Adverse health consequences of noise

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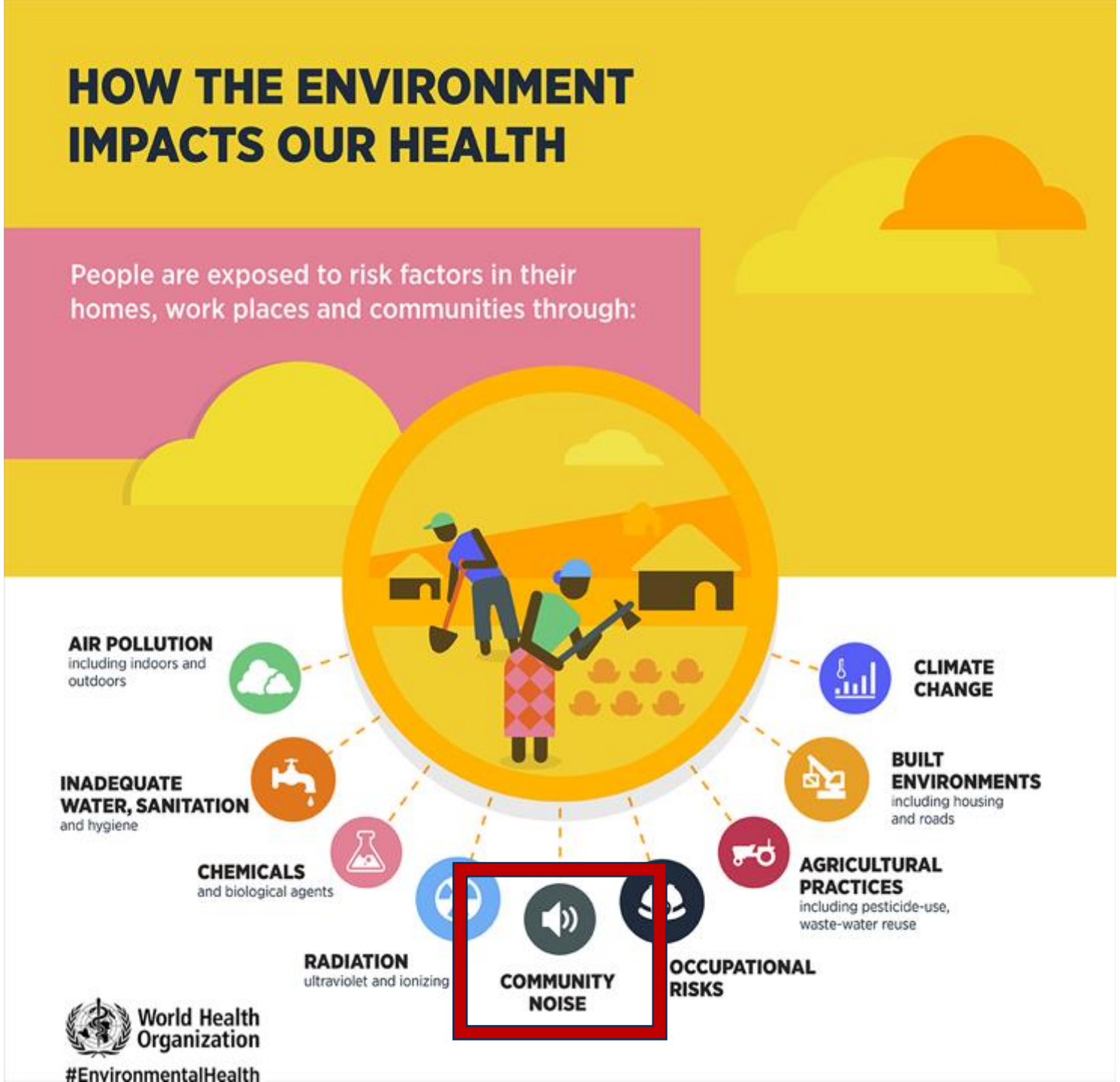
24th of June 2024

The environment is important

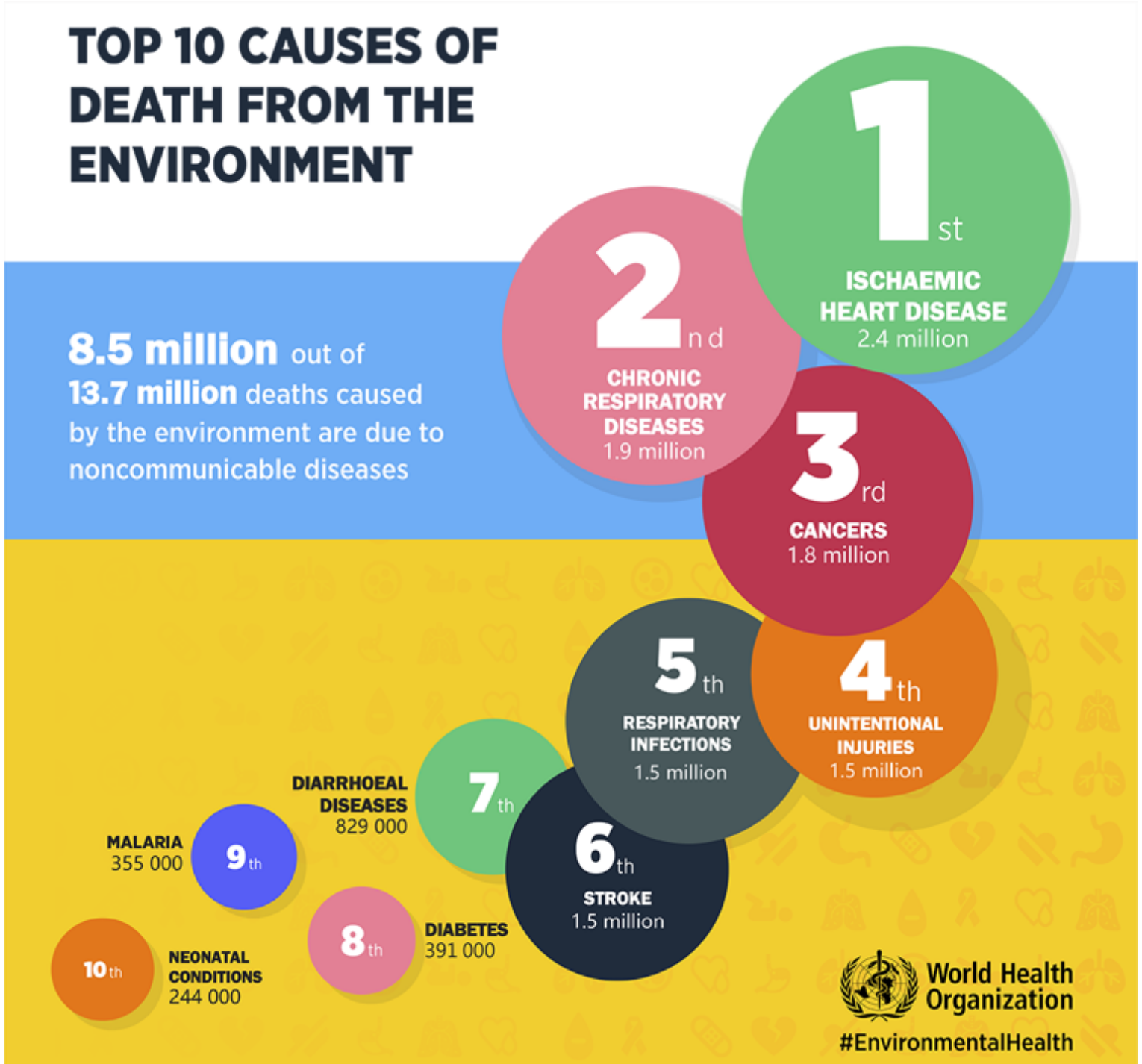
https://www.who.int/activities/environmental-health-impacts

Environmental risk factors



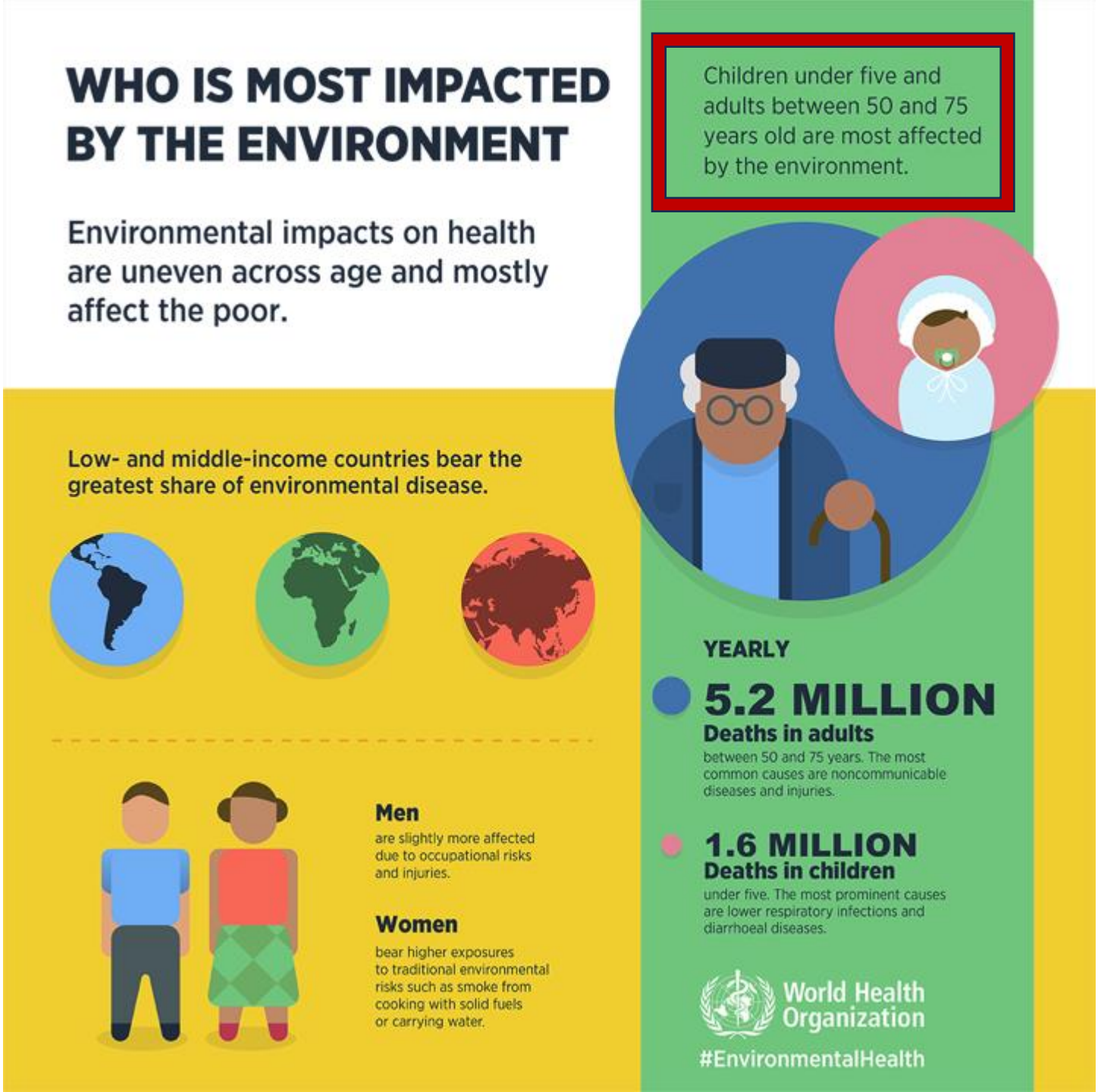
https://www.who.int/activities/environmental-health-impacts

Environmental causes of death



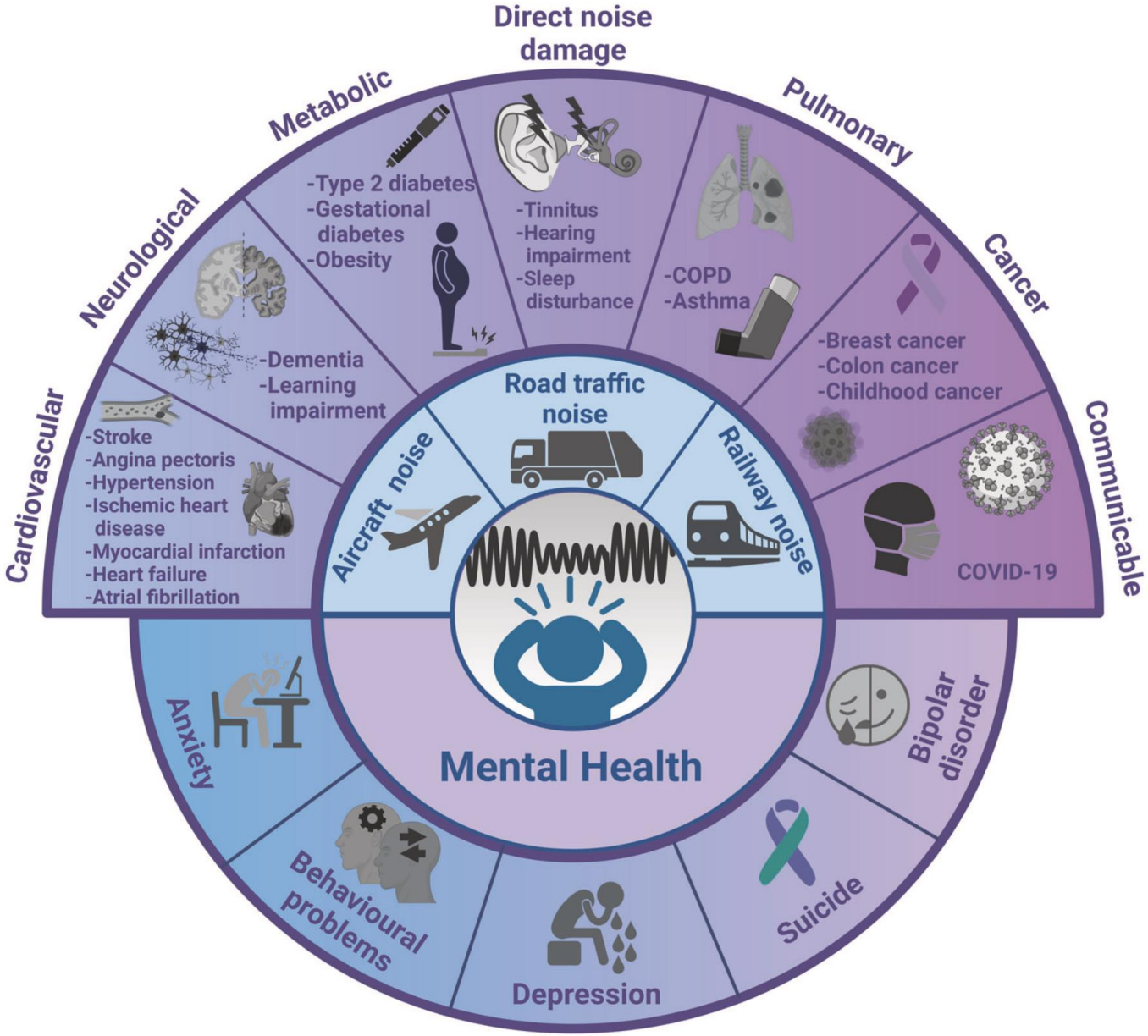
https://www.who.int/activities/environmental-health-impacts

Who is at risk?



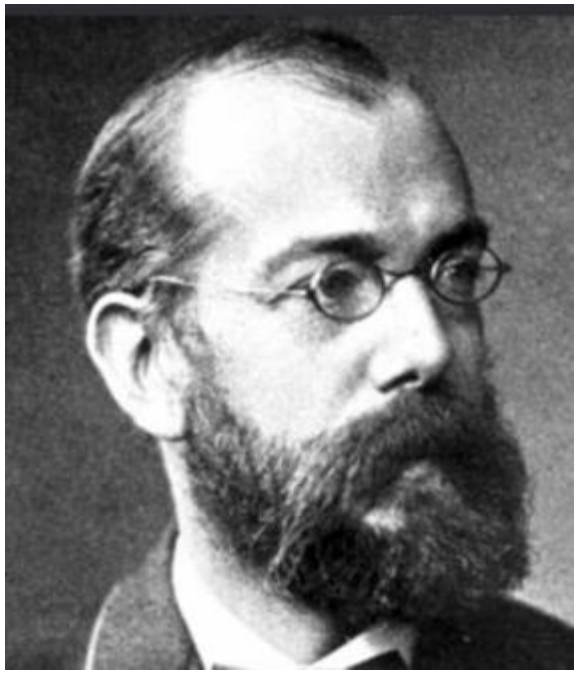
https:// www.who.int / activities /environmental- health -impacts

Is noise harmful to health?



Hahad O et al. Noise and mental health: evidence, mechanisms, and consequences. J Expo Sci Environ, 2024.

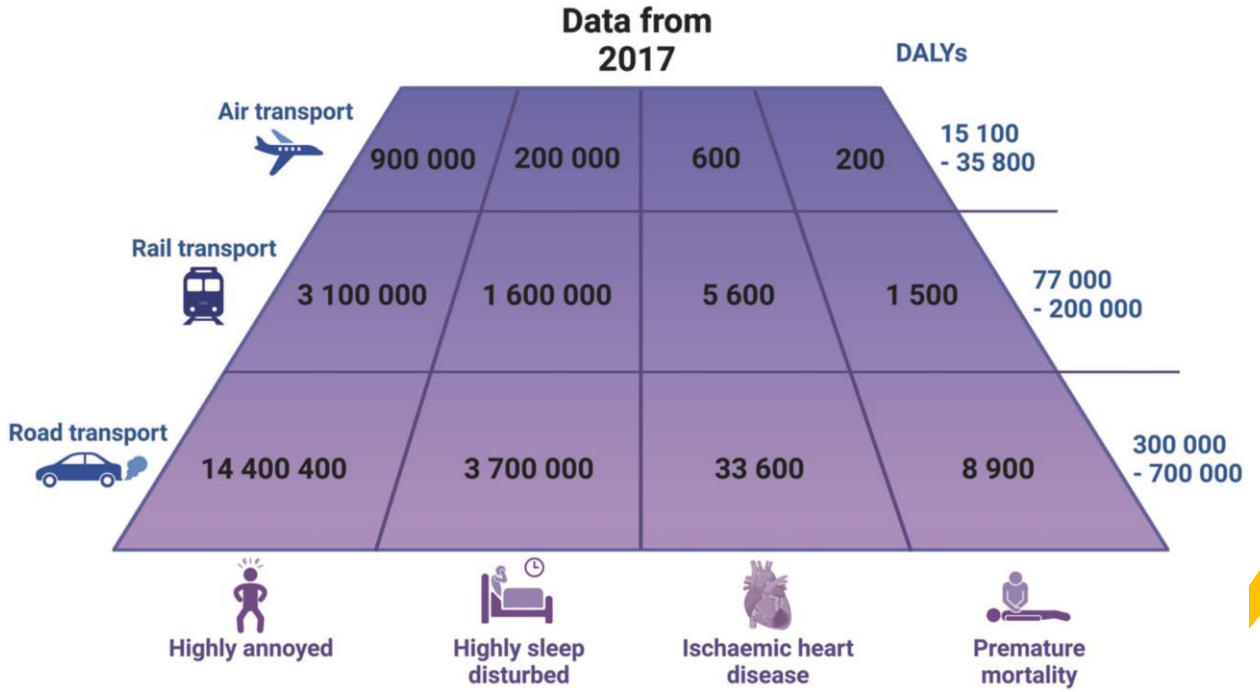
Noise and health



„One day man will have to fight noise as fiercely as cholera and pest.”

Nobel Prize winner Robert Koch (1910).

Environmental noise causes the loss of up to **1.6 million healthy life years** (healthy life years lost due to illness, disability and premature death) in Western European countries every year

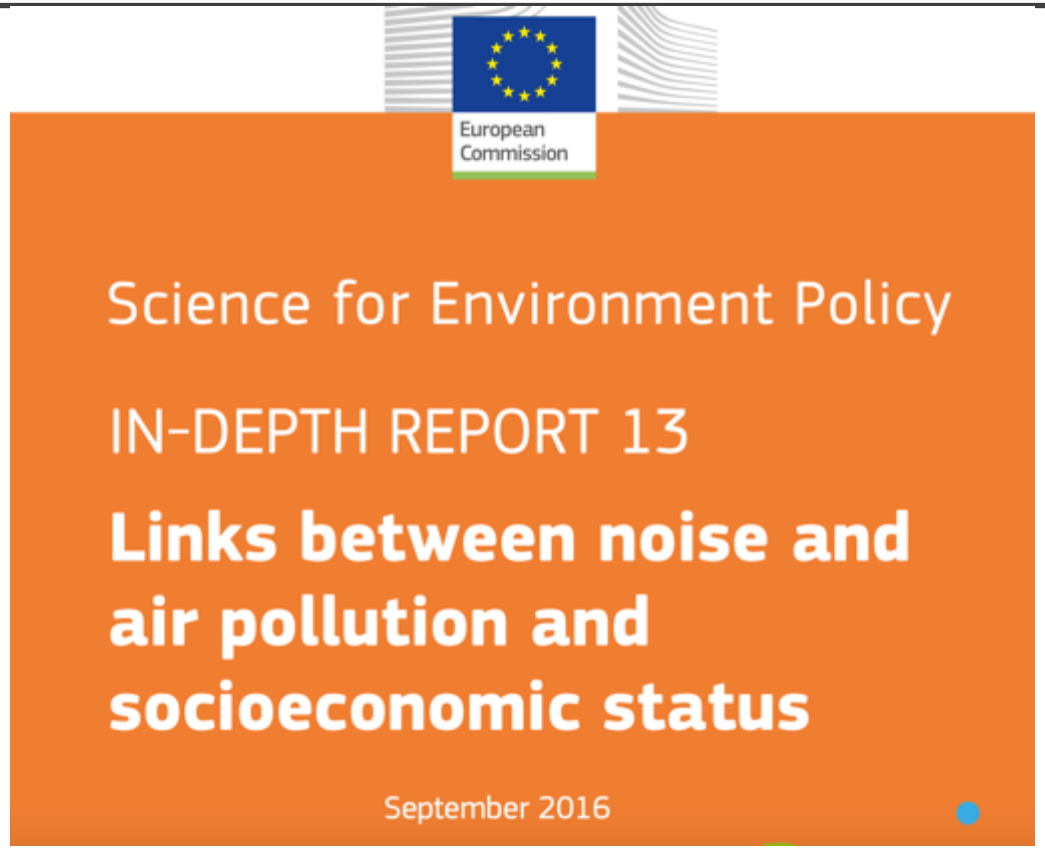


European Environment Agency

https://www.who.int/publications/i/item/9789289002295

https://www.eea.europa.eu/data-and-maps/figures/additional-information-on-health-impacts

Noise rarely comes alone

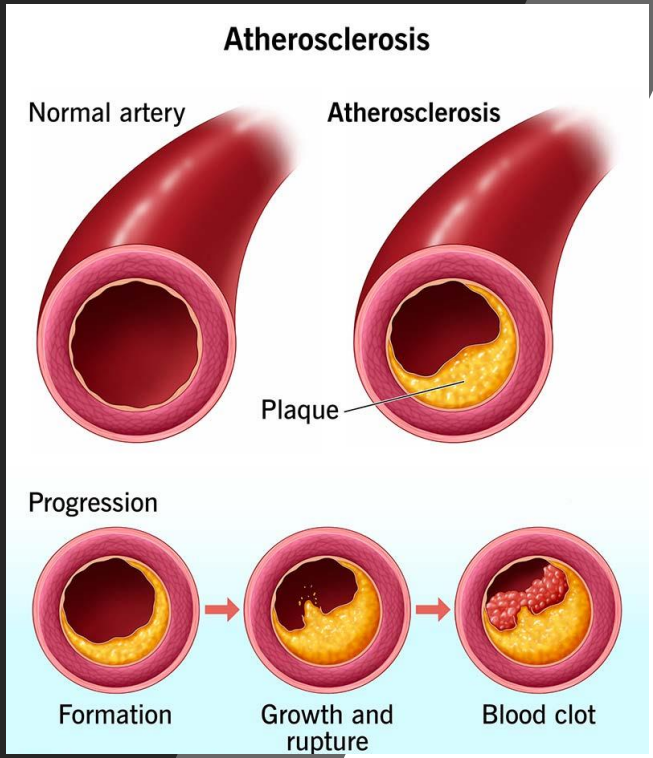


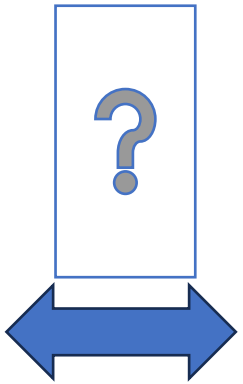
https://op.europa.eu/en/publication-detail/-/publication/1a3f0657-9a83-11e6-9bca-01aa75ed71a1/language-en

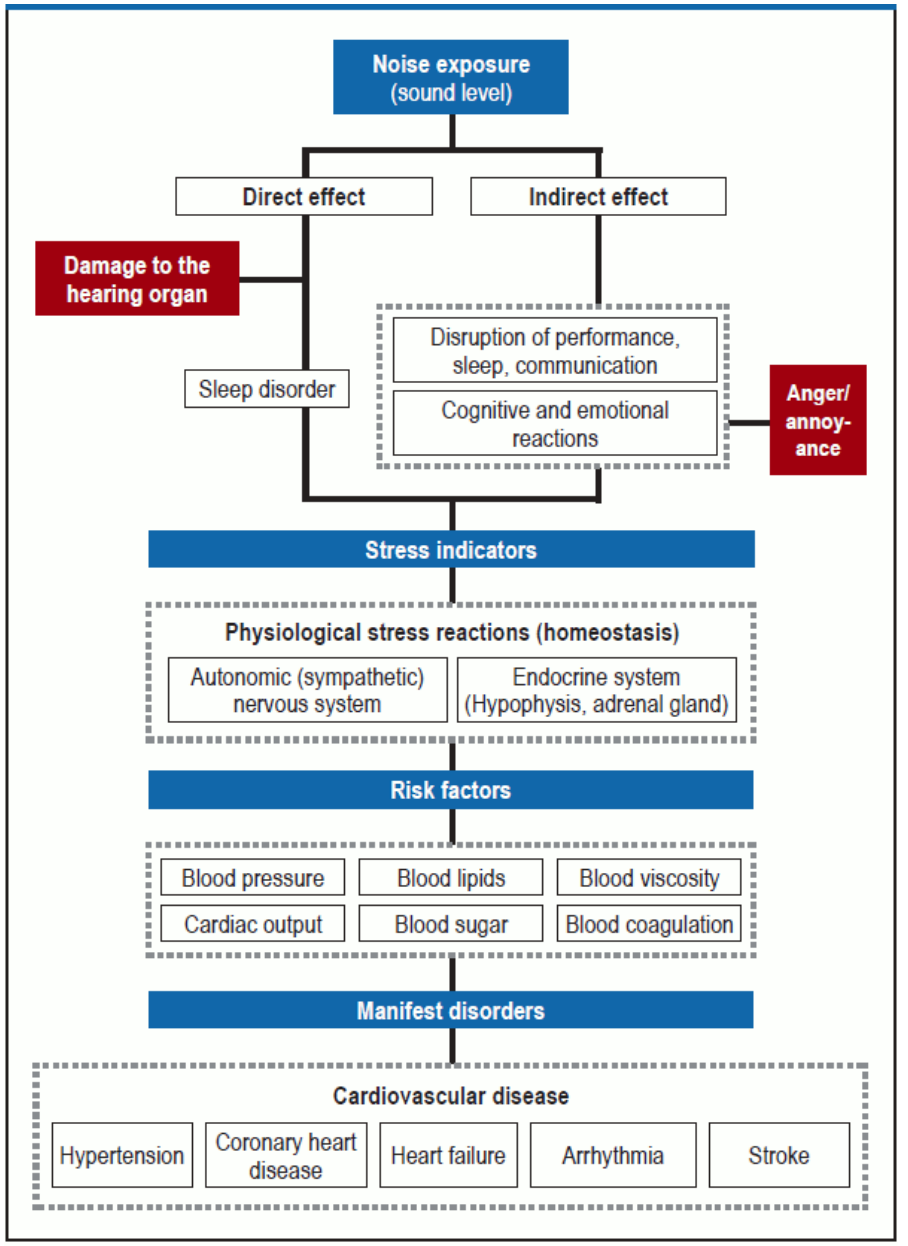
- Research suggests that the **social cost of noise and air pollution** in the EU - including death and disease — could be nearly **€1 trillion**.
- For comparison, the social cost of **alcohol** in the EU has been estimated to be **€50-120 billion** and **smoking at €544 billion**.

How does noise make us sick?

Noise reaction scheme according to W. Babisch

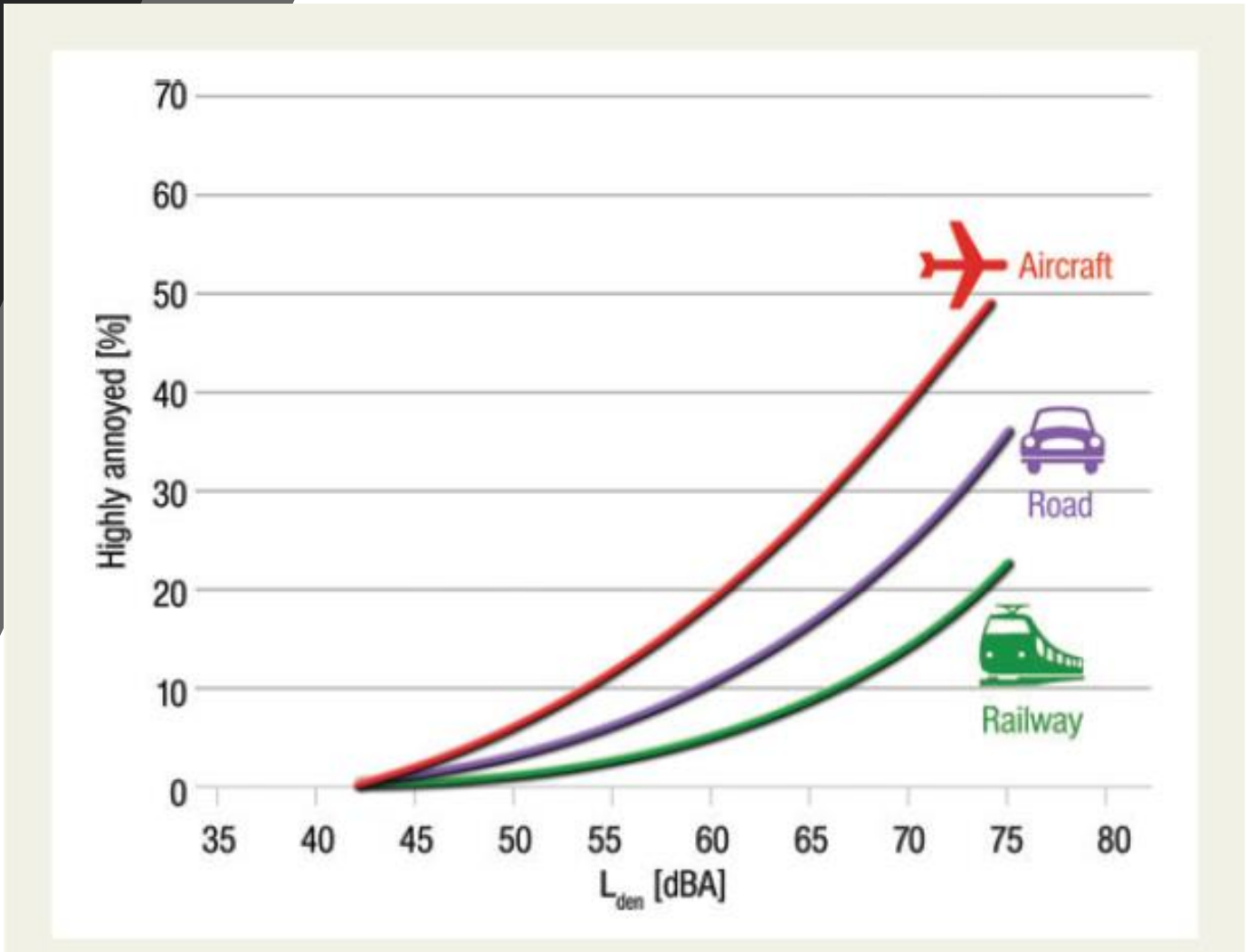






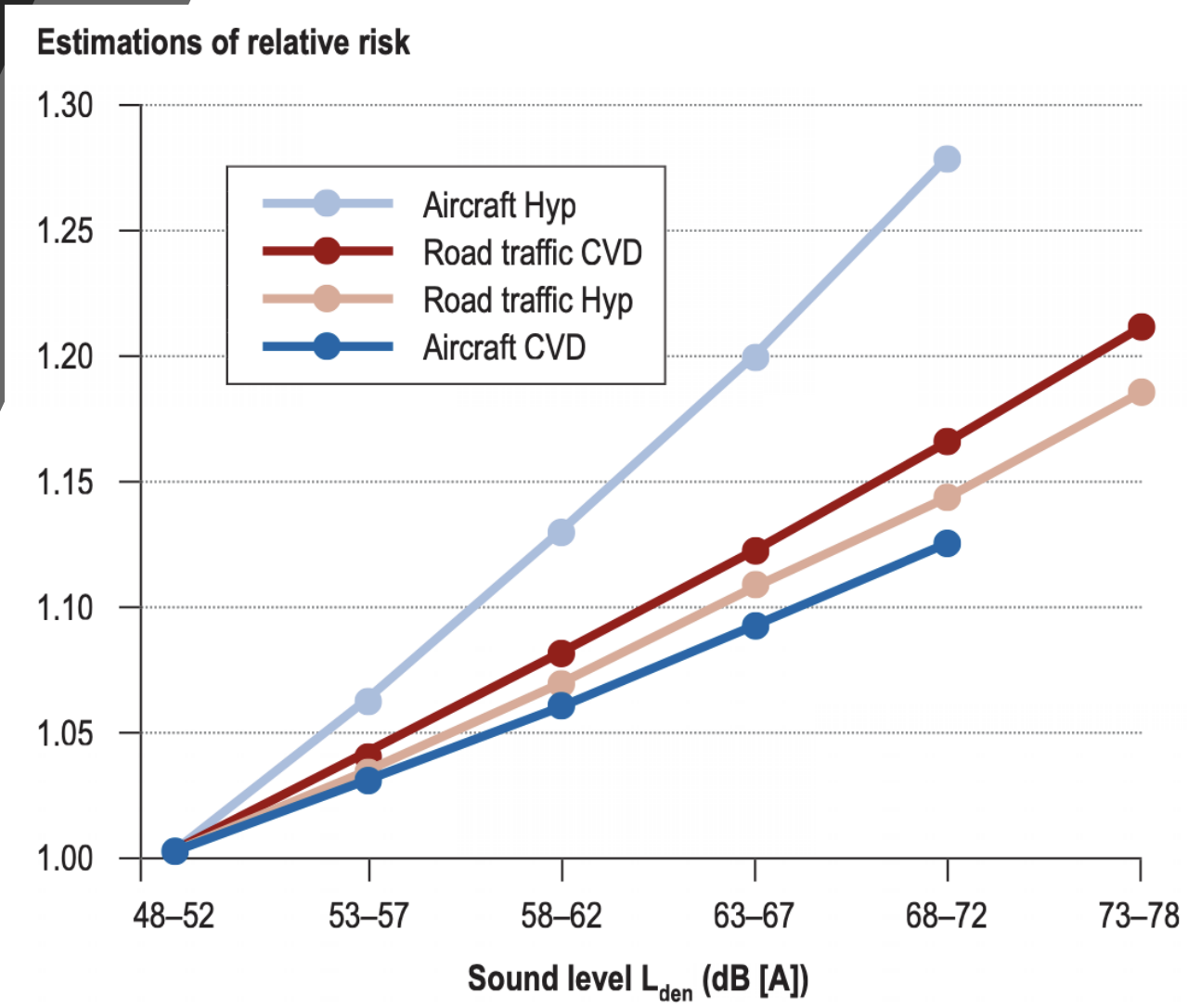
Hahad O et al. The Cardiovascular Effects of Noise. Dtsch Arztebl Int, 2019.

Aircraft noise bothers us the most



Münzel et al. Cardiovascular effects of environmental noise exposure. European Heart Journal, 2014.

Risk of high blood pressure and coronary heart disease due to aircraft noise

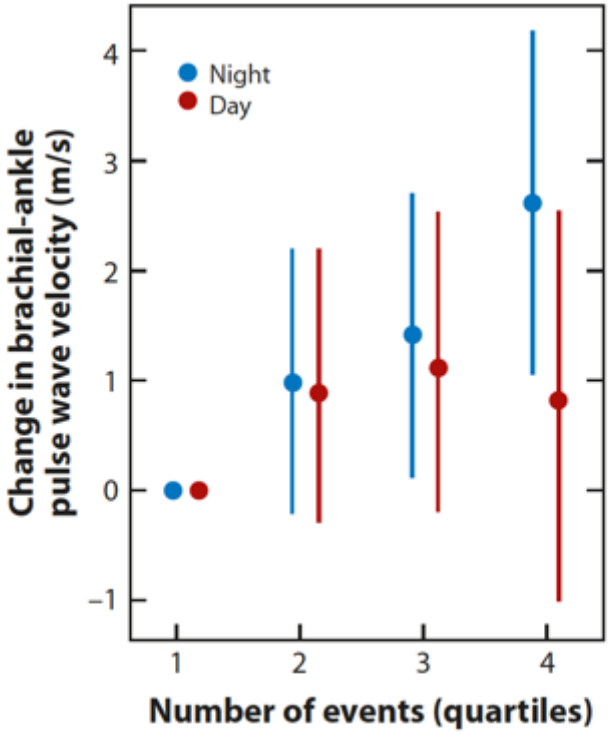


Hahad O et al. The Cardiovascular Effects of Noise. Dtsch Arztebl Int, 2019.

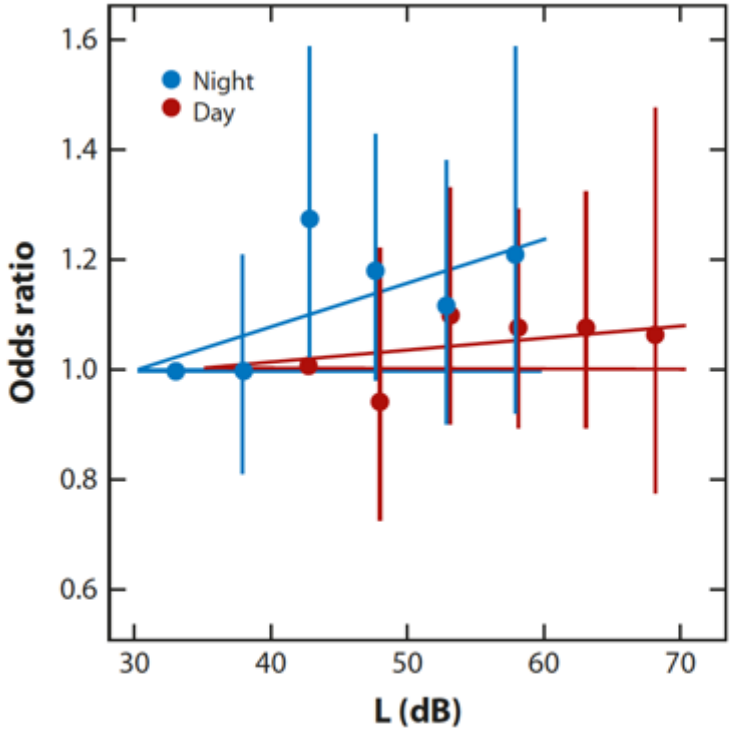
Important: Nocturnal aircraft noise

In particular, nighttime noise events (in blue) are responsible for increased vascular stiffness and high blood pressure compared to daytime noise events

Stiffness of the vessels



high blood pressure



Münzel T. et al. Adverse Cardiovascular Effects of Traffic Noise with a Focus on Nighttime Noise and the New WHO Noise Guidelines. 2020. Annual Reviews of Public Health .

Acute overflight and hypertension

European Heart Journal Advance Access published February 12, 2008

European Heart Journal
doi:10.1093/eurheartj/ehn013

CLINICAL RESEARCH

Acute effects of night-time noise exposure on blood pressure in populations living near airports

Alexandros S. Haralabidis[1], Konstantina Dimakopoulou[1], Federica Vigna-Taglianti[2], Matteo Giampaolo[3], Alessandro Borgini[4], Marie-Louise Dudley[5], Göran Pershagen[6], Gösta Bluhm[6], Danny Houthuijs[7], Wolfgang Babisch[8], Manolis Velonakis[9], Klea Katsouyanni[1]*, and Lars Jarup[5] for the HYENA Consortium

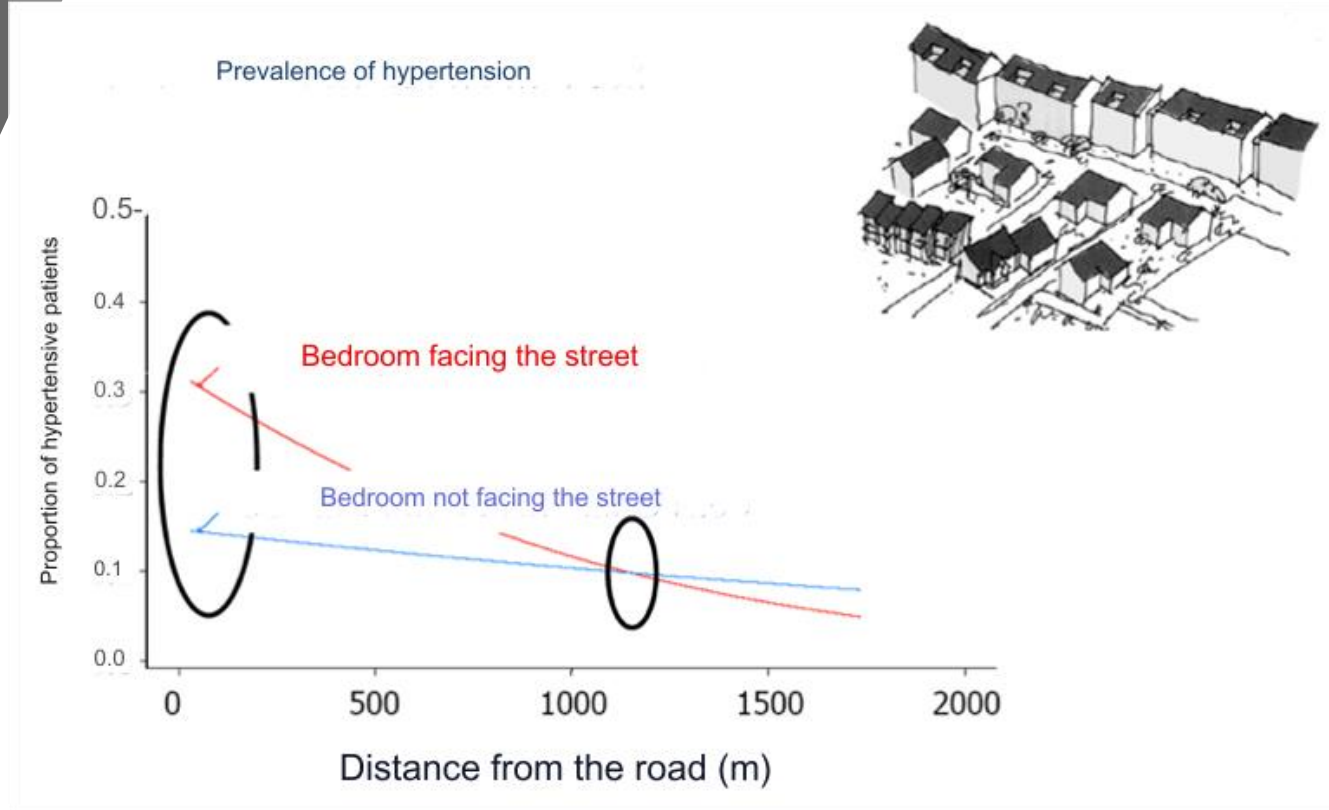
Aims Within the framework of the HYENA (hypertension and exposure to noise near airports) project we investigated the effect of short-term changes of transportation or indoor noise levels on blood pressure (BP) and heart rate (HR) during night-time sleep in 140 subjects living near four major European airports.

Methods and results Non-invasive ambulatory BP measurements at 15 min intervals were performed. Noise was measured during the night sleeping period and recorded digitally for the identification of the source of a noise event. Exposure variables included equivalent noise level over 1 and 15 min and presence/absence of event (with LAmax $>$ 35 dB) before each BP measurement. Random effects models for repeated measurements were applied. An increase in BP (6.2 mmHg (0.63–12) for systolic and 7.4 mmHg (3.1, 12) for diastolic) was observed over 15 min intervals in which an aircraft event occurred. A non-significant increase in HR was also observed (by 5.4 b.p.m.). Less consistent effects were observed on HR. When the actual maximum noise level of an event was assessed there were no systematic differences in the effects according to the noise source.

Conclusion Effects of noise exposure on elevated subsequent BP measurements were clearly shown. The effect size of the noise level appears to be independent of the noise source.

Keywords Environmental noise • Blood pressure • Night-time sleep • Acute effects • Epidemiological study

Room orientation and high blood pressure



Lercher et al. (2000)

Insufficient sleep adversely affects both physical and mental well-being

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 Cooper[1], Lanfranco D'Elia[2], Pasquale Strazzullo[2], and Michelle A. Miller[1†]

[1]Warwick Medical School, University of Warwick, CSB Building, UHCW Campus, Clifford Bridge Road, Coventry CV2 2DX, UK; and [2]Department 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

ELSEVIER

Journal of Adolescent Health
Volume 66, Issue 5, May 2020, Pages 567-574

Original article

Sleep Disturbance Predicts Depression Symptoms in Early Adolescence: Initial Findings From the Adolescent Brain Cognitive Development Study

Aimée Goldstone Ph.D. [a], Harold S. Javitz Ph.D. [a], Stephanie A. Claudatos [a], Daniel J. Buysse M.D. [b], Brant P. Hasler Ph.D. [b], Massimiliano de Zambotti Ph.D. [a], Duncan B. Clark M.D., Ph.D. [b], Peter L. Franzen Ph.D. [b], Devin E. Prouty Ph.D. [a], Ian M. Colrain Ph.D. [a, c], Fiona C. Baker Ph.D. [a, d]

Nighttime aircraft noise around Zurich Airport

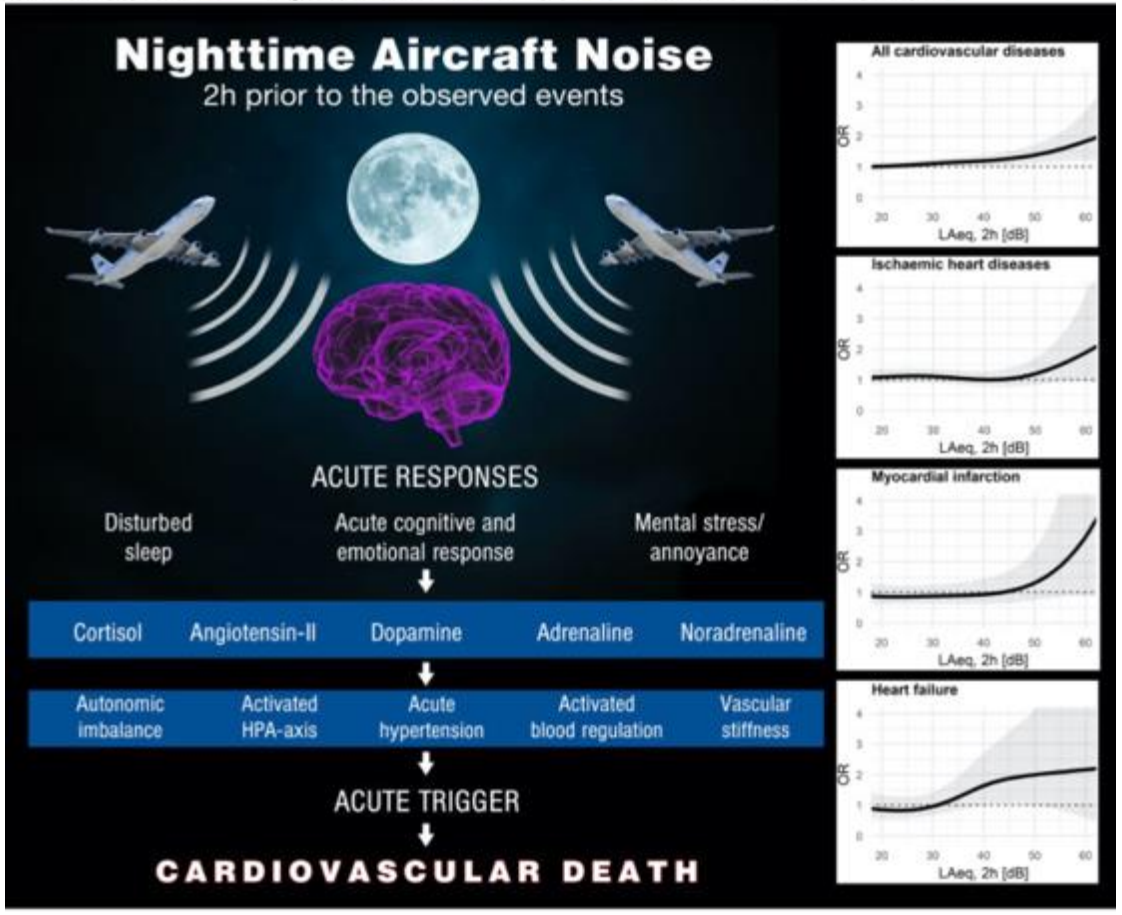
→The study found that the risk of cardiovascular death increases by 33 percent with nighttime noise levels betwee 40-50 decibels and by 44 percent with noise levels of 55 decibels.

ESC European Society of Cardiology
European Heart Journal (2020) **00**, 1–9
doi:10.1093/eurheartj/ehaa957

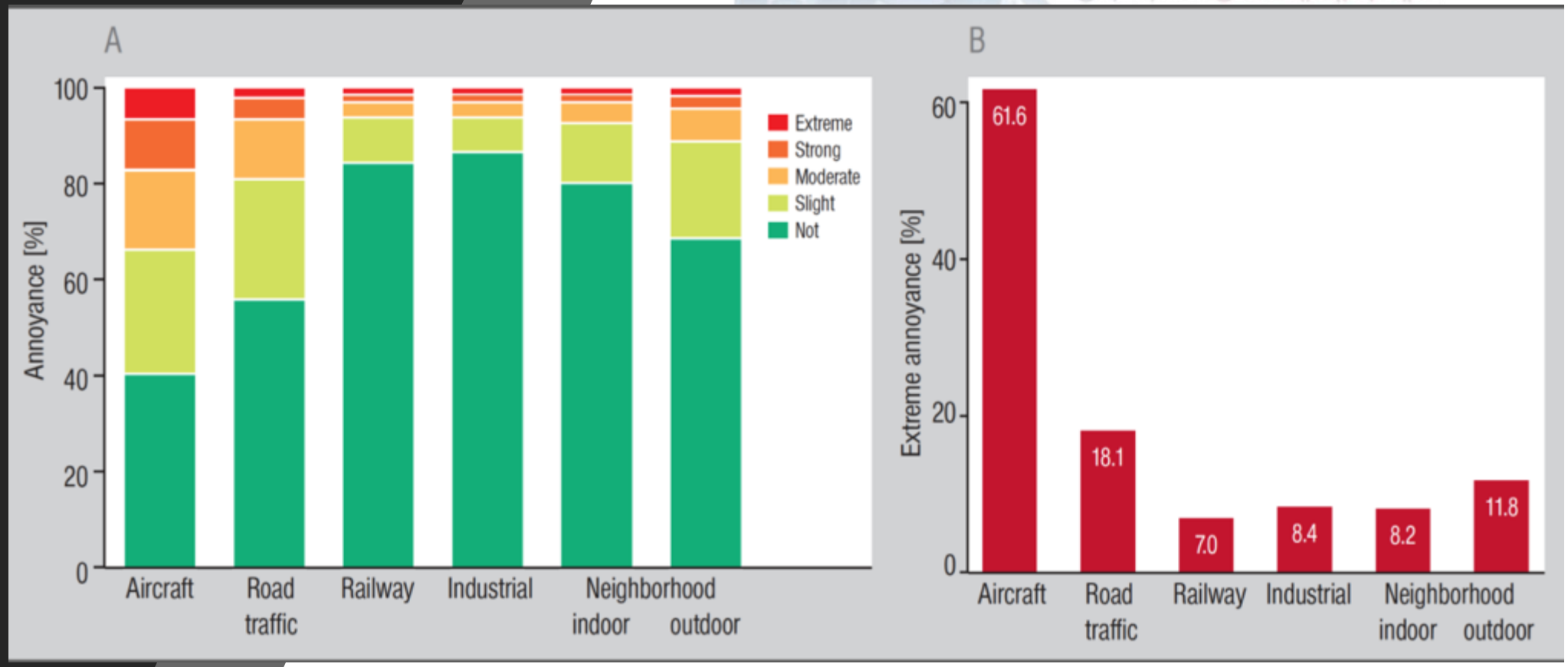
CLINICAL RESEARCH
Epidemiology

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]*



Our noise studies: Aircraft noise is dominant



Aircraft noise accounts for the largest share of total extreme noise pollution (right figure).

Aircraft noise annoyance in the general population

→more depression
→more atrial fibrillation

PLOS ONE

RESEARCH ARTICLE

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

Manfred E. Beutel[1]*, Claus Jünger[2], Eva M. Klein[1], Philipp Wild[3,4,5], Karl Lackner[6], Maria Blettner[7], Harald Binder[7], Matthias Michal[1], Jörg Wiltink[1], Elmar Brähler[1], Thomas Münzel[2]

1 Department of Psychosomatic Medicine and Psychotherapy, University Medical Center of the Johannes Gutenberg University Mainz, Mainz, Germany, **2** Medical Clinic for Cardiology, Angiology and Intensive Care Medicine, University Medical Center of the Johannes Gutenberg University Mainz, Mainz, Germany, **3** Preventive Cardiology and Preventive Medicine, Department of Medicine 2, University Medical Center of

International Journal of Cardiology 264 (2018) 79–84

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

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 [h], Karl Lackner [f], Mette Sørensen [g], Jürgen H. Prochaska [a], Philipp S. Wild [a], Thomas Münzel [a,*]

[a] Center of Cardiology, Cardiology I, University Medical Center of the Johannes Gutenberg-University Mainz and DZHK Standort Rhein-Main, Mainz, Germany
[b] Department of Psychosomatic Medicine and Psychotherapy, University Medical Center of the Johannes Gutenberg-University Mainz, Germany
[c] Preventive Cardiology and Preventive Medicine, Department of Medicine II, University Medical Center of the Johannes Gutenberg-University Mainz, Germany
[d] Institute of Medical Biostatistics, Epidemiology & Informatics, University Medical Center of the Johannes Gutenberg-University Mainz, Germany
[e] Department of Ophthalmology, University Medical Center Mainz, Germany
[f] Institute of Clinical Chemistry and Laboratory Medicine, University Medical Center of the Johannes Gutenberg-University Mainz, Germany
[g] Danish Cancer Society Research Center, Copenhagen, Denmark
[h] Center of Cardiology, Cardiology I, University Medical Center of the Johannes Gutenberg University Mainz, Germany

Field Study 1

European Heart Journal (2013) **34**, 3508–3514
doi:10.1093/eurheartj/eht269

CLINICAL RESEARCH

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

Frank P. Schmidt[1], Mathias Basner[2], Gunnar Kröger[1], Stefanie Weck[1], Boris Schnorbus[1], Axel Muttray[3], Murat Sariyar[4], Harald Binder[4], Tommaso Gori[1], Ascan Warnholtz[1], and Thomas Münzel[1]*

[1]Department of Medicine II, University Medical Center, Johannes Gutenberg University Mainz, Langenbeckstrasse 1, 55131 Mainz, Germany; [2]Unit of Experimental Psychiatry, Division of Sleep and Chronobiology, Department of Psychiatry, University of Pennsylvania Perelman School of Medicine, Philadelphia, PA, USA; [3]Institut für Arbeits-, Sozial- und Umweltmedizin, University of Mainz, Mainz, Germany; and [4]Institute for Medical Biometry, Epidemiology and Informatics, University of Mainz, Mainz, Germany

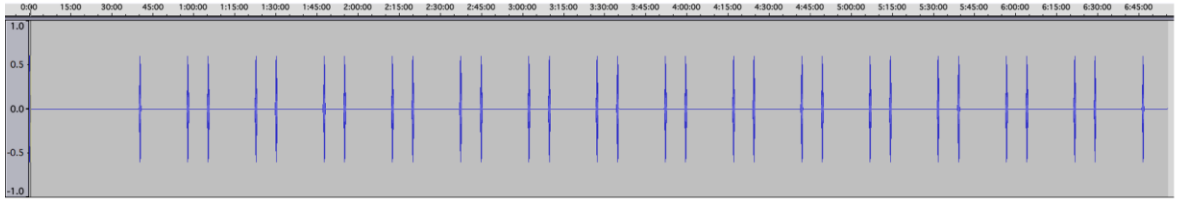
Received 31 January 2013; revised 6 June 2013; accepted 20 June 2013; online publish-ahead-of-print 2 July 2013

Noise scenarios

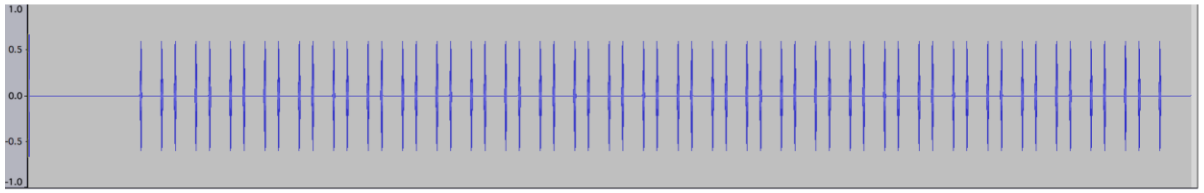
- **75 healthy subjects were** exposed to **simulated nighttime aircraft noise** at home while they slept
- **3 scenarios** : control scenario (no noise exposure), Noise30 (30 aircraft noise events) and Noise60 (60 aircraft noise events)
- **Average noise levels** of **35** , **43** and **46 dB(A)** and **peak noise levels of 60 dB(A**)

Setting

Noise 30



Noise 60

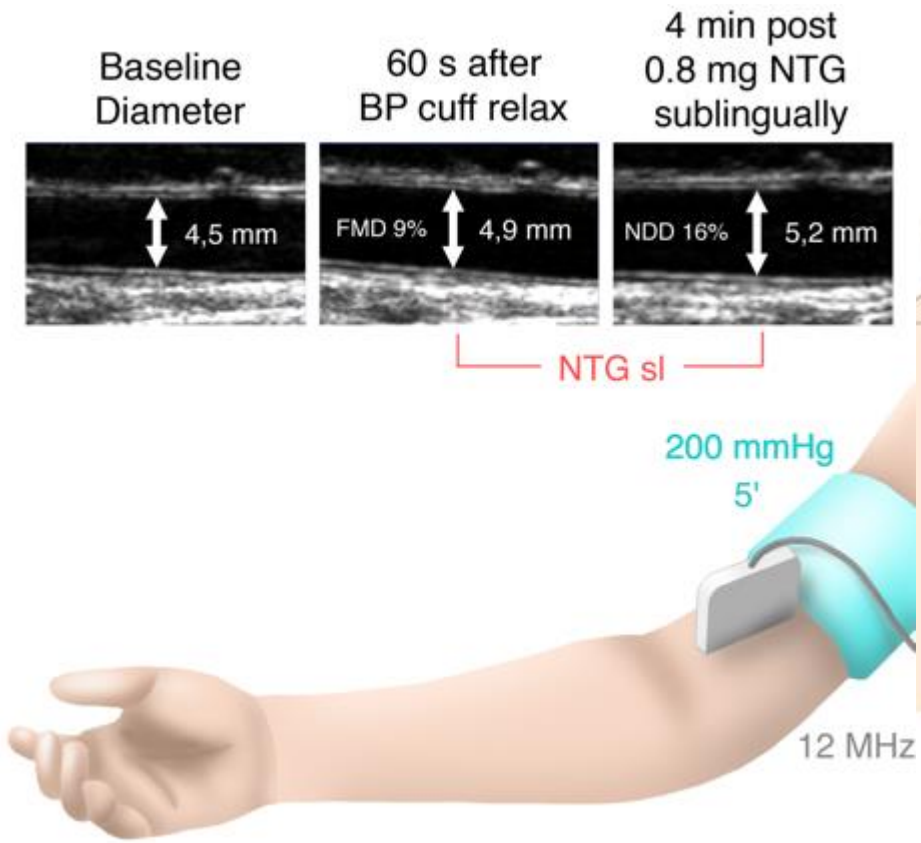


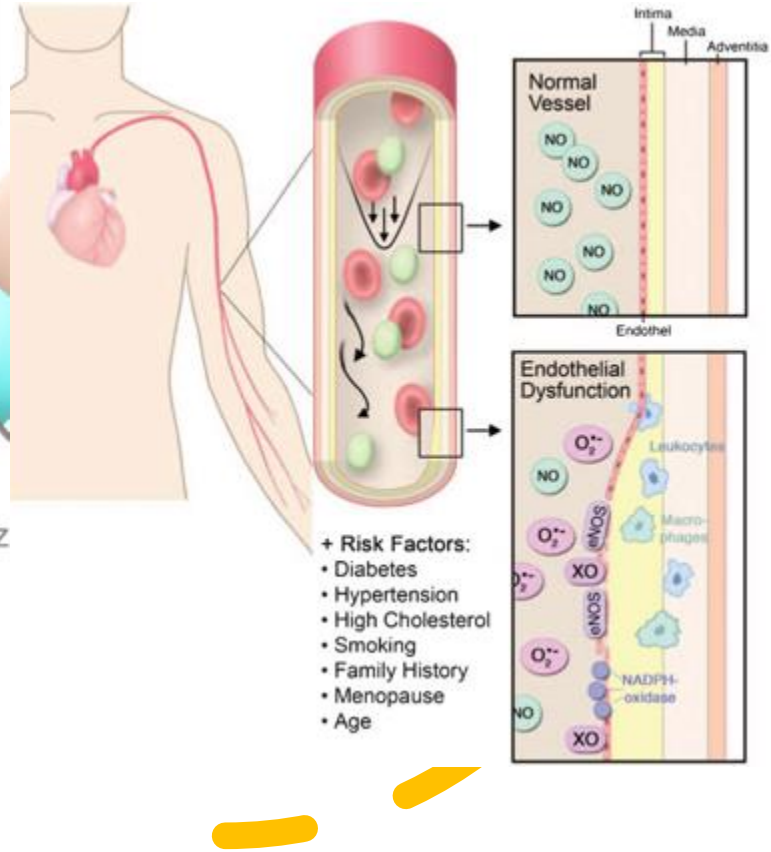
Noise scenario

Polygraphy

Player

Measurement of vascular endothelial function





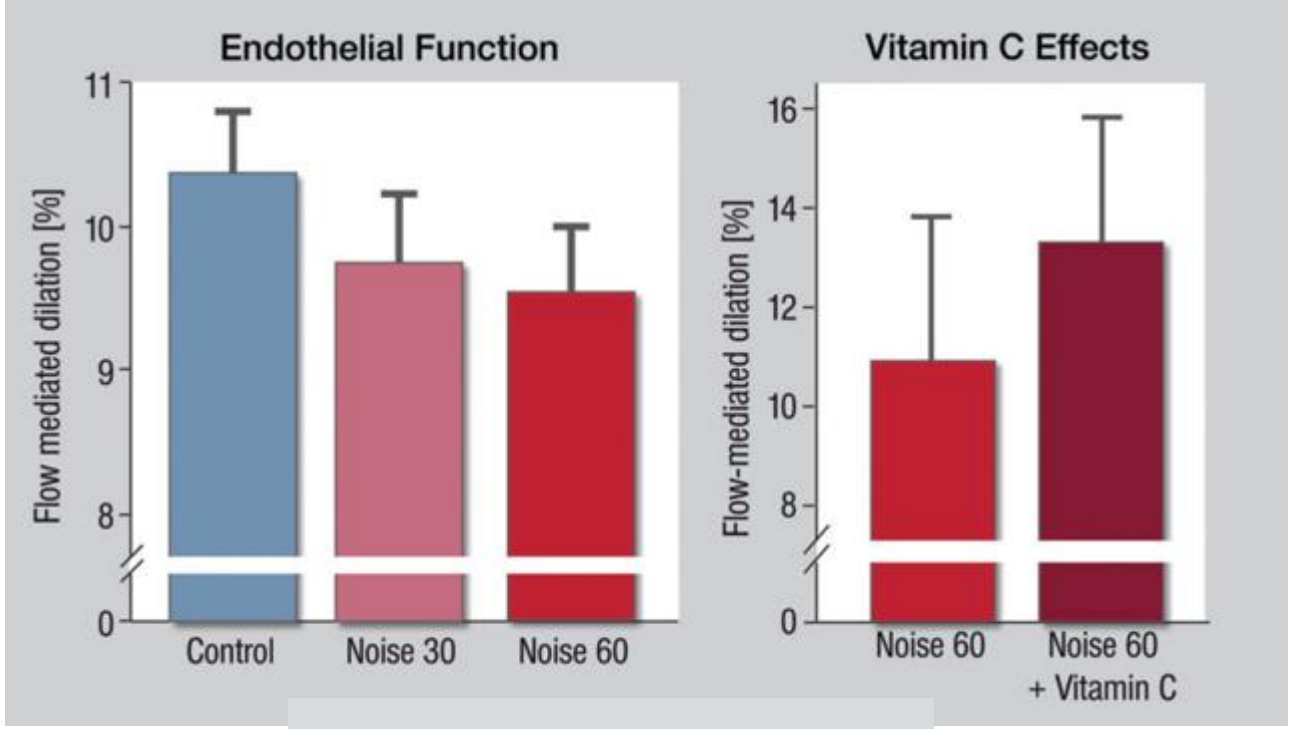
Results :

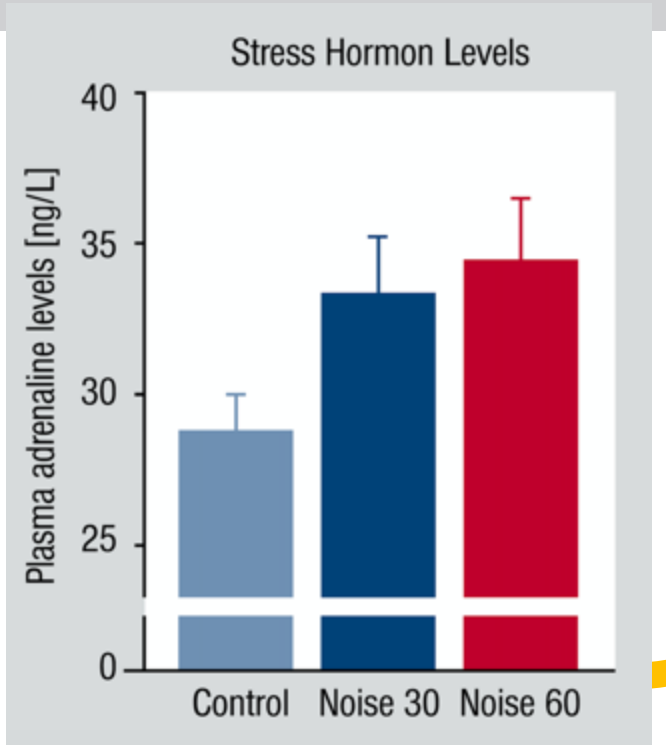
Significant deterioration in **sleep quality**

Increased release of **adrenaline**

Deterioration in **endothelial function**

Interesting: **Vitamin C** improves vascular function after noise exposure





Field Study 2: Patients with coronary heart disease

In patients with existing coronary heart disease, the aircraft noise effects were significantly more pronounced

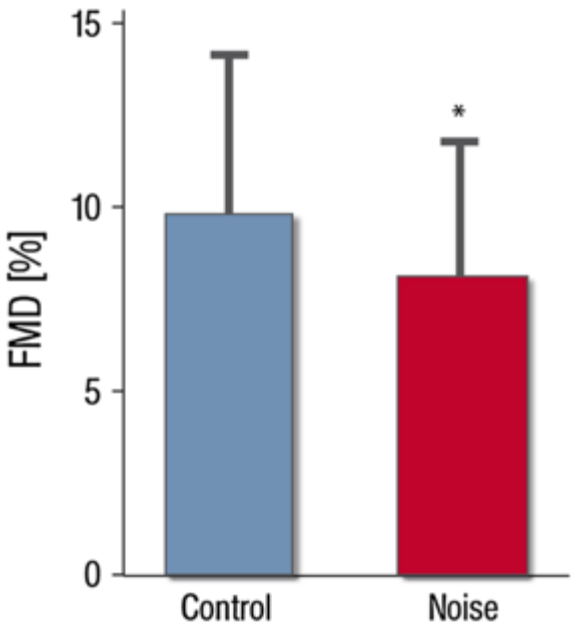
Clin Res Cardiol (2015) 104:23–30
DOI 10.1007/s00392-014-0751-x

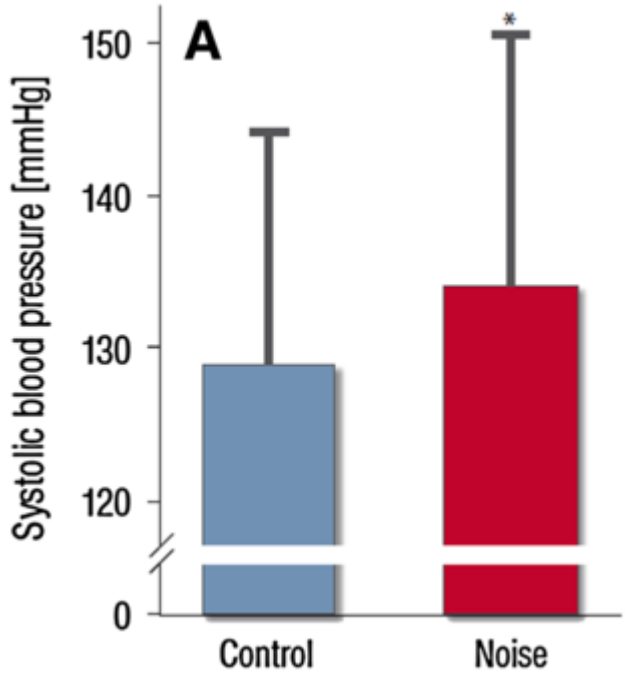
ORIGINAL PAPER

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

Received: 25 June 2014 / Accepted: 1 August 2014 / Published online: 22 August 2014





ESC European Society of Cardiology
Cardiovascular Research (2021) 117, 1382–1390
doi:10.1093/cvr/cvaa204

The impact of aircraft noise on vascular and cardiac function in relation to noise event number: a randomized trial

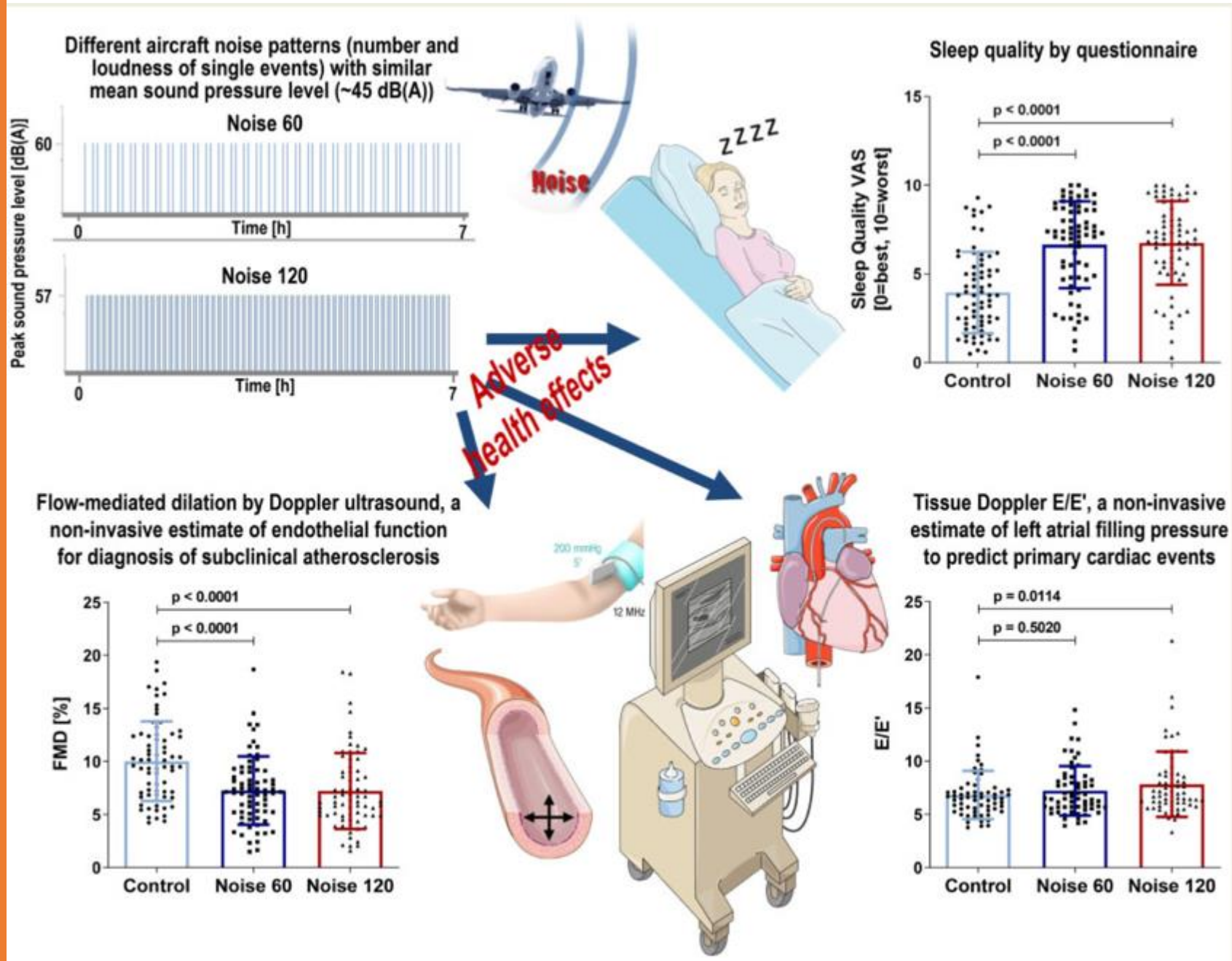
Frank P. Schmidt[1†], Johannes Herzog[1†], Boris Schnorbus[1], Mir Abolfazl Ostad[1], Larissa Lasetzki[1], Omar Hahad[1,2], Gianna Schäfers[1], Tommaso Gori[1,2], Mette Sørensen[3], Andreas Daiber[1,2], and Thomas Münzel[1,2]*

[1]Department of Cardiology I, University Medical Center of the Johannes Gutenberg-University Mainz, Langenbeckstraße 1, 55131 Mainz, Germany; [2]German Center for Cardiovascular Research (DZHK), Partner Site Rhine-Main, Mainz, Germany; and [3]Diet, Genes and Environment Unit, Danish Cancer Society Research Center, Copenhagen, Denmark

Received 7 May 2020; revised 1 June 2020; editorial decision 23 June 2020; accepted 2 July 2020; online publish-ahead-of-print 10 October 2020

Field Study 3: Little loud vs. many quiet Aircraft noise events

result in comparable damage



What we need:

- Noise should be officially recognized as a manifest (cardiovascular) risk factor
- Integration into medical guidelines for prevention
- Legal regulation in line with WHO limits
- Restriction of nighttime noise (no-fly times, etc.)

Thank you for your attention