

Aircraft noise and cardiovascular and cerebral disease

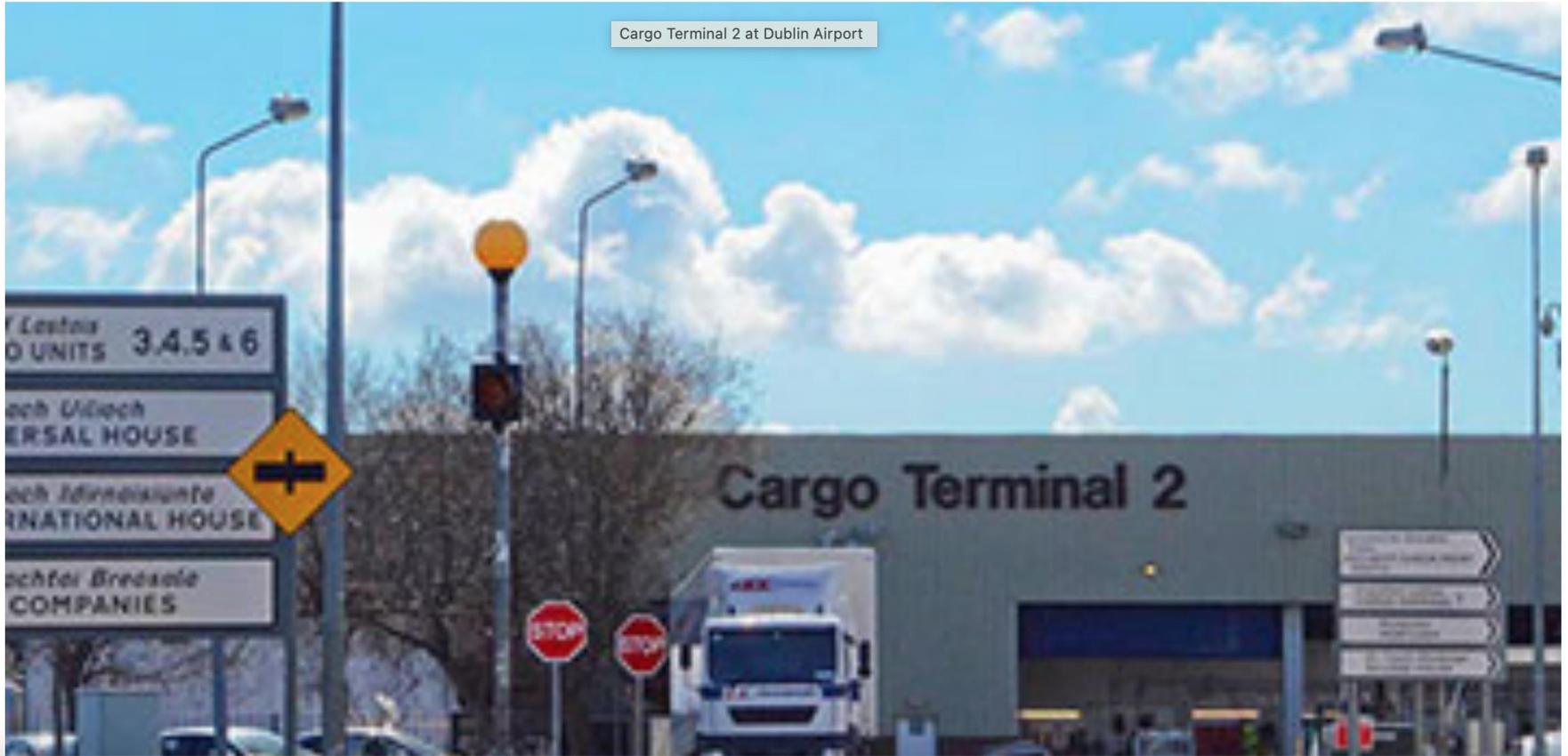
Thomas Münzel
University Medical Center Mainz, Germany



New Report Highlights Cargo's Importance To Ireland's Economic Recovery

February 23, 2021

[← Back to all news](#)

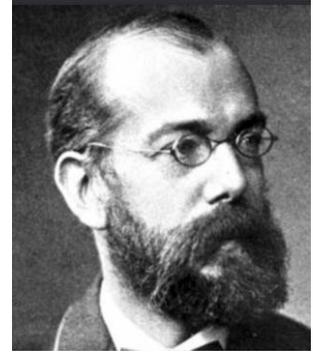


- Removal of night-time flying restrictions ?
- This planning application comes under the regulation EU598/2014, which uses the Balanced Approach to amend/insert operating restrictions and will result in night-time flights between 23:00-24:00 and 06:00-07:00 on the North Runway and unlimited night-time flights on the South Runway

Who is paying healthcare costs for the more oo cardiovascular ad cerebral diseases?

One day man will have to
fight the noise as fiercely as
cholera and plague”

1910



Robert Koch

**Founder of the
Modern
Bacteriology**

**Nobel Prize
1905**

How Environmental Noise Harms the Cardiovascular System

Sound from cars, aircraft, trains, and other man-made machines is more than just annoying. It increases the risk of cardiovascular disease.

HURT BY NOISE

Sound from cars, aircraft, trains, and other man-made machines is more than just annoying. It increases the risk of cardiovascular disease.

BY THOMAS MÜNZEL AND OMAR HAHAD





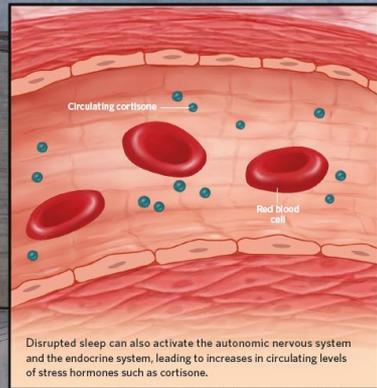
Nighttime noise can disrupt sleep and cause cognitive and emotional responses via activation of the amygdala.

NOISE DAMAGE PATHWAYS

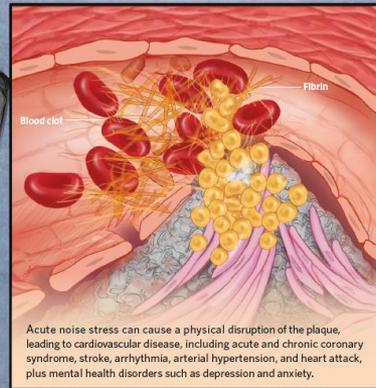
Epidemiological data have long linked exposure to noise such as aircraft, railway, or traffic sounds to increased risks of cardiovascular disease. And in recent years, experimental work has been revealing the biological mechanisms underlying that link. Specifically, researchers are finding that noise activates the brain's limbic system, which plays a role in emotional regulation, the release of stress hormones into the blood, and controlling of the sympathetic nervous system. These stress responses can lead to cerebral and vascular inflammation, oxidative stress, and altered gene expression, sometimes culminating in endothelial dysfunction and cardiovascular disease.

© LAURIE OXLEY

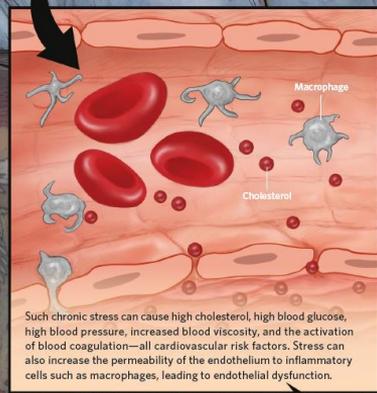
NOISE STRESS REACTIONS



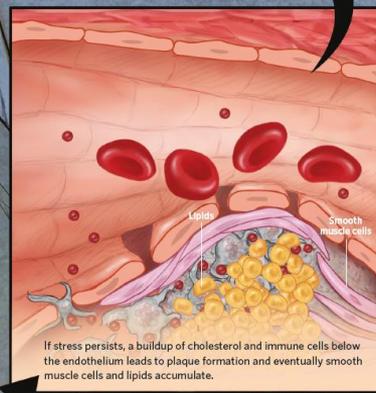
NOISE-TRIGGERED PLAQUE RUPTURE



ENDOTHELIAL DYSFUNCTION

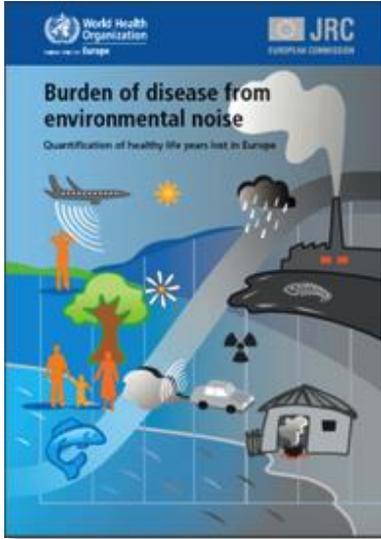


PLAQUE BUILDUP





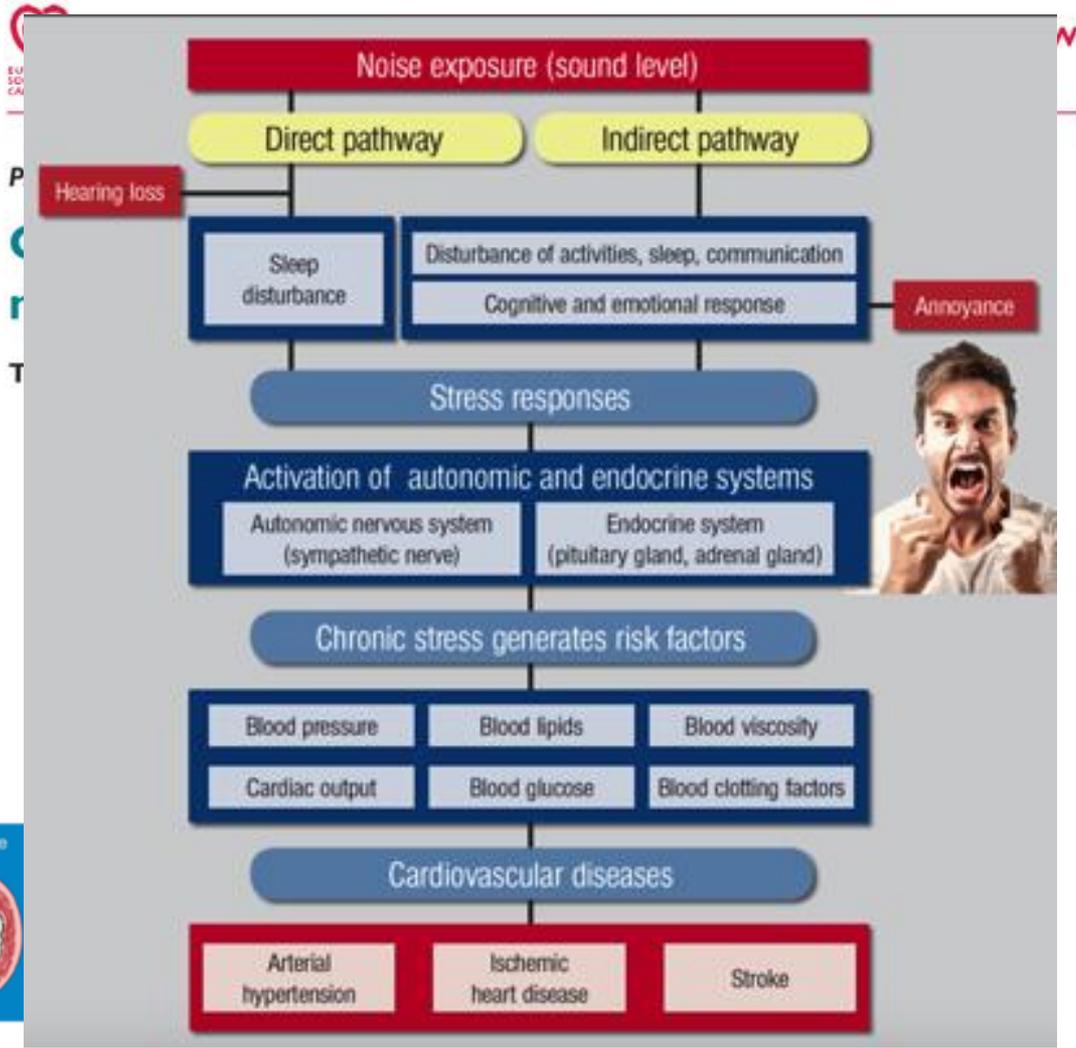
WHO/EEA and Noise



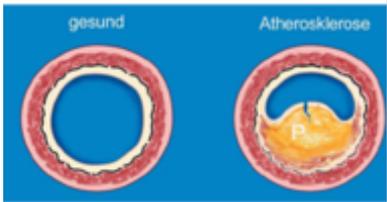
- **WHO:**
- **At least 1.6 Mio healthy life years are lost every year from traffic related noise in the western part of Europe**
- each day nearly **113 million Europeans** in towns and cities are **exposed to noise levels in excess of 55 decibels** just from traffic.



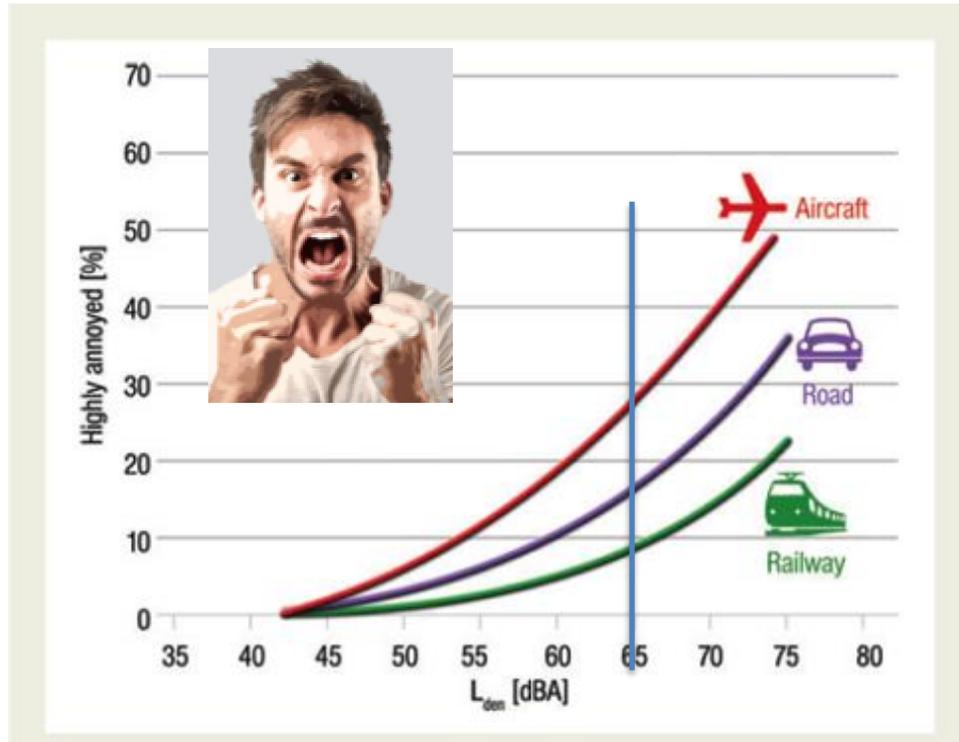
- **European Environment Agency (EEA):**
- 900,000 cases of hypertension
- 43,000 hospital admissions
- >10,000 premature deaths per year related to coronary heart disease and stroke
- **6.5 Mio** people suffer from **high sleep disturbance**
- **22 Mio** people suffer from **chronic high annoyance**



?



Aircraft Noise Most Annoying



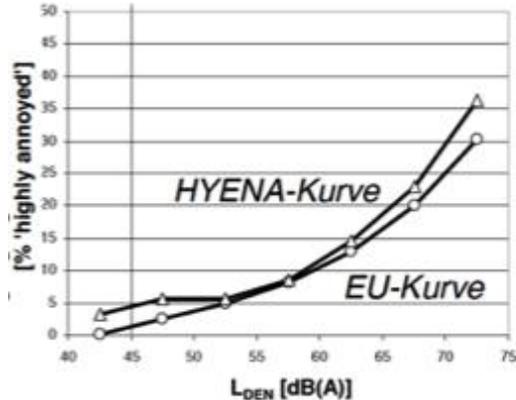
Münzel, Daiber, Basner, Babisch Eur H J 2014

Increase in annoyance in response to aircraft noise within the last ten years

Road Traffic Noise



—○— EU —△— Pooled



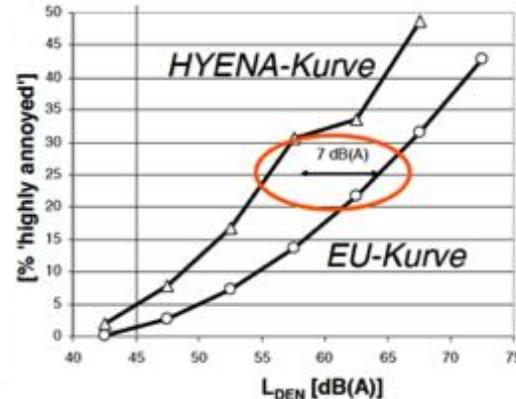
HYENA Study 6 European Airports

% 'highly annoyed'

Aircraft Noise

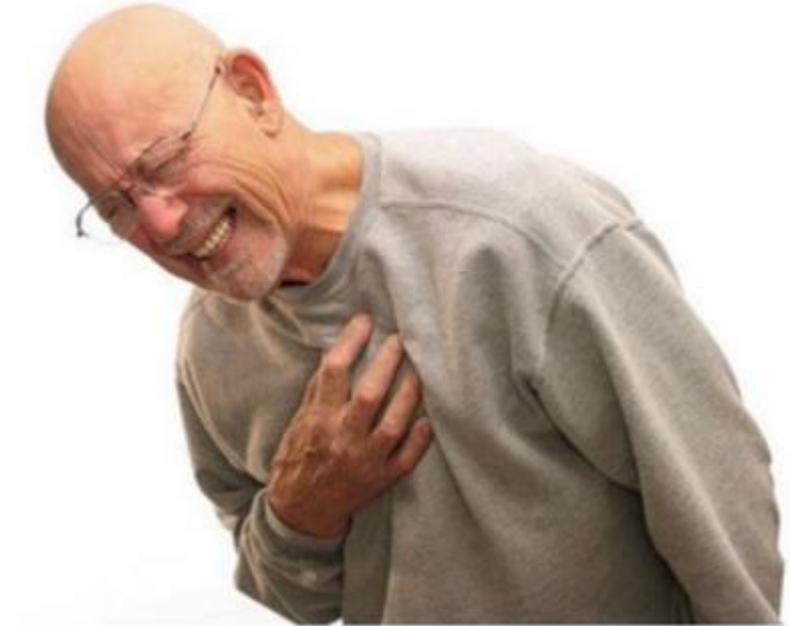


—○— EU —△— Pooled



(Aircraft) Noise and cardiovascular disease

- Hypertension
- Coronary artery disease
- Heart failure
- Stroke
- Arrhythmia

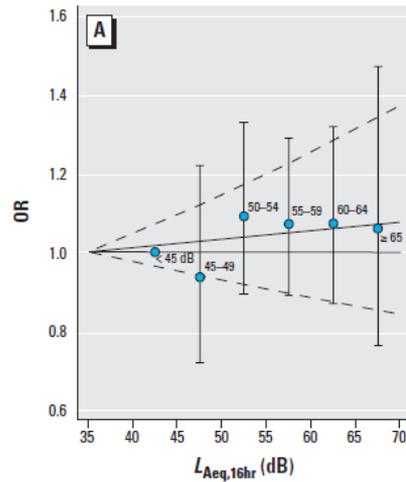


Hypertension and Exposure to Noise Near Airports: the HYENA Study

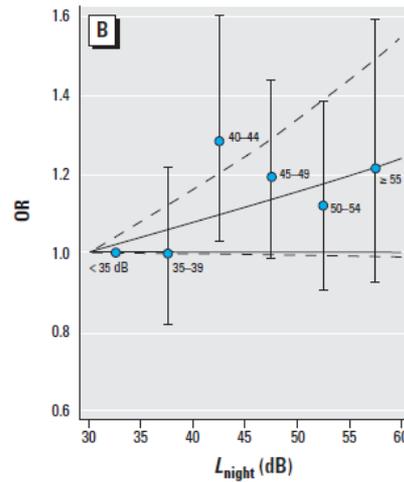
Lars Jarup,¹ Wolfgang Babisch,² Danny Houthuijs,³ Göran Pershagen,⁴ Klea Katsouyanni,⁵ Ennio Cadum,⁶ Marie-Louise Dudley,¹ Pauline Savigny,¹ Ingeburg Seiffert,² Wim Swart,³ Oscar Breugelmans,³ Gösta Bluhm,⁴ Jenny Selander,⁴ Alexandros Haralabidis,⁵ Konstantina Dimakopoulou,⁵ Panayota Sourtzi,⁷ Manolis Velonakis,⁷ and Federica Vigna-Taglianti,⁶ on behalf of the HYENA study team



Daytime Noise



Nighttime Noise



Jarup et al. 2008

Our results indicate excess risks of hypertension related to long-term noise exposure, primarily for night-time aircraft noise



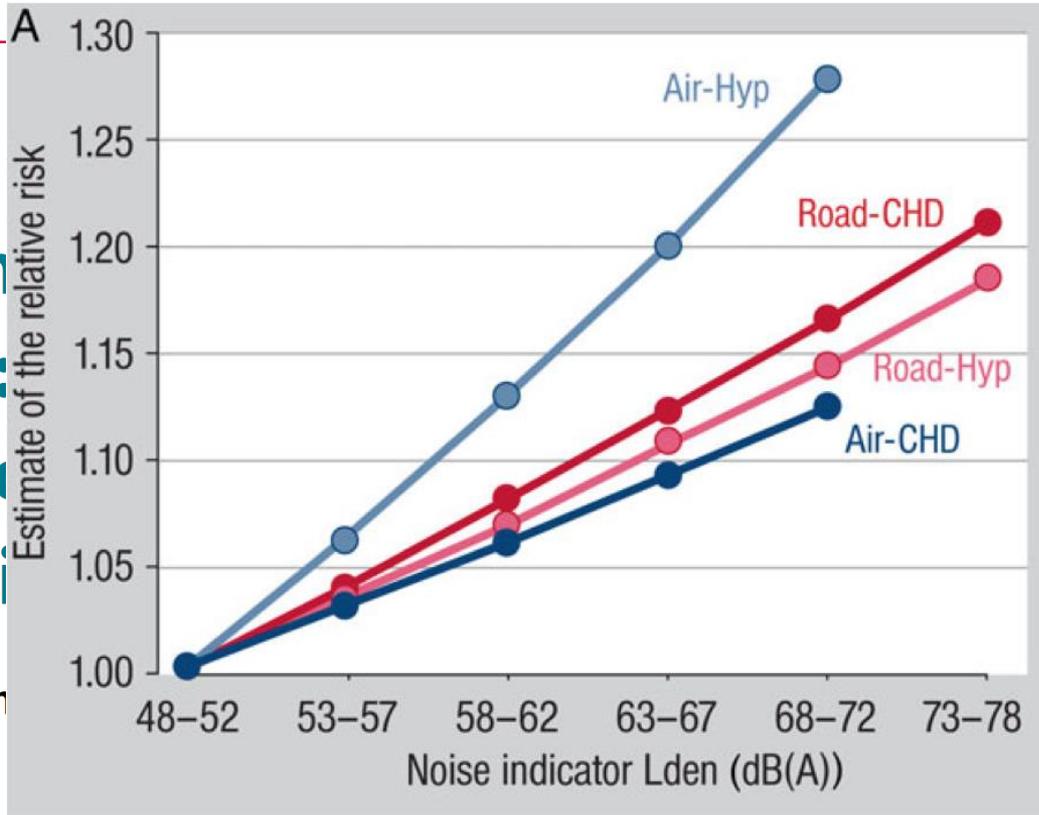
European Heart Journal
doi:10.1093/eurheartj/ehw269

REVIEW

Prevention

Environmental
diseases:
a role for
mitigation

Thomas Münzel



Endo-metabolic
diseases
supporting
effects of

P. Schmidt¹,

Aircraft Noise and Coronary Artery Disease



ESC

European Society
of Cardiology

European Heart Journal (2019) 40, 598–603
doi:10.1093/eurheartj/ehy650

CLINICAL RESEARCH

Prevention and epidemiology

A systematic analysis of mutual effects of transportation noise and air pollution exposure on myocardial infarction mortality: a nationwide cohort study in Switzerland

Harris Héritier^{1,2†}, Danielle Vienneau^{1,2†}, Maria Foraster^{1,2,3}, Ikenna C. Eze^{1,2}, Emmanuel Schaffner^{1,2}, Kees de Hoogh^{1,2}, Laurie Thiesse^{4,5}, Franziska Rudzik^{4,5}, Manuel Habermacher⁶, Micha Köpfl⁶, Reto Pieren⁷, Mark Brink⁸, Christian Cajochen^{4,5}, Jean Marc Wunderli⁷, Nicole Probst-Hensch^{1,2}, and

Conclusion

Our study suggests that transportation noise is associated with MI mortality, independent from air pollution. Air pollution studies not adequately adjusting for transportation noise exposure may overestimate the cardiovascular disease burden of air pollution.

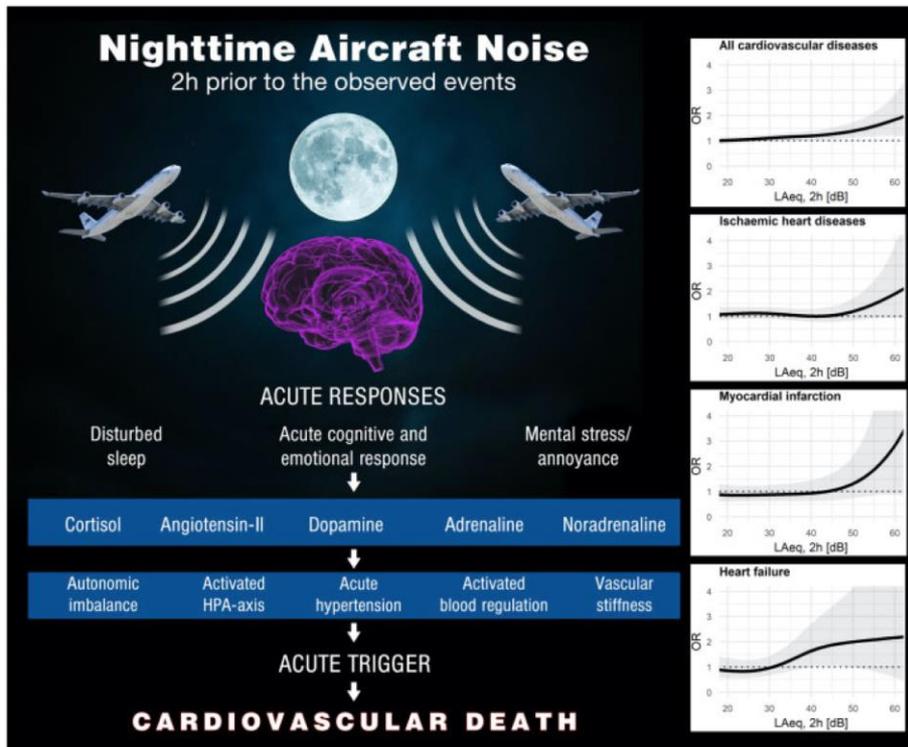
Does night-time aircraft noise trigger mortality? A case-crossover study on 24 886 cardiovascular deaths

Apolline Saucy ^{1,2}, Beat Schäffer ³, Louise Tangermann ^{1,2},
Danielle Vienneau ^{1,2}, Jean-Marc Wunderli ³, and Martin Röösli ^{1,2*}

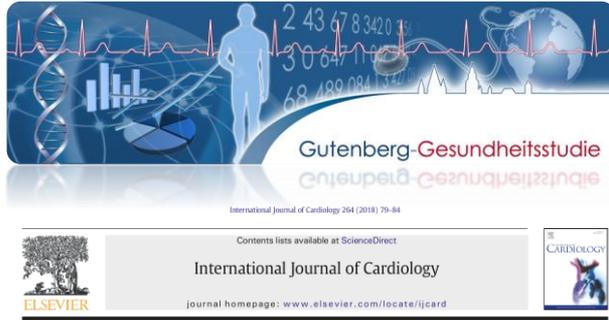
¹Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Socinstrasse 57, Basel 4002, Switzerland; ²Faculty of Science, University of Basel, Petersplatz 1, Basel 4003, Switzerland; and ³Empa, Swiss Federal Laboratories for Materials Science and Technology, Überlandstrasse 129, Dübendorf 8600, Switzerland

Received 29 July 2020; revised 6 October 2020; editorial decision 4 November 2020; accepted 11 November 2020

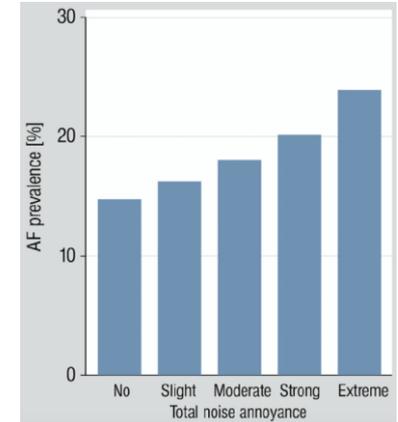
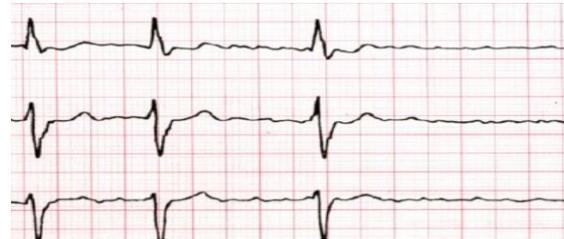
- For night-time deaths, exposure levels 2 h preceding death were significantly associated with mortality for all causes of CVD [OR = 1.44 (1.03–2.04)]
- for the highest exposure group (LAeq > 50 dB vs. <20 dB)]



Annoyance and Arrhythmia and Cerebral Disease



Gutenberg Health Study
Prospective Cohort Trial Mainz
15.000 Participants



Annoyance to different noise sources is associated with atrial fibrillation in the Gutenberg Health Study

Omar Hahad^a, Manfred Beutel^b, Tommaso Gori^a, Andreas Schulz^c, Maria Blettner^d, Norbert Pfeiffer^e, Thomas Rostock^b, Karl Lackner^f, Mette Sorensen^e, Jürgen H. Prochaska^a, Philipp S. Wild^g, Thomas Münzel^{h,*}

RESEARCH ARTICLE

Noise Annoyance Is Associated with Depression and Anxiety in the General Population- The Contribution of Aircraft Noise

Manfred E. Beutel^{1*}, Claus Jünger², Eva M. Klein¹, Philipp Wild^{3,4,5}, Karl Lackner⁶, Maria Blettner⁷, Harald Binder⁷, Matthias Michal¹, Jörg Wiltink¹, Elmar Brähler¹, Thomas Münzel²



Depression	adj. PR [95% CI]	P-value
Slight annoyance	0.98 [0.81, 1.18]	0.83
Moderate annoyance	1.20 [1.00, 1.45]	0.047
Strong annoyance	1.59 [1.32, 1.91]	<0.0001
Extreme annoyance	1.97 [1.62, 2.39]	<0.0001

Generalized anxiety	Prevalence Ratio	P-value
Slight annoyance	1.18 [0.95, 1.46]	0.13
Moderate annoyance	1.42 [1.15, 1.74]	0.0010
Strong annoyance	1.75 [1.41, 2.16]	<0.0001
Extreme annoyance	2.14 [1.71, 2.67]	<0.0001



European Society
of Cardiology

European Heart Journal (2019) 0, 1–11

doi:10.1093/eurheartj/ehz820

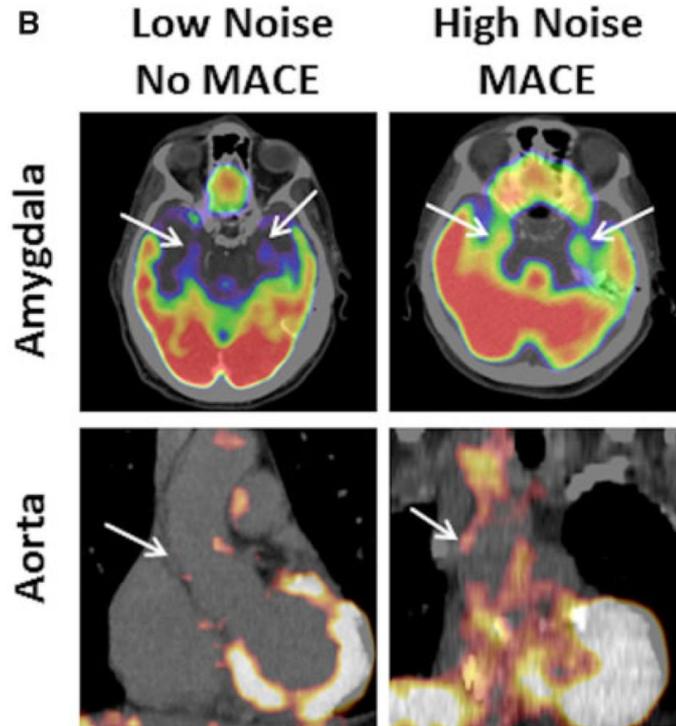
CLINICAL RESEARCH

Imaging

A neurobiological mechanism linking transportation noise to cardiovascular disease in humans

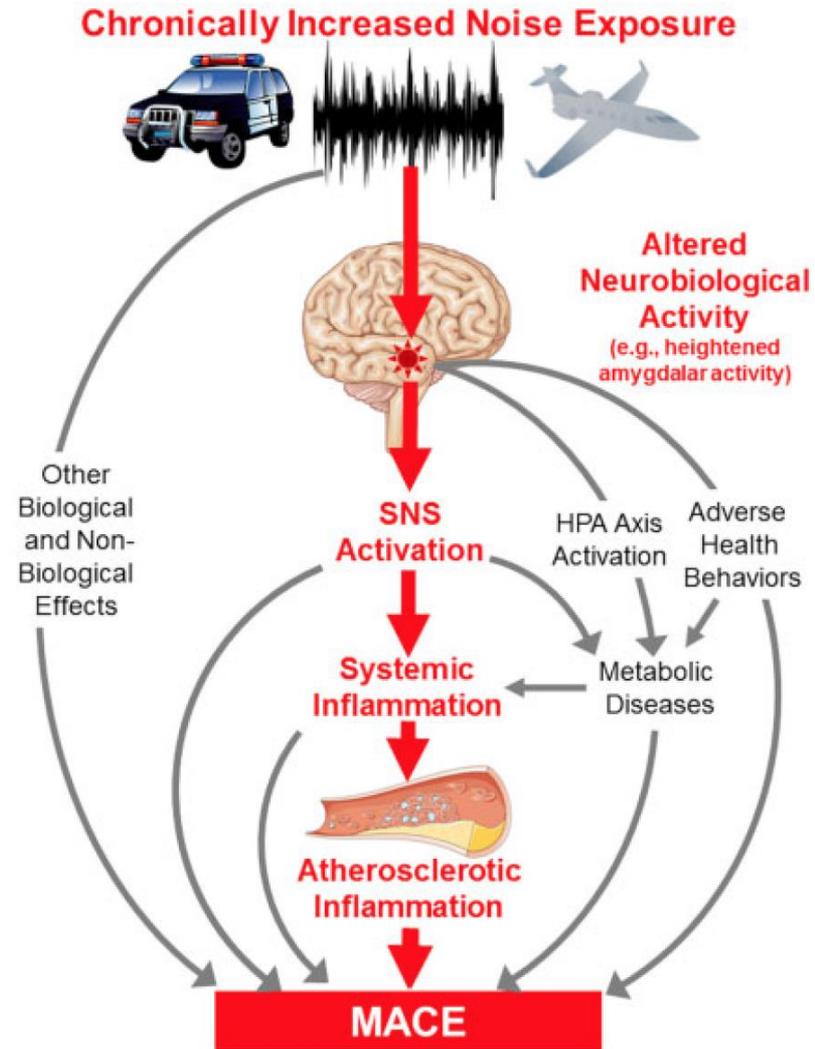
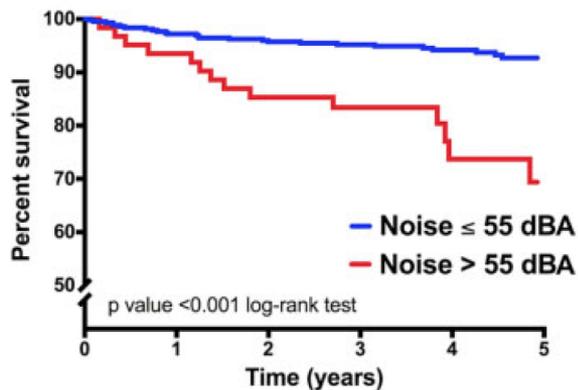
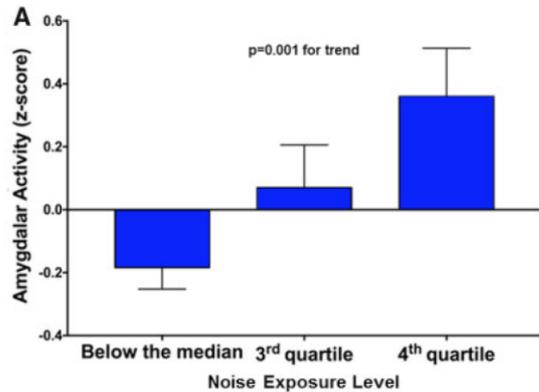
Michael T. Osborne ^{1,2†}, **Azar Radfar** ^{1,2†}, **Malek Z.O. Hassan** ¹,
Shady Abohashem ^{1,2}, **Blake Oberfeld** ¹, **Tomas Patrich** ¹, **Brian Tung**¹,
Ying Wang ^{1,3}, **Amorina Ishai**¹, **James A. Scott** ⁴, **Lisa M. Shin**^{5,6},
Zahi A. Fayad ⁷, **Karestan C. Koenen** ⁸, **Sanjay Rajagopalan** ⁹,
Roger K. Pitman ⁶, and **Ahmed Tawakol**^{1,2*}

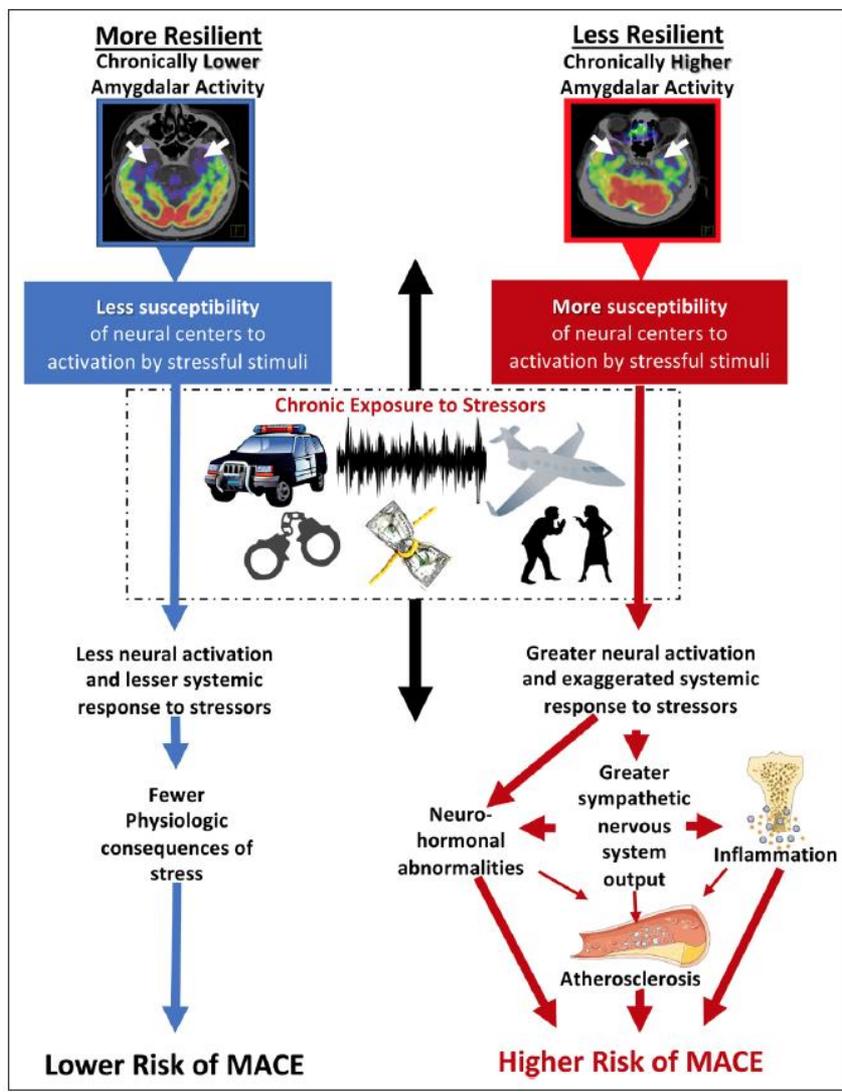
Amygdalar activity correlates with vascular inflammation



- **amygdala modulates the fear, anxiety response in humans**
- 500 subjects
- No CVD or cancer
- 18 Fluorodeoxyglucose PET/CT
- **Increased noise exposure was associated with higher amygdalar activity** and, vascular inflammation and MACE (within 5y)

Noise-Amygdala





Resilience protects:

MACE:

- CVD Death
- Myocardial Infarction
- Heart Failure
- Coronary and peripheral Revascularization



Mechanisms of noise-induced vascular damage?



2013/2015



European Heart Journal (2013) 34, 3508–3514
doi:10.1093/eurheartj/eh269

CLINICAL RESEARCH

Effect of nighttime aircraft noise exposure on endothelial function and stress hormone release in healthy adults

Frank P. Schmidt¹, Mathias Basner², Gunnar Kröger¹, Stefanie Weck¹, Boris Schnorbus¹, Axel Muttray³, Murat Sariyar⁴, Harald Binder⁴, Tommaso Gori¹, Ascan Warnholtz¹, and Thomas Münzel^{1*}

Clin Res Cardiol
DOI 10.1007/s00392-014-0751-x

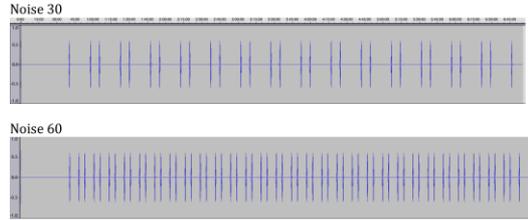
ORIGINAL PAPER

Nighttime aircraft noise impairs endothelial function and increases blood pressure in patients with or at high risk for coronary artery disease

Frank Schmidt · Kristoffer Kolle · Katharina Kreuder · Boris Schnorbus · Philip Wild · Marlene Hechtner · Harald Binder · Tommaso Gori · Thomas Münzel

Methods:

Simulated nighttime aircraft noise



MP3 Player
Aircraft Noise
Simulation

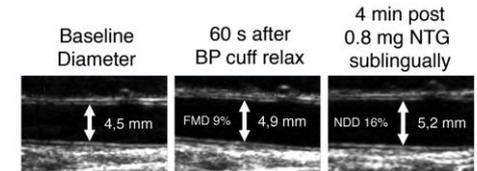


- Field study
- 60 dBA
- 30 or 60 Flights per night
- Mean sound pressure levels: 43 and 46 dBA

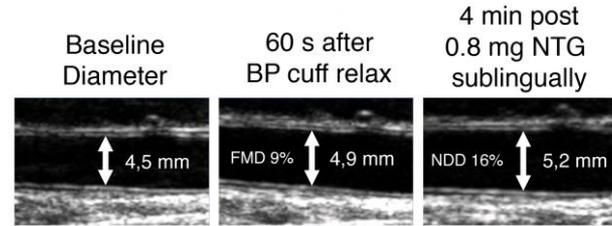
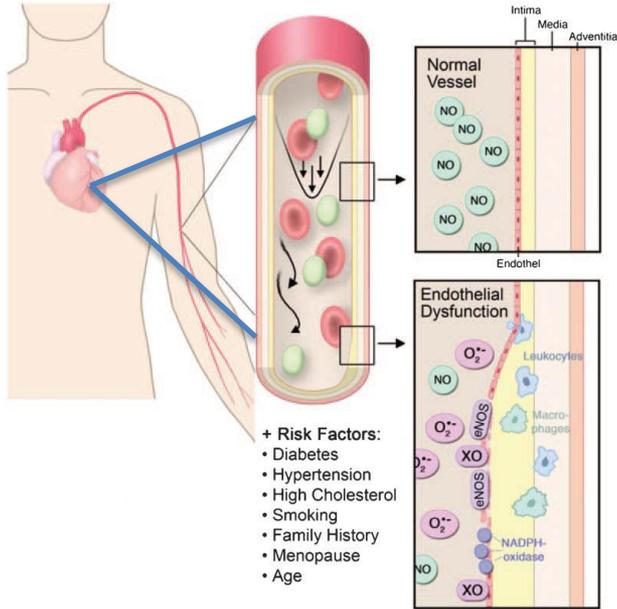
Polygraphic screening devices (SOMNOWATCH PLUS)



Measurement of endothelial function (flow mediated dilation)



NO, the endothelium regulates vascular tone



NTG sl

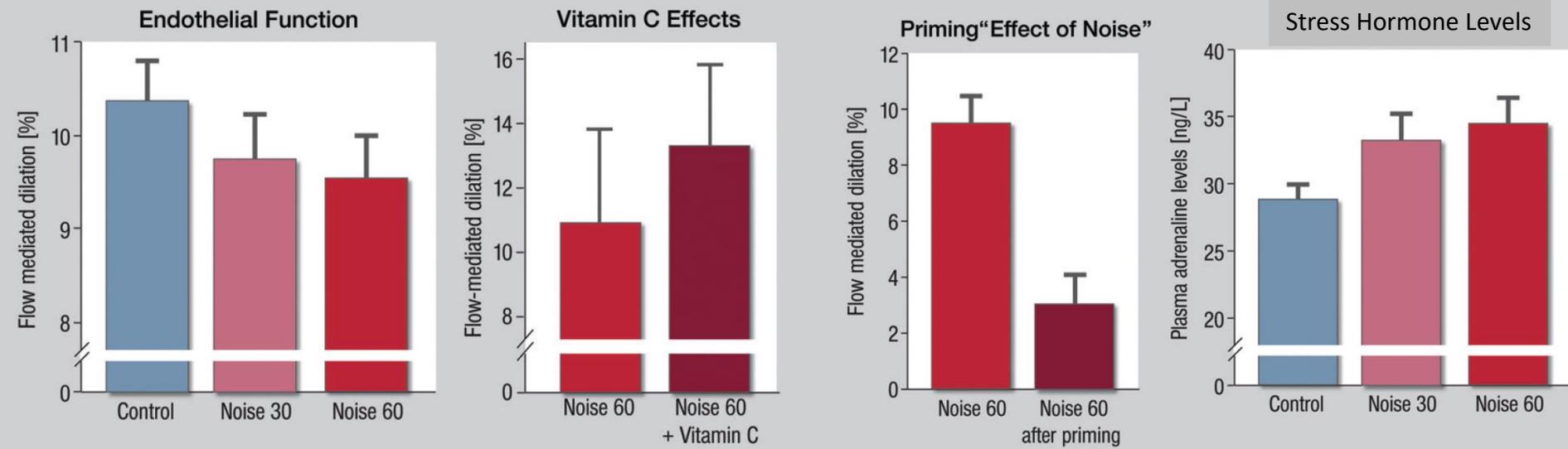


Results:

Effect of nighttime aircraft noise exposure on endothelial function and stress hormone release in healthy adults

Frank P. Schmidt¹, Mathias Basner², Gunnar Kröger¹, Stefanie Weck¹, Boris Schnorbus¹, Axel Muttray³, Murat Sariyar⁴, Harald Binder⁴, Tommaso Gori¹, Ascan Warnholtz¹, and Thomas Münzel^{1*}

Healthy subjects



Randomization plan (C-30-60, C-60-30, 30-C-60, 30-60-C, 60-C-30, 60-30-C).

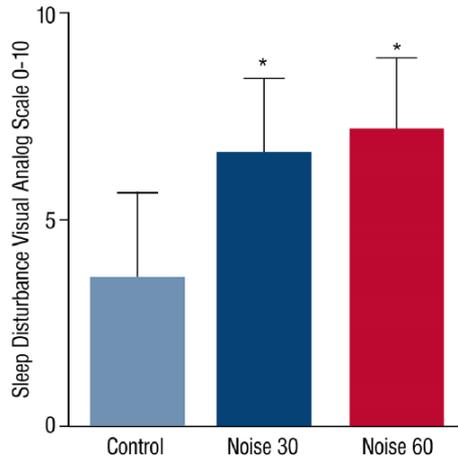


Acute exposure to nocturnal train noise induces endothelial dysfunction and pro-thromboinflammatory changes of the plasma proteome in healthy subjects

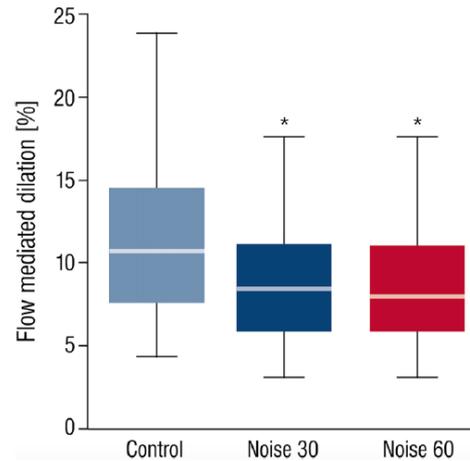
Johannes Herzog¹ · Frank P. Schmidt^{1,8} · Omar Hahad¹ · Seyed Hamidreza Mahmoudpour^{2,3} · Alina K. Mangold¹ · Pascal Garcia Andreo¹ · Jürgen Prochaska^{3,4,5} · Thomas Koeck^{4,5} · Philipp S. Wild^{3,4,5} · Mette Sørensen^{6,7} · Andreas Daiber^{1,5} · Thomas Münzel^{1,3,5}



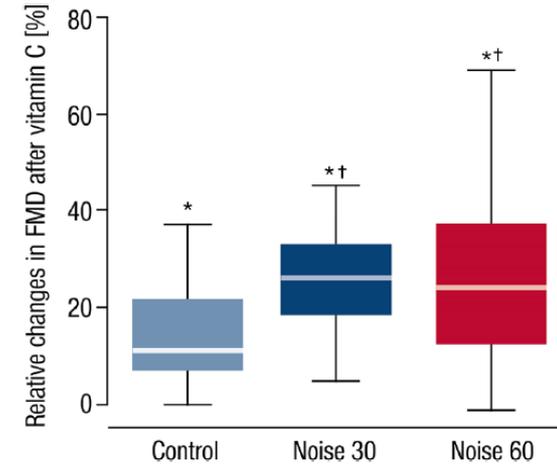
Sleep disturbance



Endothelial Dysfunction



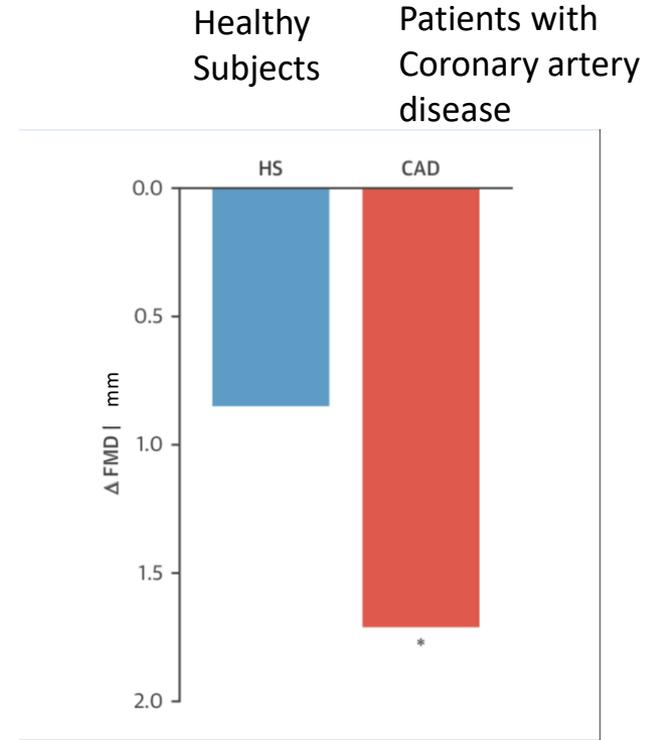
Vitamin C Effects



REVIEW TOPIC OF THE WEEK

Environmental Noise and the Cardiovascular System

Thomas Münzel, MD,^a Frank P. Schmidt, MD,^a Sebastian Steven, MD,^a Johannes Herzog, MD,^a Andreas Daiber, PhD,^a Mette Sørensen, PhD^b



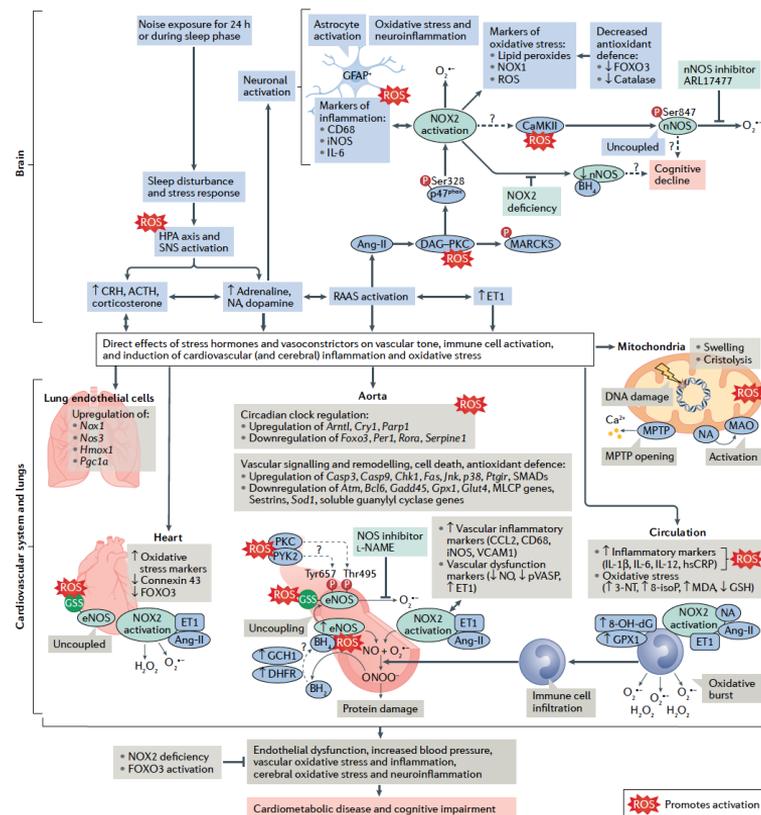
REVIEWS

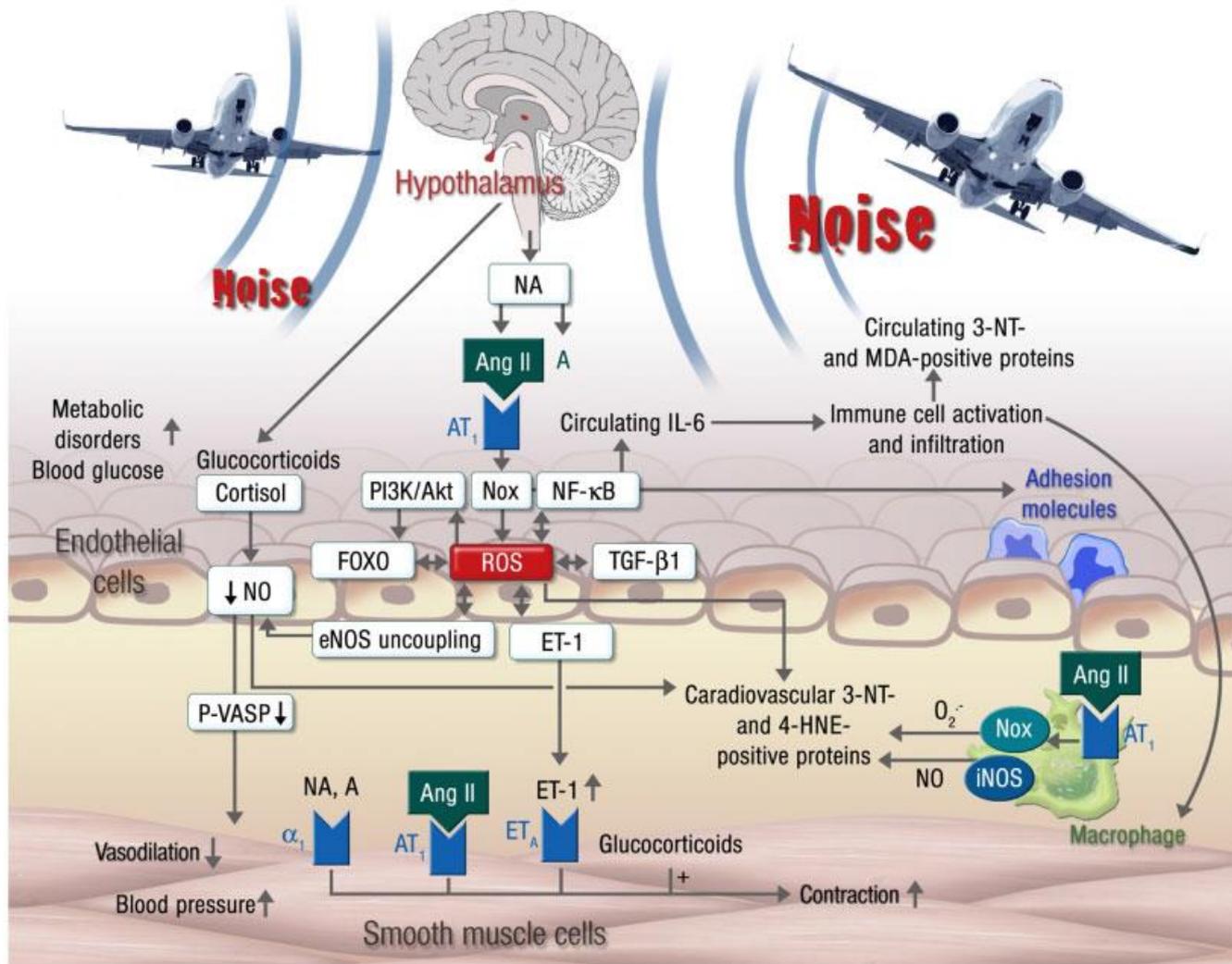
Check for updates

Transportation noise pollution and cardiovascular disease

Thomas Münzel^{1,2}, Mette Sørensen^{3,4} and Andreas Daiber^{1,2}

- Aircraft : Peak Decibel Level, 85 dBA, mean SPL 72dBA
- Noise for 1,2 and 4d
- For comparison: Identical mean sound pressure levels of white noise







European Heart Journal (2011) **32**, 1484–1492

doi:10.1093/eurheartj/ehr007

CLINICAL RESEARCH

Prevention/epidemiology

Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies

**Francesco P. Cappuccio^{1*†}, Daniel Cooper¹, Lanfranco D'Elia², Pasquale Strazzullo²,
and Michelle A. Miller^{1†}**

¹Warwick Medical School, University of Warwick, CSB Building, UHCW Campus, Clifford Bridge Road, Coventry CV2 2DX, UK; and ²Department of Clinical and Experimental Medicine, Federico II Medical School, University of Naples, Naples, Italy

Received 7 August 2010; revised 13 December 2010; accepted 13 January 2011; online publish-ahead-of-print 7 February 2011

Nighttime noise: more risk for hypertension ?

Environment

ORIGINAL ARTICLE

Is aircraft noise exposure associated with cardiovascular disease and hypertension? Results from a cohort study in Athens, Greece

Konstantina Dimakopoulou,¹ Konstantinos Koutentakis,¹ Ifigeneia Papageorgiou,¹ Maria-Iosifina Kasdagli,¹ Alexandros S Haralabidis,¹ Panayota Sourtzi,² Evangelia Samoli,¹ Danny Houthuijs,³ Wim Swart,³ Anna L Hansell,^{4,5} Klea Katsouyanni^{1,6}

the night. Specifically, the OR for hypertension per 10 dB increase in L_{night} aircraft noise exposure was 2.63 (95% CI 1.21 to 5.71). Doctor-diagnosed cardiac arrhythmia was significantly associated with L_{night} aircraft noise exposure, when prevalent and incident cases were considered with an OR of 2.09 (95% CI 1.1 to 4.08). Stroke risk was also increased with increasing,

Environment

ORIGINAL ARTICLE

Does aircraft noise exposure increase the risk of hypertension in the population living near airports in France?

Anne-Sophie Evrard,¹ Marie Lefèvre,¹ Patricia Champelovier,² Jacques Lambert,^{2,3} Bernard Laumon⁴

Results After adjustment for the main potential confounders, an exposure–response relationship was evidenced between the risk of hypertension and aircraft noise exposure at night for men only. A 10-dB(A) increase in L_{night} was associated with an OR of 1.34 (95% CI 1.00 to 1.97).

Day - versus nighttime noise



European Society
of Cardiology

European Heart Journal (2018) 00, 1–14
doi:10.1093/eurheartj/ehy333

BASIC SCIENCE

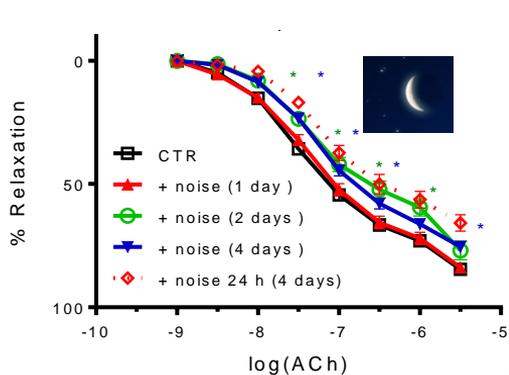
Crucial role for Nox2 and sleep deprivation in aircraft noise-induced vascular and cerebral oxidative stress, inflammation, and gene regulation

Swenja Kröller-Schön^{1†}, Andreas Daiber^{1,2†}, Sebastian Steven¹, Matthias Oelze¹,

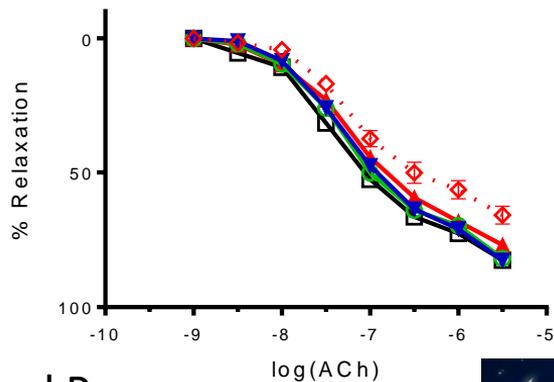
- Nighttime aircraft noise more damaging than daytime noise?
- Adverse cerebral effects?
- NOX2 knockout protective?

Sleep versus Awake Phase Noise

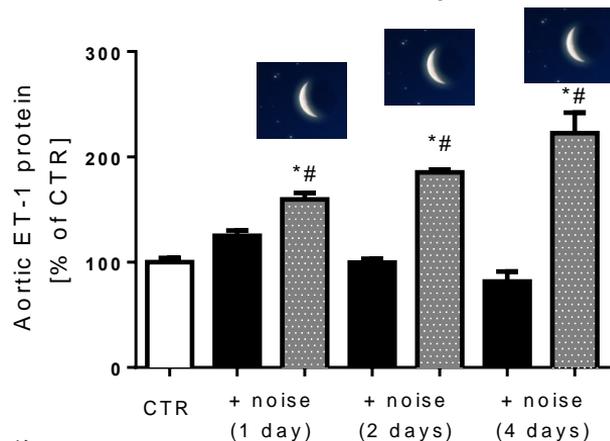
Sleep Phase



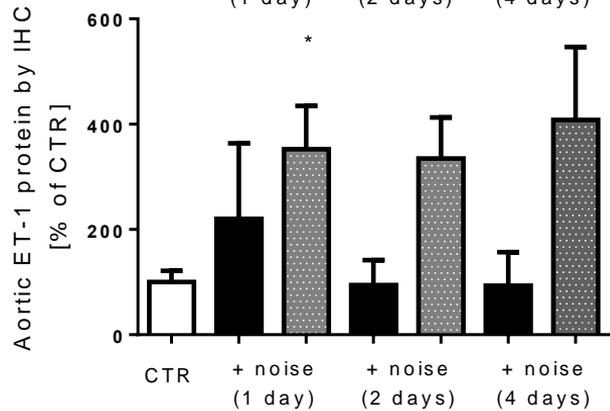
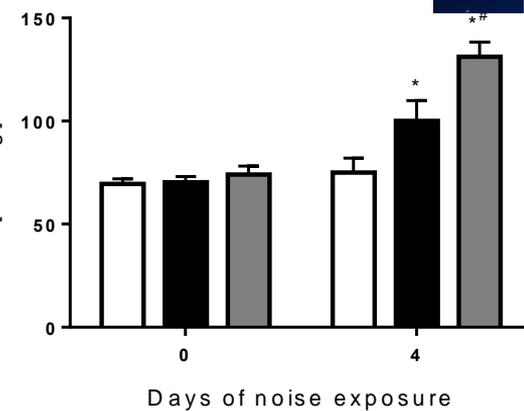
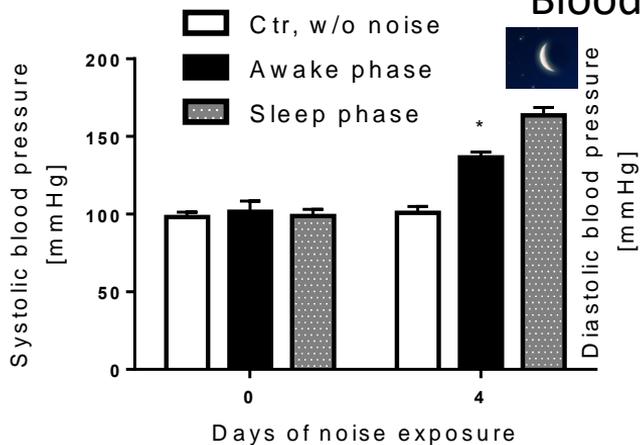
Awake Phase



Endothelin Expression



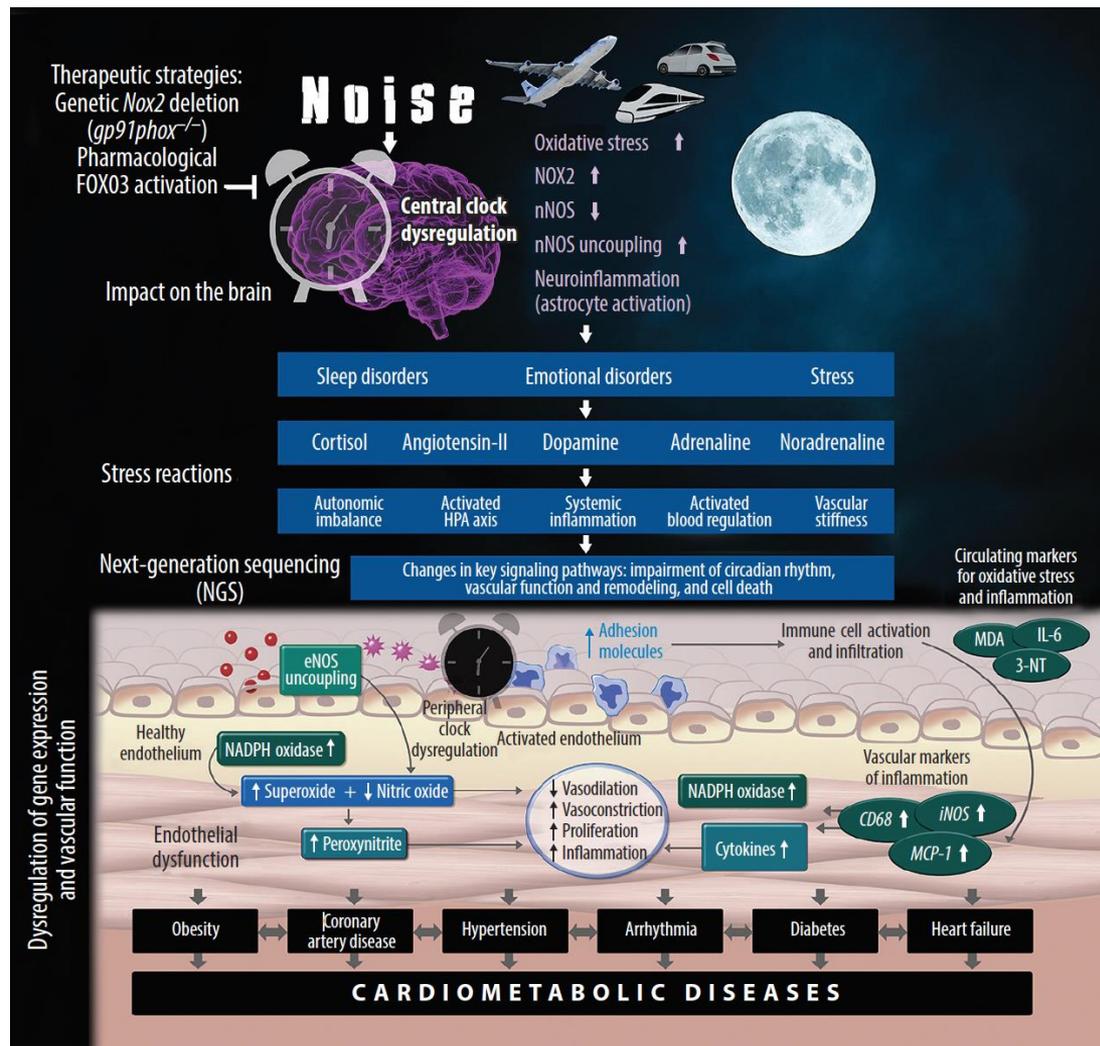
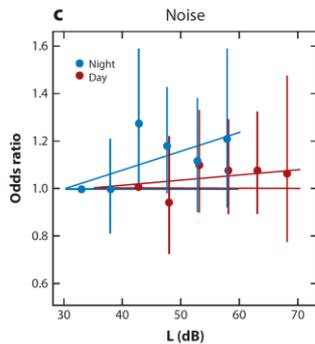
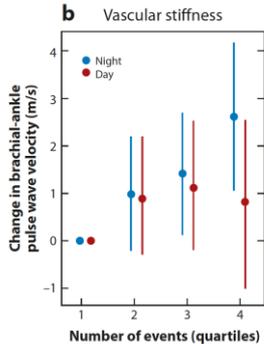
Blood Pressure



Adverse Cardiovascular Effects of Traffic Noise with a Focus on Nighttime Noise and the New WHO Noise Guidelines

Vascular Stiffness

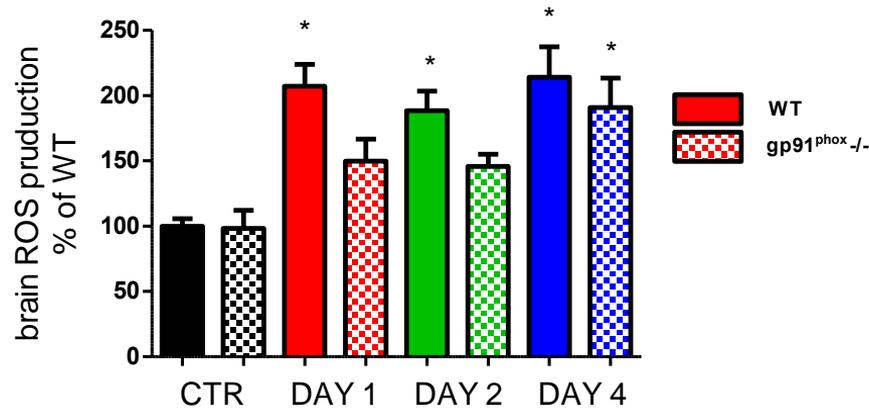
Blood pressure



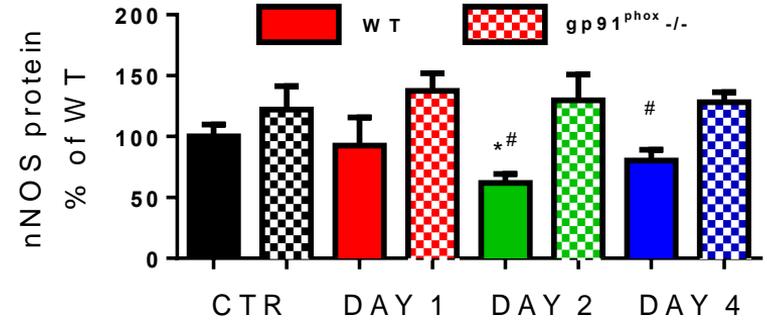
Adverse effects on brain



Aircraft noise increases cerebral oxidative stress



Aircraft noise downregulates of nNOS



Aircraft and road traffic noise and children's cognition and health: a cross-national study

*SA Stansfeld, B Berglund, C Clark, I Lopez-Barrio, P Fischer, E Öhrström, MM Haines, J Head, S Hygge, I van Kamp, BF Berry, on behalf of the RANCH study team**

Reading Capacity

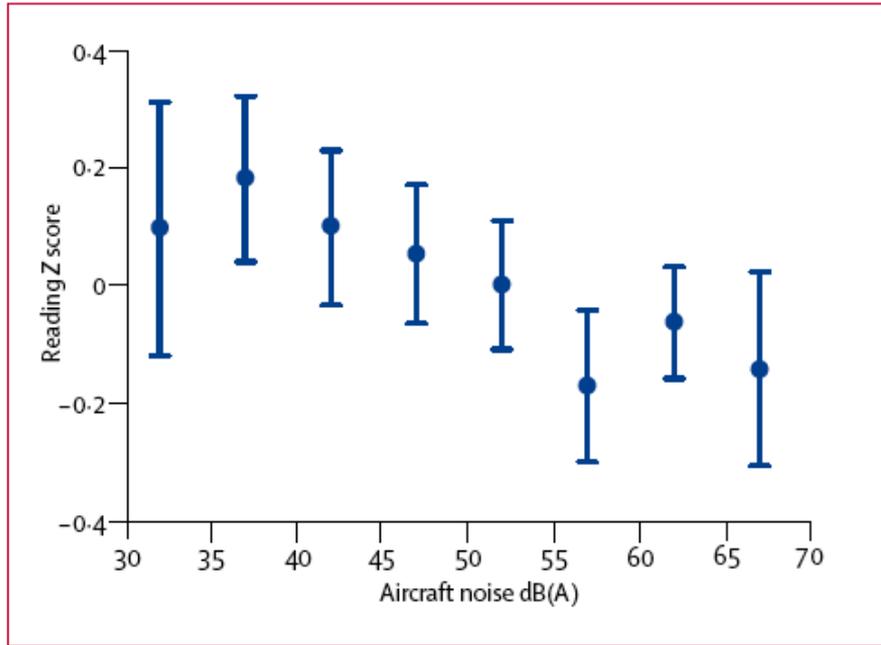
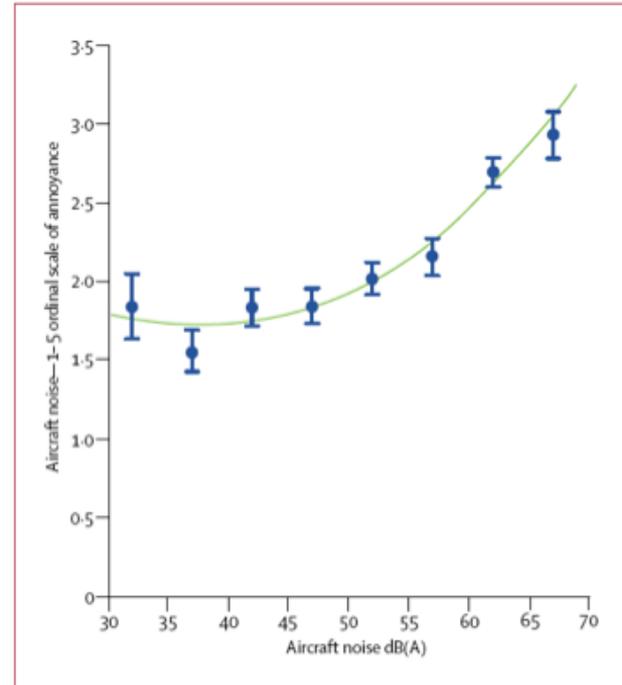


Figure 1: Adjusted mean reading Z score (95% CI) for 5 dB bands of aircraft noise (adjusted for age, sex, and country)

Noise Annoyance



Residential exposure to transportation noise in Denmark and incidence of dementia: national cohort study

Manuella Lech Cantuaria,^{1,2} Frans Boch Waldorff,^{3,4} Lene Wermuth,^{5,6} Ellen Raben Pedersen,¹ Aslak Harbo Poulsen,² Jesse Daniel Thacher,² Ole Raaschou-Nielsen,^{2,7} Matthias Ketzel,^{7,8} Jibrán Khan,^{7,9} Victor H Valencia,⁷ Jesper Hvass Schmidt,^{10,11,12,13} Mette Sørensen^{2,14}

CONCLUSIONS

This nationwide cohort study found transportation noise to be associated with a higher risk of all cause dementia and dementia subtypes, especially Alzheimer's disease.

Noise and Air Pollution have Many of the Same Sources.....



Science for Environment Policy

IN-DEPTH REPORT 13

**Links between noise and
air pollution and
socioeconomic status**

September 2016



Air and noise pollution have many of the same sources, such as heavy industry, aircraft, railways and road vehicles.

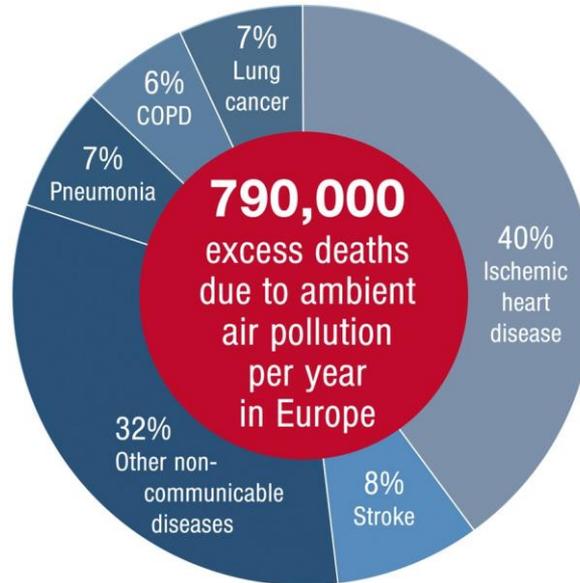
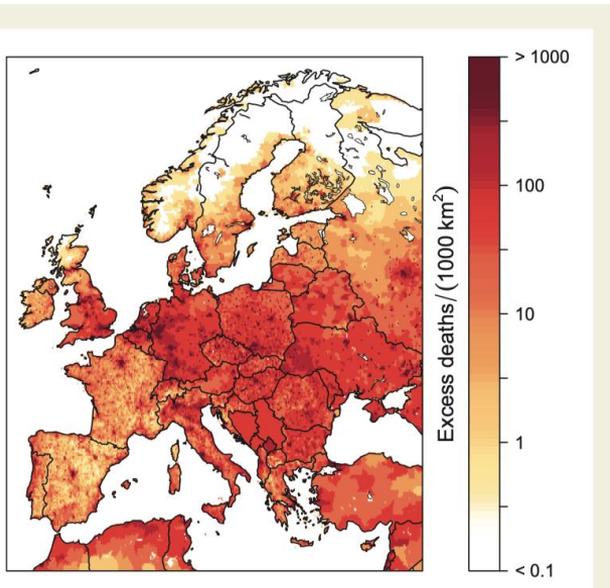
Research suggests that the social cost of noise and air pollution in the EU — including death and disease — could be nearly €1 trillion. For comparison, the social cost of alcohol in the EU has been estimated to be €50-120 billion and smoking at €544 billion.

Air pollution and noise pollution have negative health impacts on all socioeconomic groups, rich and poor. However, the risks may not be evenly shared; it is often society's poorest who live and work in the most polluted environments. Furthermore, these same people may be more impacted by pollution's damaging effects than more advantaged groups of society.

Cardiovascular disease burden from ambient air pollution in Europe reassessed using novel hazard ratio functions

Jos Lelieveld^{1,2*}, Klaus Klingmüller¹, Andrea Pozzer¹, Ulrich Pöschl¹, Mohammed Fnais³, Andreas Daiber^{4,5}, and Thomas Münzel^{4,5*}

Excess deaths ambient air pollution: Worldwide 8.9 Mio. ; 7.2 Mio due to smoking

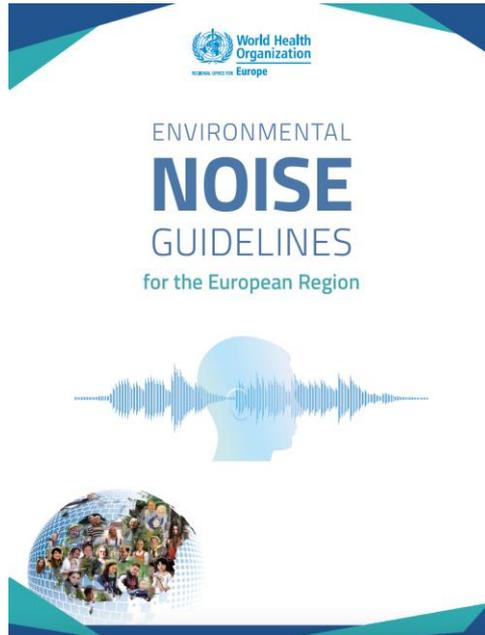


	All causes	
	Total CVD mortality ($\times 10^3$)	Deaths per 100,000
World	17,689	120
EU-28	1,837	129
Germany	330	154
Italy	221	136
Poland	180	150
United Kingdom	147	98
France	144	105

Active Aircraft Noise Abatement

- CDA Approach
- Flying higher, landing steeper
- GPS guide approach is a satellite-based approach procedure. Approaches can be directed around residential areas.
- Monitoring the use of reverse thrust

WHO Noise Guidelines



Aircraft noise

Recommendation

For average noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft below **45 dB L_{den}** , as aircraft noise above this level is associated with adverse health effects.

Strength

Strong

For night noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night time below **40 dB L_{night}** , as night-time aircraft noise above this level is associated with adverse effects on sleep.

Strong

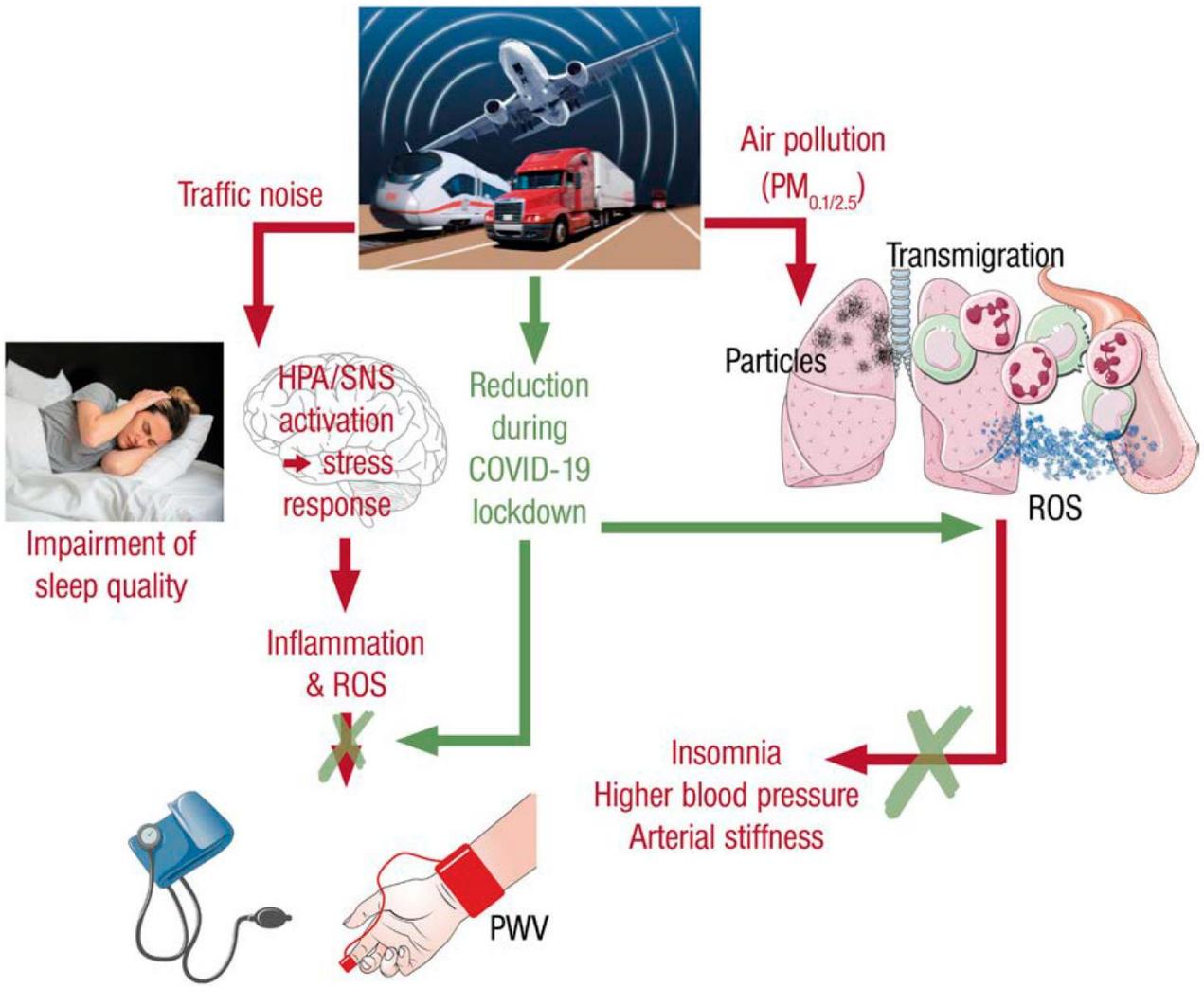
To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from aircraft in the population exposed to levels above the guideline values for average and night noise exposure. For specific interventions the GDG recommends implementing suitable changes in infrastructure.

Strong

EDITORIAL

Reduce
COVID-
Cardio
Reducti

Omar Hahad , And



ution

Conclusion:

- There must be a complete night flight ban