where else may be partly to blame. Research by instructor in otology and laryngology Brian Fligor, who directs the Diagnostic Audiology Program at Harvard Medical School, suggests that if you’re not willing to trade them in for something more old-fashioned, you should at least be careful.

Fligor’s study, published in Ear and Hearing, the journal of the American Auditory Society, compares differences in the level of sound produced by large, over-the-ear headphones, and by the small, in-ear-style headphones typified by the iPod. When playing the same recordings at the same setting on the same CD player, the smaller headphones produced sounds that were louder by as much as 9 decibels (dB), depending on the particular brand. That’s enough to push safe listening into unsafe territory. Decibels are measured on a logarithmic scale: going from 60 to 70 decibels means having 10 times as much force acting on the eardrum and inner ear. In everyday terms, playing the noise of a vacuum cleaner (60 dB) through in-ear headphones would generate sound as loud as a motorcycle engine’s (70 dB).

Fligor emphasizes that headphones can’t really cause deafness; they can only enable listeners to deafen themselves. Decibel levels depend on both the headphones and the music player’s output, so listeners can choose levels and durations that won’t damage hearing. Fligor recommends not exceeding 50 to 60 decibels (usually the halfway level for a CD player) for an hour of listening.

Unfortunately, many people don’t limit themselves to safe levels. In the case of home stereos or car radios, the tolerance of neighbors or the length of the commute are limiting factors, but with personal headphones, says Fligor, “There’s no one to stop you but yourself.” A survey by the National Acoustic Laboratories in Australia suggests that we aren’t stopping ourselves: a quarter of those sampled regularly listened to headphones at potentially hazardous levels.

What makes such high levels habitual? Ironically, it’s the same quality that lets the oblivious iPod user finally hear you shout “Excuse me”—most in-ear headphones don’t block background noise. Meanwhile, their portability permits listening in many different environments, even noisy ones. Although it’s convenient (and safer) to hear the traffic sounds while jogging to iPod music, most listeners compensate for intruding noise by increasing the loudness of their music proportionally. Commuters who regularly adjust their music’s level to 60 dB (as loud as people talking in the same room) will dial the same tune up to 80 dB or higher on a subway train. (Fligor hopes that headphones that attenuate background noise will someday ameliorate this problem.)

Thus far, the number of people who’ve lost hearing via headphones is relatively small—Fligor himself has only seen 5 such patients, all with mild hearing loss—but he believes that today’s cases are “the tip of the iceberg.” He estimates that 10 to 20 percent of headphone users are at risk of hearing loss due to their bad habits. “We’re all gradually losing our hearing,” he explains. “This just increases the rate of that loss.”

~John La Rue

**TANKLESS JOB**

**Waiting to Inhale**

Extreme sports usually mean speed, danger, or spectacular stunts—things like snowboarding, skateboarding, rock climbing. They may reach heights (paragliding), or depths, as in free diving, whose devotees submerge themselves far below the ocean’s surface without air tanks. In 2003, free diver Tanya Streeter descended on a weighted sled to a record depth of 400 feet and, using a balloon, returned to the surface on a single breath, which—when standing in a pool with her face in the water—she can hold for more than six minutes.

Another diver, Tom Sietas, boasts the world record for a single-breath hold: nine minutes and 58 seconds. (The average adult can go about one minute.) Recently, Streeter, Sietas, and two other free divers came to the Harvard School of Public Health (HSPH) to help associate professor of medicine Robert Banzett and his colleague, research scientist Andrew Binks, investigate dyspnea (shortness of breath, or breathlessness). The divers’ visits were part of a larger research program run by assistant professor of anaesthesia

---

Reprinted from Harvard Magazine. For more information, contact Harvard Magazine, Inc. at 617-495-5746.
Massimo Ferrigno. The investigators hope that studying people so adept at managing their air supply may reveal something that helps those who have trouble getting any air at all.

Breathing troubles turn out to resemble pain—agonizing, hard to describe, fraught with uncertainty. They are also equally common: half the patients admitted to hospitals report dyspnea, the same number who report pain. Dyspnea is a symptom of asthma, emphysema, pneumonia, and heart disease, as well as a leading indicator of panic and anxiety disorders. One-quarter of people over 40 report breathlessness, Banzett notes, and those who experience it are twice as likely to die early.

“We don’t have ways to deal with it as well as [we deal with] pain,” says Banzett, who believes that pain management is about 20 years ahead of treatment for breathlessness. He has directed a dyspnea research lab at HSPH since the late 1980s. His clinic at Beth Israel Deaconess Medical Center is one of only two in the country, but the field is growing. Last spring, Banzett helped organize the first international symposium on dyspnea in 40 years.

Dyspnea includes breathing with difficulty, a tightness in the chest familiar to asthmatics, and a sensation called “air hunger,” in which people feel they can’t get enough oxygen. In 1997, Banzett and colleagues mapped the area of the brain associated with air hunger and found it in the anterior insula, part of the cortex involved with conscious awareness and a place where some kinds of pain also arise. (Autonomic breathing, the kind we do without our awareness, is another way to think about it.)

To explore air hunger, Banzett and his colleagues control breathing with a mechanical ventilator that regulates how often and how deeply each subject breathes. In the course of several minutes, the researchers gradually add more carbon dioxide to the mix to raise CO2 levels in the subjects’ arterial blood. Every 30 seconds, subjects slide a marker over the word best describing their air hunger, from “none” to “extreme.” Afterward, they fill out questionnaires about their state of mind during the test, because mental states can strongly affect the way someone gauges both pain and dyspnea. Says Banzett, “It’s probably that emotional content that gets you to go to the doctor to have it checked out.”

The test subjects often say the sensation they feel in the lab is akin to a long breath hold. Hence Banzett and Binks, a professor at the University of New England, gave free divers (and a control group) the air-hunger test, hypothesizing that the extreme athletes would take far longer to reach a threshold of discomfort than the controls. Instead, the divers experienced air hunger at about the same time as the normal participants. “I was surprised,” says Banzett, who plans to try other tests on the divers. There may be mental adaptations that they use. One of their physical tricks is to hyperventilate for a couple of minutes before going underwater; this expands their lungs and empties them of CO2. Just before submerging, they take in as big a breath as they can, packing in even more air by gulping it with their mouth. (Such tricks, unfortunately, are hardly useful for elderly heart patients, who would likely pass out if they tried them.)

Despite the lack of a breakthrough so far, even null results like these help fill out the picture. “[The results] tell me air hunger is a primal sensation,” says Banzett. “Air hunger is our friend” because, like pain, it’s a warning sign. Yet people can live for years with pain, but no one can long ignore the need for air.

---KATHARINE DUNN

**Breathing troubles turn out to resemble pain—agonizing, hard to describe, fraught with uncertainty.**