



Anderson
Acoustics

HEATHROW COMMUNITY NOISE FORUM (HCNF)

Noise & Health Research Papers Update

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1. Introduction

Noise and health research update. November 2016

- In 2015, the Heathrow Community Noise Forum requested quarterly updates on published research papers relating to aircraft noise and health.
- It was agreed that Anderson Acoustics would provide this regular update in a Powerpoint format.
- Each update provides an initial table summarising the strength of evidence relating health effects to aircraft noise & health relationships based primarily on information from independent reviews.
- Recent research is outlined in terms of stated scope and outcomes. A link to each reference is also supplied.
- This information is factual and does not aim to offer any interpretation of the findings.



2. Strength of evidence

The current strength of evidence between aircraft noise and each of the health effects and specific outcomes

EFFECT	SPECIFIC OUTCOMES	STRENGTH OF EVIDENCE
Cardiovascular	Hypertension	Sufficient but no proven causal link
	Coronary Heart Disease (CHD)	
	Acute Myocardial Infarction (AMI)	
	Stroke	
Sleep disturbance	Short term: Awakenings	Sufficient but self-reported
	Long term effects	Lacking
Cognitive development	Adults	Lacking
	Children – reading age	Sufficient
Mental health	Symptoms	Lacking
Annoyance	Short term	Sufficient
Hearing impairment	Loss in hearing	None at <75dB(A)

International standardised evidence categories according to WHO:

Sufficient: If a relationship has been observed in which chance, bias, and confounding can be ruled out with reasonable confidence.

Limited: If an association has been observed, but chance, bias and confounding cannot be ruled out without reasonable confidence.

Inadequate: If the available studies are insufficient in quality, consistency or statistical power to permit conclusions regarding the presence or absence of a causal relationship.

Lacking: Several adequate studies are mutually consistent in not showing a positive association between exposure and health effects.



3. Useful summary papers

The papers below provide a collation of information and references on aircraft noise and health

- **AEF – Aircraft Noise and Public Health: The Evidence is Loud and Clear**, UK (2016)
<http://www.aef.org.uk/uploads/Aircraft-Noise-and-Public-Health-the-evidence-is-loud-and-clear-final-reportONLINE.pdf>
- **Aircraft Noise Effects on Health – for Airports Commission** (Clark, 2015)
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446311/noise-aircraft-noise-effects-on-health.pdf
- **Auditory and non-auditory effects of noise effects on health** (Basner, 2014)
Lancet 383 pp. 1325-1332
[http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(13\)61613-X/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(13)61613-X/abstract)

See June Update for further analysis of these reports



4. Recent published research papers

Based on literature review the following papers have been identified (individual summaries follow)

- A The WHO evidence review on noise annoyance 2000-2014** (Guski, Schrekenberg, Schuemer, 2016). InterNoise 2016 Proceedings.
- B Airport Noise Management: Benchmarking of 12 International Airports** (Clairbois, Van Oosten, 2016). InterNoise 2016 Proceedings.
- C Noise Respite at Frankfurt Airport** (Schrekenberg et al, 2016). InterNoise 2016 Proceedings.
- D Effects of noise exposure of other people on aircraft noise tolerability using a reference point approach** (Phun, Hirata, Yai, 2016). Transport Research Part D: 48 pp. 171-186.
- E The effect of aircraft noise on sleep disturbance amongst the residents near a civilian airport: a cross-sectional study** (Kwak et al, 2016). Annals of Occupational and Environmental Medicine 28:38.
- F Does aircraft noise exposure increase the risk of hypertension in the population living near airports in France?** (Evrard et al, 2016). Occup Environ Med (Online First).



4. Recent published research papers (*continued*)

A. The WHO evidence review on noise annoyance 2000-2014.

Guski, Schrekenberg, Schuemer. 2016

- Systematic review on the effects of environmental noise on residential **long-term annoyance** concerning aircraft, road traffic, railway, wind turbine noise.
- 15 aircraft related surveys considered, covering a wide range of noise levels and airport sizes.
- Higher %Highly Annoyed (%HA) at **high-rate-change airports** (airports which have undergone an abrupt change or expect such a change in the near future).
- More recently there has been an increase in annoyance responses **above currently accepted %HA curve** defined by Miedema & Oudshoorn in 2001.
- Face-to-face surveys show significantly higher rated annoyance.



4. Recent published research papers (*continued*)

B. Airport Noise Management: Benchmarking of 12 International Airports. Clairbois, Van Oosten. 2016

- Benchmarking exercise of airports' noise management. 12 international airports' implementation of ICAO's guideline '**Balanced Approach**' and **number of complaints** received investigated. Only UK airport included was Manchester.
- The **higher the noise exposure** (based on $L_{den, pop}$ – which incorporates the L_{den} of each respondent) the **more tools from Balanced Approach required to manage noise complaints**.
- Airports with higher noise exposure levels that **implemented more tools** received **fewer complaints**.
- Tools to improve residents' perceptions and reduce complaints include: noise abatement procedures, community outreach, financial incentives, operational restrictions, sound insulation schemes, land use planning, monitoring.

Clairbois, Van Oosten (2016) 'Airport Noise Management: Benchmarking of 12 International Airports',
InterNoise Proceedings 2016
<http://pub.dega-akustik.de/IN2016/data/articles/000064.pdf>



4. Recent published research papers (*continued*)

C. Noise Respite at Frankfurt Airport. Schreckenber, Benz, Goetz, Flindell. 2016

- One year trial began in April 2015, allowing for **extending night flight ban** over areas around airport in **evening/morning** – with redistribution of traffic in shoulder hours between 3 or 4 runways. **Residents' perceptions** investigated through focus groups and telephone survey.
- **Perception of relief was weak**, even with reductions of 10 dB reduction in evening and 4-6 dB in morning. Respite believed by residents to be a **complete break**, not reduction in traffic.
- Preference to **morning respite over evening**.
- Residents with a **higher degree of trust** in authorities report **less annoyance and sleep disturbance** by aircraft noise.
- Even those who weren't aware of operations or were not positive about respite trials were **in favour of continuing respite project**.

Schreckenber, Benz, Goetz, Flindell, (2016) 'Noise Respite at Frankfurt Airport'

InterNoise Proceedings 2016

<http://pub.dega-akustik.de/IN2016/data/articles/000064.pdf>



4. Recent published research papers (*continued*)

D. Effects of noise exposure of other people on aircraft noise tolerability using a reference point approach. Phun, Hirata, Yai. 2016

- Study examines whether the noise level tolerated by individuals is affected when they **compare their own situation to the situations of other people** who are more severely affected by the noise.
- **Questionnaire and face-to-face interviews** for residents living around Manila Airport, Philippines.
- Pre-recorded aircraft noise played to subjects through headphones.
- Individuals **tolerated more overhead flights** when considering those **worse affected by noise**.

Phun, Hirata, Yai (2016) 'Effects of noise exposure of other people on aircraft noise tolerability using a reference point approach'

Transport Research Part D: 48 pp. 171-186

<http://www.sciencedirect.com/science/article/pii/S1361920915302492>



4. Recent published research papers (*continued*)

E. The effect of aircraft noise on sleep disturbance amongst the residents near a civilian airport: a cross-sectional study. Kwak et al. 2016

- Large-scale epidemiological study carried out around **Gimpo International Airport, Seoul, Korea**.
- Included **door-to-door survey** carried out for 3308 adults living around and aged between 20-75, separated into high- mid- and non-exposure groups.
- **Self-reported sleep disturbance** measured on scales of insomnia and daytime hypersomnia (sleepiness).
- **Prevalence of insomnia and daytime hypersomnia** greater in residents **exposed to aircraft noise** (no relationship for the effect of increasing degrees of exposure).

Kwak et al. (2016) 'The effect of aircraft noise on sleep disturbance amongst the residents near a civilian airport: a cross-sectional study'
Annals of Occupational and Environmental Medicine 28:38
<https://aoemj.biomedcentral.com/articles/10.1186/s40557-016-0123-2>



4. Recent published research papers (*continued*)

F. Does aircraft noise exposure increase the risk of hypertension in the population living near airports in France? Evrad et al. 2016

- Examined 1244 participants aged over 18 years based around three French airports – **blood pressure, noise exposure and socio-economic status** results detailed.
- Exposure-response relationship for **hypertension risk** and **airport exposure at night** determined for **men only**.
- **No relationship** found for **women**.
- Association also implies a risk for **cardiovascular disease**.
- Results broadly in line with previous studies.

Evrard et al. (2016) 'Does aircraft noise exposure increase the risk of hypertension in the population living near airports in France?'

Occup Environ Med (Online First)

<http://oem.bmj.com/content/early/2016/08/01/oemed-2016-103648.abstract>



5. What next?

Upcoming and Anticipated Research

- CAA ERCD Report on the 2014 SONA attitudes study
- Updated World Health Organisation Guidelines on Community Noise



6. Glossary of terms

Metrics

A-weighted: The sound level is weight in frequency bands to reflect the response of the human ear to noise – as the human ear is less sensitive to low frequencies, sound levels in these bands are reduced. Measurements made using an A-weighting are usually presented with an “A” in the metric, e.g. dB(A), $L_{Aeq,T}$, L_{Amax} .

$L_{Aeq,T}$: Equivalent Continuous Sound Pressure Level is the continuous sound pressure level that would generate the same energy as that of the fluctuating noise level over a period T. It is in effect the average sound level over a defined time period, T. Typically A-weighted.

L_{Amax} : Maximum Noise Level is the highest A-weighted sound pressure level during a noise event, it is an instant value;

L_{night} : The average sound level derived over the night-time period of 23:00 to 07:00.

L_{dn} : Day-night equivalent sound level - the equivalent sound level over a 24 hour period, with a penalty of 10dB added for noise during the night-time hours of 23:00 to 07:00.

L_{den} : Day-evening-night equivalent sound level – the average sound level over a 24 hour period, with 5 dB added for the evening hours or 19:00 to 23:00, and a penalty of 10 dB added for the night-time hours of 23:00 to 07:00.

SEL: Sound Exposure Level – the sound pressure level that would arise for if all the energy of the event were to be delivered in 1 second. It is a measure of the total sound energy in an event – it takes account of both the duration and intensity of an event.

Health

Acute: A medically used, a term describing a condition that has either sudden onset or short duration; as used here it generally refers to short-term effects

Arousal: Depending on the usage it can refer to awakening from sleep, or an increase in readiness for action, or a transition from a deeper to a lighter stage of sleep, or the excitation of the cardiovascular system characterized by increases in blood pressure and heart rate.

Cardiovascular: the system of the body including the heart, lungs, and blood vessels, responsible for distributing nutrients and oxygen to the body.

Causal: A causal relationship is one in which one circumstance leads to another that would not have occurred without it, or in a population would have occurred less frequently.

Confounding: Confounding variables are two variables that are confounded when their effects on a response variable cannot be distinguished from each other.



6. Glossary of terms (*continued*)

Cross-sectional Study: A study examining a portion of the population at a fixed time; it is often compared with other snapshot. This can only imply associations.

DALY: Disability-Adjusted Life Year. A standard measurement of a health effect on the population. $DALY = YLL + YLD$

DW: Disability Weighting – DW is associated with each health condition and lies on a scale between 0 (indicating the health condition is equivalent to full health) and 1 (indicating the health condition is equivalent to death).

Dose-response relationship: (or Exposure-response relationship) A mathematical relationship usually determined from epidemiological studies, used to describe a proven causal link between noise exposure and health outcome. Use of a particular d-r relationship can be recommended in guidance from the World Health Organisation **and other governing bodies.**

HA: Highly Annoyed – a measure of annoyance, often reported as a percentage of the total population.

Hormone: Chemicals used by the body to affect the actions of various systems of the body.

HSD: Highly Sleep Disturbed – a measure of sleep disturbance, often reported as a percentage of the total population.

Hypertension: Long-term high blood pressure; the World Health Organization defines hypertension as blood pressures consistently over 140 mmHg systolic blood pressure or 90 mmHg diastolic blood pressure.

Ischemic heart disease: Heart disease characterized by reduced blood flow to the heart tissue.

Longitudinal Study: A type of study design in which a population is followed and measured in order to determine correlation between observed variables and determine possible relationships. Can lead to proof of causality.

Modifiers: Variables which may change the way the other variables interact: e.g. the noise level at a subjects house may be known, but the subjects' window opening habits may

change experienced noise exposure

Monetisation: A technique used by economists to predict the monetary value of an effect to the population. Here, dose-response relationships would be used to calculate the effect of noise on health. This technique should only be used as a comparison between two health effects or scenarios and should not be taken as a direct cost to the population.

Myocardial infarction (also known as a heart attack): This occurs when blood flow to part of the heart is disrupted leading to cessation of function and possible death of heart muscle tissue, as well as possible death.

Subjective (as compared with objective): Often refers to measures of opinion or subject feelings rather than measurement of physiological parameters; evaluation often involves the use of a questionnaire.

YLD: Years Lost due to Disability – “healthy” life lost by virtue of being in states of poor health or disability.

YLL: Years Life Lost – due to premature death.



6. Glossary of terms (*continued*)

Operating procedures

Steeper Approach: Increasing the angle of descent of an aircraft. At Heathrow, aircraft come in to land at an angle of 3 degrees.

CDA, Continuous Descent Approach: A procedure used by aircraft before landing, in which the aircraft descends maintaining a constant angle, as opposed to descending through steps with periods of level flight in between, as is more common practice. The intention of a CDA is to keep aircraft higher for longer, thereby reducing arrival noise.

