

SFO Roundtable Meeting

April 4, 2018

Effects of Aircraft Noise on People

Presented by:
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Agenda



Community Annoyance



Children's Learning



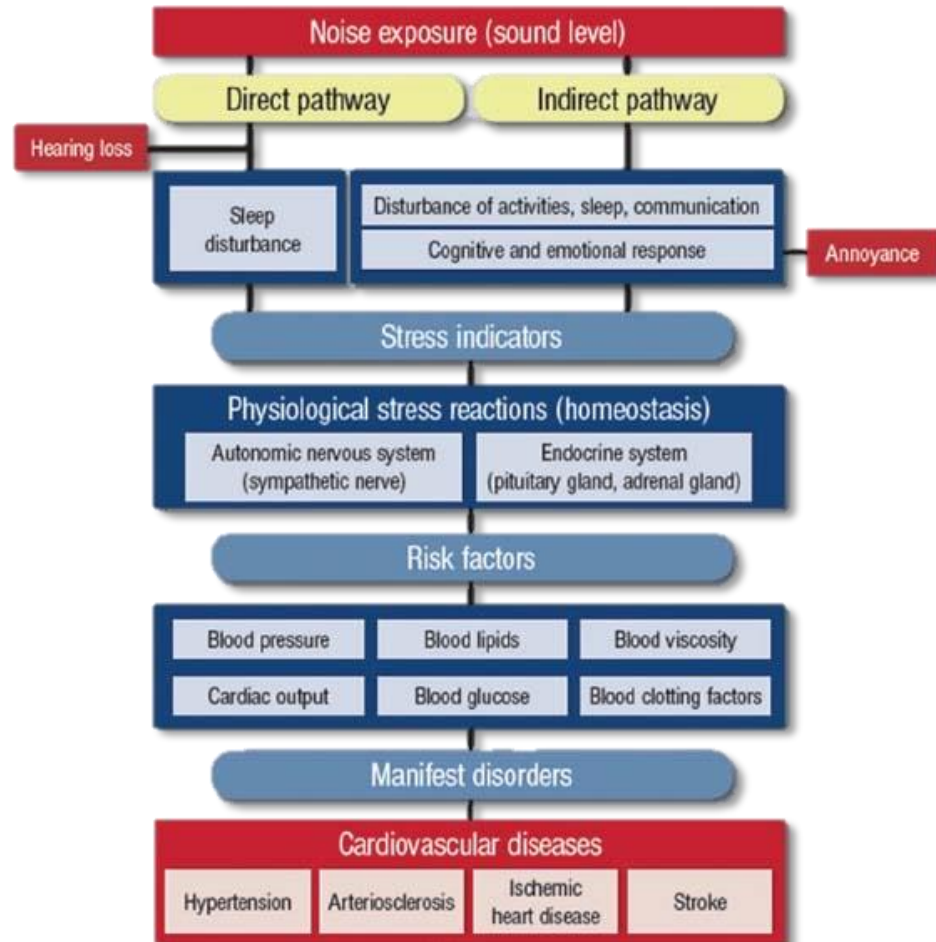
Sleep Disturbance



Non-Auditory Health Effects



Overview of Potential Health Effects of Noise



- Auditory:
 - Hearing loss
- Non-auditory:
 - Annoyance
 - Speech disruption
 - Sleep disturbance
 - Learning/cognitive impacts

Source: Cardiovascular Effects of Noise on Man – Wolfgang Babisch, 2015 ASA Meeting



COMMUNITY ANNOYANCE

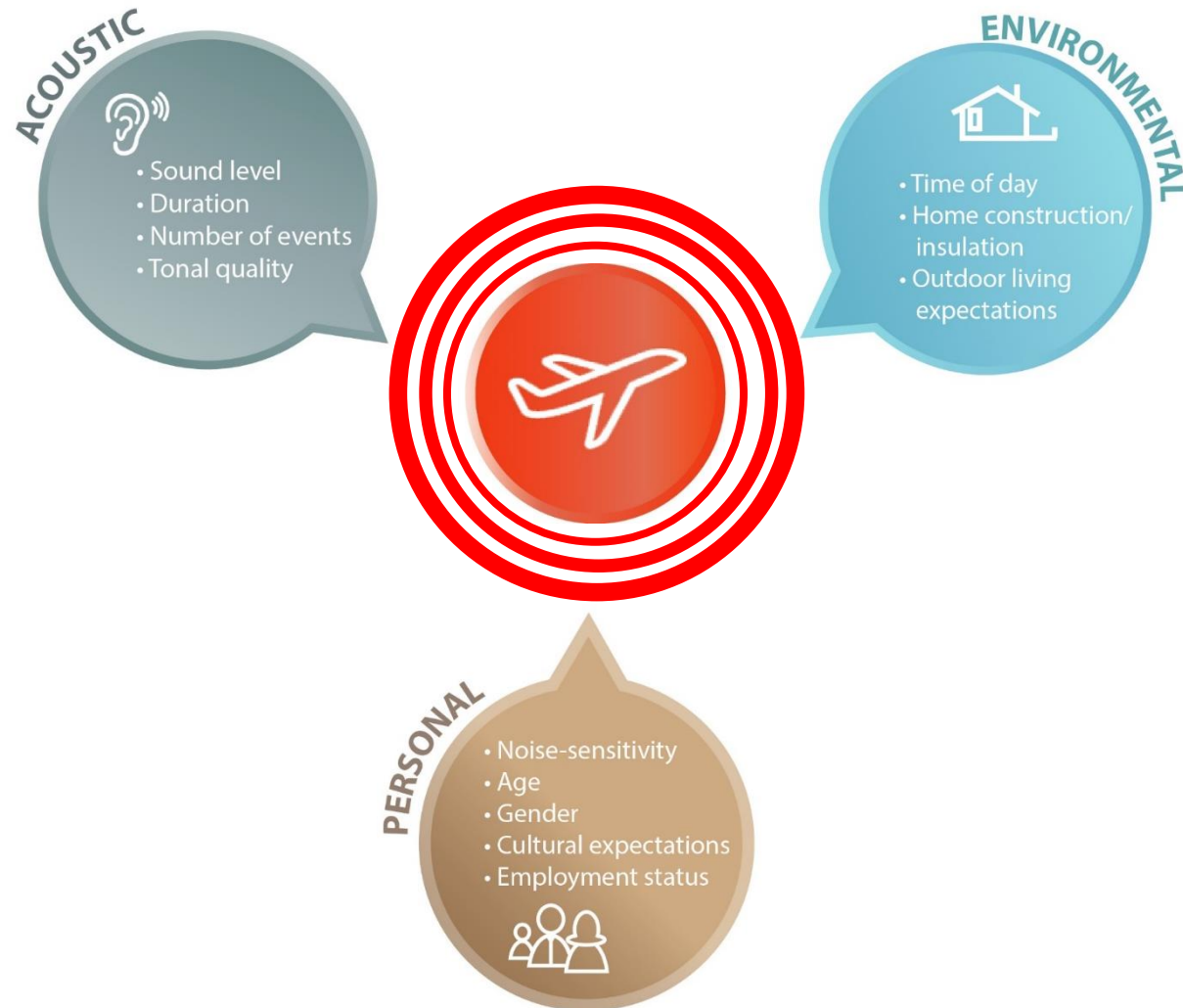


Summary of ICAO Findings on Annoyance

- Community annoyance refers to the average evaluation of the disturbing aspects or nuisance of a noise situation by a “community” or group of residents, combined in a single outcome, annoyance.
- The percentage of highly annoyed respondents is considered to be the main indicator of community annoyance.
- Annoyance and complaints are different phenomena, the first being a privately held opinion, and the latter being an overt action.
- **Conclusions:** There is substantial evidence that aircraft noise exposure is associated with annoyance indicators, and exposure-response relationships have been derived to estimate the expected percentage of highly annoyed persons at a community level. Still, several personal and situational factors importantly affect the annoyance of individuals.

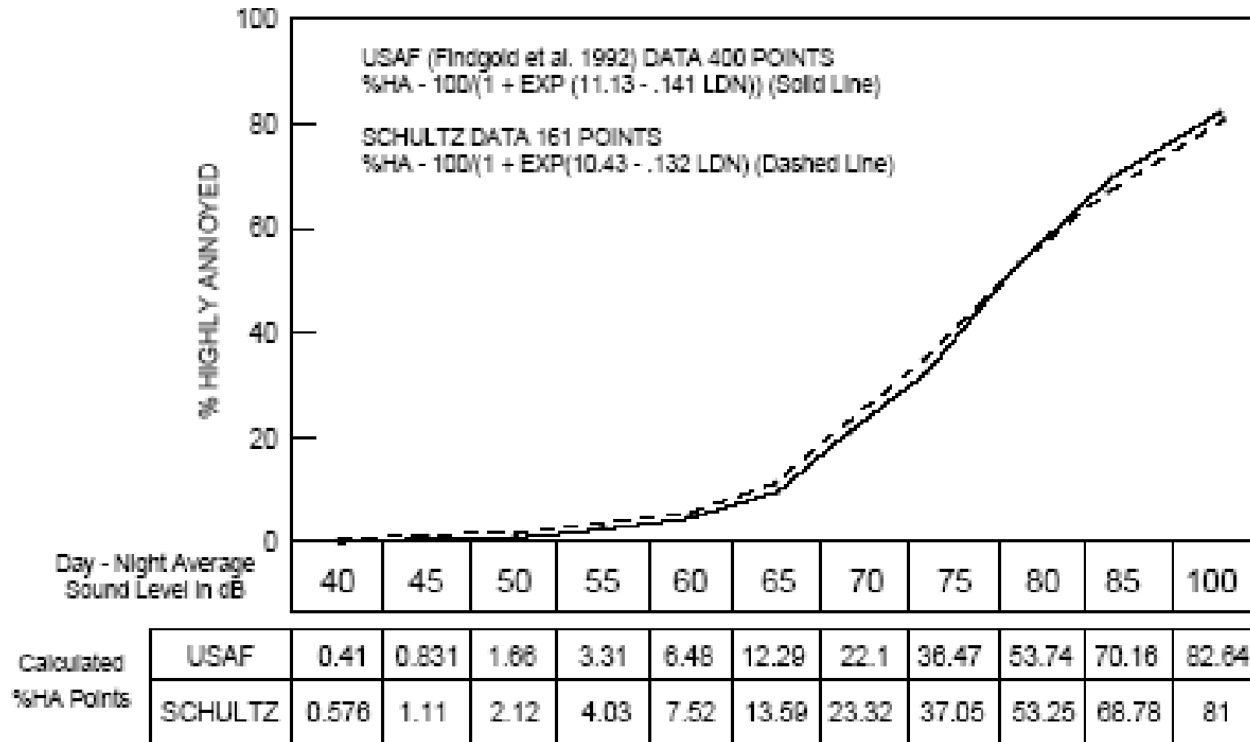


Aircraft Annoyance Factors

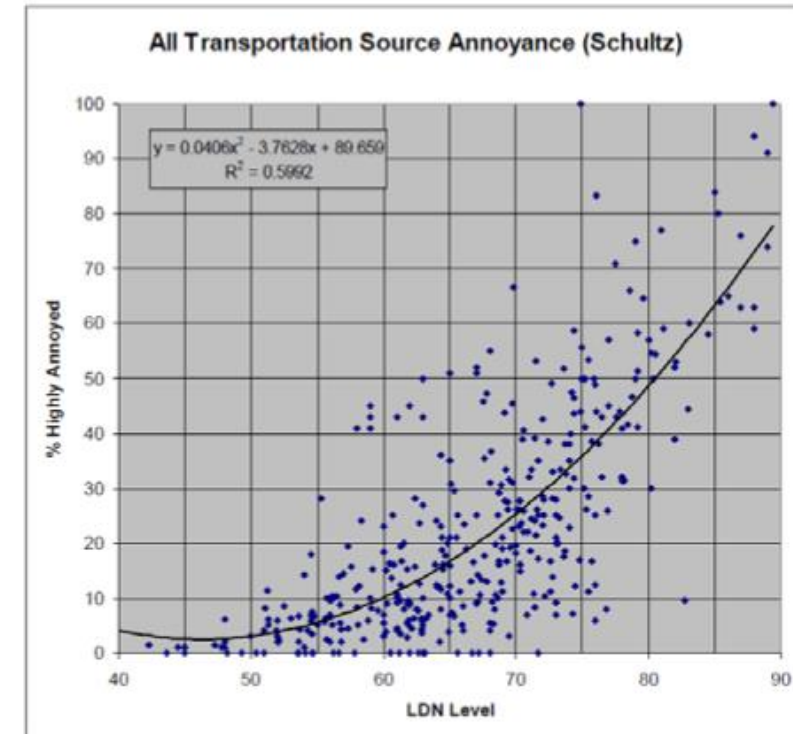




FAA Policy Based on FICON Annoyance Data



Source: Federal Agency Review of Selected Airport Noise Analysis Issues, Volume 2: Technical Report, Federal Interagency Committee on Noise, August 1992

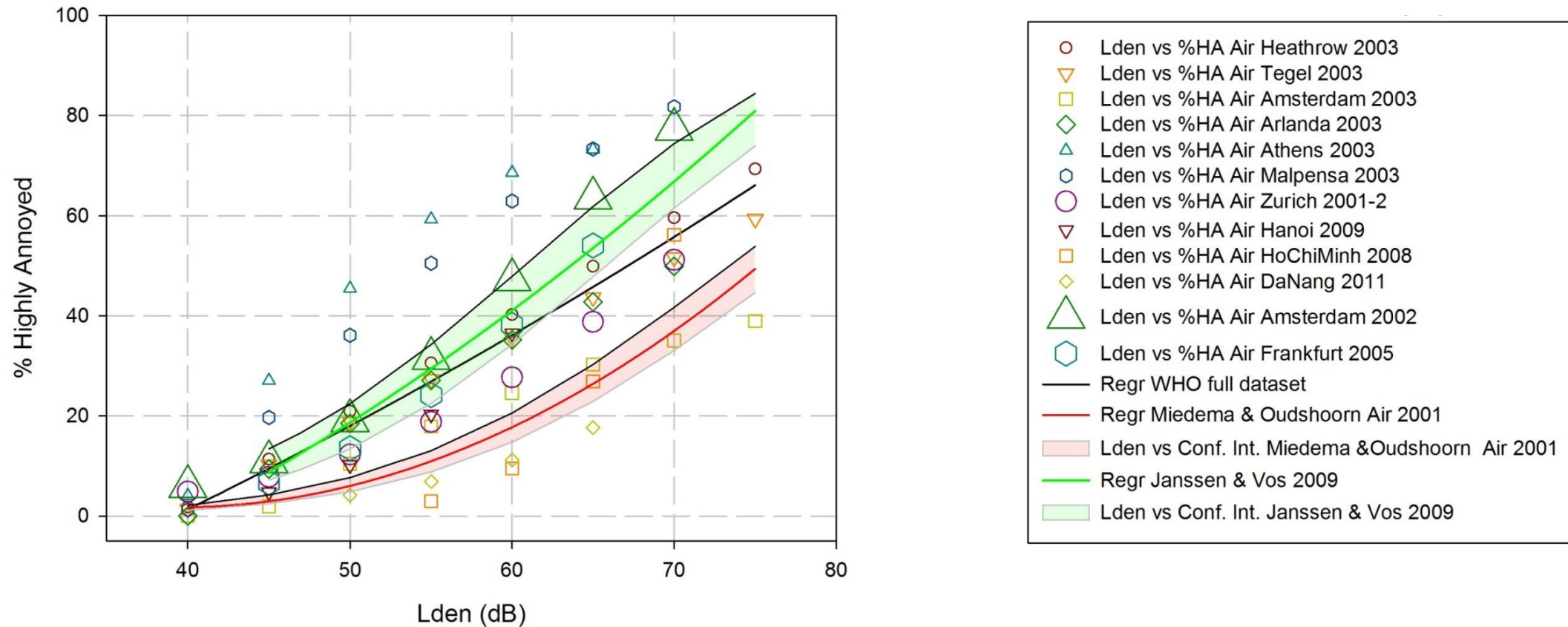


Source: Is the Schultz Curve Still a Useful Measure of Community Annoyance with Aircraft Noise? Woodward, Mestre, Landrum & Brown, December 8, 2009





More Recent Studies Show Higher Annoyance Rates



Source: Guski et al (2016). The WHO Evidence report on noise annoyance 2000-2014. *Proceedings of Internoise 2016, August 21-24, 2016, Hamburg, Germany.*

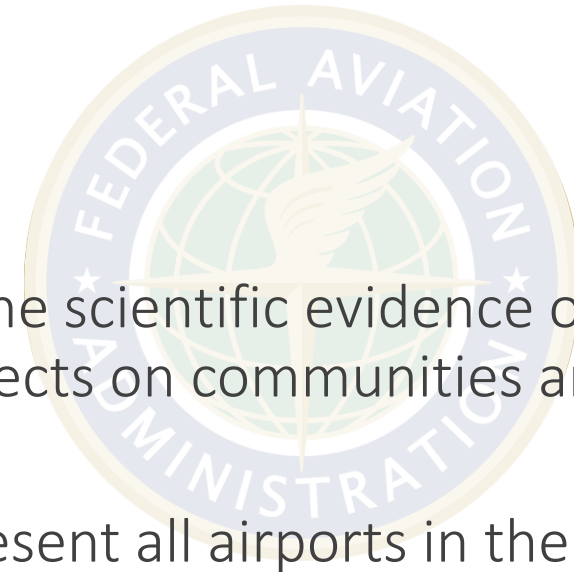


FAA ANNOYANCE STUDY





National Noise Survey



Goal: To conduct a new nation-wide survey to update the scientific evidence of the relationship between aircraft noise exposure and its effects on communities around airports

- National survey conducted at 20 airports, which represent all airports in the nation based on statistical approach
- Four critical airports included due to number of people exposed to aviation noise around those airports and the number of operations at those airports
- These 20 airports represent (in 2015):
 - 44% of people exposed to DNL 65 dB
 - 41% of people exposed to DNL 60 dB
 - 39% of people exposed to DNL 55 dB





FAA Milestones



- 2018: Release results of Annoyance Study
- 2019: Complete policy research:
 - Implications of changing NEPA impact criteria
 - Residential sound insulation efficacy
 - Mitigation options other than sound insulation
- After policy research completed: finding on whether change in level warranted
- After decision on level finalized, initiate research on alternative metrics



CHILDREN'S LEARNING



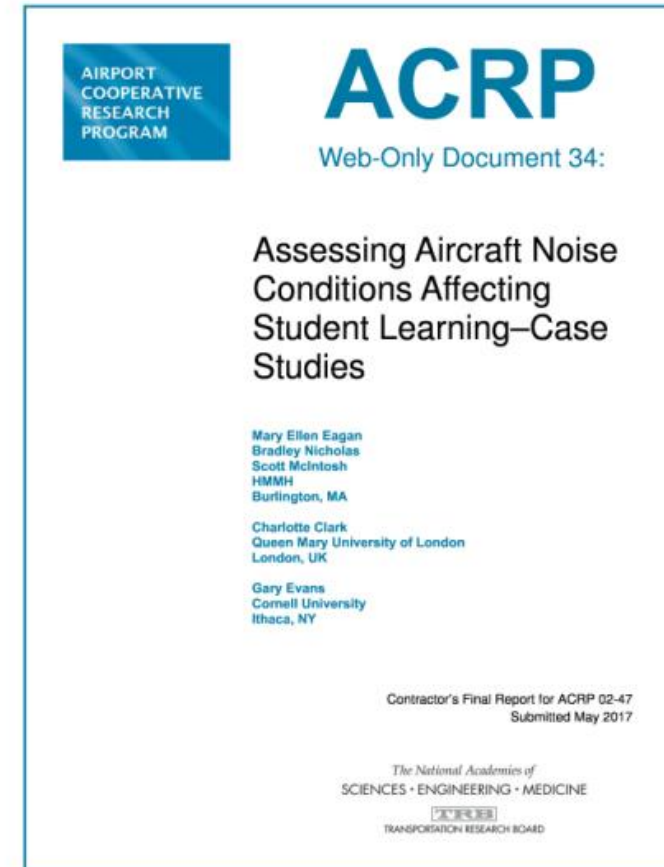
Summary of ICAO Findings on Children's Learning

- Aircraft noise exposure at school or at home is associated with children having poorer reading and memory skills.
- The RANCH Study found exposure-response associations between aircraft noise and poorer reading comprehension and poorer recognition memory, after taking social position and road traffic noise, into account.
- A range of pathways and mechanisms for the effects have also been proposed. Effects might be accounted for by communication difficulties, teacher and pupil frustration, reduced morale, impaired attention, increased arousal – which influences task performance, and sleep disturbance from home exposure which might cause performance effects the next day.
- **Conclusions:** There is sufficient evidence for a negative effect of aircraft noise exposure on children's cognitive skills such as reading and memory, as well as on standardized academic test scores.



ACRP Study: Assessing Aircraft Noise Conditions Affecting Student Learning – Case Studies

- Study focused on a methodology to identify and measure teacher and student behaviors in classrooms; it also included a survey of teachers' attitudes toward aircraft noise and coping mechanisms.
- The classroom observations show: (1) a range of noise metrics demonstrated associations with the onset of teacher voice masking events; (2) Number of Event (NA) metrics showed better correlation with teacher voice masking and teacher voice raising; and (3) external noise seems to matter even when controlled for internal noise.
- The teacher survey findings suggest that even at levels of aircraft noise exposure that are considered normally compatible, teachers report adverse impact on teaching activities and student behavior.





SLEEP DISTURBANCE



Summary of ICAO Findings on Sleep Disturbance

- Undisturbed sleep is important for next day performance, well-being, and health. For these reasons, noise-induced sleep disturbance is considered the most deleterious non-auditory effect of environmental noise exposure.
- Field studies in the vicinity of airports have shown that most arousals cannot be attributed to aircraft noise, and noise-induced sleep-disturbance is in general less severe than that observed in clinical sleep disorders like obstructive sleep apnea.
- **Conclusions:** Aircraft noise can disturb sleep and impair sleep recuperation. Further research is needed to (a) derive reliable exposure-response relationships between aircraft noise exposure and sleep disturbance, (b) explore the link between noise-induced sleep disturbance and long-term health consequences, (c) investigate vulnerable populations, and (d) demonstrate the effectiveness of noise mitigation strategies. This research will inform political decision-making and help mitigate the effects of aircraft noise on sleep.



FAA Sleep Disturbance Study



- Objective: Develop and use an inexpensive, scientifically sound methodology to obtain objective measures of sleep disturbance from aircraft noise
- Results: Study results will be used to develop relationship between aircraft noise exposure and sleep disturbance. This data will inform future considerations regarding aviation noise in the U.S.
- Status and Timeline:
 - 2016: 1st airport pilot study: established feasibility of unattended acquisition of acoustic and physiological field data, unattended sleep measurements
 - 2017: 2nd airport pilot study: determined field study recruitment methodology that maximizes response rate and minimizes cost; no staff, all equipment is mailed
 - 2018-2023: National Field Study: acquire sleep disturbance data at many airports; develop relationship between aircraft noise exposure and sleep disturbance; results will inform policy





HEALTH EFFECTS



Summary of ICAO Findings on Health Effects

- There are several ways in which noise could affect health, including a physiological response via the autonomic nervous system, leading to rises in blood pressure and heart rate, stress potentially mediated by annoyance, and disturbed sleep.
- The number of health studies to date is limited, but have been done in these areas:
 - Cardiovascular disease (CVD) hospitalizations and mortality
 - Hypertension
 - Birth outcomes
 - Psychological health
- **Conclusions:** Studies are suggestive of impacts on cardiovascular health especially hypertension, but limited and inconclusive with respect to quantification of these, with a relatively small number of studies conducted to date. More studies are needed to better define exposure-response relationships, the relative importance of night versus daytime noise and the best noise metrics for health studies (e.g. number of aircraft noise events versus average noise level).



Ongoing FAA-Supported Research

- Cardiovascular Disease and Aircraft Noise Exposure (NIEHS), the Women's Health Initiative (WHI)
- Aircraft Noise Exposure and Cardiovascular Disease, Nurses Health Study/Health Professional Follow-up Study (FAA)



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**HEALTH PROFESSIONALS
FOLLOW-UP STUDY**



References

- *ICAO 2016 Environmental Report*, <https://www.icao.int/environmental-protection/Documents/ICAO%20Environmental%20Report%202016.pdf>
- *ACRP Synthesis 9, Effects of Aircraft Noise: Research Update on Select Topics*, <http://www.trb.org/Publications/Blurbs/160286.aspx>
- *ACRP Web-only Document 17, Research Methods for Understanding Aircraft Noise Annoyances and Sleep Disturbance*, <http://www.trb.org/Publications/Blurbs/170979.aspx>
- *ACRP Web-only Document 34, Assessing Aircraft Noise Conditions Affecting Student Learning—Case Studies*, <http://www.trb.org/Main/Blurbs/176782.aspx>

Discussion