



Project 003 Cardiovascular Disease and Aircraft Noise Exposure

Boston University

Project Lead Investigator

Junenette L. Peters
Assistant 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): Jonathan Levy (University PI); Junenette Peters (Project PI)
- FAA Award Number: 13-C-AJFE-BU-002;
- Period of Performance: October 1, 2016 to September 30, 2017

Tasks:

1. Assign aircraft noise exposures over time to geocoded participant addresses for new cohorts - Nurses' Health Study (NHS), NHSII, NHS3, Health Professional Follow-up Studies (HPFS), and HPFS2.
2. Link aircraft noise exposures to participant data for NHS, NHSII, NHS3, HPFS, and HPFS2.
3. Determine the numbers of CVD-related outcomes of interest available in NHS, NHSII, and HPFS participants living near airports.
4. Develop and execute models for estimating CVD health risks associated with aircraft noise exposure.
5. Determine the number of NHS3/HPFS2 participants residing near airports based on the 2010 and 2015 airport noise data.

Project Funding Level

Total Funding \$200,000
Matching: \$66,667
Source of Matching:

Matching contribution is in the form of non-federal funds provided to the cohorts studies including the Women's Health Initiative and the Nurses' Health Study and companion Health Professional Follow-up Study in which Boston University and partners are performing noise-health research.

• Nurses'/Health Professional	\$1.4 M
• <u>Women's Health Initiative</u>	<u>\$17.5 M</u>
• Total	\$18.9 M

Investigation Team

Junenette Peters, PI, Boston University

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

Jonathan Levy, Boston University



Dr. Levy will participate in the noise exposure assessment effort and provide expertise in the area of predictive modeling and air pollution.

Francine Laden and Jamie Hart, Harvard University

Dr. Laden is our NHS and HPFS sponsor for this ancillary study. Dr. Jamie Hart's will assign aircraft noise exposures to cohorts' participant geocoded address coordinates. Dr. Laden and Dr. Hart will also assist with documentation of data from the NHS and HPFS based on previous experience working on air pollution and chronic disease outcomes research in these cohorts.

Project Overview

Aircraft noise is a considerable source of stress among near-airport communities. Exposure has been associated with sleep disturbance, physiological responses and psychological reactions, with corresponding effects on blood pressure. However, the extent to which aircraft noise increases the risk of cardiovascular disease (CVD) has not been fully elucidated. Likewise, the role of CVD risk factors in mediating an association between noise and CVD has not been assessed. Additionally, exposure assessment that includes time-varying and spatially resolved noise exposures has not been systematically incorporated into previous epidemiological studies, making it key to receive aircraft noise data over multiple years. FAA PARTNER 44 and ASCENT 03 projects provided the pilot data and collaborations necessary to successfully compete for National Institute of Health (NIH) funding to evaluate noise effects on cardiovascular outcomes in the longitudinal Women's Health Initiative (WHI) cohorts. This study proposes to extend ongoing efforts in the WHI and evaluate the effects of aircraft noise exposure on cardiovascular disease in both women and men in the longitudinal Nurses' Health Studies (NHS, NHSII, and NHS3) and companion Health Professional Follow-up Study (HPFS and HPFS2) cohorts. These studies began with the original cohort (NHS) in 1976 and is currently recruiting the third generation (NHS3), with over 330,000 total participants.

The proposed scope of this research effort would involve multiple years, with activities within Phase I providing the foundation for future activities. The objectives for this year include: 1) Determining noise exposure estimates for study participants; 2) Linking noise exposure estimates to participant data on outcomes (health effects) and other risk factors; 3) Developing and executing models to evaluate cardiovascular effect(s) of noise.

Tasks based on receiving noise data for 90 airports over time in multiple metrics:

- Initially projected timeline for receiving data for 2000, 2005 and 2010 – March 2015
- Also negotiated for noise data for additional years (1995 and 2015)

However, data was modeled by two facilities (Wyle and Volpe) using different methods and assumptions. Data for 37 airports needed to be rerun to harmonize data.

- Requested test rerun of Wyle modeled airports by Volpe for one year (2000) and metric to determine impacts of using differing methods and assumptions on noise estimates assigned to participants. Received test rerun data – February 2017.
- Performed extensive analyses to determine the effect of differing methods and assumptions on noise estimates.
- Rerun negotiated – July 2017.
- Currently projected timeline for receiving data from rerun of 37 airport for key metrics – October 2017.
- Currently projected timeline for receiving data from rerun for remaining metrics – November 2017.

Pre-Tasks

Objective

To gain approval to conduct noise health research in the NHS and HPFS.

Research Approach

BU (Dr. Peters) as an external collaborator will enter into a collaborative agreement with the primary NHS/HPFS investigator (Harvard; Dr. Laden). The BUSPH team will obtain exemption for human subjects research from the Institutional Review



Boards (IRBs) at Boston University Medical Campus and the Harvard team will obtain approvals for human subjects research from the IRB at the Harvard Medical School/Brigham and Women's Hospital.

Milestones

- Receive approval for 'ancillary' noise-health study.
- Execute final Data Use Agreement with Harvard.
- Obtain IRB approvals for human subjects research.

Major Accomplishments

- Submitted and presented proposal to NHS and HPFS for noise-health study and received approvals.
- Obtained IRB exemption at BU and IRB approval at Harvard for human subjects research.
- Executed Data Use Agreement with BU, Harvard and FAA.

Task #1: Assign Aircraft Noise Exposures over Time to Geocoded Participant Addresses

Objective

To intersect geocoded addresses available from 1995 to 2015 with noise surfaces obtained.

Research Approach

We will intersect geocoded addresses with noise contours available from 1995 to 2015. Given the longitudinal nature of this study, noise exposures will be assigned reflecting specific residential addresses over time based on participant address histories. We will estimate the percent of participants across noise exposure categories (e.g., DNL > 55 dB) and assess overall trends in participant noise exposure levels over time.

Milestone

(Dependent on receiving noise data – originally projected for March 2015; now projected for October/November 2017)

- Assign aircraft noise exposures – November 2016

Major Accomplishments

- Successfully collaborated to obtain 1995 and 2015 data in all metrics for 90 airports.
- Received aircraft noise data for 53 airports for the years 2000, 2005 and 2010 in May 2016; metrics received include Day-Night Average Sound Level (DNL), Equivalent Sound Level (Leq), Leq Day and Leq Night), Time above Threshold (TA) 65 dB and TA 85 dB.
- Received the data for the above airports and metrics for 1995 and 2015 in April 2017.
- Submitted documentation for need for rerun of data for 37 airports using the same methods and attributes.
- Developed processes for converting noise data into useable formats.
- Received rerun of aircraft noise data in DNL and Leq Night using Volpe methods and attributes for 17 of the 37 Wyle airports in September 2017.
- Linked NHS and HPFS participants to previously obtained 2009 DNL data to get an estimate of the number of participants near airports (within 45 dB contours) (Figures 1 and 2).
 - NHS: 5,666
 - NHS II: 5,802
 - HPFS: 2,952
- Updated penultimate draft of the noise modeling documentation (metadata).



Figure 1. Location of NHS & NHSII participants in relation to airports

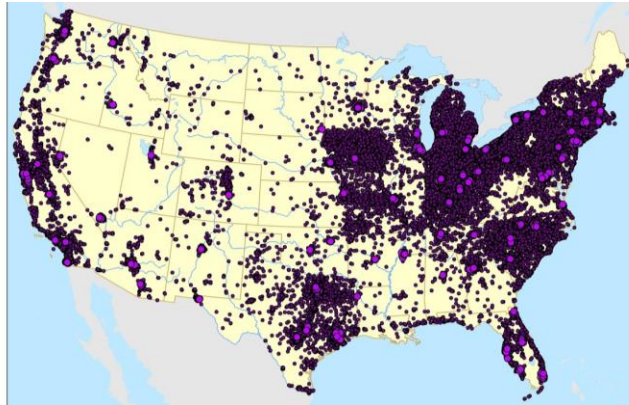
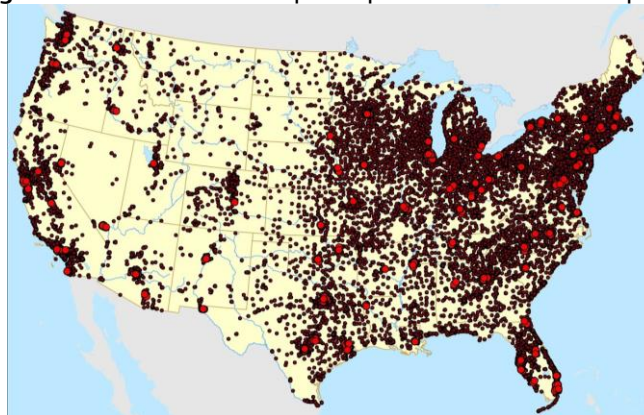


Figure 2. Location of HPFS participants in relation to airports



Task #2: Link Aircraft Noise Exposures to Participant Data for NHS, NHSII, NHS3, HPFS, and HPFS2

Objective

To link with the individual level information in NHS and HPFS.

Research Approach

We will link information with the wealth of individual level information on socio-demographics (e.g., age, race/ethnicity, education); lifestyle factors (e.g. physical activity/exercise, diet, smoking, alcohol consumption); and relevant outcomes (e.g., hearing and hearing loss, sleep disturbance, diabetes, CVD and CVD mortality).

Milestone

(Dependent on receiving noise data – originally projected for March 2015; now projected for October/November 2017)

- Link aircraft noise exposures to individual data for all cohorts – December 2016

Major Accomplishments

- None (awaiting final noise exposure data).



Task #3: Determine the Numbers of CVD-Related Outcomes of Interest Available In NHS, NHSII, and HPFS Participants Living Near Airports

Objective

To identify all cases of overall and cause-specific incident cardiovascular, cardiovascular mortality and incident hypertension.

Research Approach

We will identify all cases of overall and cause-specific incident CVD, CVD mortality, and incident hypertension among individuals in the NHS, NHSII, and HPFS living within the 45 dB contours. These cohorts have been followed over a long enough period (over two to four decades) to observe health outcomes and participants are of an age when they are at risk for CVD.

Milestones

(Dependent on receiving noise data – originally projected for March 2015; now projected for October/November 2017)

- Determine the number of cardiovascular-related outcomes among those living near airports – January 2016
- Determine the number of participants at risk for cardiovascular disease (free of CVD at baseline/earliest time with available noise data [1995]).

Major Accomplishments

- Determined the number of cohort participants alive and free of CVD at baseline (1995). Characteristics of participants provided in Table 1.
 - NHS: 96,000 alive and free of CVD
 - NHSII: 115,000 alive and free of CVD
 - HPFS: 50,000 alive and free of CVD



Table 1. Characteristics of participants alive and free of CVD at baseline (1995)

Characteristics	NHS	NHSII	HPFS
	Mean ± SD or %		
Age (years)	68.6 ± 7.3	46.6 ± 7.0	63.8 ± 10.2
Body mass index (kg/m ²)	25.6 ± 7.5	21.2 ± 3.2	26.6 ± 11.5
Race			
Black	2	2	6
White	94	96	91
Other/Multiple races	6	2	3
Smoking Status			
Never	45	64	40
Former	45	25	41
Current	11	9	6
Family History of MI	32	22	13

Task #4: Develop and Execute Models for Estimating CVD Risk Associated With Noise Exposure in NHS, NHSII, and HPFS

Objective

To develop appropriate measures to evaluate the effects of aircraft noise on cardiovascular outcomes.

Research Approach

The team will develop hazard models for estimating time varying CVD risk associated with noise exposure in the vicinity of each airport. We will also explore methods to account for clustering and spatial correlation between individuals living near each airport. We will then conduct epidemiological analyses to estimate the health effects of noise exposure on each CVD outcome controlling for other risk factors thought to be related to CVD

Milestones

(Dependent on receiving noise data – originally projected for March 2015; now projected for October/November 2017)

- Develop models for estimating cardiovascular health risks associated with aircraft noise exposure – January 2016
- Perform analysis of cardiovascular health risks associated with aircraft noise exposure – June 2016

Major Accomplishments

- Submitted, presented and received approval from NHS/HPFS for two manuscript proposals titled:
 - Association of aircraft noise exposure and incident hypertension
 - Association of aircraft noise exposure and prevalent and incident cardiovascular disease
- Developed initial plan for statistical analysis.



Publications

None

Outreach Efforts

None

Awards

None

Student Involvement

None

Plans for Next Period

(October 1, 2017 to September 30, 2018)

- Obtain final metadata on aircraft noise modeling.
- Obtain resolved noise data run with the same assumption and attributes.
- Assign all noise exposure estimates to participants.
- Execute models estimating CVD related risks associated with noise exposure.
- Develop abstracts for presentation at professional conferences.
- Determine the number of newly recruited participants (NHS3/HPFS2) residing near airports from whom survey questions or measurements of noise and sleep disturbance may be obtained.
- Develop suite of survey questions on built environment and noise perception.