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The Echoes of Noise: Residential Exposure to Traffic and Risk of Tinnitus

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Noisy occupational settings place workers at risk for adverse auditory outcomes, including tinnitus.[1] But exposure to loud noise off the job—for example, when using earbuds, shooting firearms, visiting nightclubs, or cranking up the volume on computer games—also puts people at risk for tinnitus.[2–4] Tinnitus is characterized by the perception of sound in the absence of an external source—sometimes experienced as a ringing in the ears—and it is a common problem, affecting up to 38% of adults.[5–7] In a cohort study recently published in *Environmental Health Perspectives*, Manuella Lech Cantuaria and colleagues quantified the risk of tinnitus associated with residential road and railway noise exposure.[8]

Loud noises are thought to cause tinnitus by damaging the inner ear hair cells, which transmit sound signals to the brain.[9] However, it is still unclear how, or even whether, chronic noise exposures lead to the condition. The authors of the new study point to papers suggesting that "stressful situations and sleep disturbances precede tinnitus occurrence and contribute to the transition from mild to severe symptoms."[10–12]

The researchers used data from health, administrative, and housing registers for more than 3.5 million Danish adults from 2000 to 2017. By the end of the follow-up period, 40,692 new cases of tinnitus had been diagnosed.[8] The authors used precisely geocoded data for the location and floors of homes and apartment buildings. They modeled noise exposures using detailed information on road traffic (average daily traffic, vehicle distribution, road type, and travel speed) and railway traffic (average train length, train type, and travel speed). Then they quantified associations between road and railway noise at the most- and least-exposed façades of the dwelling and development of tinnitus, based on estimated average exposure over 1-, 5-, and 10-year periods.

No association was found for railway noise. But for road traffic, the estimated risk of tinnitus rose as the average 10-year noise level increased. The risk increased by 6% for every 10-decibel (dB) increase in average exposure at the quietest façade. At the loudest façade, the risk increased by 2% for every 10-dB increase in noise level.

"By using high-quality Danish registers, we had access to the address history of all people in Denmark, and we could then estimate the exact amount of road traffic and railway noise each person was exposed to over a long period of time," says first author Cantuaria, an assistant professor of epidemiology and data science at the University of Southern Denmark's Maersk McKinney Møller Institute. "We found that road traffic noise was associated with a higher risk of tinnitus, with a linear exposure–response relationship when noise was estimated at the least-exposed façade."

Cantuaria suggests that noise levels at the least-exposed façade—or the quieter side of the building—tend to reflect

The researchers considered road traffic noise levels on the quiet side of buildings as a proxy for nighttime exposure or noise during sleep. Roadway noise exposures on both the quietest and noisiest sides were associated with higher risk of developing tinnitus. Railway noise was not associated with tinnitus risk. Image: © iStock.com/mathess.

exposures during sleep, because people may choose to sleep in the quieter rooms.[13] "Our results suggest that noise exposure during sleep can have an even greater effect in increasing tinnitus risk than daytime exposure," she says.

According to the paper's senior author Mette Sørensen, the authors believe this to be the first epidemiological study investigating associations between residential exposure to transportation noise and tinnitus. "Environmental health studies to date have focused on non-auditory health effects of noise," says Sørensen, a senior researcher at the Danish Cancer Society Research Center in Copenhagen. These include cardiovascular diseases,[14,15] stroke,[16,17] and diabetes.[18] Her point is underscored by the World Health Organization (WHO), which in 2018 reported finding no studies investigating road transportation noise and hearing-related outcomes, even though these are among the critical outcomes identified for development of policies regarding noise pollution.[19]

Martin Röösli, an associate professor of environmental epidemiology and head of the Environmental Exposures and Health Unit at the Swiss Tropical and Public Health Institute, says previous studies on tinnitus focused on noise levels above 85 dB (such as occupational noise), at which there is solid evidence for a link.[1,20] Röösli, who was not involved in the Danish study, noted, "The pattern of higher risks of tinnitus among women, people without hearing loss, people with high education and income, and people who had never been in a noisy job is plausible as these groups may have less competing risk from occupational exposure; thus, the road traffic noise effect is not diluted." Moreover, the authors suggested that women and those with higher education and income might be more likely to seek—and receive—medical help for the problem than other groups.

Noise exposure is just one risk factor for tinnitus; others include anxiety, depression, hearing loss, and other health conditions.[9,21,22] The WHO estimated that, in Europe, environmental noise—which was defined as including noise from transportation (road traffic, railway, and aircraft), wind turbines, and leisure activities—caused a loss of 22,000 disability-adjusted life-years (years of living without disability) due to tinnitus.[23]

"Since the number of studies linking traffic noise with adverse health effects continues to grow, there are reasons to believe that the health consequences of traffic noise are likely much greater than what we assume today," says Cantuaria. "It is thus essential to know more about the harmful effects of noise so that effective public health policies can be implemented."

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