

Community Noise, Hearing Health, and Communication Limits

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Soundscapes

Community noise soundscapes are a mix of soft to loud sounds at different times of day. For example, a soundscape might include voices, birds chirping, gas leaf blowers, vehicle traffic, or construction noise.

World Health Organization (WHO, 2018) internationally recommended Environmental Noise Guidelines prevent speech interference and protect everyone from noise-related mental, physical, and hearing health damage. This protects two basic human rights:

- Human right to hearing health
- Human right to communication

Most people don't have loud non-work noise exposure every day. But even occasional indoor or outdoor noise adds up over time. This includes chronic, intermittent, and impact noise from wind turbines, aircraft, traffic, sirens, trains, transit, yard equipment, construction, restaurants, bars, cinemas, gyms, nightclubs, sports arenas, and more.

“If ears bled” (Schmid, 2019)

Community Noise Statistics

- People get 58% of unhealthy exposure from community noise (non-work)

- 70% of men and 65% of women have community exposure higher than recommended WHO (2018) limits
- Average noise exposures exceed community health limits around the world, e.g. soundscape noise is too loud. If ears bled, ears would be bleeding for:
 - 88% of people in Sweden
 - 70% of people in U.S.
 - 84% of people in Spain
 - 85% of people in China

Hearing safe listening limits are based on international public health guidelines meant to protect 100% of the general population from noise-related hearing health damage.

Table: Auditory Safe Listening Limit by Average Noise Level

Auditory Safe Listening Limit	Average Noise Level
15 minutes	90 dB Leq
30 minutes	87 dB Leq
1 hour	84 dB Leq
2 hours	81 dB Leq
4 hours	78 dB Leq
8 hours	75 dB Leq

Auditory Safe Listening Limit (WHO, 2011, 2018). dB Leq = equivalent continuous noise level

Noise Damage to Hearing Health

People with “normal” hearing notice noise-induced music and speech distortion long before permanent noise-induced hearing loss shows up on hearing tests. Noise damage includes hidden hearing loss, speech-noise-ratio loss, tinnitus (ringing or other ear noises), noise-induced hearing loss, and early age-related hearing loss.

Hidden Hearing Loss (cochlear synaptopathy) was discovered in 2009. It's called hidden hearing loss because there are no signs or symptoms, and it can't be detected on any current hearing system tests. Hidden hearing loss can only be identified after death during hearing system autopsy:

- snapped connections between inner ears (cochleas) and hearing nerves
- progressive fraying of hearing nerves for 6 or more months after noise ends

Speech-to-Noise Ratio Loss is when people have problems communicating in background noise or difficult listening situations. Noise-induced hearing system distortion is a leading cause, whether people have “normal” hearing or hearing loss.

Tinnitus can be temporary or permanent after noise damage. Scientists suggest noise-induced hearing nerve damage is an underlying cause, whether people have “normal hearing” or hearing loss.

Noise-Induced Hearing Loss has different severity depending on the noise level and whether a person keeps having repeated unhealthy exposure over time.

- Noise-induced temporary hearing changes or muffled hearing goes away about 24 hours after noise stops
- By the time people notice temporary changes, hidden hearing loss has already happened.
- A small group of scientists deny hidden hearing loss. They believe there is no ethics problem with using high level noise on human subjects to study hearing protection drugs. The answer is noise control not more pharmaceuticals.
- Permanent noise-induced sensorineural hearing loss is from inner ear sensory damage plus hearing nerve damage

Preventable Early Age-Related Hearing Loss starts around age 20 to 55 years old. It happens when people have a history of chronic noise exposure. This

sensorineural loss is mainly hearing nerve related, so there is also hearing system distortion, and speech-to-noise ratio loss.

Age-Related Hearing Loss normally starts around age 55 years and older. It's part of the natural aging process, and is mainly from changes to inner ear sensory systems plus some hearing nerve changes.

Table: Sensorineural Components of Presbycusis versus Noise Damage + Presbycusis

Presbycusis	Noise Damage + Presbycusis
Permanent progressive sensorineural hearing loss	Permanent progressive sensorineural hearing loss
Late onset	Early onset at age of first hidden hearing loss or temporary threshold shift
Primary cause = mechanical and metabolic changes	Primary cause = cochlear synaptopathy
Primary sensory pathology = cochleas	Primary neural pathology = auditory nerves
	Neural speech-to-noise ratio loss (hearing tests normal)
	Tinnitus (normal or impaired hearing)
	Noise-induced hearing loss
Presbycusis onset (age 55+)	Presbycusis onset (age 55+)
Primary sensory presbycusis	Primary neural presbycusis greater than sensory presbycusis alone
Primary sensory speech-to-noise ratio loss	Primary neural speech-to-noise ratio loss greater than sensory speech-to-noise ratio loss alone

speech-to-noise ratio loss = degraded communication in indoor/outdoor noise exceeding public health speech interference limits.

“Even mild hearing loss can be a major disadvantage in a world of ever-faster information exchange. People who cannot hear spoken language well enough to

process it quickly may find themselves cut off from others at work, at home, or in social situations.” Zahnert (2011, p. 433)

Conclusion

The goal of making environmental noise softer isn't about silence. Soundscapes will still be mixes of healthy natural human and natural habitat or wilderness sounds. But unhealthy community noise levels must be lowered by abatement and other methods including controlled at source or completely prevented in the first place. Quiet habitat and wilderness areas must be protected and conserved.

WHO Environmental Noise Guidelines (2018, pages 105-111) recommends how experts at local, regional, and national levels should implement environmental noise control and prevention. Their target audience includes, “civil society, patients and other advocacy groups to raise awareness and encourage actions to protect the population, including vulnerable groups, from exposure to noise (p. 108).”

Healthy forward-thinking government policy and legislation must require mandatory noise control for transportation industries, quiet consumer product regulations, action plans for existing noise, and thoughtful community planning, architecture, and quiet design to prevent future noise. It's time to protect:

- Human right to communication (≤ 55 dB avg equivalent continuous noise)
- Human right to hearing health (≤ 70 dB avg equivalent continuous noise)

Sources

Schmid, H. & Raab, K. (2019, Feb 28). The soundscape: too often neglected and poorly understood. [PowerPoint presentation]. Accessed at: Noise in the City [Public presentation], Simon Fraser University, J.S. Woodsworth Chair in the Humanities. Available at: <https://www.youtube.com/watch?v=Vc0t6k07S-8&feature=youtu.be>

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