

TINNITUS TODAY

To Promote Relief, Help Prevent, and Find Cures for Tinnitus

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Unraveling the Complexity of **Tinnitus Research**

**Why Is There No Cure for
Tinnitus?**

**Regenerating Hair Cells
to Repair Hearing Loss
and Tinnitus**

**What Questions Should
a Tinnitus Patient Be Asked?**

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Research on Noise and Its Health Impact

A publication of the



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Noise Affects More Than Your Tinnitus

• NOISE

Rick Neitzel, PhD

The Problem

What if I told you that there is an invisible, odorless, and tasteless pollutant in the environment to which nearly all Americans are exposed, and that this pollutant is increasingly being associated with the number one killer of Americans (cardiovascular disease) as well as cognitive impacts, sleep disturbance, and injuries? This pollutant is also well known for its ability to cause hearing loss.

Since you are reading this article in *Tinnitus Today*, you may not be surprised to learn that this pollutant is noise, which has been linked to tinnitus, in addition to the other effects mentioned above. But you are in the minority — most Americans are

not aware that noise is one of the most common pollutants in our environment or that so



many adverse health impacts have been connected to it. This is not a coincidence and is a direct result of the fact that the United States regulates (or, more accurately, does not regulate) noise in a way that is very different from other, better-recognized pollutants that occur in our air, water, and food.

The Idea

Given the lack of recognition of noise as an important public health threat, we need to better understand and educate the public and policymakers on the health impacts associated with noise exposure. To help do so, the U.S. Centers for Disease Control and Prevention (CDC) National Center for Environmental Health commissioned my research team at the University of Michigan to evaluate health effects potentially associated with noise. We did so using a standardized research method called systematic review.

The goal of a systematic review is to identify all current evidence relevant to a particular research question, and then to analyze and provide a comprehensive and exhaustive summary of that evidence. A systematic review also rates the level of confidence in the evidence after considering potential bias in the studies included in the review. There are a number of possible ways in which scientific studies can be biased, typically as a result of how data are collected, analyzed, and/or interpreted. Reliance on studies with a high degree of bias can lead us to draw incorrect conclusions.

The objective of our systematic reviews was to identify which noise levels, and exposure for how long, cause which health outcomes. The reviews included studies of the effects of occupational, recreational, and ambient environmental noise, with the goal of collecting information necessary to assess and address the public health risks presented by noise.

What We Studied

Based on the results of our initial review of the literature, the CDC and my team identified 11 health outcomes, each of which had been linked to occupational or community noise exposure in at least six existing studies. These 11 health outcomes, in alphabetical order, are as follows:

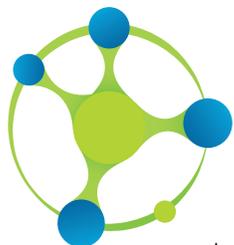
1. Cancer
2. Cognitive effects
3. Endocrine disruption
4. Hypertension
5. Injuries
6. Ischemic heart disease (IHD)
7. Low birth weight (LBW)/ premature birth
8. Mental health and psychological effects
9. Noise-induced hearing loss
10. Obesity/overweight
11. Sleep disturbance

What We Did

We used three large databases to search for available evidence and relevant scientific studies. These included PubMed, a service of the U.S. National Library of Medicine, and two commercial databases, Embase and the ProQuest Agricultural and Environmental Science Database.

We limited our literature searches for each of the health outcomes to chronic studies where people were exposed to noise over a period of at least three weeks. We did this because, although there have been many studies done on people over short periods of time in highly controlled laboratory settings, these studies do not necessarily provide relevant information about the longer exposure periods that people experience in the real world.

| Outcome | # of Studies | Confidence Level |
|--|--------------|--|
| Cancer Including sub-outcomes for certain types of cancer, e.g., breast cancer | 10 | Low or evidence of no health effect, depending on sub-outcome |
| Cognitive effects Including sub-outcomes for reading comprehension and other than reading comprehension | 19 | Low to Moderate , depending on sub-outcome |
| Endocrine disruption Including sub-outcomes of development of, and death from, type 2 diabetes mellitus, as well as changes in cortisol levels | 31 | Low |
| High blood pressure Including sub-outcomes such as changes in blood pressure and hypertension | 65 | Low to Moderate , depending on sub-outcome |
| Injuries Available studies focused on only occupational injuries, accidents, and fatalities | 16 | High for nonfatal injuries, Low to Moderate for other sub-outcomes |
| Ischemic heart disease Including sub-outcomes such as heart attacks and stroke | 38 | High for heart attack, stroke, and any cardiovascular disease Moderate for other sub-outcomes |
| Low birth weight and premature birth Including sub-outcomes of reductions in birth weight and diagnosed premature birth or low birth weight | 12 | Low or inadequate evidence depending on sub-outcome |
| Mental health and psychological effects Including sub-outcomes of depression, anxiety, antidepressant use, and Strengths and Difficulties Questionnaire scores | 30 | Low , Moderate , or inadequate evidence depending on sub-outcome |
| Noise-induced hearing loss Including only studies of non-occupational noise | 28 | Low |
| Obesity and overweight Including sub-outcomes for waist circumference, overweight, obese, increased body mass index, and others | 10 | Low or inadequate evidence depending on sub-outcome |
| Sleep disturbance Including insomnia, difficulty falling asleep, awakenings, and other sub-outcomes | 35 | High for difficulty falling asleep, subjective sleep quality, any sleep-related outcome Low to Moderate for other sub-outcomes |



We also limited the search to include only studies that assessed noise using A-weighted decibels (dBA), the standard approach for human noise exposure measurements. We did this because studies that rely on self-reported or perceived noise exposures cannot give us useful information about specific noise levels above which health outcomes become a risk. This information is essential for setting exposure limits to protect the public.

All of our systematic review searches included studies of occupational, recreational, and ambient environmental noise, with the exception of the search for noise-induced hearing loss. On that topic, another systematic review was recently published focused on occupational noise, so ours focused on nonoccupational noise only.

Finally, for each systematic review, we assessed a range of different possible biases in all studies using a bias assessment tool created by the U.S. National Toxicology Program. We also evaluated our confidence in the association between the studies and outcome (or outcomes) in each systematic review and rated that confidence as *high*, *moderate*, *low*, *evidence of no health effect*, or *insufficient evidence*.

What We Found

The table shows the initial results for all 11 systematic reviews. The number of studies available differed widely between reviews, from 10 for cancer to 65 for high blood pressure.

For three of the 11 health outcomes, we have high confidence

that there is an association between the outcome and noise. These were ischemic heart disease, sleep disturbance, and injuries. There were another three outcomes for which we have moderate confidence that there is an association between the outcome and noise. These were cognitive impacts, high blood pressure, and mental health and psychological effects.

It may be surprising to note the low confidence noted in the table for noise-induced hearing loss. Whereas the association between occupational noise and noise-induced hearing loss has been proven beyond a doubt, most existing studies that have examined the association between recreational and ambient environmental noise and noise-induced hearing loss have been small or of low quality, which lowers our confidence in their results.

For three of the outcomes assessed in our systematic reviews, inadequate evidence is available to assess the association between the outcome and noise exposure, and more research is needed. These three outcomes are cancer, low birthweight and premature birth, and obesity and overweight.

What's Next?

Our assessment of all 11 systematic reviews is ongoing, and the results have not yet been finalized. In particular, we continue to review the specific levels of noise associated with each health outcome as well as the statistical relationship

between increases in noise levels and risk of each outcome. This information is critical to develop guidelines and recommendations to limit public exposures to noise and reduce the risk of health effects.

In the short term, my research team will work with the CDC to finalize the systematic reviews and publish our results in peer-reviewed journals. The goal of these publications will be to increase awareness among the public and policymakers of the health effects associated with noise exposure.

Over the long term, the results of these systematic reviews, as well as other reviews of the existing literature on occupational and non-occupational exposures to and impacts from noise, may be used to develop and refine recommended public exposure limits for noise. The results may also help guide public health interventions designed to reduce the risk of auditory and non-auditory health effects from noise. These efforts will be critical to improve public health in the United States from this important, but under-recognized, pollutant to which most of us are exposed. 



How Can You Protect Yourself From Noise?

By Rick Neitzel, PhD

Noise is an insidious and under-recognized environmental hazard that can negatively impact our lives and health in many ways. The many problems associated with noise and the fact that noise is present in virtually every aspect of our lives can make this hazard seem unconquerable. In fact, research suggests that at least one out of three Americans may be exposed to noise levels that are high enough to harm hearing,¹ and that among Americans living in the largest U.S. cities, that fraction may be as high as nine out of 10!² And it's not just noise-induced hearing loss we have to worry about but also emerging health effects like high blood pressure, heart attacks, and cognitive impacts.

But the good news is that there are many ways for us to tackle this problem. Below are some suggestions for how to reduce exposures to and the impacts of noise.

Recognize the Risk

The first step to solving any problem is admitting the problem exists. And people living in the United States and virtually everywhere else in the world have a noise problem.

Think about your daily and less frequent activities: Where and when does it seem like you get the most noise exposure? If you want to make a more objective assessment, download a smartphone app designed to measure noise. Although such apps are typically not as accurate as dedicated sound measurement

devices, they can provide a sense of noise levels during particular activities and in certain locations.

There are many noise measurement apps available, but one of the best (for iPhones only) also happens to be free and created by the U.S. government. Learn more about the NIOSH Sound Level Meter (SLM) app created by the U.S. National Institute for Occupational Safety and Health at [cdc.gov/niosh/topics/noise/app.html](https://www.cdc.gov/niosh/topics/noise/app.html)

Protect Your Health

Once you identify areas and activities in your life that involve high noise exposures, do something!

- **Limit** your time in high noise by avoiding noisy activities when possible.
- **Move** as far away as possible from high noise sources when you can't limit your time.
- And, when high noise is unavoidable, **use hearing protection** — either earplugs or earmuffs.

You can learn more about how to reduce your risk of hearing loss by visiting the Dangerous Decibels website at [dangerousdecibels.org/](https://www.dangerousdecibels.org/)

Get Educated

The United States has not always turned a blind eye to issues related to noise exposure — in fact, in the 1970s and early 1980s, we led the world in evaluating public noise exposures and their associated impacts. But all that changed in 1981.

If you'd like to learn more why the U.S. Environmental Protection Agency (EPA) — the agency formally

responsible for assessing and addressing the noise problem in the nation — has been unable to take action on this issue for more than 35 years, read the historical account of the situation at [airportnoiselaw.org/epaonac3.html](https://www.airportnoiselaw.org/epaonac3.html)

Reach Out

Legislators and policymakers in the United States have innumerable issues and challenges to deal with, and, unfortunately, noise has not been a high priority in recent decades. However, as citizens, we all have a responsibility — and an opportunity! — to make ourselves heard if we want policies and laws developed to address our concerns.

Take time to identify your local, state, and federal legislators, and let them know by phone call or letter that noise is harmful pollution that needs to be addressed in the same ways we address pollutants in our air, water,

What Can You Do About Noise? (continued)

and food. Ask them to reestablish funding for the EPA Office of Noise Abatement and Control, which would allow the federal government to get back in the business of regulating harmful noise exposures among the American public.

Become a Part of Something Bigger Than You

If you're reading this, you're likely already a member of the American Tinnitus Association, which is a great start. Other organizations are also working to make the United States a quieter and healthier place. You can either join or support to help further this effort:

- National Hearing Conservation Association (hearingconservation.org)
- The Quiet Coalition (thequietcoalition.org)
- Noise Pollution Clearinghouse (nonoise.org)
- Noise Free America (noisefree.org)

What to Expect

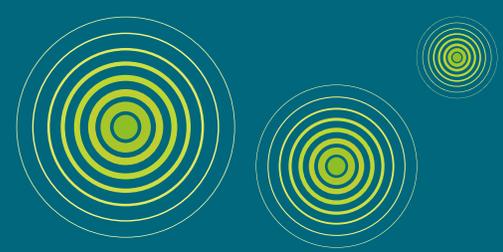
It has taken us decades to get to the point where we are today, and it will take decades to fully address the problem. In the short term, we can ask that noise impacts be considered in planned commercial building and public works projects and ask for the development and enforcement of local noise ordinances.

Over the longer term, we can ask that regulations be put in place to limit noise emissions from motor vehicles, roadways, railways, and other common noise sources, in the same way that emissions from commercial aircraft have been successfully reduced through regulations established by the Federal Aviation Administration.³ We can also ask that the U.S. Occupational Safety and Health Administration place a stronger emphasis on limiting workplace noise exposures in order to reduce noise-induced hearing loss,

one of the most common occupational diseases in the nation.

To learn more about actions that can be taken to address the noise problem in the United States, watch this video created by the University of Michigan School of Public Health: <https://youtu.be/KAhX0sv6Hcw>

- 1 Hammer, M.S., Swinburn, T. K., & Neitzel, R. L. (2014). Environmental noise pollution in the United States: Developing an effective public health response. *Environmental Health Perspectives*, 122(2), 115–119. Available free of charge at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC24311120/>
- 2 Neitzel, R. L., Gershon, R. R., McAlexander, T. P., Magda, L. A., & Pearson, J. M. (2012). Exposures to transit and other sources of noise among New York City residents. *Environmental Science & Technology*, 46(1), 500–508. Available free of charge at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC22088203/>
- 3 Waitz, I. A., Bernhard, R. J., & Hanson, C. E. (2007). Challenges and promises in mitigating transportation noise. *Bridge*, 37, 25–32.



Rick Neitzel, PhD, CIH, FAIHA, is an associate professor of environmental health sciences and global public health in the Department of Environmental Health Sciences at the University of Michigan

(UM) School of Public Health, and he also serves as associate chair of the department.

Neitzel has published nearly 100 peer-reviewed articles focused on exposures to and impacts of noise and other occupational and environmental hazards. He is particularly interested in incorporating new methodologies and exposure-sensing technologies into research and has a strong interest in translating his research findings into occupational and public health practice. In partnership with Apple Inc., he recently launched a national study of music and noise exposure and associated impacts on hearing and heart rate among U.S. adults. He has created a first-ever national job exposure matrix for occupational

noise exposures in the United States and Canada, available at <http://noisejem.sph.umich.edu/> Neitzel is chair of the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values for Physical Agents (TLV-PA) Committee. He is a fellow of the American Industrial Hygiene Association and has been a certified industrial hygienist since 2003. He is also a cofounder of the Quiet Coalition (<https://thequietcoalition.org/>) and serves as an expert consultant to the Make Listening Safe initiative of the World Health Organization.