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# Music-Induced Hearing Loss: What Do College Students Know?

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Noise-induced hearing loss (NIHL) has been attributed to several factors such as environmental (e.g., restaurants [Buckley, 2012] and subways [Neitzel, Gershon, McAlexander, Magda, & Pearson, 2011]) and occupational influences. Sociocusis, hearing loss as a result of potentially noxious levels of noise due to modern civilization, increases the risk of NIHL (Montgomery & Fujikawa, 1992).

Listening to music is the most common form of recreational exposure to sound (Henry & Foots, 2012). Personal listening device (PLD) users are not considered to be listening to noise because noise is defined as unwanted or undesired sound (Occupational Safety and Health Administration [OSHA], 2013). Music is not noise; thus, music-induced hearing loss (MIHL) is more appropriate nomenclature than NIHL (Morata, 2007; Morata & Johnson, 2011).

The popular iPod has sold more than 360 million units since 2006 (Statista, 2014). Of particular interest and concern to public health officials, audiologists, and pediatricians is the high-frequency

ABSTRACT: **Purpose:** The purpose of this study was to examine college students' knowledge of intense levels of music on their hearing and the effects of safe listening habits.
**Method:** Four hundred college students (100 each freshmen, sophomores, juniors, and seniors) were surveyed on their knowledge of safe listening levels of personal listening devices (PLDs).
**Results:** College students' knowledge of safe PLD-listening levels was related to gender, college class, and PLD-pattern use. A statistically significant relationship between gender and PLD-pattern use was found: $X^2(1, N = 399) = 8.72$, $p = .003$, $\Phi = .15$. More males reported heavy PLD use and were less knowledgeable than females regarding safe PLD use. Significant relationships were also found between college class and safe PLD-listening levels at maximum output/day, $X^2(3, N = 400) = 8.03$, $p = .045$, Cramer's V = .14, and between PLD-pattern use safe PLD-listening levels at maximum output/day, $X^2(3, N = 399) = 13.23$, $p = 0.04$, Cramer's V = .18. Freshmen were less knowledgeable than sophomores regarding safe PLD habits. As PLD-pattern use increased, fewer students selected less than 5 min as the maximum/output per day.
**Conclusion:** College students' knowledge of safe PLD-listening levels was related to gender, PLD-pattern use, and college class. This information could assist speech-language pathologists in developing and implementing hearing conservation strategies to target this challenging population better.

KEY WORDS: noise, hearing conservation

hearing loss (HFHL) that can result from repeated and prolonged listening to music and other media using PLDs such as smartphones, compact discs (CDs), iPods, and MP3 players. It is estimated that more than 90% of college students own some type of PLD (Torre, 2008). A potential consequence of prevalent PLD use by college-age students puts them at greater risk of hearing loss when these devices are operated inappropriately.

Excessive exposure to music/media and/or noise can result in hearing loss that is irreversible; this is the second most common form of acquired hearing loss. The most common form of acquired hearing loss is *presbycusis*, or age-related hearing loss (Levey, Levey, & Fligor, 2011). Damage to the outer hair cells in the inner ear leads to threshold elevations, or notches, at the frequencies from 3 kHz to 6 kHz. This noise-induced hearing threshold shift (NITS) reduces one's ability to hear high-frequency sounds (Niskar et al., 1998; Sliwinska-Kowalska & Davis, 2012). Specifically, although speech may be intense enough to be heard, the high-frequency sounds/phonemes that give speech its clarity become unclear or muffled (Harrison, 2008; Humes & Bess, 2007). Typically, NITS is temporary, lasting anywhere from a few minutes to a few weeks (Niskar et al., 1998). However, repeated exposure to hazardous levels of sounds can lead to an irreversible or permanent threshold shift, which can result in permanent hearing loss (Niskar et al., 1998). Permanent hearing loss can be caused by sounds that are more intense than 85 dBA (American Speech-Language-Hearing Association [ASHA], 2014).

The Zogby International survey (2006) found that 12% of adults and 17% of high-school students reported tinnitus or ringing in the ears. In another study, Fung, Marcum, Seil, and Caffarelli (2013) found that hearing problems among individuals between the ages of 17 and 44 increased 17% between 2000 and 2006 in New York City. Ten percent of New Yorkers ages 18 to 24 years reported tinnitus or hearing loss (Fung et al., 2013). Berg and Serpanos (2011) found that almost 25% of female adolescents of low socioeconomic status living in a residential foster care facility in New York City who reported regular PLD use also reported tinnitus and/or presented with HFHL. These studies support and corroborate the Zogby survey.

Keith, Michaud, and Chiu (2008) reported that maximum sound levels from digital PLDs ranged from 83.4 dBA to 107.3 dBA depending on headphone type, maximum PLD-output voltage, and recorded level of music. Considering that the general rule of thumb is not to exceed 85 dBA, digital PLDs pose a potential risk to one's hearing (Levey et al., 2011). Levey et al. (2011) found that 58.2% of PLD users exceeded daily sound exposure limits, and 51.9% of users exceeded weekly limits. Thus, individuals who use PLDs are at increased risk for MIHL when they use these devices at high volumes and for lengthy periods of time (Fligor, 2006; Morata, 2007).

iPods and other PLDs are typically used in conjunction with headphones. Headphones act as a transducer that converts electrical signals into acoustical energy, which is then delivered to the ear (Humes & Bess, 2007). Multiple types of headphones (e.g., circumaural, closed circumaural, supra-aural, intra-aural) are currently available, some with varying degrees of noise-isolation, -reduction, or -cancellation capabilities (*Consumer Reports*, 2013). The risks of MIHL from use of a variety of headphones have been examined. Fligor and Cox (2004) compared intraconcha headphones to supra-aural headphones in CD players and found that the intraconcha headphones were 7 dBA to 9 dBA greater in intensity than the supra-aural headphones.

Other researchers (Fligor & Ives, 2006; Henry & Foots, 2012; Hodgetts, Riegor, & Szarko, 2007) examined preferred listening levels (PLLs) as a function of amount of environmental noise and type of headphone. They found that individuals' PLLs to music decreased when noise-isolating headphones were used (Fligor & Ives, 2006; Hodgetts et al., 2007) and increased significantly when attenuation decreased (Fligor & Cox, 2004; Morata, 2007). Hodgetts et al. (2007) found that headphone type did indeed affect individuals' PLLs in noisy environments. PLLs were greatest for intraconcha headphones, followed by supra-aural, and were lowest for supra-aural headphones with noise-cancellation capabilities (Hodgetts et al., 2007).

Henry and Foots (2012) compared intraconcha and intracanal headphones and discovered that individuals' PLLs were greater for intraconcha headphones in noisy environments, which they attributed to the lack of attenuation of extraneous noises provided by this type of headphone. Henry and Foots concluded that selected PLLs were associated with the amount of noise attenuation provided by the headphones.

In a survey of college students, Hoover and Krishnamurti (2010) found that 91.8% of the participants used intraconcha headphones, and less than 10% used supra-aural or noise-cancelling headphones. Supra-aural headphones have decreased in popularity among consumers, increasing the risk of MIHL of PLD users due to increased PLLs (Henry & Foots, 2012). Fligor and Ives (2006) found that whereas intraconcha headphones have the capacity to produce greater intensity of music, they are not

necessarily used at higher levels. Factors that affected individuals' PLLs included gender, amount of background noise in the listening environment, and amount of attenuation provided by the headphones (Fligor & Ives, 2006).

Fligor and Meinke (2009) concluded that individuals' PLLs and the duration of listening were more critical factors in the determination of MIHL than headphone type. Most recently, Fligor, Levey, and Levey (2014) examined PLLs and the duration of PLD use of 160 adults as a function of ethnicity, education, and music genre on a quiet college campus and on a very busy interchange in New York City. They found that on average, PLLs were 94.1 dBA, with 62% (college campus) and 58% (busy interchange) of adults exceeding daily and weekly sound-exposure limits. Factors attributed to greater PLLs included age and ethnicity, with African American participants listening at the greatest levels (99.8 dBA). Gender, education, location (college campus vs. busy interchange), and cognizance of the connection between PLD use and NIHL were not significant factors (Fligor et al., 2014).

Portnuff, Fligor, and Arehart (2011) recommended that safe levels of PLDs be limited to no more than 4 hr per day at 70% volume or 90 min per day at 80% volume. Levey et al. (2011) found that 58.2% of the college students they studied exceeded daily sound-exposure limits, and 51.9% exceeded weekly sound-exposure limits. These results corroborate and are similar to the findings of Fligor et al. (2014). Levey et al. concluded that the average urban college student represented in their study was at risk for MIHL due to prolonged PLD use.

Carter, Williams, Black, and Bundy (2014) conducted an extensive review of the literature that examined pure-tone threshold data for adolescents/young adults, approximations of noise exposure due to PLD use or other social activities (e.g., discos), and associations between hearing thresholds and exposure to excessive levels of sound during social activities. They concluded that although sufficient data existed to confirm that PLD use and other social activities in noisy environments are potentially hazardous to one's hearing, the character of the relationship between the amount and duration of exposure and hearing loss has yet to be determined (Carter et al., 2014).

Consumer and health industries are beginning to take note of the dangers of MIHL. For example, Samsung provides an action-required warning message on its phones when the volume exceeds safe listening levels. Apple, however, has yet to provide a warning message to its consumers. In May 2008, the Centers for Disease Control and Prevention listed the National Healthy People Objectives for 2010. Reducing the prevalence of hearing loss as well as accommodating adults with hearing loss and providing equal access to health services were included in their goals (Schoenborn & Heyman, 2008). Most recently, the New York City Department of Health and Mental Hygiene launched an ad campaign in December 2013 about the dangers of excessive exposure to noise in order to encourage the protection of one's hearing by turning down the volume when using headphones. The ad has run in subway cars, on the Internet, and on radio.

The purpose of this study was to determine college students' knowledge of the effects of intense levels of music on their hearing and of safe listening habits. We hypothesized that PLD-listening patterns would be related to gender and that knowledge of safe PLD use would be related to both gender and college class (i.e., freshman, sophomore, junior, senior).

## METHOD

This study was approved by Pace University's Institutional Review Board, and there was no conflict of interest or financial or nonfinancial relationship relevant to the research.

### Participants

Four hundred undergraduate college students, all within the age range of 19–22 years, participated in this study (100 freshman, 100 sophomores, 100 juniors, and 100 seniors). According to the 2013 Pace University census, the following approximate demographics regarding gender and race/ethnicity apply to the New York City campus: 39.0% male; 61.0% female; 9.0 African American%; 0.2% Native Hawaiian/Pacific Islander; 11.0% Asian; 15.0% Hispanic; 44.0% Caucasian; 0.3% American Indian/Alaska Native; 3.0% multiracial; 5.0% unknown; and 12.0% nonresident alien.

With the cooperation of instructors, we recruited participants from required courses to reflect Pace's demographics as best as possible. Freshmen were recruited from University 101, a first-year college-experience course that is required of all freshmen and transfer students regardless of major. As all Pace students are required to take public speaking, English, and a lab science, sophomores, juniors, and seniors were recruited from these compulsory core courses. Recruitment stopped when the requisite number of participants was achieved. Students majoring in communication sciences and disorders were excluded, as they could potentially be more knowledgeable about NIHL and MIHL than the typical student.

## Procedure

Participation in this study was strictly voluntary. Participants were asked to complete a pen-and-paper survey during class to determine their PLD-listening patterns, their knowledge of safe PLD use, and their knowledge and practice of the effect of listening to potentially excessive levels of music on their hearing as well as to safe levels. A copy of this survey is included as Appendix A. Participants were asked to agree/disagree (a 5-point Likert scale: strongly disagree, mildly or somewhat disagree, undecided or unsure, mildly or somewhat agree, strongly agree) to three statements on the effects of PLD use and to answer two questions on safe sound and listening levels and the limit for safe PLD listening per day. To avoid low expected frequencies in each of the cells, we collapsed the categories to agree and disagree; an undecided or unsure response was included in the disagree category. The two questions had three possible choices. The correct choice was one category, and the two incorrect choices were collapsed to form the other category. The survey took less than 5 min to complete. Following completion of the survey, the participants, as well as those students who elected not to participate, were given an information/fact sheet about PLD use and MIHL (Appendix B).

## RESULTS

We discovered that 382 (95%) of the college students surveyed used a PLD; 18 (5%) reported that they never listen to music using a PLD (Table 1). These findings are consistent with Torre's (2008) research, which estimated that more than 90% of college students own a PLD.

Males and females reported different PLD-pattern use, $X^2(3, N = 399) = 13.23$, $p = 0.04$, Cramer's V = .18. The Gender × Pattern contingency table is shown in Table 1. Females reported decreased PLD use, from light to heavy (–18.2%). In contrast, males reported increased PLD use (+12.0%) These changes were significantly different (Holm-Bonferroni, $p < .05$).

Tables 2, 3, and 4 contain five rows that summarize the contingency tables and the chi-square analyses. The first three rows indicate the participants' responses to the three knowledge statements: (a) listening to a PLD at high volumes for a prolonged time can contribute to hearing loss, (b) NIHL is reversible, and (c) an insert earphone delivers greater sound to the ear than an earphone that covers or goes over the ear. The last two rows indicate the participants' responses to the two safety questions: (a) the length of time it is safe to listen to a PLD at maximum output per day, and (b) the limit for safe PLD listening per day.

We recoded the three statements and two questions into two categories, respectively: (a) For Statement 1, not agree (64, 16%) and agree (355, 84%); (b) for Statement 2, not agree (312, 78%) and agree (87, 22%); (c) for Statement 3, not agree (208, 52%) and agree (192, 48%); (d) for Question 1, ≤5 min (199, 50%) and > 5 min (200, 50%); and (e) for Question 2, >4 hr per day (115, 29%) and ≤4 hr per day (284, 71%). *Unsure/undecided* responses were collapsed and were included in the disagree category due to low expected values, and an unsure/undecided response was considered a lack of knowledge. Analyses without the unsure responses were nonsignificant; that is, class level was unrelated to those questions.

As shown in Table 2, a greater number of female students chose the correct answer to the safe PLD-listening limit/day question than male students, $X^2(1, N = 399) = 8.72$, $p = .003$, $\Phi = .15$.

**Table 1.** Personal listening device (PLD) pattern use by gender.

| *PLD-pattern use* | *Female* (n = 291) | *%* | *Male* (n = 108) | *%* |
|---|---|---|---|---|
| Never use | 13 | 4.5 | 5 | 4.6 |
| Light use: Around 1 hr per day (but not more than 10 hr per week) at more than half volume | 108 | 37.1 | 23 | 21.3 |
| Moderate use: Between 1.5 and 2.5 hr per day (between 10.5–14 hr per week) at more than half volume | 115 | 40.0 | 44 | 40.7 |
| Heavy use: More than 2.5 hr per day (more than 14 hr per week) at more than half volume | 55 | 18.9 | 36 | 33.3 |

***Note.*** $N = 399$. One student self-identified as transgender.

**Table 2.** PLD knowledge and safety responses by gender.

| *Statement/question* | *Female* (n = 29) n | *Female* (n = 29) % | *Male* (n = 108) n | *Male* (n = 108) % | $X^2(1)$ |
|---|---|---|---|---|---|
| Listening to a PLD at high volumes for a prolonged time can contribute to hearing loss.[a] | 245 | 84.2 | 90 | 83.3 | 0.04 |
| Noise-induced hearing loss, which means hearing loss caused by repeated exposure to loud sounds, in this case music, is reversible.[a] | 59 | 20.3 | 28 | 25.9 | 1.48 |
| An insert earphone delivers greater sound to the ear than an earphone that covers or goes over the ear.[a] | 135 | 46.4 | 57 | 52.8 | 1.29 |
| For how long is it safe to listen to a PLD at maximum output per day?[b] | 154 | 52.9 | 46 | 42.6 | 3.36 |
| What is the limit for safe PLD listening per day?[c] | 219 | 75.3 | 65 | 60.2 | 8.72** |

***Note.*** $N$ = 399; one student self-identified as transgender.

[a]Response categories (strongly disagree, mildly or somewhat disagree, undecided or unsure, mildly or somewhat agree, and strongly agree) were collapsed to form one category of agree and one category of disagree.

[b]Response categories (≤5 min, between 16–30 min, and between 31–45 min) were collapsed to form one ≤5 min and one >5 min.

[c]Response categories (up to 4 hr/day with volume set at 70% or 90 min at 80% volume, 5 hr/day with volume set at 70% or 60 min at 80% volume, and 6 hr/day with volume set at 70% or 60 min at 80% volume) were collapsed to form one category of ≤4 hr/day with volume set at 70% or 90 min at 80% and one >4 hr.

*$p$ < .05, **$p$ < .01, ***$p$ < .001.

As shown in Table 3, college class was significantly related to safe PLD-listening levels at maximum output/day, $X^2(3, N = 400) = 8.03$, $p = .045$, Cramer's V = .14. The percentages for freshmen, sophomores, juniors, and seniors who selected less than 5 min were 40%, 59%, 54%, and 48%, respectively. The only reliable difference was between freshmen and sophomores (Holm-Bonferroni, $p < .05$).

As shown in Table 4, PLD-pattern use was significantly related to safe PLD-listening levels at maximum output/day, $X^2(3, N = 400) = 16.83$, $p = .001$, Cramer's V = .21. The percentages for never, light, moderate, and heavy users who selected less than 5 min as the maximum/output per day were 77.8% ($n$ = 14), 57.3% ($n$ = 75), 50.3% ($n$ = 80), and 34.8% ($n$ = 32), respectively. A negative trend was noted: As PLD-pattern use increased, fewer students selected less than 5 min as the maximum/output per day, $X^2(1, N = 400) = 15.76$, $p < .001$. Reliable differences were found between never and heavy PLD use and between light and heavy PLD use (Holm-Bonferroni, $p < .05$).

## DISCUSSION

The purpose of this study was to examine college students' knowledge of safe PLLs when using PLDs. We surveyed 400 college students and found statistically significant findings for gender, college class, and PLD-pattern use.

### Gender Differences

We found a statistically significant association between gender and PLD-pattern use (never, light, moderate, heavy). That is, more males than females reported heavy PLD use, which is consistent with and supportive of previous research (Catalano & Levin, 1985; Shah, Gopal, Reis, & Novak, 2009; Torre, 2008) but in contrast to findings by Fligor et al. (2014). In addition, significantly fewer males than females chose the correct response for safe PLD-listening limit/day (4 hr/day with volume set at 70% or 90 min at 80% volume: males, 60.2%; females, 75.3%). This result suggests that males are less knowledgeable than females regarding safe PLD habits. Other research has shown that gender also affects individuals' PLLs, with males selecting significantly higher PLLs than females (Ahmed et al., 2007; Fligor & Ives, 2006; Henry & Foots, 2012; Torre, 2008; Williams, 2005).

These observed gender variances could be due to differences in judgment of risky behaviors between males and females. Although music and excessive exposure to intense levels of sound have not traditionally been associated with risk-taking behaviors,

**Table 3.** PLD knowledge and safety responses by college class.

| *Statement/question* | *Freshman (n = 100)* | *Sophomore (n = 100)* | *Junior (n = 100)* | *Senior (n = 100)* | $X^2(3)$ |
|---|---|---|---|---|---|
| Listening to a PLD at high volumes for a prolonged time can contribute to hearing loss.[a] | 77 | 85 | 88 | 86 | 5.21 |
| Noise-induced hearing loss, which means hearing loss caused by repeated exposure to loud sounds, in this case music, is reversible.[a] | 21 | 18 | 21 | 28 | 3.15 |
| An insert earphone delivers greater sound to the ear than an earphone that covers or goes over the ear.[a] | 45 | 53 | 51 | 43 | 2.72 |
| For how long is it safe to listen to a PLD at maximum output per day?[b] | 40 | 59 | 54 | 48 | 8.03* |
| What is the limit for safe PLD listening per day?[c] | 68 | 71 | 74 | 72 | 0.92 |

***Note.*** $N = 400$. Cell numbers are counts and percentages.

[a]Response categories (strongly disagree, mildly or somewhat disagree, undecided or unsure, mildly or somewhat agree, and strongly agree) were collapsed to form one category of agree and one category of disagree.

[b]Response categories (≤5 min, between 16–30 min, and between 31–45 min) were collapsed to form one ≤5 min and one >5 min.

[c]Response categories (up to 4 hr/day with volume set at 70% or 90 min at 80% volume, 5 hr/day with volume set at 70% or 60 min at 80% volume, and 6 hr/day with volume set at 70% or 60 min at 80% volume) were collapsed to form one category of ≤4 hr/day with volume set at 70% or 90 min at 80% and one >4 hr.

*$p < .05$, **$p < .01$, ***$p < .001$.

Bohlin, Sorbring, Widen, and Erlandsson (2011) posited an association between individuals taking what is associated with traditional risks and those taking what is associated with hearing risks. Bohlin and Erlandsson (2007) analyzed the relationship between Swedish adolescents' exposure to high levels of sound and their involvement in more traditional risk situations (e.g., discotheques). They found that young women judged loud music at nightclubs as riskier than their male counterparts. This difference in judgment of loud levels of music between males and females provides a plausible explanation for the gender differences found in our present study.

## College-Class Differences

We also found a significant association between college class and safe PLD-listening levels at maximum output/day. Specifically, 40% of freshmen selected less than 5 min of listening at 100% volume compared to 59% of sophomores. No relationship between sophomores, juniors, or seniors and safe PLD-listening levels was noted. This finding suggests that freshmen are less knowledgeable than sophomores regarding safe PLD use, which possibly can be attributed to an increase in knowledge with increased age and maturity.

## PLD-Pattern Use

Finally, we found a significant relationship between PLD-pattern use and safe PLD-listening levels at maximum output/day. The noted negative trend—as PLD-pattern use increased, fewer students selected less than 5 min—suggests that heavier PLD users were less knowledgeable and/or careful regarding safe PLD levels than were students who were more temperate in their PLD use. These results are consistent with Ahmed et al. (2007), who found that individuals who were most at risk for hearing loss seemed less concerned about its potential consequences and attributed this difference to a lack of knowledge.

## Study Limitations

This study had several limitations. First, difficulty in survey interpretation in selecting the correct answer

**Table 4.** PLD knowledge and safety responses by PLD-pattern use.

| *Statement/question* | *Never* (n = 18) | % | *Light* (n = 131) | % | *Moderate* (n = 159) | % | *Heavy* (n = 92) | % | $X^2(3)$ |
|---|---|---|---|---|---|---|---|---|---|
| Listening to a PLD at high volumes for a prolonged time can contribute to hearing loss.[a] | 16 | 88.9 | 112 | 85.5 | 130 | 81.8 | 78 | 84.8 | 1.17 |
| Noise-induced hearing loss, which means hearing loss caused by repeated exposure to loud sounds, in this case music, is reversible.[a] | 7 | 38.9 | 22 | 16.8 | 33 | 20.8 | 26 | 28.3 | 7.31 |
| An insert earphone delivers greater sound to the ear than an earphone that covers or goes over the ear.[a] | 8 | 44.4 | 62 | 47.3 | 75 | 47.2 | 47 | 51.1 | 0.51 |
| For how long is it safe to listen to a PLD at maximum output per day?[b] | 14 | 77.8 | 75 | 57.3 | 80 | 50.3 | 32 | 34.8 | 16.83*** |
| What is the limit for safe PLD listening per day?[c] | 17 | 94.4 | 103 | 78.6 | 112 | 70.4 | 53 | 57.6 | 16.62*** |

***Note.*** $N = 400$.

[a]Response categories (strongly disagree, mildly or somewhat disagree, undecided or unsure, mildly or somewhat agree, and strongly agree) were collapsed to form one category of agree and one category of disagree.

[b]Response categories (≤5 min, between 16–30 min, and between 31–45 min) were collapsed to form one ≤5 min and one >5 min.

[c]Response categories (up to 4 hr/day with volume set at 70% or 90 min at 80% volume, 5 hr/day with volume set at 70% or 60 min at 80% volume, and 6 hr/day with volume set at 70% or 60 min at 80% volume) were collapsed to form one category of ≤4 hr/day with volume set at 70% or 90 min at 80% and one >4 hr.

*$p < .05$, **$p < .01$, ***$p < .001$.

may have existed. Specifically, a temporary threshold shift and potential permanent threshold shift are both possible with MIHL. A temporary threshold shift is reversible and could have been experienced by some of the participants. Second, an inadvertent and potential bias could have occurred. The survey stated that the purpose of the study was to determine participants' knowledge of *risk* of MIHL rather than their *understanding* of issues surrounding PLD use. Third, the hearing status of the participants was not obtained. Though unlikely, the hearing status of the participants could theoretically have had an impact on their response. Finally, the survey did not probe the type of earphone that the participants employed, which could potentially have influenced answer selection.

## Study Implications

Accurate knowledge of MIHL and safe PLD-listening levels on behavior change in adolescents/young adults warrants further examination. Specifically, evidenced-based information of MIHL, safe PLD-listening level, and earphone type geared to differences in ethnicity, age, gender, and environment may have a larger impact on adolescents' and young adults' use of PLDs than more generic types of information. This knowledge could assist speech-language pathologists in developing and implementing hearing conservation strategies that would better and more effectively target this challenging population.

## Conclusion

Substantial evidence has shown that exposure to excessive levels of sound can result in hearing loss. The increase of HFHL and/or tinnitus reported in adolescents and young adults is due in large part to the unsafe use of PLDs.

We found that college students' knowledge of safe PLD-listening levels was related to gender, college class, and PLD-pattern use. A statistically significant association between gender and PLD-pattern use was found; specifically, more males reported heavy use than females. The results of this study also suggest that males are less knowledgeable than females regarding safe PLD use. In addition, a significant association between PLD-pattern use and safe PLD-listening levels at maximum output/day was found; specifically, as PLD-pattern use increased, fewer students selected less than 5 min. Lastly, a significant association between college class and safe PLD-listening levels at maximum output/day was found; specifically, freshmen were less knowledgeable than sophomores regarding safe listening levels.

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## APPENDIX A. SURVEY

Purpose of Study: To determine urban college students' knowledge of the risks of noise-induced hearing loss (NIHL) due to use of personal listening devices (PLDs; e.g., iPods, MP3 players).

Class Status (circle one):
Freshman Sophomore Junior Senior

I identify my gender as (circle one):
Male Female Transgender

I would describe my PLD listening patterns as (circle one):

- Never
- Light: around 1 hour per day (but not more than 10 hours per week) at more than half-volume
- Moderate: between 1.5 and 2.5 hours per day (between 10.5–14 hours per week) at more than half-volume
- Heavy: more than 2.5 hours per day (more than 14 hours per week) at more than half-volume

To what extent do you agree or disagree with each of the following statements (please circle your choice):

1. Listening to a personal listening device (PLD; e.g., iPod, MP3 Player) at high volumes for a prolonged time can contribute to hearing loss.

| Strongly disagree | Mildly or Somewhat Disagree | Undecided or Unsure | Mildly or Somewhat Agree | Strongly Agree |
|---|---|---|---|---|

2. Noise-induced hearing loss, which means hearing loss caused by repeated exposure to loud sounds, in this case music, is reversible.

| Strongly disagree | Mildly or Somewhat Disagree | Undecided or Unsure | Mildly or Somewhat Agree | Strongly Agree |
|---|---|---|---|---|

3. An insert earphone (one that is placed in the ear) delivers greater sound to the ear than an earphone that covers or goes over the ear.

| Strongly disagree | Mildly or Somewhat Disagree | Undecided or Unsure | Mildly or Somewhat Agree | Strongly Agree |
|---|---|---|---|---|

4. For how long is it safe to listen to a PLD at maximum output (full volume) per day? Choose one.

Less than or equal to 5 minutes Between 16–30 minutes Between 31–45 minutes

5. What is the limit for safe PLD listening per day? Choose one.

| Up to 4 hours per day with volume set at 70% or 90 minutes at 80% volume | 5 hours per day with volume set at 70% or 60 minutes at 80% volume | 6 hours per day with volume set at 70% or 60 minutes at 80% volume |
|---|---|---|

## APPENDIX B. SOME FACTS ABOUT NOISE, MUSIC, AND HEARING LOSS

**Did you know???**

- The percentage of adolescents and young adults in the U.S. with at least slight (if not more) hearing loss increased by ***30%*** between 1988–2008.
- 10% of New Yorkers aged 18 to 24 years reported ringing in the ears or hearing loss. Much of this increase in hearing loss can be attributed to increased use and availability of personal listening devices (PLDs; e.g., iPods, MP3 players).
- At maximum volume, an iPod reaches about 103 decibels (dB), equivalent to a ***JACKHAMMER***. This level can cause a permanent hearing loss.
- Over time, a temporary loss of hearing can progress to a permanent one with repeated exposure to intense levels of sounds, which include music.
- Hearing loss acquired due to continued exposure to loud sounds contributes to even greater difficulty hearing, especially in noisy environments.

**Answers to survey questions:**

**1.** Listening to a PLD at high volumes for a prolonged time ***contributes*** to hearing loss.
**2.** Noise-induced hearing loss, hearing loss caused by repeated exposure to loud sounds, which includes music, is ***irreversible***.
**3.** An insert earphone (one that is placed in the ear) ***delivers*** greater sound to the ear than an earphone that covers or goes over the ear.
**4.** The safest amount of time to listen to a PLD at maximum output (full volume) per day is ***less than or equal to 5 minutes***.
**5.** The safe limit for PLD listening per day use is ***up to 4 hours with volume set at 70% or 90 minutes at 80% volume.***

**Symptoms of hearing loss:**

- Needing to turn up volume on audio devices - e.g. cell phone, iPod, TV
- Ringing in the ears
- Difficulty hearing normal conversations - e.g. saying “what?” or “huh?”

**What can I do to protect my hearing?**

- Limit exposure to loud sounds
- If you use headphones in noisy environments, make sure they are noise-cancelling or earphones that suppress outside sounds
- Wear earplugs or earmuffs in noisy areas - e.g. subways

**For more information on hearing loss due to noise and how to protect your hearing go to:**


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