

*Research letter***Can hockey playoffs harm your hearing?****William E. Hodgetts, Richard Liu**

Excessive exposure to loud sounds is the leading cause of preventable hearing loss,¹ and most cases of noise-induced hearing loss are due to occupational exposure. The importance of hearing protection in the workplace is now well recognized, and most industries in North America have programs and regulations in place to ensure the hearing health of their workers. Far less attention has been paid to auditory damage caused by noise outside of work. With the popularity of loud devices, such as MP3 players and cellular telephones, and noisy activities, such as rock concerts and sporting events, everyday life is increasingly hazardous to hearing for all members of society. Therefore, there is a growing need to increase awareness of potential sources of damaging sounds and education about the use of hearing protection during leisure pursuits.

This report illustrates the impact that even brief exposure to leisure noise can have on an individual's hearing, through the example of a Stanley Cup final hockey game. The success that the Edmonton Oilers enjoyed during the 2006 Stanley Cup playoffs electrified the city. It was suggested in the media that the arena used by the team was one of the loudest buildings in the National Hockey League, and the Canadian Broadcasting Corporation demonstrated noise levels at certain times during broadcasts with the use of a sound level meter. Although measuring sound levels at key points is informative, what matters most is the exposure of a given individual over the course of the entire game and the effects of that exposure on the person's hearing.

To measure cumulative sound exposure, the second author wore a noise dosimeter to games 3, 4 and 6 of the 2006 Stanley Cup finals between the Edmonton Oilers and Carolina Hurricanes. The effect on the hearing function of the second author and his wife was measured by audiological testing immediately before and after game 3.

Methods**Noise measurement**

A data-logging noise dosimeter was set to sample the noise level near the second author's ear every second for the entire game. Thus, no matter where he was in the building, the dosimeter sampled his noise exposure.

Audiometric tests

Two audiometric tests were used for the pre- and post-game measures: pure-tone audiometry and otoacoustic emissions. Both tests were performed in a double-walled audiometric booth by a licensed audiologist using calibrated equipment. For the pure-tone audiometry test, we measured the softest pure tone that could be detected (threshold) at the following frequencies: 250, 500, 1000, 2000, 4000 and 8000 Hz. The distortion production otoacoustic emissions test assesses the integrity of the outer hair cells of the inner ear. The outer hair cells are important for detecting soft sounds and allow tolerance of a wide range of input intensities. Unfortunately, outer hair cells are usually the first structures to be damaged by exposure to loud noise.

Results**Noise data**

During game 3 of the series, the scoring of goals led to fairly obvious spikes in the noise level (Fig. 1). A level of 120 dB A is roughly equivalent to the sound level of a jet taking flight. (A-weighting is a filtering function applied to the noise dosimeter so that it is sensitive to input frequencies in the same way as the typical adult ear is.) The intermissions offered a temporary reprieve for the ears, but even during those interludes, the noise level was such that in an equivalent 8 h/day workplace environment, hearing protection would be required by law.

The average exposure levels for each game (> 3 hours) were 104.1, 100.7 and 103.1 dB. Standards have been defined for maximum allowable daily noise doses,² and an average level of 85 dB A for 8 hours is generally considered the maximum allowable daily noise dose. Stated differently, this means that there is a risk of hearing damage if you experience that level of noise for more than 8 hours. For each 3 dB increase in average noise level, the time you can safely stay at a level is halved. Thus, at 88 dB, it would take only 4 hours to reach the maximum allowable daily noise dose, at 91 dB it would take only 2 hours, and so on. For the levels experienced in game 3 of the series, the time to reach the maximum allowable daily noise dose was less than 6 minutes. In terms of projected noise dose, each person in the arena not wearing

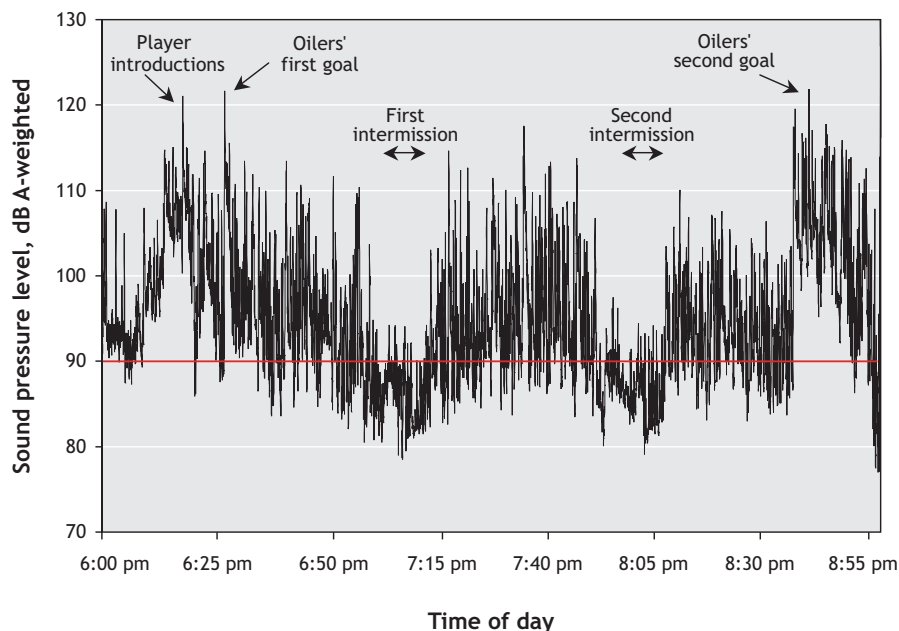


Fig. 1: Noise exposure level for the duration of game 3 of the 2006 Stanley Cup finals. Key points of interest are indicated. The red line at 90 dB indicates a derived “safe” level of this 3-hour game. Sounds above the line have the potential to damage hearing.

hearing protection received about 8100% of their daily allowable noise dose. Given that most fans do not wear hearing protection during hockey games, thousands are at risk for hearing damage.

Audiometric data

Pure-tone audiometric data indicated that the hearing thresholds of both subjects deteriorated by 5 to 10 dB for most frequencies. The biggest changes occurred at 4000 Hz (the frequency known to be most susceptible to noise damage), where subject 2 experienced a temporary threshold shift in one ear of 20 dB. Whereas 5 to 10 dB may be within the test–retest confidence limits of pure-tone audiometry, 20 dB represents a real change in hearing status. It is important to note that this temporary threshold shift usually disappears in a day or two. However, if the ears are subjected to further noise exposure before full recovery, the temporary threshold shift may become permanent.³

According to the otoacoustic emissions data, subject 1 experienced a decrease in the strength of the outer hair cell responses. Consistent with the pure-tone results, the decrease was more pronounced at higher frequencies. For subject 2, the otoacoustic emissions were so strong both before and after the game that any decrease in emissions might have been masked by an equipment ceiling effect. Both subjects described the world as sounding muffled after the games, and both experienced mild ringing tinnitus.

Interpretation

Most people do not consider the risk of excessive noise exposure when participating in leisure activities. However, as this brief report shows, leisure noise over a period of a few hours can be harmful if precautions are not taken. The risk of hearing loss for those who attend hockey games frequently (e.g., season ticket holders, arena workers and the hockey players themselves) warrants serious consideration. Even the cheapest foam earplugs will attenuate sounds by about 25 to 30 dB. At the levels experienced during these hockey games, such earplugs would drop the average sound exposure to below 80 dB, where no hearing damage is likely to occur (even if the game were to go into quadruple overtime). And, contrary to popular belief, communication in noisy environments is actually easier with earplugs than without.⁴

The 2 most common symptoms of excessive noise exposure are hearing loss and tinnitus, both of which can have a substantial negative impact on quality of

life. We live in an increasingly clamorous world, and many of our occupations and leisure activities are potentially hazardous to hearing. More than ever before, there is a need to broaden awareness and better educate everyone about the need to protect hearing, both at work and at play.

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