Project 003 Cardiovascular Disease and Aircraft Noise Exposure

Boston University

Project Lead Investigator

Junenette L. Peters
Associate Professor
Department of Environmental Health
Boston University School of Public Health
715 Albany St., T4W, Boston, MA 02118
617-358-2552
petersj@bu.edu

University Participants

Boston University (BU)

- P.I.s: Prof. Jonathan Levy (university P.I.), Prof. Junenette Peters (project P.I.)
- FAA Award Number: 13-C-AJFE-BU-016
- Period of Performance: October 1, 2021 to September 30, 2022

Massachusetts Institute of Technology (MIT)

- Sub-P.I. and co-P.I.: Prof. R. John Hansman (sub-P.I.), Dr. Florian Allroggen (sub-co-P.I.)

Tasks (performance period)
Related to 2018 FAA Reauthorization, Section 189, Tasks 1–3:

1. Present results of analysis of hypertension and aircraft noise exposure based on the day–night average sound level (DNL) metric, and generate new results on exposure to nighttime noise
2. For supporting analysis
    a. Write up and publish final results of supporting analysis of sociodemographic patterning of aircraft noise exposure
    b. Generate final results and write up supporting analyses of trends in aircraft noise exposure
3. Generate final results and write up analysis of sleep quantity and quality, and aircraft noise exposure
4. Generate final results on cardiovascular disease (CVD) and aircraft noise exposure
5. Generate preliminary results on intermediate risk marker (adiposity) and aircraft noise exposure

Related to 2018 FAA Reauthorization, Section 189, Tasks 4 and 5:

6. Develop a model for measuring changes in business activities attributable to aircraft noise exposure, prototype a model city, and include an assessment comparing a change in the visibility of aircraft due to a change in aircraft flight paths

Related to 2018 FAA Reauthorization, Section 189, all tasks:

7. Draft a report on the study results for policy-makers

Project Funding Level

Total funding (3-year funding): $1,729,286
Matching funds: $1,729,286
Sources of matching funds: Nonfederal donors to the Nurses' Health Study (NHS), Health Professional Follow-up Study (HPFS), and Women's Health Initiative (WHI) cohorts

Investigation Team

Junenette Peters, P.I., Boston University
Dr. Peters is responsible for directing all aspects of the proposed study, including study coordination, design and analysis plans, and co-investigator meetings.

Jonathan Levy, Boston University
Dr. Levy will participate in noise exposure assessment and provide expertise in the areas of predictive modeling and air pollution.

Francine Laden, Jaime Hart, and Susan Redline, Harvard Medical School/Brigham and Women's Hospital
Dr. Laden is our NHS and HPFS sponsor for this ancillary study. Dr. Hart will assign aircraft noise exposures to the geocoded address history coordinates of each cohort member. Dr. Laden and Dr. Hart will also assist in documenting data from the NHS and HPFS, on the basis of their previous experience in research on air pollution and chronic disease outcomes in these cohorts, and in performing appropriate analyses of hypertension and cardiovascular outcomes. Dr. Redline will lead efforts related to noise and sleep disturbance in the NHS and WHI.

John Hansman and Florian Allroggen, Massachusetts Institute of Technology
Dr. Hansman will participate in the economic impact assessment and will provide expertise on analytical approaches for quantifying noise. Dr. Allroggen will perform an economic impact assessment based on his expertise in analyzing the societal costs and benefits of aviation.

Project Overview

Exposure to aircraft noise has been described as "the most readily perceived environmental impact of aviation" in communities surrounding airports (Wolfe et al., 2014). Exposure to aircraft noise has been associated with physiological responses and psychological reactions (Bluhm & Eriksson, 2011; Hatfield et al., 2001) including sleep disturbances, sleep-disordered breathing, nervousness, and annoyance (Hatfield et al., 2001; Rosenlund et al., 2001). Recent literature, primarily from European studies, has provided evidence of a relationship between aircraft noise and self-reported hypertension (Rosenlund et al., 2001), elevated blood pressure (Evrard et al., 2017; Haralabidis et al., 2008; Haralabidis et al., 2011; Jarup et al., 2008; Matsui et al., 2004), antihypertensive medication use (Bluhm & Eriksson, 2011; Floud et al., 2011; Franssen et al., 2004; Greiser et al., 2007), and the incidence of hypertension (Dimakopoulou et al., 2017; Eriksson et al., 2010). However, the extent to which aircraft noise exposure increases the risk of adverse health outcomes is not well understood. Impacts related to annoyance have been empirically studied with the stated preference approach (Bristow et al., 2015) and the revealed preference approach, which often relies on analyses of transaction prices for residential properties (Almer et al., 2017; Kopsch, 2016; Wadud, 2013). Although the impacts of aircraft noise on individuals are well understood, little evidence has been presented regarding the impact of aircraft noise exposure on businesses in communities located beneath flight paths. Section 189 of the FAA Reauthorization Act of 2018 (Pub. L. 115–254) calls for a study on the potential health and economic impacts attributable to aircraft overflight noise.

The goal of this ongoing project is to examine the potential health impacts attributable to noise exposure resulting from aircraft flights; this project leverages ongoing work within ASCENT to respond to Section 189. This study aims to assess the potential associations between aircraft noise exposure and outcomes such as sleep disturbance and elevated blood pressure. The study will leverage existing collaborations with well-recognized and respected studies that have followed more than 250,000 participants through courses of their lives to understand factors that affect health. These studies include the NHS and HPFS. Furthermore, this work is aligned with a concluded National Institutes of Health-funded effort that examined these associations in the WHI. The research team is leveraging aircraft noise data for 90 U.S. airports from 1995 to 2015, generated with the Aviation Environmental Design Tool; these data are being linked to demographic, lifestyle, and health data for the participants in long-term health studies. These studies provide considerable geographic coverage of the United States, including all geographic areas specified in Section 189.

This work also responds to the aspect of Section 189 calling for the study of economic harm or benefits for businesses located in communities underneath regular flight paths. The study involves a first-of-its-kind empirical assessment of the economic impacts on businesses located beneath flight paths at selected U.S. airports. These impacts are expected to be driven by (a) potential positive economic impacts related to the airport and its connectivity, and (b) environmental impacts such as noise, which may decrease the revenue and productivity of businesses beneath flight paths. The team proposed to evaluate whether such impacts can be empirically identified while considering economic outcome metrics such as the gross domestic product (GDP), employment, and revenue.

The overall aims for the 3-year project as it relates to the provisions of Section 189 are as follows:

- Perform Tasks 1–3 [*Sec. 189. (b)(1–3)*]: Potential health impacts attributable to aircraft overflight noise
  - Investigate the relationship between aircraft noise exposure and the incidence of hypertension in the NHS and HPFS, accounting for other individual- and area-level risk factors
  - Investigate the relationship between aircraft noise exposure and the incidence of CVD in the NHS and HPFS cohorts, and determine whether sufficient data exist to demonstrate a causal relationship
  - Determine whether a relationship exists between annual average aircraft noise exposure and general sleep length and quality in the NHS and the Growing Up Today Study (GUTS), and report whether sufficient data exist to demonstrate a causal relationship
  - Evaluate the potential relationship between residing under a flight path and measures of disturbed sleep in the WHI WHISPER sub-study
- Perform Task 6 [*Sec. 189. (b)(4–5)*]: Potential economic impacts attributable to aircraft overflight noise
  - Model noise exposure before and after the introduction of area navigation (RNAV) procedures, on the basis of FAA flight trajectory data
  - Combine noise data with yearly county-level data from the Bureau of Economic Analysis (e.g., GDP, employment) and with city-level statistics for the years 2007, 2012, and 2017 from the Economic Census (e.g., revenue and employment)
  - Compare economic outcomes through state-of-the-art econometric approaches while controlling for regional and national economic trends
  - Evaluate whether the spatial resolution of the available data can substantially influence the study results
  - New task [*Sec. 189. (b)(4)*]: Assess the relationship between a perceived increase in aircraft noise and increases in visibility of aircraft, in collaboration with ASCENT 72
- Perform Task 7: Draft report on study results for policy-makers

Task 1 - Present Final Results of Analyses of Average Aircraft Noise and Hypertension, and Generate Results on Nighttime Noise and Hypertension

Boston University, Harvard University

Objective

The aim of this task is to present the final results of analyses of aircraft noise (DNL) and hypertension, and generate preliminary results of analyses of aircraft noise (nighttime equivalent sound levels [L_{night}]) and hypertension.

Research Approach

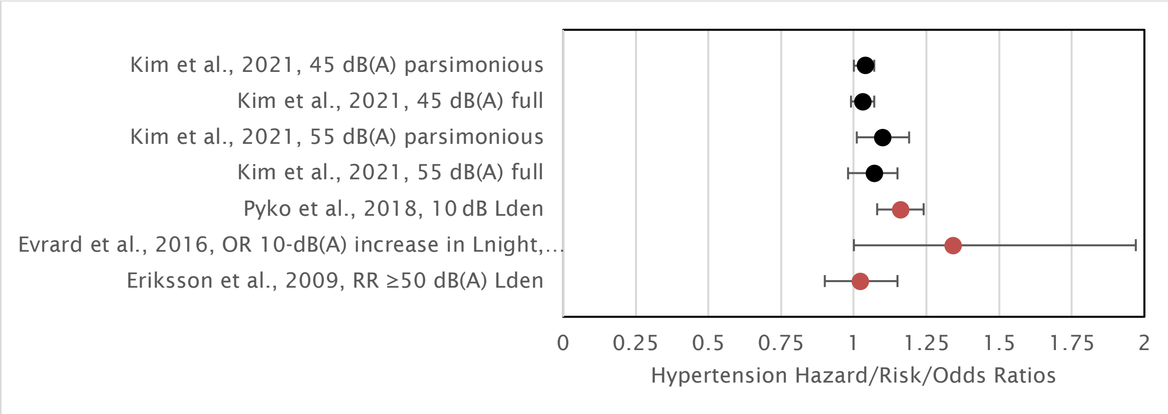
We intersected modeled noise exposure surfaces for 1995, 2000, 2005, 2010, and 2015 with the geocoded addresses of the participants over the follow-up period. We selected a large set of a priori variables to be examined as confounders and/or effect modifiers, and used time-varying Cox proportional hazards models to estimate the hypertension risk associated with time-varying aircraft noise exposure, while adjusting for both fixed and time-varying covariates. We also performed sensitivity analyses to address potential biases.

Milestones

- Present findings at the 182nd Meeting of the Acoustical Society of America (ASA) (May 2022)
- Generate preliminary results on aircraft noise (L_{night}) and hypertension

Major Accomplishments

- Generated tables comparing results from our study on aircraft noise (DNL) and hypertension in the NHS/NHSII for presentations (Figure 1)
- Presented research on aircraft noise (DNL) and hypertension at the ASA meeting
- Generated preliminary results on aircraft noise (L_{night}) and hypertension



[1]Parsimonious model: adjusted for age, calendar year, race, physical activity, smoking status, alcohol use, dietary approaches to stop hypertension (DASH), spouse's educational attainment, neighborhood-level socioeconomic status, and region of residence.
[2]Fully adjusted model: adjusted for age, calendar year, race, physical activity, smoking status, alcohol use, DASH, spouse's education attainment, neighborhood-level socioeconomic status, region of residence, menopausal status, family history of hypertension, and body mass index (BMI).

Figure 1. Hazard, risk, or odds ratios (95% confidence intervals) for studies evaluating the association between aircraft noise and hypertension, comparing our Nurses' Health Studies (Kim et al., 2021) with previous studies.

Interpretation of our results (Kim et al., 2021) using the DNL 55-dB cut point as an example
In the combined parsimonious model, participants in NHS and NHS II exposed to levels ≥ DNL 55 dB had a 10% greater risk of hypertension than participants exposed to levels < DNL 55 dB, with a 95% confidence interval (CI) of 1% to 19%. In the combined fully adjusted model, participants exposed to ≥ DNL 55 dB had a 6% greater risk (95% CI: −2%, 15%) than unexposed individuals. The hazard ratios were relatively stable across the sensitivity analyses, including after controlling for air pollution. The findings suggested that smoking modifies the relationship between noise and hypertension.

Task 2 - For Supporting Analyses, (a) Write up and Publish Final Results on Sociodemographic Patterning of Aircraft Noise Exposure and (b) Generate Final Results on Trends in Aircraft Noise Exposure

Boston University

Objective

The aim of this task is to understand changes in exposure that will facilitate the interpretation of time-varying exposure measures in noise-health analyses and to understand the sociodemographic patterning of noise exposure that may confound or modify potential associations between noise and health.

Research Approach

For (a) (sociodemographic patterning), we described the characteristics of populations exposed to aviation noise by race/ethnicity and income/education, by using data from the U.S. Census Bureau and American Community Survey for 2010. We then performed univariate and multivariable hierarchical and multinomial analyses. For (b) (noise trend), we overlaid noise contours for 2000, 2005, 2010, and 2015 with census block data from the U.S. Census Bureau and American Community Surveys for 2000, 2010, and 2015 in a geographic information system to estimate population changes within noise levels. We used group-based trajectory modeling to statistically identify fairly homogeneous clusters of airports, that follow similar changes in outcomes over time. We used linear fixed-effects models to estimate changes in the sizes of exposure areas according to airport clusters for DNL values ≥65 dB and ≥45 dB and L_{night} value ≥45 dB.

Milestones

- Publish supporting analyses characterizing aircraft noise trends and sociodemographic patterns of exposure to aviation noise

- Perform supporting analyses characterizing population changes within noise levels over time (noise trends)
- Submit manuscript reporting results on trends in aircraft noise exposure

Major Accomplishments

- We overlaid noise contours for 2000, 2005, 2010, and 2015 and census block data from the U.S. Census Bureau and American Community Surveys for 2000, 2010, and 2015.
- We determined social patterning of aircraft noise exposure by race/ethnicity and income/education for 2010 using univariate and multivariable analysis (multinomial, mixed effects, hybrid, and Bayesian approaches) at three DNL cut points: 45 dB, 55 dB, and 65 dB, Overall, across multiple airports, block groups with larger Hispanic populations and higher proportions of residents with only high school education had higher odds of exposure. However, substantial heterogeneity was observed across airports.
- We evaluated the sociodemographic patterns of exposure to aircraft noise over time (1995–2015).
- We evaluated geographic and airport characteristics as predictors of patterns of exposed area over time. We found that non-monotonic trends in noise contour areas over time among our sample of 90 U.S. airports by airport characteristics peaked in 2000, then generally decreased until 2010, and subsequently increased from 2010 to 2015. Using group-based trajectory modeling at three cut points—DNL 45 dB and 65 dB, and L_{night} 45 dB—we identified four distinct trajectory groups of airports that shared underlying airport characteristics (Figure 2 for 45 dB for (a) DNL and (b) L_{night}). We also found that populations who identified as White or non-Hispanic/Latino had the highest counts of exposure, yet underrepresented groups (e.g., Hispanic, Black/African American, Asian, etc.) carried a disproportionate burden of exposure among their respective sub-populations.

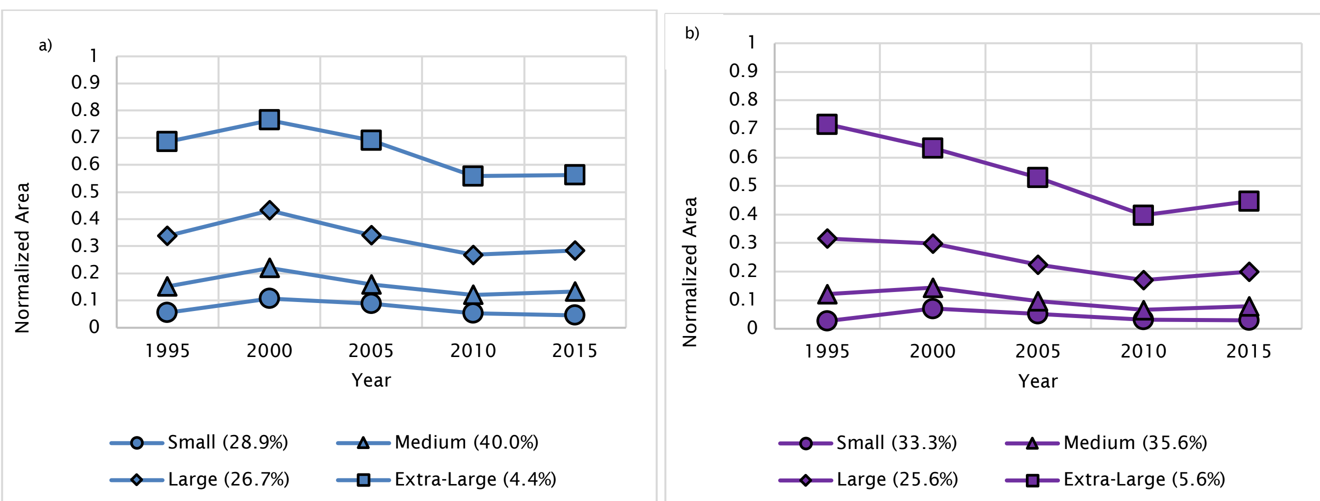


Figure 2. Trends in noise contour areas by clustering of airport types using group-based trajectories for (a) DNL ≥45 dB(A) and (b) L_{night} ≥45 dB(A).

Task 3 - Generate Final Results and Write Up Analysis of Sleep Quantity and Quality, and Aircraft Noise Exposure

Boston University, Harvard University

Objective

The aim of this task is to generate final results of analyses of aircraft noise (DNL and L_{night}) and nighttime equivalent sound levels, and identified sleep outcomes.

Research Approach

We intersected modeled nighttime noise exposure surfaces for 1995, 2000, 2005, 2010, and 2015 with the geocoded addresses of the participants over the follow-up period (first in NHS [original]). We selected a large set of a priori variables to be examined as confounders and/or effect modifiers, used generalized estimating equations to estimate the odds from repeated measures of sleep insufficiency over multiple survey years, and used conditional logistic regression models of sleep quality to estimate the odds for the one survey year.

Milestone

- Obtain final results of analysis of DNL and nighttime aircraft noise, and sleep quantity and sleep quality in NHS (original)

Major Accomplishments

- Produced descriptive statistics of sleep measures and numbers of individuals exposed for each measure in NHS
- Determined relevant confounders and effect modifiers
- Performed final analysis of noise, and sleep quantity (insufficiency) and sleep quality.
- Drafted manuscript reporting the results of analysis of aircraft noise and sleep
- Gained all Harvard/Brigham and Women's Channing Division manuscript approvals including undergoing scientific, program, and technical review; submitted manuscript for FAA review
- Submitted the manuscript to a peer-reviewed journal
- Responded to journal reviewer comments; awaiting journal decision

Table 1. Odds ratio of the relationship between L_{night} ≥45 vs. <45 dB and repeated measures of sleep insufficiency and a one-time measure of poor sleep quality.

Model	Sleep insufficiency	Poor sleep quality
L_{night} ≥45 vs. <45 dB	**OR (95% CI)**	**OR (95% CI)**
Model 1: crude[a]	1.34 (1.17, 1.53)	0.94 (0.72, 1.21)
Model 2: adjusted[b]	1.27 (1.11, 1.45)	0.91 (0.70, 1.18)
Model 3; adjusted + ambient environmental[c]	1.23 (1.07, 1.41)	0.91 (0.70, 1.18)

OR, odds ratio; CI, confidence interval.
Models were adjusted for (a) age; (b) other demographics, behaviors, and comorbidities were added; (c) ambient environmental factors were added: particulate matter ≤2.5 microns ($PM_{2.5}$), greenness (normalized difference vegetation index, NDVI), and light at night.

Interpretation using L_{night} 45 dB as an example

In Model 3, participants in NHS exposed to L_{night} ≥45 had 23% greater odds of sleep insufficiency than participants exposed to L_{night} <45, with a 95% confidence interval of 7% to 41%. In addition, in Model 3, participants exposed to L_{night} ≥45 had 9% lower odds of poor sleep quality than participants exposed to L_{night} <45, with a 95% confidence interval of −30% to 18%.

Task 4 - Generate Final Results in Analyses of Cardiovascular Disease and Aircraft Noise

Boston University, Harvard University

Objective

The aim of this task is to perform final analysis of the potential relationship between CVD and aircraft noise.

Research Approach

We designed the statistical analysis and selected a large set of a priori variables to be examined as confounders and/or effect modifiers. We compiled appropriate data sets and conducted descriptive statistics analysis. We are using time-varying Cox proportional hazards models to estimate the CVD risk associated with time-varying aircraft noise exposure.

Milestones

- Obtain final results of analysis of aircraft noise and CVD

- Present at the 51st International Congress and Exposition in Noise Control Engineering (Inter-Noise 2022) (August 2022)
- Present at the 34th Annual Conference of the International Society of Environmental Epidemiology (ISEE) (September 2022)

Major Accomplishments

- Determined relevant confounders and effect modifiers
- Performed final analyses of noise and CVD and mortality
- Drafted manuscript reporting the results of analysis of aircraft noise, and CVD and mortality
- Presented research at the Inter-Noise Congress
- Presented research at the ISEE Conference

Table 2. Hazard ratios (95% confidence intervals) for associations between aircraft noise exposure (DNL) and cardiovascular disease in NHS and NHSII, meta-analyzed.

DNL (dB)	Cases	Person-time	Basic	Parsimonious	Fully adjusted
≥50	317	122,642	1.01 (0.90, 1.13)	1.00 (0.89, 1.12)	0.97 (0.87, 1.09)
<50	4,212	1,583,635	Ref.	Ref.	Ref.
Continuous, per 10 dB	4,529	1,706,278	0.99 (0.84, 1.18)	0.98 (0.83, 1.16)	0.97 (0.82, 1.15)

Basic model: adjusted for age and calendar year.
Parsimonious model: adjusted for age, calendar year, race/ethnicity, marital status, spouse's educational attainment, neighborhood socioeconomic status score, region of residence, fine particulate matter ($PM_{2.5}$), and population density.
Fully adjusted model: adjusted for age, calendar year, race/ethnicity, marital status, spouse's education attainment, neighborhood socioeconomic status score, region of residence, $PM_{2.5}$, population density, physical activity, smoking status, alcohol use, diet, menopausal status, and family history of cardiovascular disease.

Interpretation using DNL 50 dB as an example
In the crude models comparing exposure to DNL ≥50 dB, participants in NHS/NHSII exposed to DNL ≥50 dB had a 1% greater risk of CVD than participants exposed to DNL <50 dB, with a 95% confidence interval of −10% to 13%. In the fully adjusted model, participants exposed to DNL ≥50 dB had a 3% lower risk of CVD than participants exposed to DNL <50 dB, with a 95% confidence interval of −13% to 9%.

Task 5 - Develop an Analysis Plan and Generate Preliminary Results of Analyses of Aircraft Noise and the Intermediate Risk Marker of Adiposity

Boston University, Harvard University

Objective

The aim of this task is to develop an analysis plan and generate preliminary results of analyses of aircraft noise and an intermediate risk marker (adiposity, a measure of cardiometabolic disease).

Research Approach

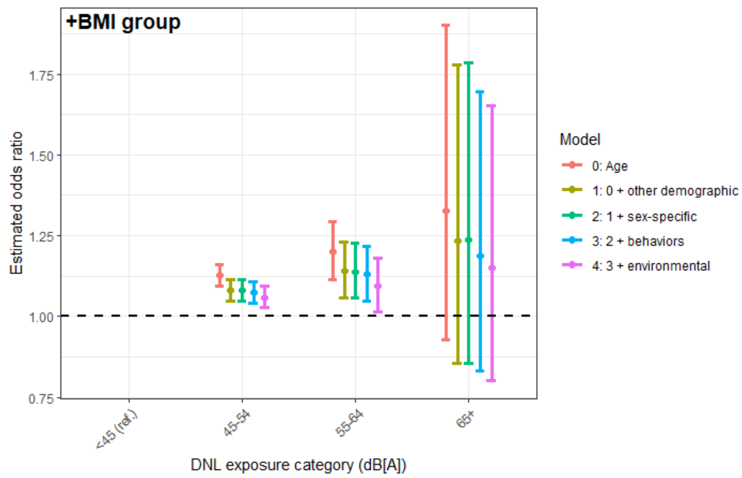
We developed an analysis plan for studying adiposity and aircraft noise, and obtained approval from the NHS and HPFS oversight committees. We designed the statistical analysis and selected a large set of a priori variables to be examined as confounders and/or effect modifiers. We compiled appropriate data sets and performed descriptive statistics analysis. We are using generalized estimating equations to estimate the relationship between aircraft noise and longitudinal, repeated measures of adiposity (body mass index [BMI], waist circumference, and waist/hip ratio).

Milestones

- Produce preliminary results of analysis of aircraft noise and adiposity
- Present at the International Society of Environmental Epidemiology 2022 meeting (September 2022)

Major Accomplishments

- Developed an analysis plan
- Obtained approval from NHS/HPFS oversight committees
- Produced descriptive statistics of sleep measures and numbers of participants exposed for each measure in NHS
- Determined relevant confounders and effect modifiers
- Performed preliminary analysis of noise in relation to adiposity (results for three ordinal categories of BMI of 18.5–24 [reference], 25–29, and ≥30 kg/m^2 in Figure 3)
- Presented research at the ISEE Conference



0: age; 1: 0 + demographics: region, race, individual socioeconomic status; 2: 1 + sex-specific: parity, menopausal status, hormone therapy; 3: 2+ behaviors: smoking status, alcohol use, diet quality, physical activity; 4: 3 + environmental: neighborhood SES, greenness, environmental noise, light at night.

Figure 3. Odds of increasing BMI groups (reference 18.5–24 kg/m^2) relative to increasing exposure group (reference DNL <45 dB); increasing BMI with increasing noise.

Task 6 - Develop a Model for Measuring Changes in Business Activities Attributable to Aircraft Noise Exposure, Prototype a Model City, and Include an Assessment Comparing a Change in the Visibility of Aircraft due to a Change in Aircraft Flight Paths

Massachusetts Institute of Technology

Objective

The long-term goal of Task 6 is to conduct an assessment of the economic impacts of aircraft noise exposure on businesses located underneath flight paths at selected U.S. airports. This goal is achieved through the following objectives:

1. Collect data on noise exposure changes over the past decade (e.g., owing to the introduction of new runways or performance-based navigation (PBN) procedures)
2. Combine noise data with yearly county-level data from the Bureau of Economic Analysis (e.g., GDP and employment), with city-level statistics from the Economic Census (e.g., revenue and employment), and/or with high-resolution business data from business databases
3. Compare economic outcomes while controlling for regional and national economic trends
4. Evaluate whether the spatial resolution of the available data can influence the results

In addition, the MIT team is working to understand how changes in flight paths might have changed aircraft visibility.

Objectives 1–4 were met during previous reporting periods. During the current reporting period, the team worked on the visibility analysis and focused on documenting results in a draft report for policy-makers.

Research Approach

The economic impact of noise exposure changes was studied for Boston Logan Airport and Chicago O'Hare Airport. The methods focused on the difference-in-difference approach, which was applied to identify differences between changes in business trends before and after exogenous noise exposure changes, i.e., the introduction of PBN procedures at Boston Logan Airport and the opening of new runway infrastructure at Chicago O'Hare Airport. Details can be found in previous reports.

During the current reporting period, the team developed a method to gain insights into whether the implementation of PBN procedures at Boston Logan Airport changed the frequency of aircraft sightings on the ground. For this purpose, the MIT team used flight track data from 2010 and 2017 to compare aircraft visibility on peak runway operation days for 33L departures, 27L departures, and 4R arrivals. An aircraft is assumed to be visible if it is above a visibility line of 45° from the ground (Figure 4). Consequently, the team obtains a grid of observation points on the ground, which can subsequently be aggregated to determine the number of aircraft visible that day from each grid location.

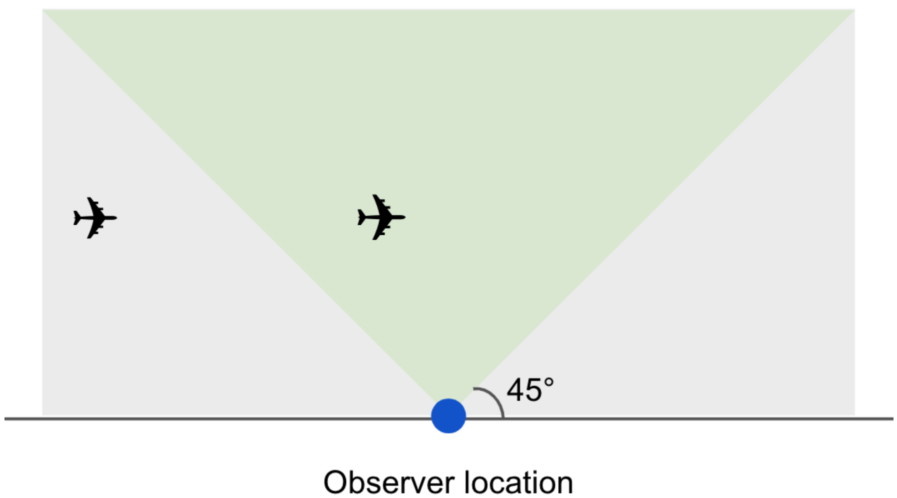


Figure 4. Visibility analysis approach. Aircraft in the green area are assumed to be visible from the observer location (blue dot). In the scenario depicted above, the aircraft on the far left is not visible, whereas the second aircraft in the center is visible.

Milestone

- Perform initial visibility analysis based on Boston Logan Airport

Major Accomplishments

- Perform visibility analysis to incorporate results of the project for policy-makers and the public

Task 7 - Draft a Report on the Study Results for Policy-makers

Boston University, Massachusetts Institute of Technology, Harvard University

Objective

The aim of this task is to develop a report of overall study results in response to Section 189 for policy makers.

Milestone
- Generate an initial first-draft report of overall study results in response to Section 189 for policy-makers

Major Accomplishments
- Drafted report summarizing the overall study results as it relates to Section 189

Publications
Simon, M. C., Hart, J. E., Levy, J. I., VoPham, T., Malwitz, A., Nguyen. D. D., Bozigar, M., Cupples, L. A., James, P., Laden, F., & Peters, J. L. (2022). Sociodemographic patterns of exposure to civil aircraft noise in the United States. *Environmental Health Perspectives, 130(2).* https://doi.org/10.1289/EHP9307

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Outreach Efforts
Presented on current progress orally during the ASCENT Spring Meeting (April 5-7, 2022).

Presented on "Associations Between Aircraft Noise Exposure and Adiposity in the U.S.-based Prospective Nurses' Health Studies" at the International Society for Environmental Epidemiology (ISEE) Conference on September 18-21, 2022.

Presented on "Associations Between Residential Exposure to Aircraft Noise, Cardiovascular Disease, and All-Cause Mortality in the Nurses' Health Studies" at the ISEE Conference on September 18-22, 2022.

Presented on "Long-term Aircraft Noise Exposure and Incident Cardiovascular Disease in National U.S. Cohort Studies" at Inter-Noise 2022 on August 21-24, 2022.

Presented on "Long-Term Aircraft Noise Exposure and Incident Hypertension in National U.S. Cohort Studies" at the 182nd Meeting of the ASA, May 23-27, 2022.

Awards
None

Student Involvement
The dissertation of Chloe Kim (doctoral graduate, BU) included the development and implementation of statistical analyses of noise and hypertension risk. Chloe Kim graduated in the fall of 2019 and is currently working for the Environmental Science, Policy, and Research Institute.

The dissertation of Daniel Nguyen (doctoral graduate, BU) included a characterization of the temporal trends in aviation noise surrounding U.S. airports. Daniel Nguyen graduated in the spring of 2022 and is currently working for the Centers for Disease Control and Prevention.

The dissertation of Stephanie Grady (doctoral candidate, BU) includes the development and running of statistical analyses on noise and cardiovascular event risk. Stephanie also worked with Chloe Kim on noise and hypertension risk.

The thesis of Carson Bullock (master's student, MIT) included conducting economic impact analysis. Carson graduated in the summer of 2021.

The thesis of Zhishen Wang (master's student, MIT) includes the visibility analysis.

Plans for Next Period

(October 1, 2022 to September 30, 2023)
Ongoing analyses, Tasks 1–5

- Complete analyses to estimate the risk of CVD events associated with aircraft noise exposure
- Complete analyses to evaluate the relationship between noise and sleep
- Continue analyses to evaluate the risk of hypertension associated with nighttime aircraft noise exposure
- Continue analyses to evaluate the relationship between noise and measures of adiposity
- Verify, document, and publish results

Related to 2018 FAA Reauthorization, Section 189, Tasks 6 and 7

- Complete aircraft visibility analyses and verify results for inclusion in the Section 189 report
- Document results for policy-makers in iterative drafts and a final report

Related to FAA's Office of Environment and Energy Roadmap

- Start processes related to adding noise to an additional cohort, and explore other health outcomes (e.g., mental health)

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