Scientist Challenges the Conventional Wisdom That What You Can't Hear Won't Hurt You

Wind turbines are rapidly becoming popular in the United States

A wind turbine is a rotary device with a gigantic propeller as big as a football field that turns in the wind to generate electricity. Although wind turbines are more often found in Europe than in the United States, they're rapidly becoming more popular here as a "green" energy source. Most people consider that a good thing, except the rotors of wind turbines also generate noise, particularly in the infrasound range, that some people claim makes them feel sick.

Since frequencies that low can't be heard, many scientists who study hearing have assumed they can't have any effect on the function of the ear. But a little known phenomenon related to the infrasound generated by wind turbines is making some scientists challenge the common wisdom that what we can't hear won't hurt us.

Infrasound is a subset of sound broadly defined as any sound lower than 20 Hertz (Hz), which is the lowest pitch that most people can hear. It's all around us, even though we might only be barely able to hear a lot of it. The whoosh of wind in the trees, the pounding of surf, and the deep rumble of thunder are natural sources of infrasound. Whales and other animals use infrasound calls to communicate across long distances. There is also a wide range of manmade infrasounds, for example, the noise generated by industrial machinery, traffic, and heating and cooling systems in buildings.

Alec Salt, Ph.D., is an NIDCD-supported researcher at Washington University in St. Louis who studies the inner ear. For years, he and his group have been using infrasound as a way to slowly displace the structures of the inner ear so that their movement can be observed. In their experiments, infrasound levels as low as 5Hz had an impact on the inner ears of guinea pigs.

“We were doing lots of work with low-frequency tones,” says Salt, “and we were getting big responses.” What they were observing in the lab, however, didn’t jibe with the scientific literature about hearing sensitivity, which was in general agreement that the human ear doesn’t respond to anything as low as 5Hz. Since human ears are even more sensitive to low frequencies than guinea pig ears, that didn’t make sense.

Salt and a colleague conducted a literature search, focusing not on papers about hearing sensitivity, but on the basic physiology of the inner ear and how it responds to low-frequency sounds. During the search, Salt found anecdotal reports of a group of symptoms commonly called “wind turbine syndrome” that affect people who live close to wind turbines.

“The biggest problem people complain about is lack of sleep,” says Salt, but they can also develop headaches, difficulty concentrating, irritability and fatigue, dizziness, and pain and pressure in the ear.

Continuing his search, Salt began to see a way in which infrasound could impact the function of the inner ear, by the differences in how inner ear cells respond to low frequencies. In function, our ear acts like a microphone, converting sound waves into electrical signals that are sent to the brain. It does this in the cochlea, the snail-shaped organ in the inner ear that contains two types of sensory cells, inner hair cells (IHCs) and outer hair cells (OHCs). Three rows of OHCs and one row of IHCs run the length of the cochlea. When OHCs are stimulated by sound, special proteins contract and expand within their walls to amplify the vibrations. These vibrations cause hairlike structures (called stereocilia) on the tips of the IHCs to ripple and bend. These movements are then translated into electrical signals that travel to the brain through nerve fibers and are interpreted as sound.

Only IHCs can transmit this sound signal to the brain. The OHCs act more like mediators between sound frequencies and the IHCs. This wouldn’t matter if the OHC behaved the same way for all frequencies—the IHCs would respond to what the OHC amplified—but they don’t. It turns out that OHCs are highly sensitive to infrasound, but when they encounter it, their proteins don’t flex their muscles like they do for sound frequencies in the acoustic range. Instead they actively work to prevent IHC movement so that the sound is not detected. So, while the brain may not hear the sound, the OHC responses to it could influence function of the inner ear and cause unfamiliar sensations in some people.

Salt and his colleagues still aren’t sure why some people are sensitive to infrasound and others aren’t. It could be the result of anatomical differences among individual ears, or it could be the result of underlying medical conditions in the ear that cause the OHCs to be ultrasensitive to infrasound.

Regardless, it might not be enough to place wind turbines further away from human populations to keep them from being bothersome, since infrasound has the ability to cover long distances with little dissipation. Instead, Salt suggests wind turbine manufacturers may be able to re-engineer the machines to minimize infrasound production. According to Salt, this wouldn't be difficult. "Infrasound is a product of how close the rotor is to the pole," he says, "which could be addressed by spacing the rotor further away."