# Project 003 Cardiovascular Disease and Aircraft Noise Exposure

## Boston University

## Project Lead Investigator

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## 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: September 1, 2015 to August 31, 2016
- Task(s):
    1. Assign aircraft noise exposures over time to geocoded participant addresses.
    2. Link to existing roadway proximity / density exposure measures by geocoded participant addresses.
    3. Link to air pollution measures by geocoded participant addresses.
    4. Link to participant individual data.
    5. Develop approaches for determining quantitative estimates of historical noise exposures for time periods when Aviation Environmental Design Tool (AEDT) modeling data are not available.
    6. Explore the Atherosclerosis Risk in Communities (ARIC) Study cohort for combined or sensitivity analysis on noise and CVD.

## Project Funding Level

Total Funding $200,000
Matching: $66,667
Source of Matching: Non-federal donor to the Women's Health Initiative (WHI) cohort

## 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.

Eric Whitsel, University of North Carolina at Chapel Hill

Dr. Whitsel's team will assign aircraft noise exposures to geocoded WHI cohorts' participant address coordinates. Dr. Whitsel will also provide expertise related to cardiovascular outcomes and the WHI. Eric is our WHI sponsor, which is required for obtaining WHI approval to conduct an ancillary study.

Gregory Wellenius, Brown University

Dr. Wellenius will assist with documentation of data from the Women's Health Initiative (WHI) based on previous experience working on air pollution and cardiovascular disease research in the 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. This study proposes to evaluate the effects of aircraft noise exposure on CVD in the longitudinal Women's Health Initiative (WHI) study cohorts, in which over 160,000 women were recruited from 1993 to 1998 from 40 clinics in 24 states.

# Task 1. Assign aircraft noise exposures over time to geocoded participant addresses.

## Objective
To intersect geocoded addresses available from 1993 to 2012 with noise surfaces obtained.

## Research Approach
Dr. Whitsel at UNC will intersect geocoded addresses available from 1993 to 2012 with noise surfaces, which will be developed by spatially interpolating between point estimates from AEDT or predictive models following standard procedures developed by the Physical and Built Environment Scientific Interest Group (SIG) to safeguard confidentiality. Given the longitudinal nature of this study, noise exposures will be assigned reflecting specific residential addresses over time based on participant address histories.

## Milestone
- Receive aircraft noise data for multiple airports and years in various metrics.
- Execute final Data and Materials Transfer and Use Agreement (DTMUA) with WHI Coordinating Center, FAA and BU.
- Receive documentation (metadata) for noise data modeling.
- Resolve concerns about differences in attributes and methods used to generate data by data modeling sources.
- Assign noise exposure to WHI participants over time.

## Major Accomplishments
- We have received aircraft noise data for 90 airports for the years 2000, 2005 and 2010; metrics received include Day-Night Average Sound Level (DNL), Equivalent Sound Level (Leq), Leq Day and Leq Night.
- Executed final DTMUA with WHI Coordinating Center, FAA and BU.
- We have linked WHI participants to 2000 DNL to identify the number of participants by region, airport and participant race/ethnicity.
- We received and reviewed draft noise modeling documentation (metadata).

## Publications
None

## Outreach Efforts
None

## Awards
None

## Student Involvement
None

**Plans for Next Period**
- Obtain final metadata on aircraft noise modeling.
- Resolve modeling differences by data source.
- Assign all noise exposure estimates to participants.

# Task 2. Link to existing roadway proximity / density exposure measures by geocoded participant addresses.

## Objectives

The objective of this task is link with roadway proximity/density measures for geocoded participant addresses.

## Research Approach

We will link to roadway proximity / density measures previously developed for the WHI, which have been estimated for primary highways (A1), primary roads (A2), and secondary and connecting roads (A3) at geocoded addresses of the WHI CT and OS participants, 1993-2012. The estimates are expressed as distances to the nearest roadway of a given type and summed roadway lengths of a given type, each within geocoded participant address-centric buffers of 100-500 meters. This road proximity exposure estimate is considered a surrogate for traffic noise and traffic-related air pollution.

## Milestone(s)
- Linked road proximity exposure estimates.

## Major Accomplishments
None

## Publications
None

## Outreach Efforts
None

## Awards
None

## Student Involvement
None

## Plans for Next Period
To link road proximity exposure estimates to dataset of aircraft noise exposure assignments.

# Task 3. Link to air pollution measures by geocoded participant addresses.

## Objective

To link air pollution exposure data for geocoded participant addresses.

## Research Approach

Data will also be linked to air pollution exposure data from the ongoing ancillary study with WHI headed by Dr. Wellenius.

## Milestone(s)
- Dataset with linked air pollution exposure data.

## Major Accomplishments
None

## Publications
None

**Outreach Efforts**
None

**Awards**
None

**Student Involvement**
None

**Plans for Next Period**
Link air pollution exposure data to dataset of aircraft noise exposure assignments.

# Task 4. Link to participant individual data.

**Objective**
To link to participant individual data.

**Research Approach**
Exposure estimates will be linked to WHI cohort data. Cohort data will be anticipated to include socio-demographic data (e.g., age, race/ethnicity, education); behavioral (e.g. physical activity/exercise, diet, smoking, alcohol consumption); other (e.g., hearing and hearing loss, sleep disturbance); and clinical (e.g., body mass index; lipids; blood pressures, hypertension; glucose, insulin, diabetes; heart rate and its variability; CVD and CVD mortality).

**Milestone**
- Dataset with linked participant individual data.

**Major Accomplishments**
None

**Publications**
None

**Outreach Efforts**
None

**Awards**
None

**Student Involvement**
None

**Plans for Next Period**
Link individual participant data to dataset of aircraft noise exposure assignments.

# Task 5. Determine approaches for estimating historical noise exposures for time periods when Aviation Environmental Design Tool (AEDT) modeling data are not available.

AEDT modeling is not be available for certain years including the baseline (recruitment) period (1993 to 1998). We will use linear interpolation to estimate noise exposure for missing years that lie between years with available AEDT modeling data for a given airport.

**Milestone(s)**
- Approaches for performing historical modeling pre-2000.
- Approaches for years not modeled post 2000.

## Major Accomplishments
- Recently negotiated to receive AEDT modeled aircraft noise data for 1995.

## Publications
None

## Outreach Efforts
None

## Awards
None

## Student Involvement
None

## Plans for Next Period
Develop plan to assign noise exposure for years between intervals 1995-2000, 2000-2005, 2005-2010.

# Task 6. Explore the ARIC cohort for combined or sensitivity analysis on noise and CVD.

## Objective
The objective of this task is to explore cohorts with both men and women.

## Research Approach
We will explore the ARIC cohort for combined analysis with the WHI or to perform sensitivity analysis to determine whether there are significant differences in the exposure-outcome relationship by gender. This task will include determining the number of participants in ARIC surrounding airports.

## Milestone(s)
- Knowledge of other cohorts including the ARIC cohort
- Determining the number of participants in the other cohorts surrounding airports

## Major Accomplishments
- Team has determined the number of ARIC participants surrounding airports. The number of participants surrounding airports is small (N=239), so the ARIC cohort will not be used for this research effort.
- However, the team was approached by researchers from the Nurses' Health Study (NHS), which also includes the Health Professional Follow-up Study (HPFS; cohort of men).
- We have developed a collaboration to begin work on noise-health research in the NHS and HPFS.
- We have determined the number of participants of NHS and HPFS surrounding airports.

## Publications
None

## Outreach Efforts
None

## Awards
None

## Student Involvement
None

## Plans for Next Period
- Perform noise-health research in the NHS and HPFS cohorts.

- Research involving the WHI cohorts is now being funded by the National Institutes of Health (NIH) [August 2016 to June 2020].

# References

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[4]Hart JE, Yanosky JD, Puett RC, et al. Spatial modeling of PM10 and NO2 in the continental United States, 1985-2000. *Environ Health Perspect.* Nov 2009;117(11):1690-1696.

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[6]Davis ME, Hart JE, Laden F, Garshick E, Smith TJ. A retrospective assessment of occupational exposure to elemental carbon in the U.S. trucking industry. *Environ Health Perspect.* Jul 2011;119(7):997-1002.

[7]Davis ME, Laden F, Hart JE, Garshick E, Blicharz A, Smith TJ. Predicting changes in PM exposure over time at U.S. trucking terminals using structural equation modeling techniques. *J Occup Environ Hyg.* Jul 2009;6(7):396-403.