Type: Not Available

Costs Measured: To characterize the economic value of built environment approaches

Potential Cost Measures: Not Available

Benefits Measures: To identify a set of key economic indicators useful for evaluation, research, and public health practice

Potential Benefits: Increased physical activity

Location: Not Available

Models Used: Not Available

Methods Used: The authors used a modified Delphi process as a multidisciplinary group of experts participated in one of five discussion groups, a two-day facilitated workshop, and/or online surveys.

Sources Used: National Collaborative on Childhood Obesity Research (NCCOR); Active Communities Tool (ACT): An Action Planning Guide and Assessment Modules to Improve Community Built Environments to Promote Physical Activity (Everson et. al., 2020); Additional sources cited in the publication.

Citation: Cradock, Angie L;Buchner, David;Zaganjor, Hatidza;Thomas, John V;Sallis, James F;Rose, Kenneth;Meehan, Leslie;Lawson, Megan;Lavinghouze, René;Fenton, Mark;Devlin, Heather M;Carlson, Susan A;Bhattacharya, Torsha;Fulton, Janet E Priorities and Indicators for Economic Evaluation of Built Environment Interventions to Promote Physical Activity. Journal of physical activity & health 18

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DOI: https://doi.org/10.1123/jpah.2021-0191

NIEHS Funding: Not Available

Other Funding: U48DP006376

An examination of genetic and environmental factors related to negative personality traits, educational attainment, and economic success.

Article #103

Details	Research article	Cost-utility analysis (CUA)

Authors: Stallings M and Neppl T

Journal: Developmental psychology

Summary: In this study, authors examine social, genetic, and economic predictors of negative personality traits during adolescence and its influences on later educational and economic success. Results suggested potential gene-environment correlation or common genetic influences underlie associations among parenting investments, negative personality traits, and educational attainment.

Population: First generation (G1) fathers and mothers with mean age 40 and 38 yrs, second generation (G2) adolscents 12 to 14 yrs old

Health Outcomes

Not Available

Environmental Agents

List of Environmental Agents: Not Available

Source of Environmental Agents: Not Available

Economic Evaluation/Methods and Sources

Type: Cost-utility analysis (CUA)

Costs Measured: G1 and G2 educational attainment; G1 and G2 income, G1 parenting investments; G1 material investments; G2 negative personality traits

Potential Cost Measures: Not Available

Benefits Measures: Not Available

Potential Benefits: Not Available

Location: Rural Iowa, United States

Models Used: Interactionist model; structural equation model

Methods Used: The authors incorporated a polygenic score derived from GWAS study of educational attainment into the Interactionist Model using — 1) full information maximum likelihood estimation to deal with missing data; 2) standardized regression coefficients partialed for all other coefficients in the model to determine standardized path coefficients of negative personality traits and socioeconomic traits; 3) estimated standard errors to determine significance of individual path coefficients; 4) a comparative fit index (CFI) and Tucker-Lewis index (TLI) to determine overall model fit; and 5) a conservative Bonferroni correction for evaluating the significance of the 23 path coefficients in the model.

Sources Used: Family Transitions Project; Interactionist model (Conger et.al., 2021); genome-wide association studies (GWAS) (Okbay et al., 2016, and Lee et al., 2018.); Additional sources cited in the publication.

Citation: Stallings, Michael C;Neppl, Tricia An examination of genetic and environmental factors related to negative personality traits, educational attainment, and economic success. Developmental psychology 57

Pubmed: https://pubmed.ncbi.nlm.nih.gov/33539127/

DOI: https://doi.org/10.1037/dev0001131

NIEHS Funding: Not Available

Other Funding: R01HD064687