

Airport Noise and Self-reported Sleep Insufficiency: Results from CDC's Behavioral Risk Factor Surveillance System

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Outline

- ❑ **Public health significance of sleep**
- ❑ **Previous sleep surveillance at CDC**
- ❑ **Research question for this study**
- ❑ **Data/Methods**
- ❑ **Results/Discussion**

Public Health Significance of Sleep

❑ Major risk factor for chronic diseases

- Hypertension
- Heart Disease
- Stroke
- Diabetes
- Depression
- Obesity

❑ Major risk factor for injuries

- Motor vehicle crashes
- Industrial disasters
- Medical and other occupational errors

❑ Productivity losses and limitations of daily functioning

Public Health Response to Sleep: National Sleep Foundation

- ❑ **Hours of sleep per day suggested by the National Sleep Foundation for optimal sleep health:**
 - Healthy adults - 7-9 hours
 - Teen-agers - 8-9 hours
 - School-age children - 10-11 hours

Public Health Response to Sleep: Healthy People 2020

- ❑ **Healthy People 2020 has four objectives for sleep health:**
 - SH-1 Evaluation for obstructive sleep apnea
 - SH-2 Reduction in vehicular crashes due to drowsy driving
 - SH-3 Sufficient sleep among 9th to 12th graders
 - SH-4 Sufficient sleep among adults

Public Health Response to Sleep: Healthy People 2020 (cont.)

❑ Multifaceted approach:

- Sleep environments (living conditions and proximity to noise)
- Type, scheduling, and duration of work
- Associated risk factors (smoking, physical inactivity, heavy drinking, other stimulants)
- Chronic conditions (obesity, respiratory disorders, depression and other comorbid mental disorders)
- Stress and socioeconomic status
- Validation of new and existing therapeutic technologies

Public Health Response to Sleep: Institute of Medicine (2006)

- ❑ **Institute of Medicine recommended that CDC:**
 - Expand surveillance and monitoring of sleep loss and sleep disorders
 - Increase public awareness of unhealthy sleep behaviors

Public Health Response to Sleep: CDC

- ❑ **Behavioral Risk Factor Surveillance System (BRFSS) - annual**
 - Sleep insufficiency – all 50 states/territories in 2008-2011
 - Sleep duration, Snoring, Daytime Sleepiness, Drowsy Driving – selected states beginning in 2009
- ❑ **Youth Risk Behavior Survey – 2007, 2009, 2011**
 - Sleep duration (number hrs sleep on average school night)
- ❑ **National Health Interview Survey (NHIS) - annual**
 - Sleep duration (number hrs sleep per day), Trouble Sleeping
- ❑ **National Health and Nutrition Examination Survey (NHANES) – 2005-2008, 2009-2012**
 - Sleep duration, snoring, sleep apnea ever diagnosed

Public Health Surveillance at CDC: BRFSS

- ❑ **Nationwide, state-level survey**
- ❑ **Major chronic diseases, injuries, and risk factors**
- ❑ **Non-institutionalized, civilian population age 18 and over**
- ❑ **World's largest ongoing telephone health interview survey**
- ❑ **Conducted by state health departments in collaboration with CDC**
- ❑ **2010 sample size: over 400,000**
- ❑ **Complex survey design for state-level prevalence estimates**
- ❑ **Allows local level estimates to link with other datasets**
- ❑ **Core and optional questions for emerging health issues**
- ❑ **Used to guide policymaking**

Sleep Surveillance at CDC

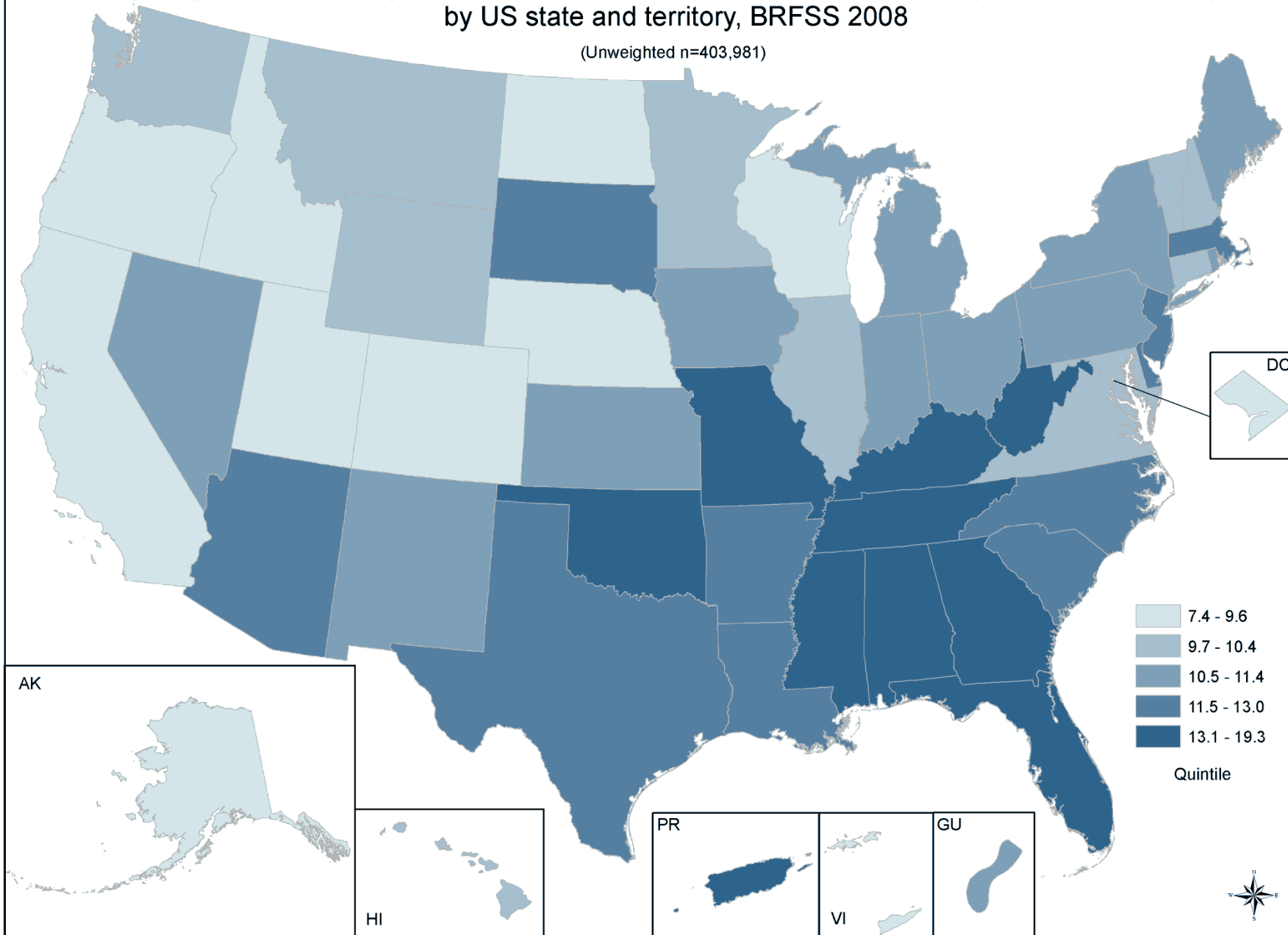
- ❑ **Perceived insufficient rest or sleep, US adults, 2006**
 - First state-level information on any sleep-related measure (DE, HI, NY, RI)
 - “During the past 30 days, for about how many days have you felt you did not get enough rest or sleep?”
 - 10.1% - insufficient rest/sleep *every day* for past 30 days
 - 29.6% - *no days* of insufficient rest or sleep for past 30 days
 - Comparable to sleep-related complaint provided to physician: “I don’t get enough rest or sleep.”

Sleep Surveillance at CDC (cont.)

- ❑ **Perceived insufficient rest or sleep, US adults, 2008**
 - First nationwide report of state-level estimates
 - All 50 states, DC, and three US territories
 - Same survey question as the 2006 study
 - 11.1% - insufficient rest or sleep *every day* in past 30 days
 - 30.7% - *no days* of rest or insufficient sleep in past 30 days
 - Distinct geographic variation

Age Adjusted Percentage of self-reported insufficient rest or sleep 30 days in the past 30 days by US state and territory, BRFSS 2008

(Unweighted n=403,981)



Sleep Surveillance at CDC (cont.)

- ❑ **Other Unhealthy Sleep-related Behaviors, 2009**
 - 12 States (CA, GA, HI, IL, KS, LA, MD, MN, NE, NY, TX, WY)
 - New (2009) sleep module added to BRFSS
 - Sleeping on average <7 hours in 24-hour period (35.3%)
 - Snoring (48.0%)
 - Unintentionally fell asleep during the day at least 1 day in past 30 days (37.9%)
 - Nodded off or fell asleep while driving in past 30 days (4.7%)
 - Module selected by additional states in 2010, 2011, and 2012 (public use dataset for 2010 available in June 2011)

Results from Previous Studies

- ❑ **More likely to experience insufficient rest or sleep if:**
 - Younger adult
 - Female
 - Non-Hispanic Black
 - Lower educational attainment
 - Unemployed or unable to work
- ❑ **Sleep insufficiency highly correlated with:**
 - Weight
 - Smoking status
 - Mental disorders

Research Question for This Study

- ❑ Is airport noise exposure associated with self-reported insufficient sleep?**
- ❑ Related to Healthy People 2020 Objective SH-4 (Sufficient sleep among adults)**

Data

❑ Noise exposure data for 95 US airports (from FAA)

- Three levels of airport noise exposure
 - Greater than or equal to 65dB (DNL)
 - 60-65dB
 - 55-60dB
- Most recent INM airport decks (various years)
- 2009 flight operation levels derived from ETMS data

❑ Population health outcome: insufficient sleep

- BRFSS, 2008-2009, Core Questionnaire
- “During the past 30 days, for about how many days have you felt you did not get enough rest or sleep?”
 - Continuous variable (0-30 days)
 - Dichotomous variable - every day (30 days vs 0-29 days)
 - Dichotomous variable - at least one day (1-30 days vs 0 days)

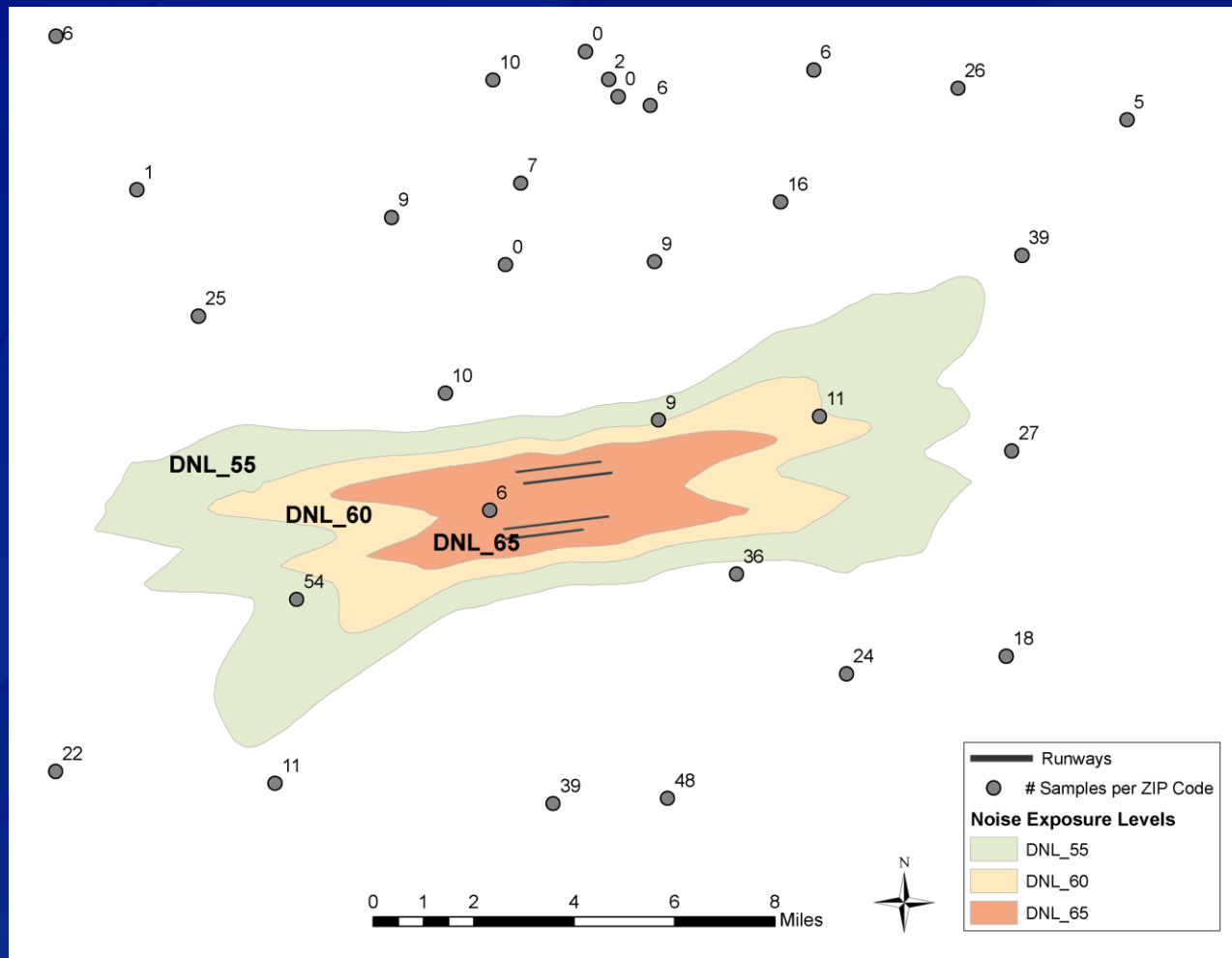
Data (cont.)

- ❑ **Individual characteristics (from BRFSS)**
 - Age
 - Sex
 - Race/ethnicity
 - Educational status
 - Smoking status
 - Weight status
- ❑ **ZIP Code level neighborhood socioeconomic status**
 - Median household income

Data Linkage

- ❑ ZIP Codes for each BRFSS record based on self-report**
- ❑ Airport noise exposure level assigned to each ZIP Code centroid through a geographic information system (GIS) spatial overlay function**
- ❑ Datasets were linked in SAS through common data element (ZIP Code)**

Example of Airport Noise Exposure Data with BRFSS Sample Sizes at ZIP Code Level



Methods

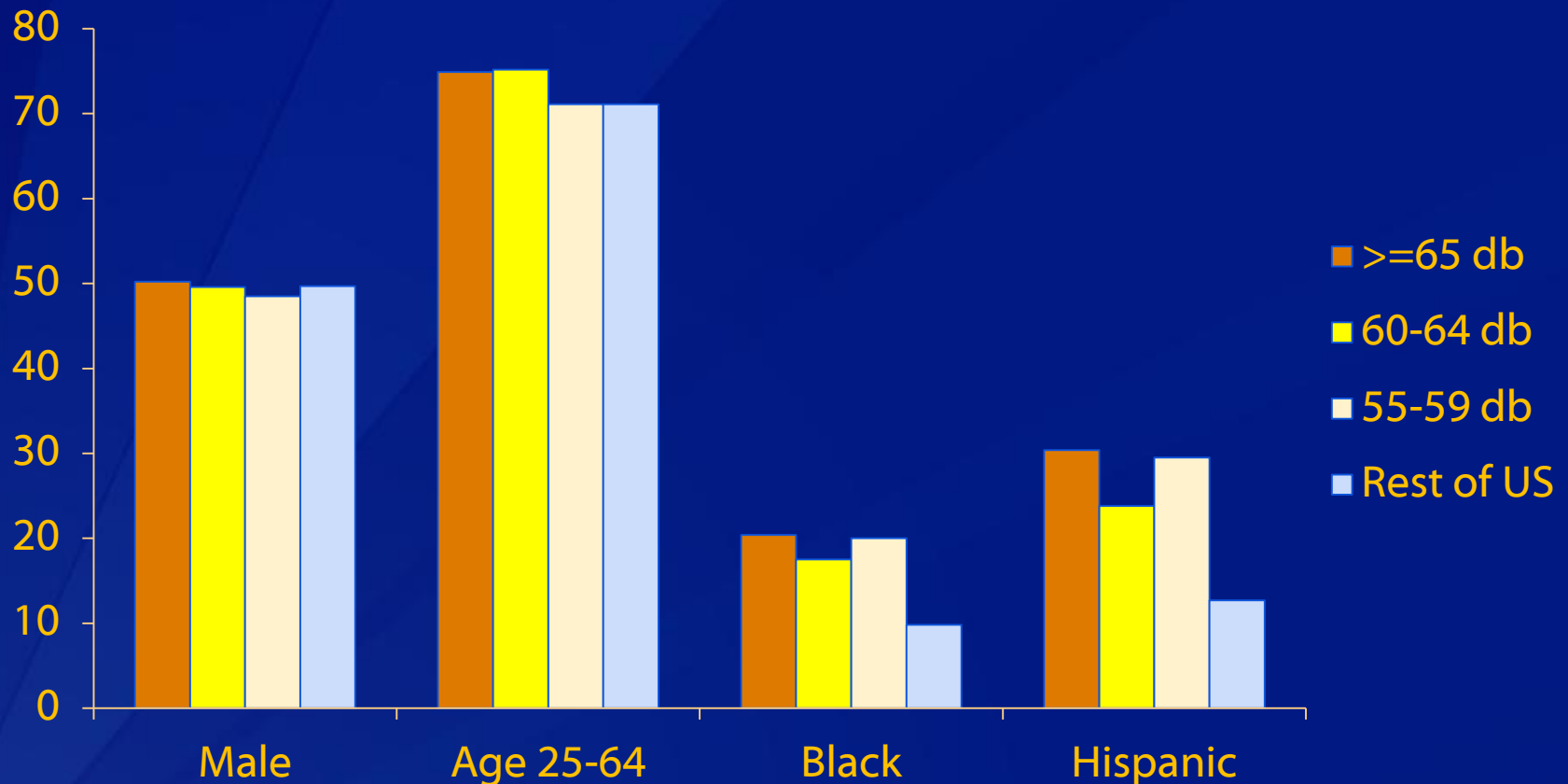
- ❑ **Evaluate the ZIP Code level airport noise impact on sleep quality while controlling for individual sociodemographics and smoking and weight status, and controlling for ZIP Code level socioeconomic status**
- ❑ **Multilevel linear regression analysis**
 - For continuous outcome variable (number of days of insufficient rest or sleep)
- ❑ **Multilevel logistic regression analysis**
 - For dichotomous outcome variables
 - At least one day of insufficient rest or sleep vs no days
 - 30 days of insufficient rest or sleep vs 0-29 days

Methods (cont.)

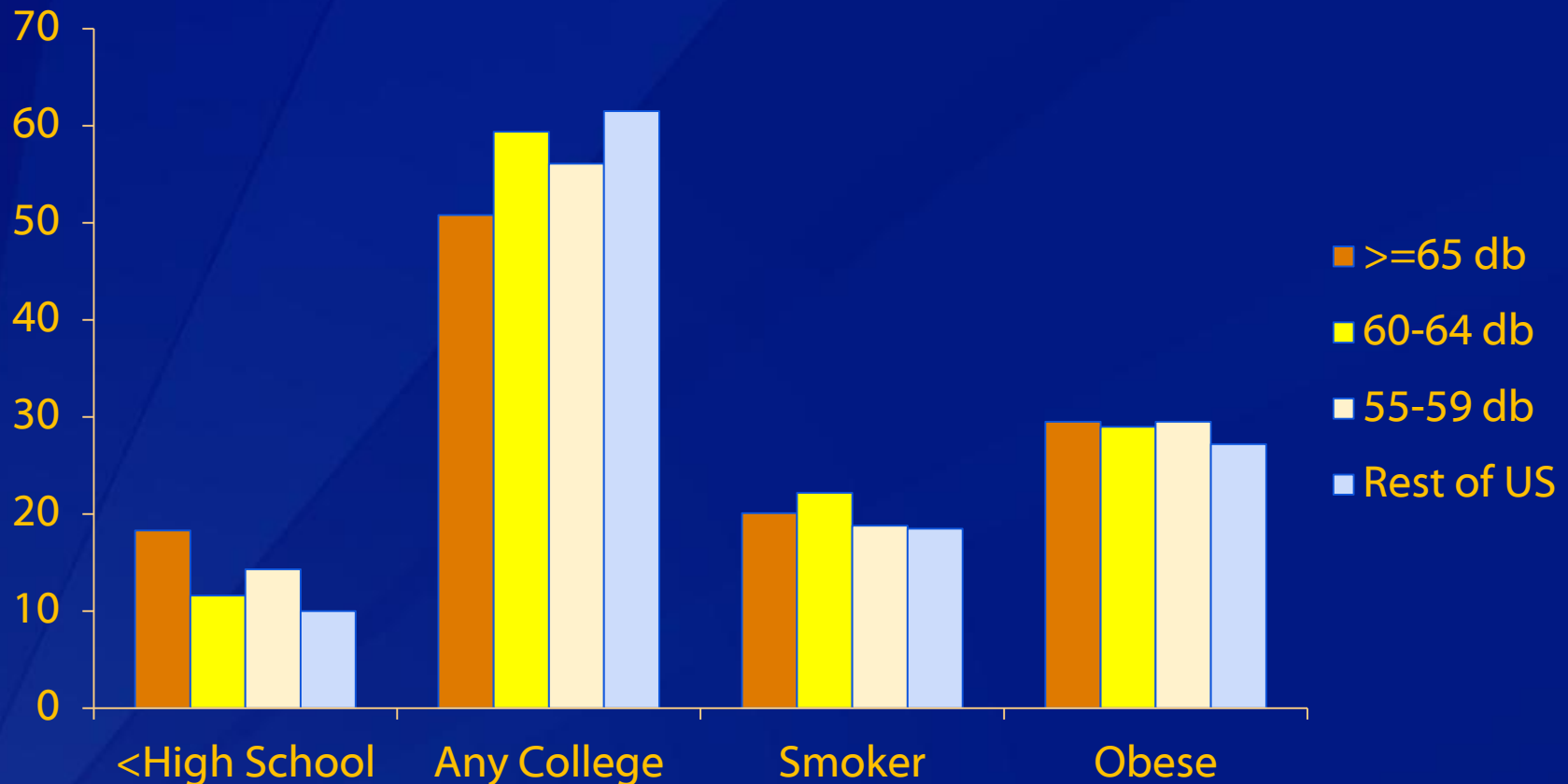
□ Spatial stratification of sample

- Three airport noise exposure zones for the 95 airports with data
 - Greater than or equal to 65dB DNL (n=855)
 - 60 to 65 dB DNL (n=2,368)
 - 55 to 60 dB DNL (n=4,576)
- Areas outside of these exposure zones (e.g., the rest of the US) (n=738,069)

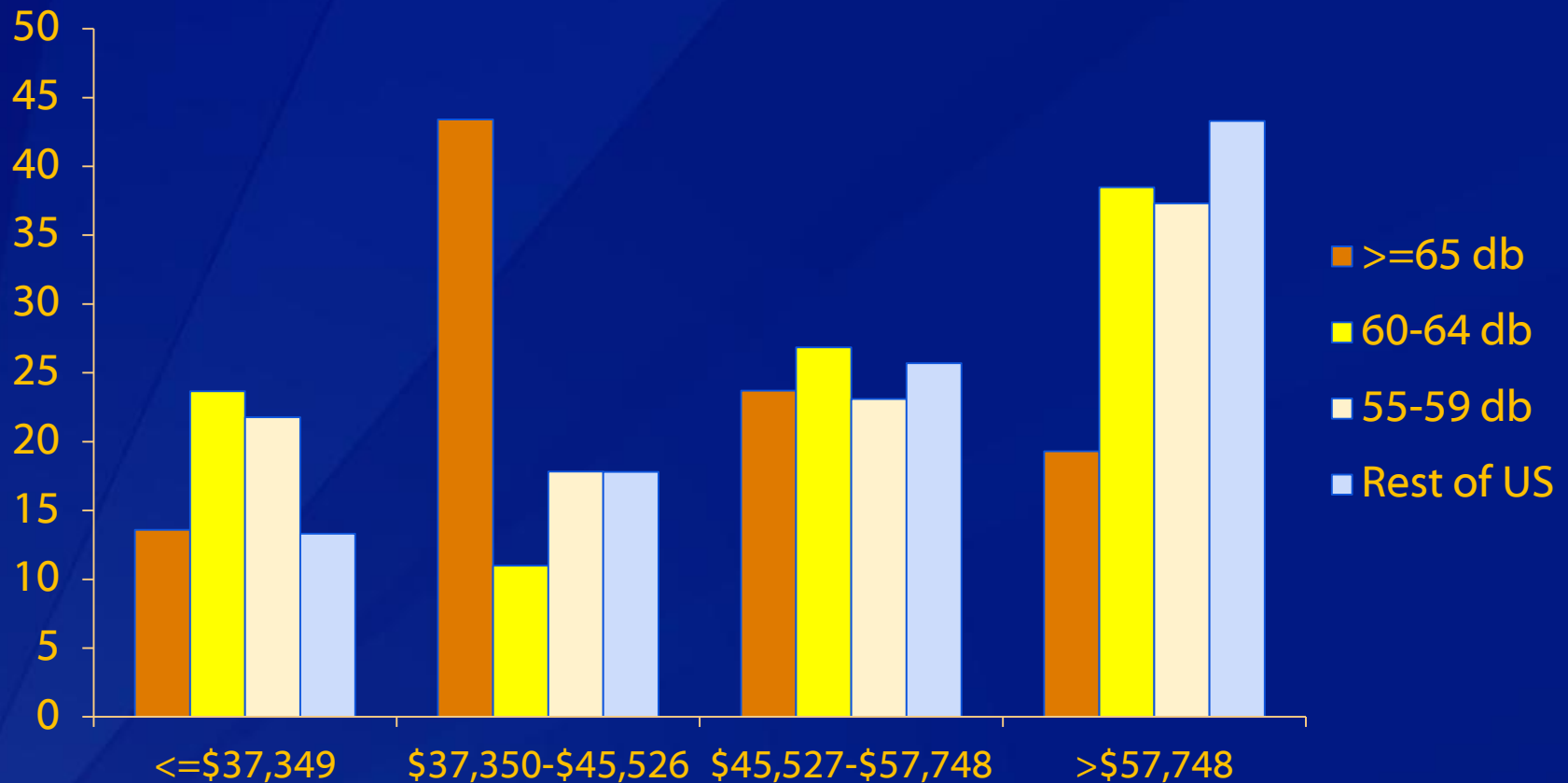
Characteristics of the Study Populations, by Airport Noise Exposure: BRFSS, 2008-2009



Characteristics of the Study Populations, by Airport Noise Exposure: BRFSS, 2008-2009



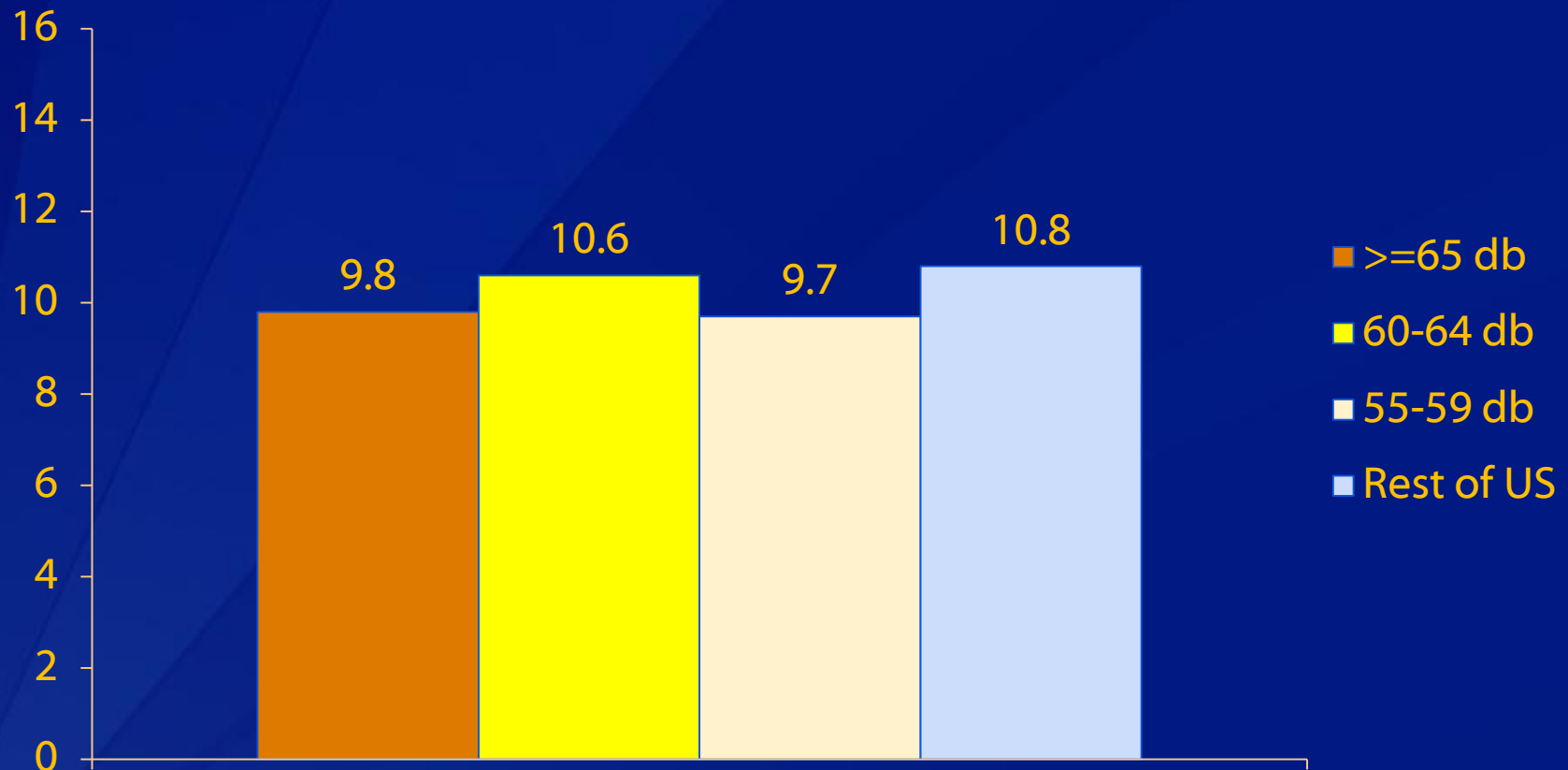
Distribution of Medium Household Income of the Study Populations, by Airport Noise Exposure: BRFSS, 2008-2009



Results (Model1)

- ❑ **Treated dependent variable, number of days of insufficient rest or sleep in the past 30 days, as a dichotomous variable**
 - 30 days
 - Less than 30 days
- ❑ **Controlled for individual covariates and ZIP code level socioeconomic status**
- ❑ **No statistically significant relationship between airport noise exposure and self-reported sleep insufficiency**

Percent (%) Reporting 30 Days of Insufficient Sleep in the Past 30 Days, by Airport Noise Exposure: BRFSS, 2008-2009

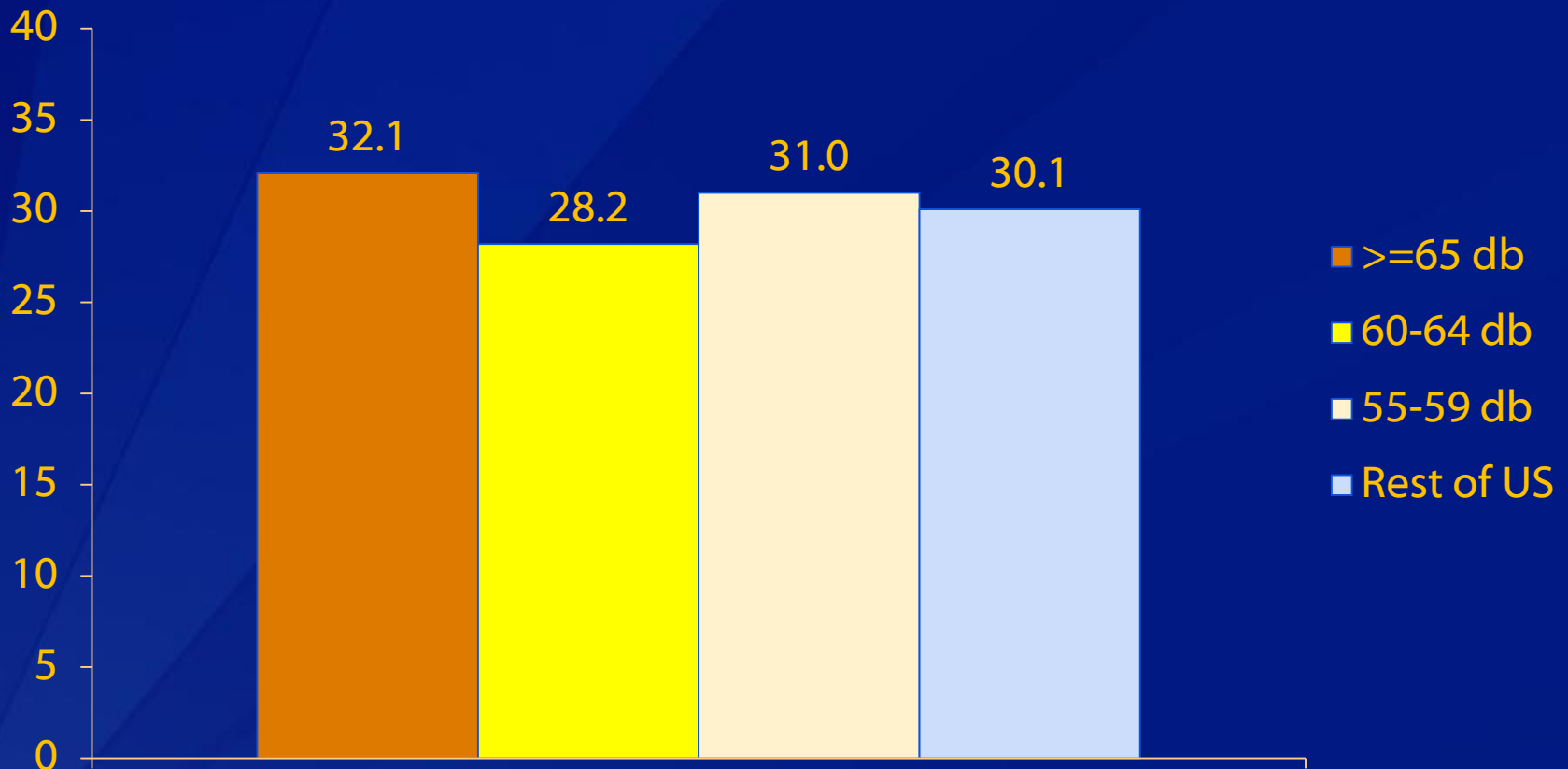


*No significant differences in logistic regression analyses adjusting for age, race, sex, educational level, smoking, weight status, and income levels.

Results (Model 2)

- ❑ **Treated dependent variable, number of days of insufficient rest or sleep in the past 30 days, as a dichotomous variable**
 - At least one day
 - 0 days
- ❑ **Controlled for individual covariates and ZIP code level socioeconomic status**
- ❑ **No statistically significant relationship between airport noise exposure and self-reported sleep insufficiency**

Percent (%) Reporting Any Days of Insufficient Sleep in the Past 30 Days, by Airport Noise Exposure: BRFSS, 2008-2009

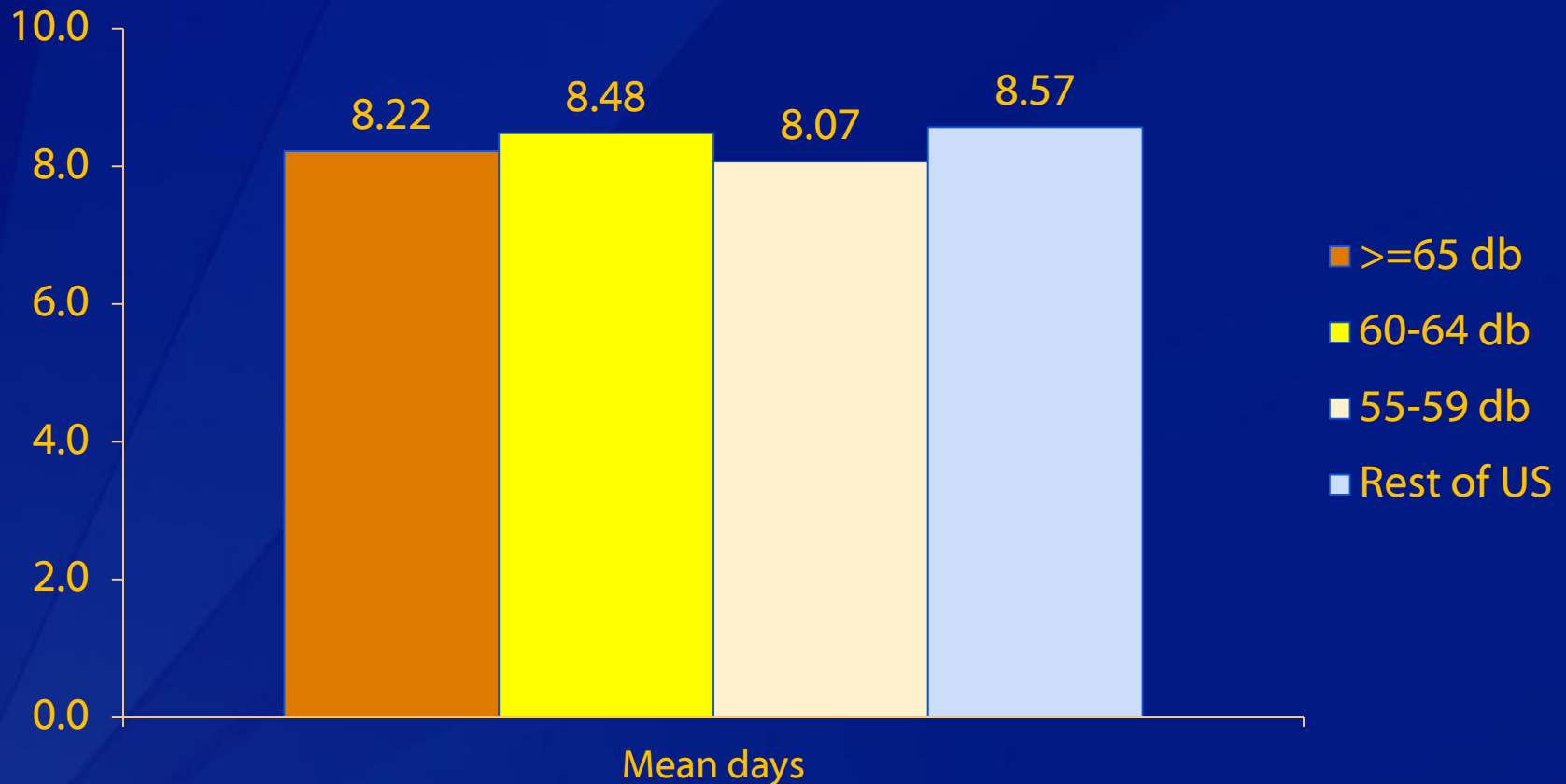


*No significant differences in logistic regression analyses adjusting for age, race, sex, educational level, smoking, weight status, and income levels.

Results (Model 3)

- ❑ **Treated dependent variable, number of days of insufficient rest or sleep in the preceding 30 days, as a continuous variable**
 - # of days (0 to 30)
- ❑ **Controlled for individual covariates and ZIP code level socioeconomic status**
- ❑ **No statistically significant relationship between airport noise exposure and self-reported sleep insufficiency**

Mean Days with Insufficient Sleep in the Past 30 Days, by Airport Noise Exposure: BRFSS, 2008-2009



*No significant differences in linear regression analyses adjusting for age, race, sex, educational level, smoking, weight status, and income levels.

Discussion

- ❑ **Self-reported Insufficient Sleep as an indicator of Sleep Complaints did not differ between BRFSS respondents exposed to various levels of airport zones.**
- ❑ **The lack of a relationship could not be explained by differences in age, race, sex, educational level, weight status, smoking status, and income levels.**
- ❑ **Another sleep indicator such as sleep duration (number of hours slept during the past 24 hours) may be a better measure of sleep health but has not been asked of all 50 states.**
- ❑ **Both measures need validation by more objective measurements before making changes in the survey.**

Strengths

- ❑ Large population survey, conducted in all 50 states, DC, and US territories**
- ❑ ZIP code level information available from survey – no other national health survey of this sample size includes this level of geographic information**
- ❑ Large sample of FAA airport noise exposures**

Limitations

- ❑ **Self-reported sleep data – subject to bias**
- ❑ **Subjective measure of sleep quality – not verified through actigraphy or polysomnography**
- ❑ **ZIP Code centroids – assumes population exposures are similar throughout the entire ZIP Code**
- ❑ **FAA noise exposure data – not from same year, and some may be potentially outdated**
- ❑ **Temporal mismatch between noise exposure data and self-reported sleep data**

Conclusions

- ❑ **Based on the results of a nationally-representative sample of the US adult population, we did not observe any statistically significant associations between living in areas subject to airport noise levels exceeding three levels (55dB, 60dB, and 65dB) and self-reported sleep insufficiency.**
- ❑ **The BRFSS is the only source of nationwide local-level data for health surveillance. Validation of BRFSS sleep measures is needed to determine the optimal measure of sleep for such a large-scale survey.**

Thank You!



For more information please contact Centers for Disease Control and Prevention

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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