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Sound Output Levels of the iPod and Other MP3 Players: Is There Potential Risk to Hearing?

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With the increasing popularity of portable digital music players (MP3 players), questions about the dangers of these devices have been prevalent in the media. This study evaluates the output levels of several popular players to determine the risks to hearing from using these devices.

We examined five MP3 players from three manufacturers, using stock earphones as well as four other models of earphones with each player. Output levels were measured from five popular music genres, noise, and pure tones using each of the players and each of the earphones. From these recordings, we determined the full range of output, from very low to maximum settings on the volume control.

Results

The graph below shows how the output level changes as the volume control increases, for each of the five players, when using their stock earphones. It is interesting to note that the output levels are fairly similar across players, especially toward the maximum volume control.

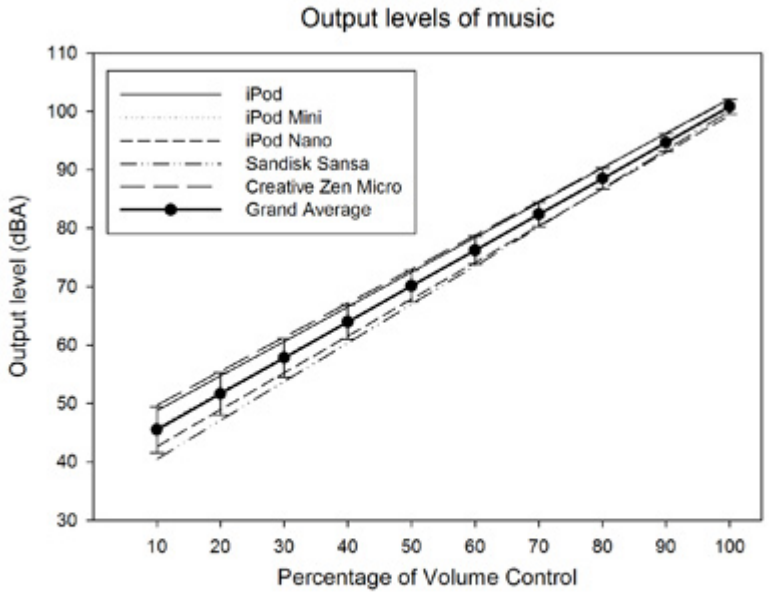

Figure 1. Free-field equivalent output levels of 5 MP3 players, using stock earphones, as a function of volume control settings. The Grand Average is the mean of all music genres across all players. Error bars represent 1 standard deviation around the Grand Average.

Differences in output level were seen across different types of earphones. The graph below shows the output levels for the five types of earphones. On average, output levels of earbud-style earphones are 5.5 decibels higher than earphones that sit on top of the ears (supra-aural earphones).

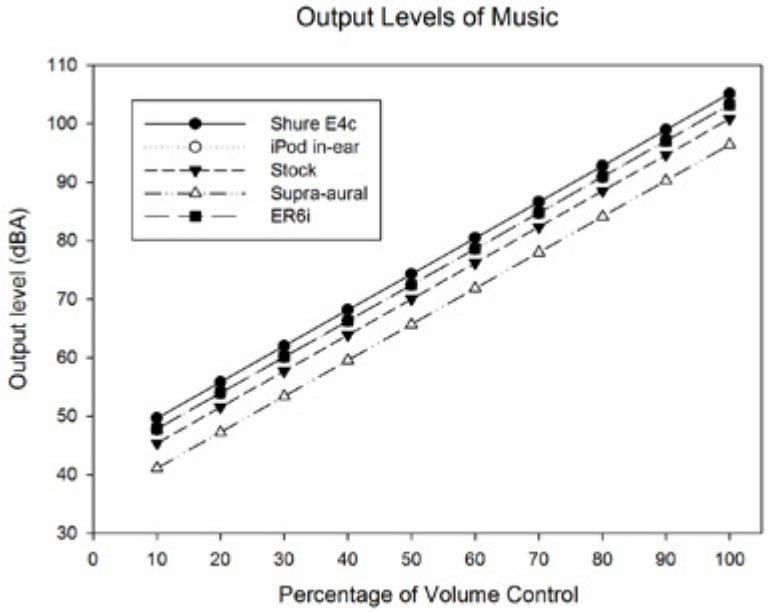

Figure 2. Free-field equivalent output level for all genres of music as a function of volume control setting for 5 models of earphones. Output levels are averaged across all MP3 players.

Furthermore, no significant differences were found between genres of music. When played at maximum volume settings, our samples of Rock, R & B, Country, Dance, and Top 40 music had similar output levels.

Recommendations

Damage to hearing occurs when a person is exposed to loud sounds over time. The risk of hearing loss increases as sound is played louder and for longer durations. Therefore, the recommended listening time varies as the volume control changes. The table below shows our recommended maximum listening time per day, depending on the style of earphones used and the volume control settings on the player. On this chart, the “Isolator” style refers to earphones that have been reported to block out background noise, and “Supra-Aural” style refers to earphones that sit on top of the ear. The final column shows our measurements for the iPod, using the stock earbuds from Apple.

% of Volume Control	Maximum listening time per day			
	Earbud	Isolator	Supra-Aural	iPod, stock earphones
10-50%	No limit	No limit	No limit	No limit
60%	No limit	14 hours	No limit	18 hours
70%	6 hours	3.4 hours	20 hours	4.6 hours
80%	1.5 hours	50 minutes	4.9 hours	1.2 hours
90%	22 minutes	12 minutes	1.2 hours	18 minutes
100%	5 minutes	3 minutes	18 minutes	5 minutes

Table 1. Maximum listening time per day using NIOSH damage-risk criteria. "Earbud" includes stock earphones and iPod In-ear earphones. "Isolator" includes Etymotic ER6i earphones and Shure E4c earphones. "Supra-Aural" includes Koss headphones that rest on top of the ear.

The maximum listening times above represent the amount of time that a typical person could listen to their MP3 player every day without greatly increasing their risk of hearing loss. It is important to note, though, that not everyone shares the same risk of hearing loss. For some people who have “tougher” ears, these recommendations are overly conservative. For other people with more “tender” ears, these recommendations do not eliminate the risk of hearing loss. Today, however, we have no way of predicting who has “tough” ears and who has “tender” ears. Hearing loss occurs slowly and is often not noticed until it is quite extensive, so early prevention is the key.

The results of this study suggest that MP3 players produce high enough sound levels to pose a risk of hearing loss, if used at high enough volumes for extended durations. As technology improves, with greater music storage and longer battery life, it is possible that people will choose to listen for long periods of time. Users of MP3 players must be aware of their volume levels, and the maximum amount of time they can listen at their chosen volume without risking hearing loss.

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