Use up-to-date guidelines

Clarifying the relationship between the WHO 2018 Environmental Noise Guidelines for the European Region and the 1999 Guidelines for Community Noise for dwellings exposed to transport noise.

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Since the publication of the WHO 2018 Environmental Noise Guidelines for the European Region (ENG2018)[1], one particular paragraph that references the Guidelines for Community Noise (CNG)[2] seems to have caused differing interpretations amongst some practitioners in the UK.

This issue has recently cropped up in a 'Letter to the Editor' by Clarke and Fiumicelli[3] and in a position statement published online by the CIEH[4]

The paragraph in question is (Section 2.6.3, p.28)[1]:

The current environmental noise guidelines for the European Region supersede the CNG from 1999. Nevertheless, the GDG recommends that all CNG indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid.*

In this article we provide guidance on how this statement should be interpreted correctly, following the principles clearly set out in the respective WHO guidelines. In particular, we explain why the ENG2018 supersede the CNG, and which aspects of the CNG remain valid.

This article is only relevant to residential settings ('dwellings') exposed to transport noise.

Summary

When referring to WHO guidelines to set criteria for residential settings (dwellings) exposed to transport noise, the main reference should be to the WHO Environmental Noise Guidelines for the European Region (ENG2018), because they are the most up-to-date guidelines. Additional consideration can be given to the indoor P34

References

* Guideline Development Group – see glossary for more details.
1 WHO (2018). Environmental Noise Guidelines for the European Region. WHO Regional Office for Europe.
2 WHO (1999). Guidelines for community noise. Geneva: World Health Organization.
3 Clarke E and Fiumicelli D (2024). Reductive proposals for BS 8233 update. IOA Acoustics Bulletin 50(6).
4 **https://www.cieh.org/media/mi1cdqqk/cieh-statement-on-proposed-revisions-to-bs8233.pdf**

Specific environment	Critical health effect(s)	L_{Aeq} (dB)	Time base (hours)	L_{Amax} fast (db)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	
Inside bedroom	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

guideline values in the Guidelines for Community Noise [CNG (1999)], but only if this is done in conjunction with the external guidelines in the ENG2018, and taking into account the source-specific characteristics of the sound (e.g. intermittency, low frequency content, etc). In writing the ENG2018 it was clear that the indoor guidelines from the CNG (1999) could not and should not be quoted or used in isolation. This is in accordance with the principles and underpinning evidence clearly set out in both documents.

Supporting information

To get clarity on the relationship between the CNG (1999) and the ENG2018, it is important to first understand how the CNG values for dwellings were derived.

WHO Guidelines for Community Noise (1999)

The WHO Guidelines for Community Noise (CNG) were the outcome of a WHO expert task force meeting held in the UK in April 1999. They were based on a 1995 report *Community Noise* prepared for the World Health Organization by the Stockholm University and Karolinska Institute. The objective was then formulated as[2]:

'to *consolidate scientific knowledge of the time on the health impacts of community noise and to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in nonindustrial environments*'.

The term 'community noise' was defined as '*noise emitted from all sources except noise at the industrial workplace*'. It included noise from road, rail and air traffic, industries, construction and public work, indoor sources (ventilation systems, office machines, home appliances), neighbours and neighbourhood (from premises and installations related to the catering trade, discotheques, live or recorded music; sport events including motor sports, playgrounds, car parks, and domestic animals such as barking dogs). The CNG were based on studies published up to 1995 and a few meta-analyses published between 1995-98. Guidelines were set for specific environments, depending on the health effects deemed relevant for a specific environment.

Above: Figure 1: An extract from Table 4.1 in the WHO Guidelines for Community Noise (1999)

For dwellings, the critical effects were deemed to be sleep, annoyance and speech interference. Figure 1 reproduces the relevant part from Table 4.1 in the CNG. A fundamental principle that is often overlooked is that the CNG provided a set of criteria for inside **and** outside dwellings. Compliance with the CNG can only be claimed if values are met **both outdoor and indoors**. Of particular note is that the outdoor and indoor guideline values are linked together by a fixed difference of 15 dB. This was chosen as representative of the outdoor to indoor sound level difference for a typical room in a dwelling with a partially open window.

In the next sections we look in a bit more detail at the underpinning evidence that informed the 35 dB $L_{Aeq,16hr}$ guideline for inside dwellings and the 30 dB $L_{Aeq,8hr}$ + 45 dB $L_{Af,max}$ for inside bedrooms.

Dwelling, indoors

For inside dwellings, the critical effects were speech intelligibility (interference with speech communication) and moderate annoyance. For speech intelligibility the guideline was based on the following (Sec 3.3):

'*For complete sentence intelligibility in listeners with normal hearing, the signal-to-noise ratio (i.e. the difference between the speech level and the sound pressure level of the interfering noise) should be 15-18 dBA (Lazarus 1990). This implies that in smaller rooms, noise levels above 35 dBA interferes with the intelligibility of speech (Bradley 1985) ... For vulnerable groups even lower background levels are needed.*'

For annoyance, the indoor guideline was based on the observation that during the daytime few people are moderately annoyed with L_{Aeq} levels (outdoors) below 50 dB (Section 4.2.7), and assuming that the noise reduction from outside to inside with windows partly open is 15 dB (Section 4.3.1).

Therefore, the CNG indoor guideline level is only met in dwellings that can achieve 35 dB $L_{Aeq,16hr}$ indoors **and** ≤50 dB $L_{Aeq,16hr}$ outdoors. Or framed differently, the CNG indoor guideline level needs to be met with a window partly open. A dwelling achieving 35 dB $L_{Aeq,16hr}$ indoors with, say 60 $L_{Aeq,16hr}$outdoors does not meet the criteria that underpinned the CNG Guideline Value, because it would not achieve 35 dB $L_{Aeq,16hr}$ indoors when the windows are partly open.

The CNG also state that for annoyance, '*Noise with low frequency components require even lower levels. It is emphasised that for intermittent noise it is necessary to take into account the maximum sound pressure level as well as the number of noise events.*"

Inside bedrooms

In bedrooms, the critical effect was considered to be sleep disturbance. The CNG states (Sec 3.4):

'*If negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30 dBA indoors for continuous*

References

2 WHO (1999). Guidelines for community noise. Geneva: World Health Organization.

noise. If the noise is not continuous, sleep disturbance correlates best with L_{Amax} and effects have been observed at 45 dB or less. This is particularly true if the background level is low. Noise events exceeding 45 dBA should therefore be limited if possible. For sensitive people an even lower limit would be preferred. It should be noted that it should be possible to sleep with a bedroom window slightly open (a reduction from outside to inside of 15 dB). To prevent sleep disturbances, one should thus consider the equivalent sound pressure level and the number and level of sound events. Mitigation targeted to the first part of the night is believed to be effective for the ability to fall asleep.'

This paragraph is reflected in Table 4.1 of the CNG (reproduced in Figure 1 above), which clearly sets out guideline values for both indoors and outdoors, expressed as both an equivalent sound pressure level and $L_{Af,max}$. The 30 dB $L_{Aeq,8hr}$ value was derived from two studies on road traffic noise and self-reported sleep disturbance. (Kageyama et al. 1997, Öhrström 1993). The CNG also state that special attention should be given to sources with low frequency components, combined noise and vibration if present, and environments with a low background noise level. To protect sensitive persons, lower guideline values for $L_{Af,max}$ would be preferred when the background level is low.

Why do the ENG2018 supersede the CNG?

The Environmental Noise Guidelines for the European Region (ENG2018) describe in detail how they differ from previously published noise guidelines. In the interests of brevity, we only highlight a selection of these differences here.

- The development process for the ENG2018 adhered to a new, rigorous, evidence-based methodology, consistent with the WHO Handbook for Guideline Development (WHO, 2014c). WHO adopted these internationally recognised standards to ensure high methodological quality and a transparent, evidence-based decision-making process in the guideline development.
- The process of guideline development was conducted by several groups with clearly defined roles and responsibilities: Steering Group, the GDG, the Systematic Review Team and the External Review Group.
- Guidelines were based on relevant risk increases of adverse health effects defined a priori.
- The process of guideline development was based on high quality systematic reviews and meta-analyses of the scientific evidence commissioned specifically by the WHO.
- The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was followed to rate the quality of the body of evidence.
- The ENG2018 include an exact exposure value for every health outcome regarded as critical, for each noise source. Guideline recommendation values were set for each of the noise sources separately, based on the exact exposure values and a prioritisation scheme.
- The ENG2018 apply a 1 dB increment scheme, whereas prior guidelines formulated or presented recommendations in 5 dB steps.
- In comparison to the 1999 CNG, which defined environment-specific exposure levels, the ENG2018 are source specific.
- The ENG2018 does not consider speech intelligibility as a health outcome, however disturbance of communication is considered as a contributor to noise annoyance[5], which is included.

The recommendations in the ENG2018 are expressed in terms of annual averaged sound levels for outdoor exposures because:
a) the relevant health outcomes are long-term (chronic) health outcomes; and
b) the most relevant high-quality evidence is expressed in terms of long-term averaged **outdoor** sound levels.

In recent years there has been an increase in high quality mechanistic studies. These studies make an important contribution to the body of evidence, in particular to test whether observed associations are causal[6]. P36

References

5 R. Guski, D. Schreckenberg, R. Schuemer (2017). WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Annoyance. Int. J. Environ. Res. Public Health 2017, 14, 1539.

6 T. Münzel et al. (2024). Transportation Noise Pollution and Cardiovascular Health. Circulation Research 134.

However mechanistic evidence tends to be less relevant when setting guidelines for the general population, due to issues with generalisability and the need for results to refer back to the population It is also important to note that noise is a psychosocial stressor[7-9], and the pathway between sound and health is not a simple, direct, straight line between the dose at a person's ear and a manifest disease. From this perspective, the averaged outdoor sound level should not be seen as a proxy to the indoor level, but a measure of the sound exposure at the place where people call 'home'.

One specific effect deserves special attention: physiological sleep disturbance.
The ENG2018 state[1]:
'*the current guideline values for the night time are only based on the prevalence of self-reported sleep disturbance and do not take physiological effects into account. The causal link between immediate physiological reactions and long-term adverse health effects is complex and difficult to prove. Thus, the current guidelines are restricted to long-term health effects during night time and therefore only include recommendations about average noise indicators: L_{night}. Nevertheless, the evidence review on noise and sleep (Basner & McGuire, 2018) includes an overview of single-event exposure–effect relationships.*'

It is important to note that 'sleep disturbance' is a broad term that should encompass the entire sleep process, including total sleep duration, time for falling asleep, difficulty falling back to sleep after an awakening and arousals during the sleep cycle.

What is the added value of the CNG1999 for dwellings exposed to transport noise?

Considering the evidence underpinning the CNG, the conclusion for disturbance to speech communication is likely to still be valid. However, the relevant value was derived under the assumption of a constant background sound, which would only be relevant to sound ingress from a constant stream of road vehicles moving at uniform speed, or for relatively large distances from source to receptor. The assumption is not applicable to other conditions of road traffic (e.g. dwellings close to busy roads in urban environments), nor to sound from rail vehicle pass-bys and aircraft flyovers. The values linked to annoyance are superseded by the evidence in the ENG2018. Similarly for values linked to self-reported sleep disturbance. For L_{max} values indoors, more recent evidence[10] suggests that road/rail/aircraft events with $L_{AS,max}$ > 35dB can cause a noise induced arousal.

Glossary

GDG – Guideline Development Group. This Group defined the key questions and priorities of the research, chose and ranked outcomes and provided advice on any modifications of the scope as established by the Steering Group. The members also outlined the systematic review methods, appraised the evidence used to inform the guidelines and advised on the interpretation of this evidence, with explicit consideration of the overall balance of benefits and harms. Ultimately, the GDG formulated the final recommendations, taking into account the diverse values and preferences of individuals and populations affected. It also determined the strength of the results and responded to external peer reviews.

References

1 WHO (2018). Environmental Noise Guidelines for the European Region. WHO Regional Office for Europe.
7 P. Lercher (1996). Environmental Noise and Health: An Integrated Research Perspective. Environment International 22(1).
8 W. Babisch (2014). Updated exposure-response relationship between road traffic noise and coronary heart diseases: A meta-analysis. Noise and Health 16(68).
9 C. Clark, D. Vienneau, GM Aasvang (2024). Ch. 4 Noise and Effects on Health and Well-Being. In A Sound Approach to Noise and Health. Springer.
10 M. Basner, S McGuire (2018). WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep. Int. J. Environ. Res. Public Health 2018, 15, 519.