ASCENT Project 003
Cardiovascular Disease and Aircraft Noise Exposure

Boston University School of Public Health
PI: Junenette Peters
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Cost Share Partner: Donators to Nurses’ Health Study
Collaborators: Harvard & MIT

Objective:
To evaluate the relationship between aircraft noise exposure and health including hypertension and sleep disturbance in existing health cohorts – Nurses Health Studies (Health Impacts)
To assess economic benefits or harm to businesses underneath regular flight paths at selected airports (Economic Impacts)

Project Benefits:
Contribution to the body of knowledge of potential health and economic impacts of aircraft noise.
Responsive to Section 189 of the 2018 FAA Reauthorization.

Research Approach:
Health Impacts

**Exposure**
Noise data for participant’s geocoded address

**Statistical Analyses**
Longitudinal Time-varying Cox Hybrid between vs within airport

**Outcomes**
Exposure patterns, Hypertension, Cardiovascular disease, Sleep

Economic Impacts

**Business & noise data**
Pre-RNAV

**Business & noise data**
Post-RNAV

Empirical analysis using difference-in-differences approach (business closure or relocation)

Major Accomplishments (to date):
1. Submitted papers to journals for publication on sociodemographic patterns of noise exposure and noise and potential risk of hypertension.
2. Submitted abstracts to international conferences on noise and potential sleep and hypertension effects.
3. Acquired business data, mapped business changes for 8 airports, and ran initial analysis for 1 airport.

Future Work / Schedule:
1. Continue analysis on noise and sleep markers – 9/2021
2. Continue analysis on noise and CVD – 12/2021
3. Complete analysis of noise patterns – 12/2021
4. Roll-out economic assessment to a set of airports and run cross-comparisons – 12/2021

This research was funded by the U.S. Federal Aviation Administration Office of Environment and Energy through ASCENT, the FAA Center of Excellence for Alternative Jet Fuels and the Environment, project (add project number here) through FAA Award Number (add grant number) under the supervision of (add PM names here). Any opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA.
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Objective:
To evaluate the relationship between aircraft noise exposure and health including hypertension and sleep disturbance in existing health cohorts (Health Impacts)

Project Benefits:
Addresses gap of limited health and noise studies in the U.S., important for policy models
Overall, contributes to the body of knowledge of potential health impacts of aircraft noise.
Responsive to Section 189 of the 2018 FAA Reauthorization.

Research Approach:
Exposure
Noise contours for 90 airports for 1995-2015 in 5 years interval; metrics day-night noise level (DNL) and nighttime sound level (Lnight)

Cohorts:
Nurses’ Health Study (NHS) and NHS II

Study Areas
1. Sociodemographic patterns of noise
2. Associations between noise and hypertension and noise and cardiovascular disease (CVD)
3. Associations between noise and sleep markers

Major Accomplishments (to date):
1. Submitted papers to journals for publication
   a. Sociodemographic patterns of exposure to civil aircraft noise in the United States
   b. Long-term aircraft noise exposure and risk of hypertension in the Nurses’ Health Studies
2. Submitted abstracts to international conferences
   a. Associations between nighttime aircraft noise exposure and insufficient sleep in the US-based prospective Nurses’ Health Study cohort
   b. Long-term aircraft noise exposure and incident hypertension in national US cohort studies

Future Work / Schedule:
1. Continue analysis on noise and sleep markers – 9/2021
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Health Impacts – Project Outline

1. Finalize Phase I CVD Analysis (Ascent 3)
   - Analysis of sociodemographic patterning of noise exposures
   - Analysis of trends of aircraft noise exposures
   - Analysis of aircraft noise (DNL and \( L_{\text{night}} \)) and hypertension

2. Perform CVD Phase II Analysis (Ascent 3)
   - Analytical approaches and analysis of relationship of aircraft noise and CVD
   - Analytical approaches and analysis of relationship of additional metrics of aircraft noise and health outcomes.

3. Develop Analytical Approach & Sleep Analysis (Section 189)
   - Assessment of potential approaches for analysis and appropriateness of sleep quality data.
   - Analysis of annual average aircraft noise exposure with general sleep length and quality (NHS).
   - Explore analysis of living under flight paths with sleep disturbance (WHISPER).
Health Impact Results-
Sociodemographic Patterns of Noise

Status:

• Completed analysis of sociodemographic patterns of noise
• Submitted manuscript for FAA review and for publication

Highlights:

• Compared exposure of U.S. Census block groups by
  race/ethnicity, education, and income at three noise thresholds
  (45 dB, 55 dB, 65 dB).
• Block groups with higher Hispanic population and proportion of
  residents with ≤ high school education had higher odds of noise
  exposure.

In progress:

• Analysis of trends in noise exposure over time
• Analysis of noise exposure and segregation and dissimilarity
Health Impact Results-Hypertension

Status:

• Completed analysis on noise and incident hypertension
• Submitted manuscript for Harvard Channing/NHS and FAA reviews and to peer-reviewed journal

Highlights:

• Examined associations between aircraft DNL and incident hypertension in NHS and NHS II.

• In combined models using a 55 dB DNL cut-point, participants in NHS and NHS II exposed to levels ≥55 dB DNL had an 8% increased risk of hypertension when compared to participants exposed to aircraft noise at levels <55 dB DNL, with a 95% confidence interval between -2% and 18%.

• Relationship between noise and hypertension in these cohorts was not affected by additional control for particulate matter air pollution.
Health Impact Results-Sociodemographic Patterns of Noise

Status:

• Analyzing noise and sleep duration and sleep quality

Highlights:

• Investigated associations between nighttime noise and insufficient sleep in NHS.
• In multivariable-adjusted longitudinal models those in block groups exposed to nighttime aircraft noise ≥45 dB had higher odds of insufficient sleep compared with those not exposed.

Next Step:

• Investigate noise and sleep markers in NHS II
• Assess measures of sleep quality of in NHS and NHS II and develop analysis plan
Objective:
To conduct an empirical assessment of the economic impacts of aircraft noise on businesses located underneath flight paths at selected U.S. airports, incl. the trade-off between impacts on businesses

Project Benefits:
1. Empirical assessment of the impacts of aircraft noise on businesses
2. Identification of most affected communities, anticipate consequences of future procedural changes

Research Approach:
Natural experiment: flight procedures changed → ± population noise exposure → possible business closure & relocation

Major Accomplishments (to date):
I. Completed data acquisition, organization and cleaning for business locations across all U.S. states
II. Mapped business changes during 2010s for eight major U.S. airports
III. Ran first data analyses and data visualization for Logan

Future Work / Schedule:
- Apply methodologies → Roll-out economic assessment to a set of airports in the U.S. (Boston, Chicago, etc.)
- Cross-comparison between multiple metropolitan areas and economic sectors (e.g. retail)
**Geospatial Analysis: Boston Logan**

**DNL Difference (post-RNAV – pre RNAV)**

**Business Count Difference (post-RNAV – pre RNAV)**

Gridded at 500m, decreases (purple) and increases (green) in counts of retail businesses, in the Boston area.

**Preliminary**

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**Scatter plot of DNL difference vs. business count difference, by grid cell, retail businesses only**
Exploratory analysis of differentiated noise impact changes: Boston Logan

**Hypothesis:**
Changes in communities that were previously relatively quiet may be more amplified.

**Analysis:**
Create different treatment groups using two criteria:
- Pre-RNAV noise exposure
- Change in noise exposure (pre-RNAV vs. RNAV)

Identification of areas formerly <50dB with DNL change > +3dB

Identification of differentiated treatment groups for Boston Logan Airport

Preliminary