The Effect Of Subway Station Noise Exposure On Commuter Hearing

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Introduction

The New York City (NYC) subway is the 7th busiest worldwide and carries 5.7 million riders on an average weekday. Unfortunately, for all their utility, subways are notoriously noisy. In NYC, subway noise averages 80-90 A-weighted decibels (dBA) and reaches peaks of 104-121 dBA. These peak subway noise levels raise concern for noise-induced hearing loss (NIHL). Above 105 dBA, recommended noise exposure limits are on the order of minutes. Excessive noise exposure risks NIHL as well as other adverse medical and quality of life issues. Although these data have clear implications for employees, who are required to wear hearing protection by occupational safety regulation, the impact of noise exposure risks NIHL as well as other adverse medical and quality of life issues. In addition, although the typical subway commute does fall within federal standards of allowable daily noise exposure (Table 1), recent Kujawa and Liberman's work demonstrating the progressive consequences of noise exposure on hearing alerts us to the hidden risks of a seemingly temporary threshold shift (TTS) in hearing.

In this study, we evaluate subjects for TTS after subway noise exposure with and without hearing protection, using both pure tone audiometry (PTA) and distortion product otoacoustic emissions (DPOAEs). We aim to better understand the chronic effects of repeated short-term noise exposure, beginning with whether single short term exposures lead to appreciable TTS.

Methods

Eligible Subjects (n = 20) Randomized to 2 Groups

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<thead>
<tr>
<th>Group 1 (n = 10)</th>
<th>First exposure without hearing protection (forced exposure with hearing protection)</th>
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<tr>
<td>Group 2 (n = 10)</td>
<td>First exposure with hearing protection (forced exposure without hearing protection)</td>
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PTA Exposures Testing

- Pure tone audiometry
- 0.5 to 8 kHz pro 3 and 6 kHz
- Threshold in 1 dB increments
- DPOAEs

Noise Exposure

- Stand on subway platform for 3 minutes
- PTA threshold shift < 15 dB
- PTA threshold shift > 15 dB

Post-Exposure Testing

- Pure tone audiometry
- 0.5 to 8 kHz plus 3 and 6 kHz
- Threshold in 1 dB increments
- DPOAEs

First time only

- Washout
- Subjects have 7 day washout period of subway exposure
- Colleagues
- Subjects switch exposures and revisit process

Results

Mean PTA Thresholds Before and After Noise Exposure

A. Left Ear

B. Right Ear

- A statistically significant improvement in PTA thresholds after subway noise exposure was identified, for subjects with and without hearing protection (p<0.001).
- For exposure without hearing protection, the mean threshold was 5.19 dB pre-exposure and 3.91 dB post-exposure (decrease of 1.28 dB; 95% CI, 0.82 – 1.74).
- For exposure with hearing protection, the mean threshold was 4.81 dB pre-exposure and 3.47 dB post-exposure (decrease of 1.34 dB; 95% CI, 0.89 – 1.79). Thresholds returned to baseline during the washout period.

Conclusions

- Subjects exposed to subway noise did not experience detrimental temporary threshold shift during the assessment time period.
- Rather, subjects demonstrated a small but statistically significant sensitization in hearing on pure tone audiometry and distortion product otoacoustic emissions after subway noise exposure.
- Larger studies assessing subway commuter hearing over time would provide a more thorough understanding of the long-term auditory consequences of daily subway noise exposure.
- Still, due to the potential for hidden hearing loss and other adverse effects associated with excessive noise, designing future stations to mitigate commuter noise exposure remains an important public health goal.

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References