



Health Impacts of Aircraft Noise Exposure

Aerospace Europe Conference 2020

Bordeaux, France 25th February

Sarah Benz

Centre for Applied Psychology, Environmental and Social Research (ZEUS)



Horizon 2020

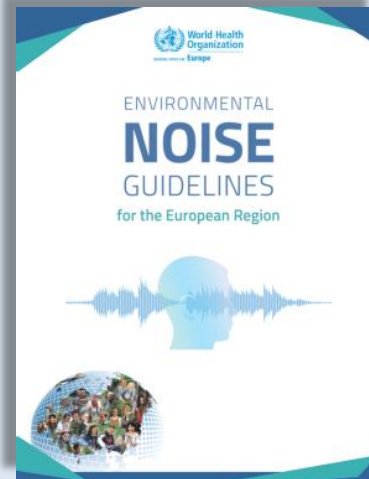
WHO Environmental Noise Guidelines For The European Region (2018)



'Critical' health outcomes

- Annoyance
- Sleep disturbance
- Cardiovascular diseases
- Cognitive impairment
- Hearing impairment

& tinnitus



'Important' health outcomes

- Diabetes and metabolic diseases
- Adverse birth outcomes
- Quality of life, well-being

Relevance criteria:

(1) Seriousness (2) Prevalence (3) Availability of evidence



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No [769627]



Horizon 2020

Aim of task

- Update the WHO evidence for the impact of aviation noise on health outcomes supplement it with findings since the cut off for the WHO reviews (around 2014)

Noise and health

Auditory effects

- hearing impairment



Non-auditory effects

- stress-related effects
outside the hearing system



M. Basner, W. Babisch, A. Davis, M. Brink,
C. Clark, S. Janssen, S. Stansfeld: Auditory and non-auditory effects of noise on health.
The Lancet 383 (2014) 1325–1332.

Noise and health

Stress

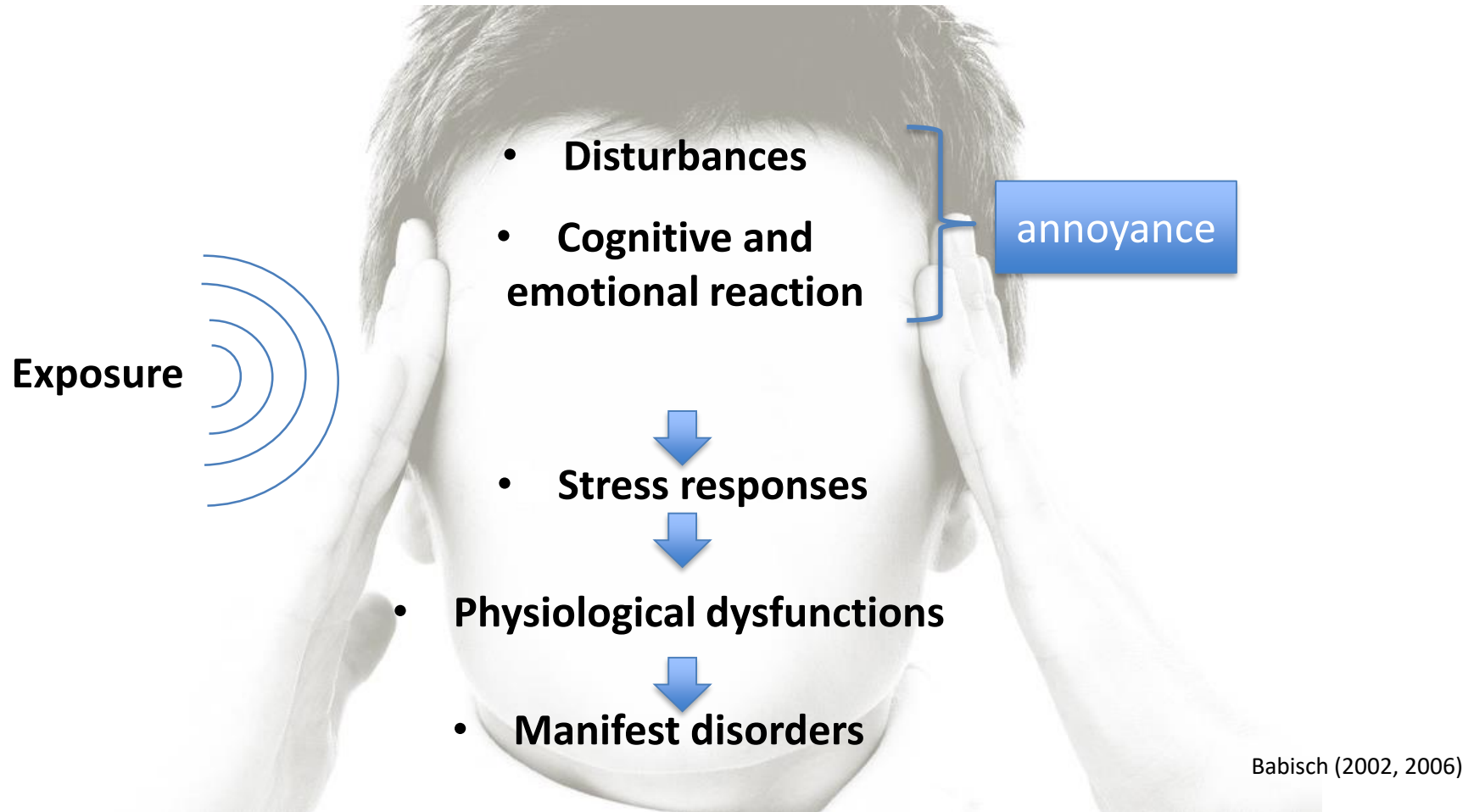
Conditions (like long-term exposure to sound) where an

- Environmental demand exceeds
- the natural regulatory capacity of an organism,
- in particular situations that include unpredictability and uncontrollability.



Koolhaas et al., 2011

Model of the impact of environmental noise



Procedure for update of reviews in ANIMA

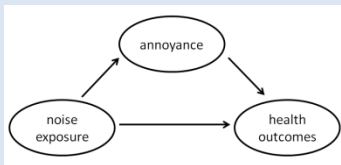
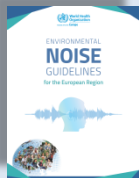
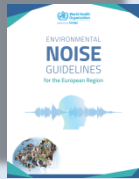
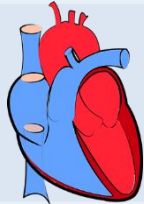
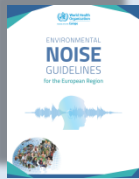
Literature Search for Studies

- Scientific data base: ScienceDirect, PsychIndex/PsychInfo, Ebsco, Web of Science, etc.
- Search terms: „environmental noise“/“transportation noise“/“aviation noise“ AND „health outcomes“
- Inclusion/exclusion criteria for selection of studies

Procedure for update of reviews in ANIMA

- Inclusion/exclusion criteria:
 1. **Noise exposure measures**, calculated or noise mapping
 2. Noise source: **aviation**, or noise from airports, no combined traffic noise exposure
 3. **Health outcomes**: cardiovascular diseases, adverse effects of the metabolic system, sleep architecture/sleep quality/sleep disturbance, cognitive impairment or mental health/quality of life/wellbeing
 4. **Analysis of the relationship** between health outcomes and aircraft noise exposure
 5. **Published after deadline** of previous systematic reviews for WHO, after 2014/2015

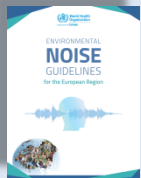
Results



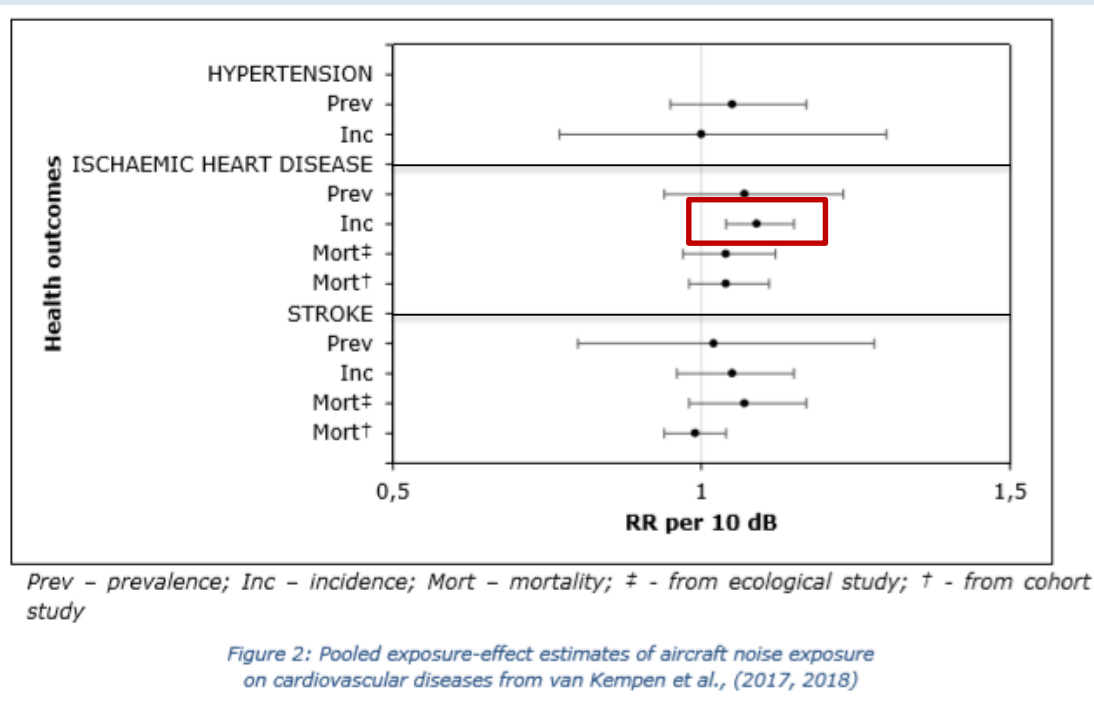
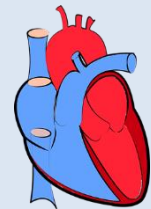
Focus on ,critical‘ outcomes
(according to WHO)

For more information on the results of
other impacts see the ANIMA report
(Hudson et al., 2019)

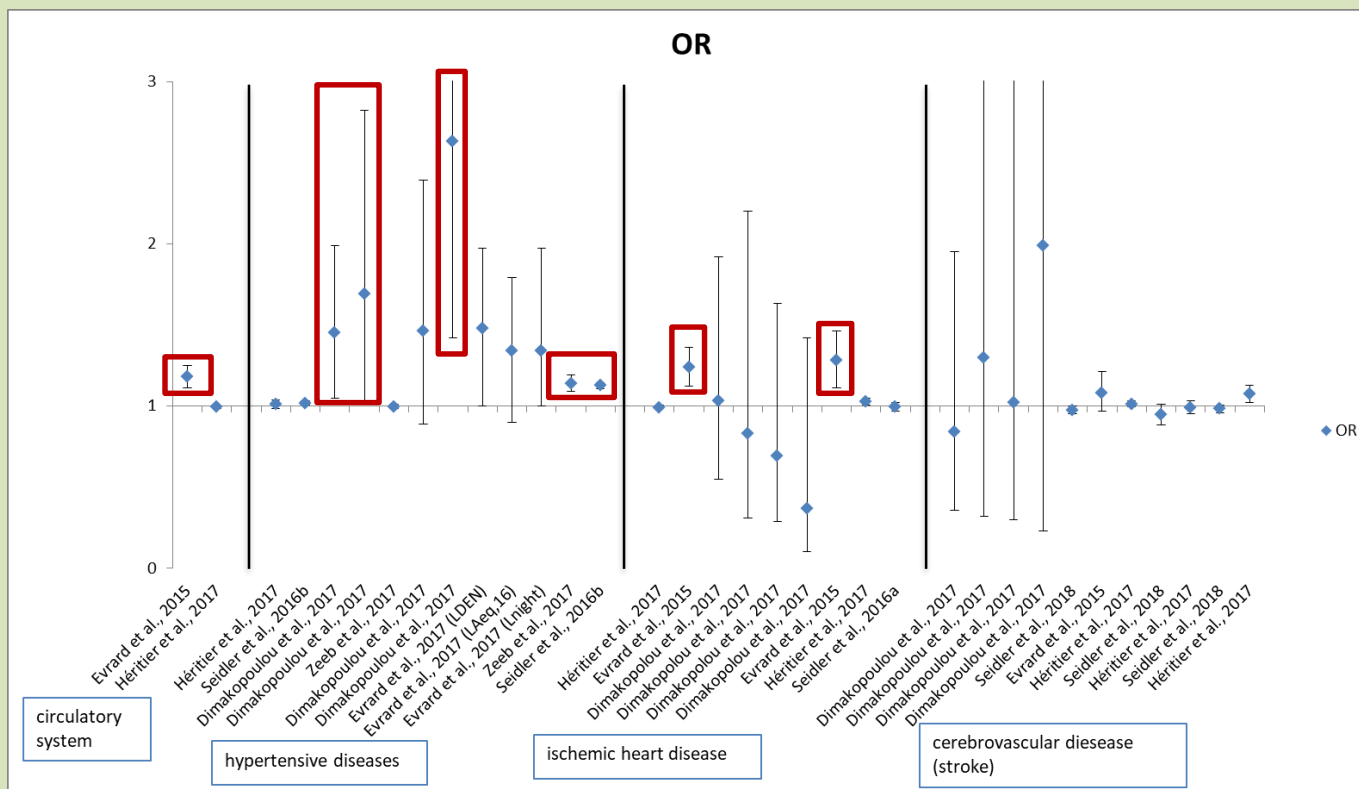
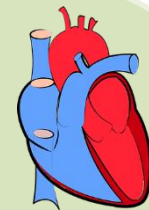
Results: Cardiovascular diseases



WHO: only significant associations between aircraft noise exposure and ischemic heart diseases (IHD)

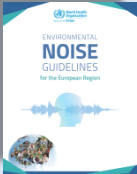


Results: Cardiovascular diseases



Exposure to aircraft noise and the assessed risk for cardiovascular diseases from epidemiological studies (in Hudson et al., 2018)

Results: Cognition



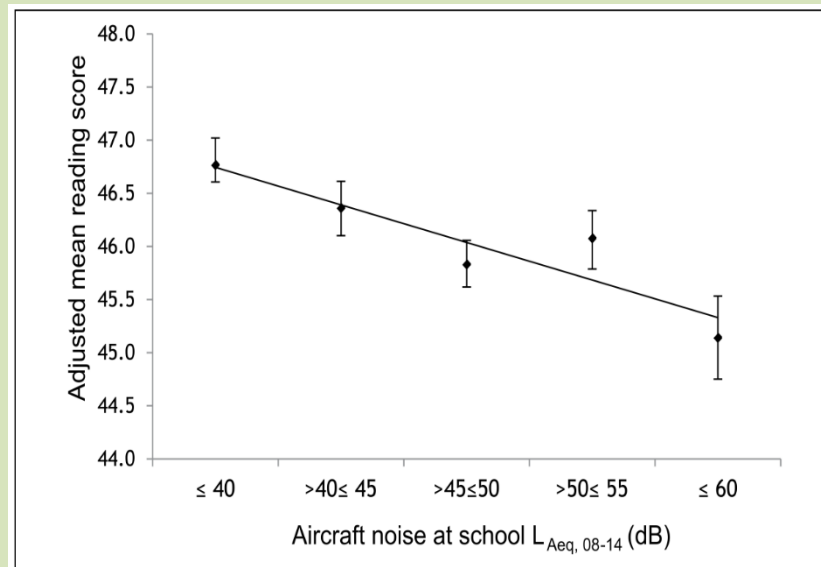
WHO: negative implications on memory functions, attention reading and oral comprehension (Clark & Paunovic, 2018)



Results: Cognition

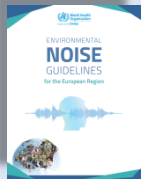


- A delay in reading and oral comprehension was associated with aircraft noise (Klatte et al., 2016)

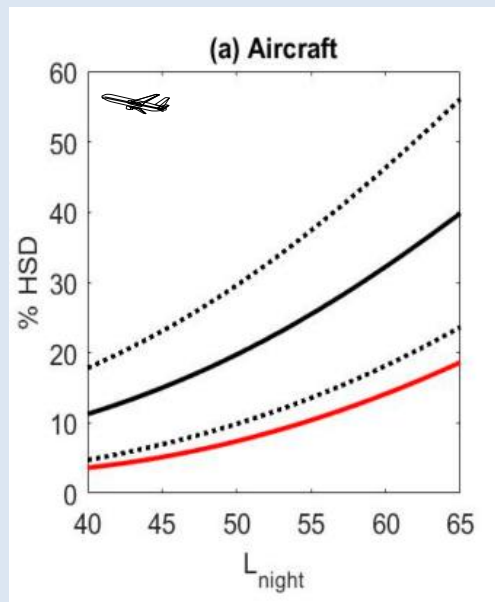


n = 1,209 children (7-9 yrs) from 29 primary schools in Rhine-Main region around Frankfurt airport

Results: Sleep



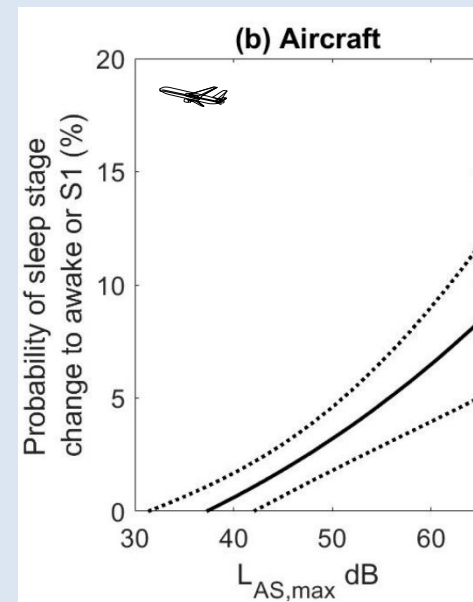
Exposure-response functions for noise impact on sleep



%HSD – reported sleep disturbances

Black curve: Basner & McGuire (2017), WHO review

Red curve: Miedema & Vos (2007), EU re-analysis



p (additional awakenings)

Basner & McGuire (2017)

Results: Sleep



Sleep measures	Study	Effect
(self) reported sleep measures	Basner et al., 2017	+
	Douglas et al., 2016	+
	Hiroe et al., 2017	+
	Holt et al., 2015	-
	Janssen et al., 2014	-
	Kim et al., 2014	+
	Kwak et al., 2016	+
	Müller et al., 2016	+
	Nassur et al., 2017	+
	Nguyen et al., 2017	-
	Rösli et al., 2017	+
	Schreckenberg et al., 2016	+
Physiological measures of sleep (polysomnography and actimetry)	Basner et al., 2017	-
	Janssen et al., 2014	+
	Müller et al., 2016, Müller et al., 2017	+

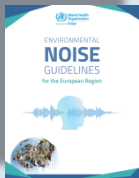
Interim results

- Guideline exposure levels = Noise exposure levels above which the GDG is confident that there is an increased risk of adverse health effects

Health outcome	Relevant risk increase	Aircraft	
		Lden	Lnight
IHD (incidence)	5% rel. risk increase	52.6	--
hypertension (incid.)	10% rel. risk increase	--	--
% HSD	3 % absolute risk		40
% HA	10% absolute risk	45.4	--
Perm. hearing impairment	No risk increase	--	--
Reading/oral comprehension	1 months delay	55	--
Guideline exposure level (rounded)		45	40
Recommendation		strong	

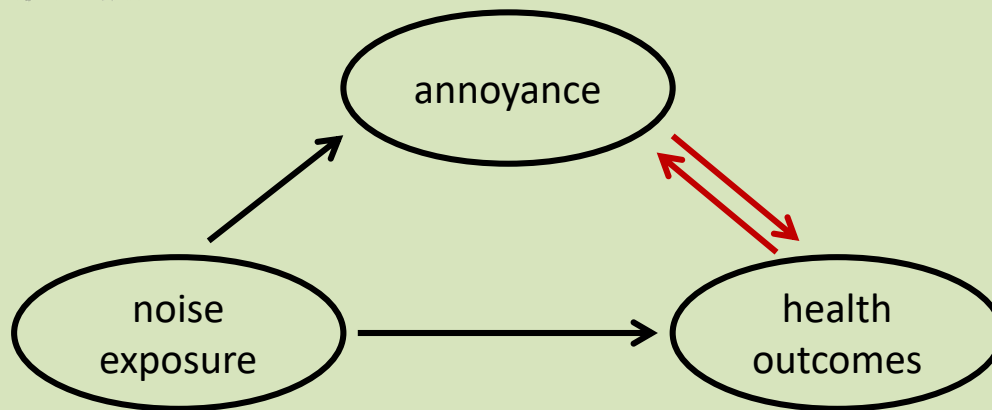
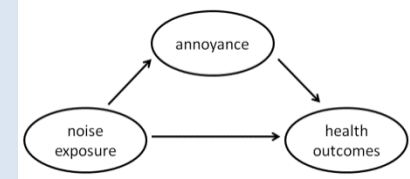
- Regulation: Noise – impact relation
- Managing: process of genesis/development of diseases in order to derive potentially influencing factors to design reasonable interventions
- Annoyance and sleep disturbances discussed as potential mediators for the effect of noise exposure on health outcomes

Results: link annoyance and health outcomes



WHO: no review, but:

Highlight it as potential mediator of other long-term health impacts



- Cardiovascular diseases (Eriksson et al., 2010; Babisch et al., 2013)
- Sleep (Bartels, 2014; van den Berg et al., 2014)
- Mental health (Schreckenberget al., 2017; Baudin et al., 2018)
- Physical activity (Foraster et al., 2016)

Conclusion of the ANIMA health review

- More evidence for the effect of aviation noise exposure on cardiovascular disease, reading and oral comprehension and sleep measures
- Indications of this reviews are not exhaustive
- But: More evidence for hypothesis that annoyance has a mediating function for the relationship between aviation noise exposure and health outcomes

Implications

- In order to optimise efforts to mitigate health risks, airports and other stakeholders should focus on annoyance and sleep outcomes in addition to conventional attempts to reduce noise exposure.
- Addressing annoyance and sleep disturbances is expected to lead to a **reduction** in other health outcomes.
- Management measures and interventions should be **evaluated** regarding the impact of noise rather than just focusing on a dB reduction.

Thanks for your attention!

Contact: Sarah Benz

benz@zeusgmbh.de

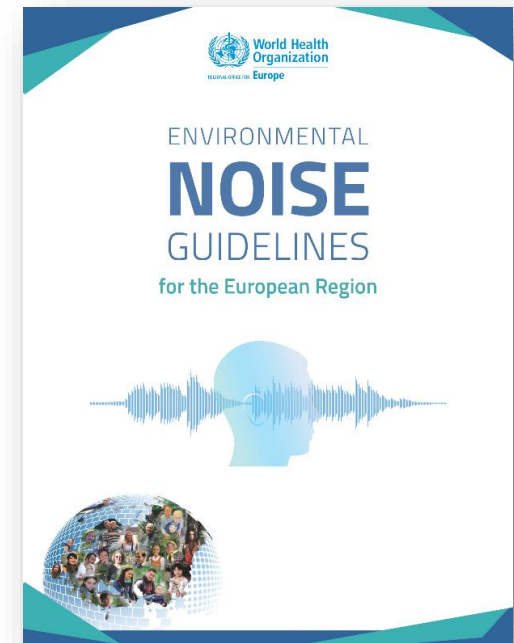
Phone: +49 2331 - 47 84 960

Backup

Health impacts according to WHO Environmental Noise Guidelines

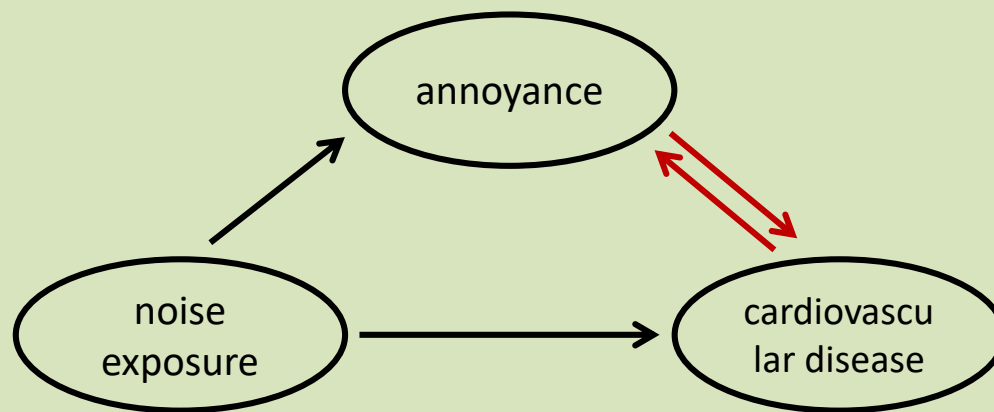
'Critical' health outcomes

- Annoyance
- Sleep disturbance
- Cardiovascular diseases
- Cognitive impairment
- Hearing impairment & tinnitus

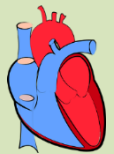


Health outcome	IHD	% HSD	% HA	Reading/oral comprehension	ENG exposure level
Relevant risk increase	5% rel. risk increase	3 % absolute risk	10% absolute risk	1 months delay	
L_{den}	52.6		45.4	55	45
L_{night}	--	40	--	--	40

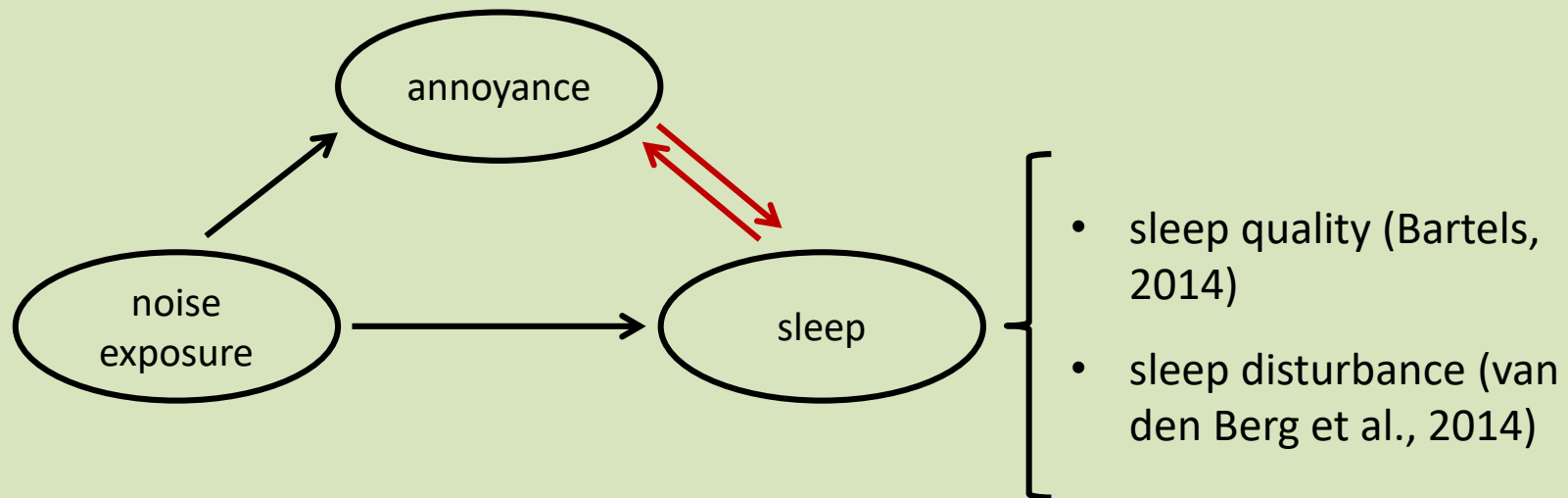
Results: Annoyance and cardiovascular disease



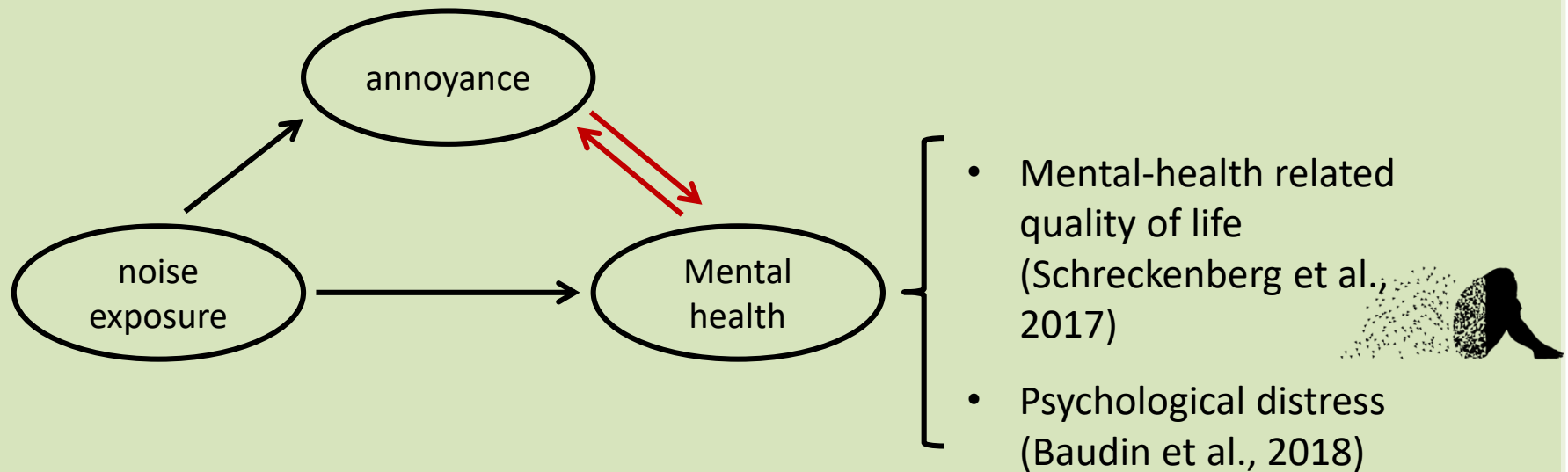
- higher risk for hypertension for participants reporting annoyance (Eriksson et al., 2010)
- Effect of noise levels on hypertension only in those reporting higher annoyance (Babisch et al., 2013)



Results: Annoyance and sleep measures



Results: Annoyance and quality of life/mental health



Results: Annoyance and physical activity

