World Health Organization
REGIONAL OFFICE FOR Europe

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WHO Environmental Noise Guidelines for the European Region

What is new?

2. New evidence on health effects from environmental noise and implications for research

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Outline

Evidence reviews: scope, noise sources, health outcomes

Knowledge gaps and research needs:

- Study design
- Noise exposure assessment
- Populations and lifecourse approaches
- Confounding factors and effect modification
- Health outcomes
- Interventions

Conclusions

Scope of the guidelines

Scoping questions:

Exposure-response relationships:

In the general population exposed to environmental noise, what is the exposure-response relationship between exposure to environmental noise (reported as various indicators) and the proportion of persons with a validated measure of health outcome when adjusted for confounders?

Effectiveness of interventions:

In the general population exposed to environmental noise, what is the effect of interventions to reduce exposure to environmental noise on adverse health outcomes?

Noise sources and settings included

- Noise sources:
  - Aircraft noise
  - Railway noise
  - Road noise
  - Wind turbine noise
  - Leisure noise (including personal listening devices)
- Combined noise sources:
  - Vibration from railway traffic
  - Air pollution
  - Visual aspects of wind turbines

- Noise settings:
  - Environment in general
  - Residences
  - Educational settings
  - Public venues

Health outcomes

- WHO definition of health:

  State of complete physical, mental, and social well-being and not merely the absence of disease or infirmity

- Health outcomes included:
  - annoyance
  - effects on sleep (subjective and objective)
  - cardiovascular diseases (ischaemic heart disease, stroke, hypertension), diabetes and metabolic diseases
  - cognitive impairment, mental health and wellbeing
  - hearing impairment and tinnitus
  - adverse birth outcomes (pre-term delivery, low birth weight, birth defects)

Interventions

- Review of evidence on interventions and their effect on change in population exposure and on adverse health outcomes

- Interventions can be defined as:
  - Source interventions
  - Path interventions
  - Infrastructure change interventions
  - Indirect interventions
  - Change in behaviour interventions

Evidence Reviews

- Systematic review of annoyance scores and % highly annoyed
- Sleep: Exposure – response curves from analysis of polysomnographic data and meta-analyses of self-report sleep disturbance
- Cardiovascular disease: updated evidence syntheses on hypertension, ischaemic heart disease, stroke, metabolic syndrome (diabetes mellitus, central obesity)
- Cognitive function: narrative reviews of reading comprehension, long term memory, working memory, executive function, attention, standardised achievement test data
- Mental ill-health: CMD, quality of life, psychotropic medication, in adults, emotional and behavioural disorders and wellbeing in children
- Adverse birth outcomes: low birth weight, pre-term delivery, congenital abnormalities
- Hearing impairment: narrative reviews of leisure noise including PLDs, permanent hearing loss, tinnitus
- Interventions: source, pathway, infrastructure, indirect and behavioural change

New research needs

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Study design

Longitudinal prospective and retrospective studies designed for noise effects!

(e.g. mental health, cognition, leisure noise)

Long term effects of sleep disturbance on health

Mechanism-guided studies to assess competing theoretical mechanisms of health effects

Use of registry health outcome data

Annoyance and sleep disturbance as intervening factors between noise exposure and health outcomes

New research needs

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Noise exposure assessment

Refining exposure assessment to reduce exposure misclassification

Include occupational assessments and noise exposure during commuting

Studies of effects of combined noise sources

Tension between harmonised noise metrics and developing new noise indicators

More rail and wind farm studies needed

New research needs

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Populations and lifecourse approaches

Lifecourse approach: helpful understanding cumulative effects and critical periods

Prenatal exposure, epigenetic changes and downstream health consequences

Influence of new migrants health in population studies

Gold standard measures of polysomnography need larger samples to explore subgroup differences (more rail, road and windfarm studies)

New research needs

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Confounding factors and effect modification

More consideration of confounding factors in sleep, birth outcome, intervention studies

Air pollution, noise exposure: an issue for road traffic noise studies

Synergistic effects, confounding, independent direct effects?

Role of ultrafine particles

Understanding differences in health risks by gender

Understanding the role of vulnerability factors e.g. pre-existing disease (sleep studies)

New research needs

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Health outcomes

Standardisation of health outcome measures across studies

Greater focus on ‘objective’ rather than self-report health outcomes e.g. for wind turbine studies

Ecological momentary assessments of annoyance and wellbeing

New outcomes: Diabetes mellitus, metabolic syndrome, cancer - need for studies on exposure-response associations in diabetes, stroke and obesity

New research needs

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Interventions

Important future priority – annoyance, cognition, mental health, sleep

Sufficient duration to cover health effects as well as noise reduction

Standardised study protocols needed for comparability and replication

Natural experiments taking advantage of noise exposure change are a priority

Conclusions

- These evidence based reviews give a solid foundation on which to base recommendations for environmental noise limits
- The strength of the evidence on environmental noise and health varies across health outcomes
- These reviews have clearly highlighted a need for new studies, new methods and new outcomes
- There is plenty of scope for new research on noise and health

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