The growing popularity of portable digital music players (PMP’s) has led to concern that listening to these devices may adversely affect hearing, particularly in children (1). Teens listen to music at a higher volume than adults and may inaccurately perceive how loud they are playing their music (2). Maximum sound outputs of iPods and other MP3 players sold in the U.S. far exceed safe levels for routine listening. The maximum sound output of the iPod Nano with use of stock earbud earphones was reported to be 111 decibels, A-weighted (3). iPod competitors are in the same range, as maximum output levels have been found to be similar across players (4).

The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit for noise exposure is 85 decibels. A-weighted (dB(A)) as an 8-hour time-weighted average (TWA) with a doubling of sound power each with 3 dB. Exposures at and above 85 dB(A), 8-hour TWA are considered hazardous. In accordance with NIOSH, each doubling of sound power, results in a halving of the recommended exposure time. At this rate, exposure to 111 dB(A), 8-hour TWA would result in a temporary hearing threshold shift (TTS) of 10 dB.

Fay and Ives (7) observed the listening habits of 100 doctoral students and found that only 6% of students listening to music in a quiet environment turned their players to risky levels; however, when in a noisy environment, a dramatically higher percent, 80%, of the students listened to music at risky levels. Research showing a 15.5% rate of noise induced hearing threshold shift among children between the ages of 12 and 19, compared to an 8.5% rate among 6 to 11 year olds (8) has led to further concern that hearing loss in children may be attributed, at least in part, to noise exposure from PMP’s. To address these concerns, foreign regulations forced iPod and other manufacturer’s to impose a 100 dB(A) output limit on units sold in France, and as a result, iPods sold in the EU are volume limited.

To determine whether high school and middle school students listen to their PMP’s at levels that may result in noise induced hearing loss (NIHL), we tested students hearing before and after listening to their PMP and compared pre and post exposure audiogram results.

**METHODS AND MATERIALS**

Subjects most at risk of NIHL due to portable digital music devices, who are likely to be middle school and high school students who report listening to portable music players (9), were recruited for inclusion in this study. Subjects were instructed to avoid loud noise for a 14-hour period. Upon presentation, research protocols were reviewed and assent of students and permission of one parent or guardian was obtained. Subjects were asked to complete a questionnaire, after which a preliminary audiogram was performed to assess the subjects’ baseline of normal hearing. Audiometric testing was conducted with the use of an AMBCO model 1000 pure tone audiometer with use of the automated testing function to avoid testing bias. In this way, testing was automated, in accordance with federal standards, from 0 to 90 dB with a frequency range from 500 Hz to 8000 Hz, with a hard copy print of audiometric results.

Subsequently, each subject was instructed to listen to music on his or her PMP at a volume and for a duration which the subject would regularly listen, for a period not to exceed 60 minutes. Finally, each subject’s hearing was re-assessed immediately after removal of earphones to test for any temporary change in audiometric results.

**CONCLUSIONS**

PMPs are sold in the U.S. without regulatory restriction of the maximum volume output or the age of the individual purchasing the device. It is well documented that the maximum volume settings of units sold in the U.S. are at levels far exceeding federal standards for the occupational setting (3, 5, 11). As these devices have remained popular among children for the past several years, the cumulative exposure of children who listen to PMPs has increased. Less than half of the subjects in our study were aware of the option to set volume limits and only a small percentage actually did so. Furthermore, typical listening patterns were found to result in a temporary noise-induced hearing loss. This research suggests a number of possibilities for future work. In particular, it would be worthwhile repeating the work when simulating conditions under which many students use their PMPs, which include much higher background noise.

Sufficient research showing a negative impact of PMPs might also have public policy implications. We note that the concern about NIHL in Europe has already caused PMPs sold there to have different characteristics than those sold in the U.S.