



Article

Use of Personal Listening Devices and Knowledge/Attitude for Greater Hearing Conservation in College Students: Data Analysis and Regression Model Based on 1009 Respondents

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Abstract: Given the concern regarding increased hearing loss in young people who use personal listening devices (PLDs), the present study analyzes the experience of PLDs among college students to identify their knowledge of and attitude toward hearing conservation. It also explains their relationship between knowledge of hearing loss and attitude-related hearing conservation as a questionnaire response using a regression model. A total of 1009 Korean college students responded to an online questionnaire. As a survey tool, the Personal Listening Device and Hearing Questionnaire was adapted as a Korean version with 78 modified items under 9 categories. Using principal component analysis, specific factors were extracted, and their relationships and paths were confirmed using multiple regression analysis. The results of the knowledge category of the questionnaire indicate that most respondents knew how to maintain healthy hearing and understood the signs of hearing loss. Regardless, many college students habitually use PLDs at high levels in noisy environments; they do not recognize how to prevent hearing loss. Even though they continue their current use pattern for PLDs, they also had a positive attitude toward receiving more information about hearing conservation. According to the regression model, the students' self-reported hearing deficits were due to the volume rather than the frequent use. Interestingly, knowledge about hearing loss may encourage students to develop a positive attitude toward reasonable restriction of PLD use. When PLD users have detailed knowledge about the hearing loss provided by professionals, we believe that most will avoid serious hearing problems and its risks and maintain a judicious attitude toward their own conservation.

Keywords: personal listening device; PLDs; college students' recreational noise exposure; hearing conservations

1. Introduction

Contemporary researchers have offered evidence of hearing loss from exposure to loud recreational noise by focusing on groups of choristers [1], symphony orchestra musicians [2], attendees at rock concerts and discotheques [3], and users of personal listening devices (PLDs) [4]. The relationship between the use of PLDs and hearing damage has been a serious concern, especially for younger people [5]. For example, Ahmed et al. (2007) reported that as many as 82% of students currently have PLDs [6] and Portnuff et al. (2009) showed that young people, compared to older people, more frequently listen to music at a higher volume while not realizing that this intensity could potentially be hazardous [7]. Why are young people addicted to PLDs? These devices allow users

to enjoy loud music without interfering with others [8], and they can serve as a companion during leisure hours and/or study time [9]. However, unlimited preferred listening levels (PLLs) increased significantly when using PLDs in noisy environments [10] and coupling with an earphone of the earbud type did not effectively attenuate background noise levels, thus greatly increasing the volume [11]. Furthermore, given the rapid development of electronic technology, access to PLDs has increased across all age groups, in addition, PLD users have changed the device they use from a portable CD player, MP3 player, or iPod [9] to a mobile phone (or Smartphone) with a free MP3 player function [12]. This new direction suggests the need to re-examine the use of PLDs among those young people who prefer to use the new technology and identify their knowledge of and attitudes toward hearing conservation.

Although a typical method used in previous PLD studies was to measure PLL and/or maximum output levels of commercially available PLDs, it is risky to infer hearing loss only induced from their use [13]. When we consider the output results of the PLDs from many studies, users' listening levels may cause a certain amount of hearing insult because the levels exceed the criteria suggested by institutes like the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA); the values are 68.3~84.3 dBA for average PLL and 96.7~107 dBA for the maximum level [11,14]. However, Rice et al. (1987) disagreed in that only 5% of their participants were potentially exposed to dangerous levels of noise [15]. Turunen-Rise et al. (1991) also argued that most listeners used PLDs below the dangerous levels for a limited time, a behavior that might minimize hearing loss [16]. This discrepancy between experimental results seems to have stemmed from a small segment of the target population and different settings, times, or cultures by which to determine the users' potential risk, and that issue warrants further study using a large data set and regional characteristics.

Based on World Health Organization (WHO) guidelines [17], the overuse of personal listening devices among college students should be restricted by reducing either the user's time or the volume of the PLD when used. The guideline has a uniform standard for recreational noise exposure, unlike occupational noise exposure, which considers each nation's laws and industrial situations. When scrutinizing these guidelines narrowly, they seem to merely inhibit the use of PLDs and may be less persuasive for changing the voluntary usage patterns of PLD users. Thus, young people have maintained poor listening behaviors [18] and have not modified their potentially harmful behaviors, even those that might cause hearing loss [19] despite being offered several educational programs designed to prevent that hearing loss. Chung et al. (2005) reported that only 8% of young participants even recognize hearing loss as a major problem [20]. However, none of the previous studies analyzed the relationships between the use of PLDs, hearing insults, and current knowledge related to hearing conservation. These relationships are likely to result in compliance with recommendations for the safe use of PLDs, particularly among young people who may have high risk of hearing loss, which broadly includes the loss of auditory awareness in certain situations that could pose a danger to both PLD users and those around them [9].

In this light, the purpose of the present study is to analyze the experience of using PLDs among Korean college students with a large sample size. A second purpose of this study is identifying their knowledge and their attitudes toward hearing conservation. Finally, a third purpose of the present study is to offer a framework for seeking and processing hearing problems and conservation [21] that address the following two research questions:

- RQ1. Which behavior involved in using PLDs might lead to a self-reported and experienced hearing problem?
- RQ2. Does knowledge of hearing loss among PLD users influence their attitude toward hearing conservation?

We believe that the results of the current study can provide new insight into the ongoing use of PLDs among college students and motivate educational institutions to establish appropriate hearing conservation guidelines.

2. Materials and Methodology

This study was divided into two phases. In the first phase, we collected data using a questionnaire to analyze PLD usage and opinions related to hearing conservation in college students. In the second phase, we investigated certain relationships found in the data by using hypothesis testing and statistical validation.

2.1. Phase 1. Analysis of the Questionnaire

2.1.1. Development of the Personal Listening Device and Hearing Questionnaire-Korean (PLDHQ-K)

The survey instrument was the Personal Listening Device and Hearing Questionnaire (PLDHQ) that Danhauer et al. developed [9]. We adapted it via translation and back-translation from English to Korean with the authors' permission. Although the original version of the PLDHQ had 83 items, the present study only included 78 items, as 5 were removed as they had less relevance or did not fit in either the current situation or the culture in Korea. In the PLDHQ, for instance, the iPod was assumed to be the main PLD, but it has since been replaced with the Smartphone's MP3 player function. After receiving professional input from colleagues, the Korean version of the PLDHQ (PLDHQ-K) was fully developed.

Apart from the participants' demographic statistics, the PLDHQ-K consisted of 9 categories: (1) knowledge about hearing loss and hearing conservation, (2) self-evaluation for hearing status and the experience of noise exposure, (3) PLD preference, (4) use pattern for PLDs, (5) reasons for using PLDs, (6) hearing effect of PLD use, (7) opinion on PLD use, (8) knowledge and attitude toward regulations, and (9) preference for education. The final item was intended to be a validity check; the participants were asked whether they had given generally conscientious responses to the questionnaire.

















2.1.2. Participants

As the target population, we recruited Koreans, primarily in their 20s and 30s, who currently attended college in South Korea. The online survey directly contacted this population by placing advertisements on social networking sites, such as Facebook and Instagram, during spring term 2018. Participants could access the PLDHQ-K, and the advertisements offered exposure to the population 56,506 times (the response rate was 1.79%). A total of 1009 participants were asked to volunteer to complete the online version of the questionnaire. The questionnaire took into consideration the regional distribution of Korean college students in seven major provinces (e.g., Seoul, Gyeonggi-do, Gangwon-do, Chungcheong-do, Jeolla-do, Gyeongsang-do, and Jeju Island) [22]; 96.8% of the respondents were 20 to 27 years in age. Seniors had the highest number of respondents (30.9%) and freshman the lowest (14.6%). Gender was almost equally distributed with 506 males (50.1%) and 503 females (49.9%). Detailed information regarding the participants is summarized in Table 1. The survey was completed by the 1009 respondents with high reliability (Q78, 99.3% for honesty).

2.1.3. Data Analysis

Participants' responses to the 78 items were tallied using Survey Monkey, which automatically calculates with high accuracy the percentage answering in each category for each item. The analyzed data were classified into similar topics and are categorized here in Appendices A–I for number of respondents and percentages. Additionally, "inserted Excel worksheet object to" was added as a graphical display in each item of the appendixes for better visualization.

Table 1. Demographic statistical information of survey participants.

Item Number	Response	Number of Respondents (%)	
Q1. Age	19 years and younger	18(1.8)	
	20~24 years	674(66.8)	
	24~29 years	309(30.6)	
	30 years and older	8(0.8)	
	Total:	1009	
Q2. Gender	Male	506(50.1)	
	Female	503(49.9)	
	Total:	1009	
Q3. Residential District	Seoul	171(17)	
	Gyeonggi-do	25(2.3)	
	Gangwon-do	87(8.6)	
	Chungcheong-do	150(14.9)	
	Jeolla-do	105(10.5)	
	Gyeongsang-do	254(25.2)	
	Jeju Island	16(1.6)	
	N/A	1	
Total:	1009		
Q4. College Status	Freshmen	147(14.6)	
	Sophomores	250(24.8)	
	Juniors	228(22.6)	
	Seniors	311(30.9)	
	Graduate Students	73(7.2)	
	Total:	1009	
Q78. Self-assessment Validity	Completely honest	961(95.24)	
	Partially honest	41(4.06)	
	Dishonest	7(0.69)	
	Total:	1009	

Note. Items receiving a 50% and higher response rate are graphically marked in darker gray, Q: Question.

2.2. Phase 2. The Regression Model

2.2.1. Research Hypotheses

To observe certain relationships closely in this large data set, we formulated two hypotheses for the current study.

Hypothesis 1 (H-1): *Of the various behaviors of PLD usage, two chronic factors, e.g., volume level and usage frequency, may negatively affect users' self-reported and experienced hearing problems.*

Hypothesis 2 (H-2): *Our respondents' knowledge of hearing loss helps determine their attitudes toward hearing conservation in either a positive or a negative way.*

2.2.2. Statistical Analysis

To test our research hypotheses, 78 items of the PLDHQ-K were analyzed using principal component analysis (PCA) with varimax rotation as the first step. Thirteen items related to 3 factors (i.e., using time/frequency of PLD use, volume of PLD, and current hearing problems) were extracted in H-1, while another 13 items related to 4 factors (knowledge of hearing loss and 3 kinds of attitude) were tied in H-2. The selection criteria for each factor were the Kaiser's rules, which select the factors that have eigenvalues greater than 1.0. Then, several cause-effect relationships of the items for each hypothesis were significantly explained using multiple regression analysis. All analyses were conducted for a statistical level of $p < 0.05$.

3. Results and Discussion

3.1. Phase 1. Analysis of Questionnaire

An online survey was employed to analyze the experience of using a PLD for 1009 Korean college student respondents to determine the level of their knowledge and their attitude toward hearing conservation.

3.1.1. Self-Evaluation for Hearing Conditions and the Experience of Noise Exposure

In terms of self-evaluated hearing condition, 76.1% of the respondents evaluated themselves as having good hearing (Q17) and 53.5% reported having no difficulty in hearing (Q35). Also, our respondents seemed generous about rating their own hearing condition. This result is similar to the result of the PLDHQ, with only 12% of respondents having experienced hearing difficulty [9]. Nevertheless, if the participants did have a hearing problem, they attributed it to PLD use (30.4% of Q36 and 79.2% of Q65); the PLDHQ returned similar results. It is interesting to recall that Portnuff et al. (2016) showed that hearing loss can be caused by both excessive and erroneous use of PLDs [23].

For experience of noise exposure, approximately 77.2% of the respondents always/frequently/sometimes were in a noisy setting (Q5). Consistent with our expectations, many college students are susceptible to environmental noise, but ironically PLD users tend to set their device volume higher in environments where there is background noise [24]; consequently, PLD usage in the noisy environments that college students experience cannot be ignored when developing better guidelines. For additional details on this point, see Appendix A.

3.1.2. Knowledge of Factors Triggering Hearing Loss and Hearing Loss Prevention

Of the 1009 respondents, 72.2% reported that hazardous noise could cause secondary hearing loss for those who already had a hearing loss (Q6). Of these respondents, 66.2% knew that the hearing loss might be preventable (Q8). This response means that many college students do understand that high levels of noise can cause damage and that it is possible to prevent noise-induced hearing loss. Similarly, 74% and 82.3% of U.S. college students responded to the same questions, respectively, in the PLDHQ [9]. Muchnik et al. (2012) also reported that 88% of the respondents had real/specific knowledge of hearing loss, and 79% knew that listening to loud music was related to hearing loss [25]. Nevertheless, our respondents did not know of any effective method of hearing conservation (Q7), so it will be necessary to provide more education about hearing conservation for better public health in the near future.

Most of the college students were aware of the symptoms related to overexposure to hazardous noise. In detail, about 80% of the respondents agreed that increasing the volume of television (TV) or a radio was a sign of hearing loss (Q15); 75% also knew that experiencing tinnitus was possible after exposure to high levels of noise (Q9). However, symptoms, such as “asking to repeat what it was” (Q11) and “speech seems to be heard as a muffled or mumbled sound” (Q13) were less familiar to these respondents. Interestingly, a regional difference from previous studies was found for how to recognize the signs of hearing loss. Two-thirds of U.S. college students [9] and half of Canadian college students reported that tinnitus was the first sign of hearing loss [6], while 60% to 70% of the students in both Mexico and Puerto Rico recognized that “turn up the volume” and “ask to repeat” were common signs of hearing loss [8]. For more detailed results, see Appendix B.

3.1.3. Preference for Personal Listening Device (PLD) Use

The preference for PLD uses dealt with such as penetration rate or type of PLDs. More specifically, almost all the respondents had used PLDs (97.6%, Q18), and most of their friends also had used them (77.1%, Q22). Reflecting the current high distribution rates of smartphones in Korea [26], 93.8% used the PLD function of their smartphones (Q19). In addition, 70.2% had used a smartphone as a PLD (Q30)

and 80.5% considered a smartphone to be the most preferred PLD (Q23). In sum, the high distribution rates of the smartphone may influence users to use the PLD function more than in the past, resulting in further concern about unlimited use of PLDs that can cause music-induced hearing loss [27] and simultaneously another potential risk, such as PLD oblivion [28]. With respect to obtaining a PLD, 80.3% of the college students purchased it themselves (Q20). Indeed, 65% said it was not a big deal to purchase a PLD even when considering their current financial status (Q21). Samsung was the most popular manufacturer of PLDs (51.4%) in Korea and Apple followed in second position (35.2%) (Q29), but unfortunately there was no indication of ongoing student compliance with the existing standards for the use of safe listening devices [17,29].

Here, an important, but expected, finding was that most of the college students listened to their PLDs using an earphone of the earbud type (66.2%, Q31). When combining PLDs with earbuds, the average attenuation of background noise was the lowest of other types of earphones [30] and users' preferred listening levels were recorded approximately 20dB(A) higher in a noisy environment than in a quiet condition [24]. Remember that wearing earbuds to listen to PLDs in a noisy environment can compromise the user's auditory system due to the increased PLD volume. Still, the respondents would consider using customized earphones or headphones to effectively reduce background noise (60.6%, Q32), but the purchase price had to be inexpensive, i.e., under \$50 (80%, Q33). Clearly, many additional studies need to be conducted to determine safe volumes for PLDs for the various earphone types, particularly with background noise and daily noise exposure. For more detailed results, see Appendix C.

3.1.4. Use Pattern of PLDs

Of the college student respondents, 77% had used a PLD for more than two years (Q34). Although about half of the respondents used their PLDs all days in the week (Q37), their use time per session was not long at 0.5 to 1 h (34.9%) and 1 to 2 h (29.6%, Q38). Also, the average use time of the PLDs in a day was rather widely distributed, ranging from 0.5 to 4 h (Q39). Regarding frequency of PLD use for more than 4 h in one particular place during a year, 1 to 3 times was the highest response (37.6%, Q40) and followed 21 or more times (23.4%, Q40). Interestingly, these results showed certainly divided responses in terms of using time in one session. In short, Korean college students did not seem to use PLDs for enough extended time to damage hearing, but they did listen longer than participants in the Kaplan-Neeman et al. (2017) study, which reported less than 30% using a PLD for 0.5 to 1 h in a single day [31]. However, the PLDs users such as '21 or more' (23.4%, Q40) should be considered heavy PLD users and managed in terms of public health.

The response for Q41, which asked about preferred volume was widely distributed at volume steps 4 to 8, although volume step 6 was the most frequent response (19.1%). Similarly, 52% of the respondents thought their volume was only 'medium' (Q42). This was not a concern when compared to the results of Kaplan-Neeman et al. (2017) [30]; their respondents reported their volumes as 'high' (43.59%). Interestingly, Levey and Fligor (2011) found that African American PLD users listened at higher levels than white/Hispanic users do, and thus researchers should consider any ethnic differences reflected in their collected data [32].

Although a relatively small number of respondents reported "using PLDs for more than 4 h" (17.3%) (Q39) and "using PLDs 21 or more times per year" (23.4%) (Q40), these results should be observed with caution. While updating the 60–60 rule (i.e., volume of up to 60% and less than 60 minutes' use each day), Portnuff and Fligor (2006) estimated that typical listeners could use their PLDs safely at 70% of full volume for 4.6 h a day if using the supplied earphones without greatly increasing their risk of hearing loss [33]. Nevertheless, a few college students in our study may still have been at risk when listening in noisy environments and/or for long periods of time, which indicates there is a need for more outreach directly to them.

With respect to background noise, 86.3% of the respondents reported increasing the volume steps of their PLDs (Q44), which was also supported by several previous studies in which the preferred

listening levels of PLDs increased with higher background noise [10,34]. For instance, when listening to favorite music (62.3%, Q43) and exercising (58.3%, Q45), users tend to increase the volume steps of their PLDs. This finding is supported by PLD HQ research in that more than half of the students reported that they turned the volume up on their PLDs when they listened to their favorite songs and when exercising [9]. In Q46, activity involving their use of PLDs included riding public transportation (18.5%), relaxing (18.1%), and walking/jogging (17.3%). PLD users also reported feeling calmer during their commute and experiencing more pleasure during even mundane work [35]. Noise levels on subway platforms are on average 85.7 dBA, with levels in subway cars ranging from 84 to 112 dBA [36]; thus, PLD users using public transportation and walking/jogging are exposed to high levels of background noise. However, Levey et al. (2011) showed that commuters using the subway (93.3 dBA) did not have significantly higher PLD sound exposure than non-subway commuters (92.3 dBA) [31] and we expected that Korean college students will also use a relatively low listening volume because they adjust the volume of PLDs to avoid disturbing others in public (72.8%, Q74). Furthermore, the reported situations, i.e., walking, jogging, biking, and driving, may preclude an awareness of hazards like automobiles and muggers and might possibly interfere with users' safety and that of others. These results indicate that education campaigns should include information beyond just the risks of hearing loss from PLDs [9]. For further details, see Appendix D.

3.1.5. Reasons for PLD Use

For college students, the main reason for using PLDs was to listen to music (95.3%, Q68), and they considered PLD convenience to be an advantage (80.1%, Q76). Also, they used their devices when feeling bored (77.4%, Q75), to help them relax (59.9%, Q69), to help them concentrate (54.7%, Q72), and to isolate themselves from others (46.2%, Q70). Indeed, music is known to stimulate the brain and change a listener's emotional state, causing either relaxation or excitation [37]. PLDs are also particularly appealing to people from modern affluent cultures, where there is a high premium on personal space, leading to a desire to withdraw and escape the streets. Thus, these users can escape from the uncontrollable sounds of the city, thereby avoiding car alarms, subway noise, car horns, and being asked for directions [38]. Unlike the iPod, which was the symbol of a new generation in the 1990s and a marker of social status [39], contemporary college students did not regard their PLD as either a fashion item (10.3%, Q71) or a form of rebellion (23.1%, Q73). Moreover, the PLD was no longer accepted as being high technology (52.4%, Q77). Thus our thinking went beyond music to the billion-plus videos enjoyed around the world; these videos usually employ streaming media (e.g., YouTube, Netflix), which offer a platform for people around the world to watch and share video content without any time and space constraints [40]. Therefore, future study of PLD abuse should not only focus on listening to music, but also consider various other sources and content that produce loud sounds. For detailed results, see Appendix E.

3.1.6. Hearing Effects from PLD Use

Most (58.3%) of the college students did not have tinnitus (Q10). The students did not experience tinnitus (75.4%, Q49) or any other ear problem (76.2%, Q50) because of their PLD use. Nevertheless, the experience of saying "huh?" or "what?" and asking for repeats was reported by 68% of respondents (Q12), but not because of the PLDs (61.7%, Q53). Our participants did not concede any possible association between PLD use and this hearing effect. Also, our PLD users did not use them at sufficiently high intensity to undergo instant signs of hearing loss right after using the PLD. These patterns were similar to those found by Danhauer et al. [9]. In Q47, 66.5% of respondents reported that when they used PLDs, people around them could not hear their PLD sound. Also, 78.6% of the respondents said that they did not receive warnings from nearby people to reduce the volume of their PLDs (Q48). These results are similar to the responses to Q74 in that Korean college students did pay attention and avoided disturbing others. For further results, see Appendix F.

3.1.7. Opinion Regarding Use of PLDs

Among the college students, 31.7% considered the acceptable age for using PLDs to be “5 to 10 years old” either 30.7% reported “11 to 13 years old” (Q54). These results are less conservative than Danhauer’s (2009) study which reported “11 to 13 years old” (39.2%) and “14 to 15 years old” (30.7%) [9]. Keep in mind also that PLD use at an early age presumably does damage the users’ hearing.

Fortunately, the students recognized that listening to PLDs at a high-intensity level can potentially cause hearing loss (90.7%, Q56). In addition to the hearing loss, students agreed that using PLDs could be dangerous in other situations, such as driving and snowboarding (83.1%, Q55), and recognized their concentration on PLDs (70.7%, Q66). Thus, we support more consciousness-raising messages that suggest that college students do not use their PLDs in situations that require their focused attention [9]. Our respondents also thought that PLDs should come with a statement that listening to music at high intensity for a long period of time may cause hearing loss (Q59). In addition, the respondents consider decreasing the listening level rather than listening time to minimize the risk to their hearing (Q60). Nevertheless, 41.5% of respondents said that they did not want to change their use patterns even if scientific evidence proved that using PLDs at high volumes can cause hearing loss (Q58). Although some warnings about music-induced hearing loss have been issued by the WHO [17], only 33.3% of our respondents considered it important to follow the manufacturer’s guidelines (Q57), a much lower number than the 61.2% of U.S. college students [9]. These results are likely due to having no short-term changes after exposure to high-intensity of PLDs [41] or having insufficient education opportunities. For detailed results, see Appendix G.

3.1.8. Knowledge of and Attitude Toward Regulations and Preference Type for Education

About half of the respondents (56%) asserted that PLD manufacturers should provide a function of volume limitation for their customers. Although 65.3% of the Korean college students were not familiar with recommendations and conservation methods offered by the manufacturers (Q25), they positively responded to using volume control software given from the manufacturer (55.8%, Q26). Additionally, they agreed that the ‘60–60 rule’ (62%, Q27) was not a violation of the public’s privacy (59.4%, Q28). Although these results were similar to those of Danhauer et al. [9], the U.S. college students agreed relatively less often (24.5%) about the ‘60–60 rule’, which seems to reflect a clear cultural difference between the two countries.

Of the respondents, 60.3% thought that current media, such as news outlets and journals, did not exaggerate the possible risk of a hearing loss caused by PLD use (Q61); however, 77.4% wanted to learn about potential hearing loss caused by excessive use of PLDs (Q62). The respondents preferred to obtain that information via e-mail (23.9%), TV (22.5%), and sometimes experts (15.4%, Q63). Most of the students also wanted to be advised by a hearing professional (42%) and a doctor (36.6%) on how to prevent noise-induced hearing loss (NIHL) (Q64). Marron et al. (2015) supported this result; 84% of their respondents stated they would shorten the duration of their PLD use or reduce their listening level if given information by audiologists or doctors [42]. Thus, they indicate a willingness to change their behavior if they deemed the behavior to be unsafe. Ultimately, audiologists, physicians, and manufacturers should work together to develop effective educational outreach campaigns targeting this particular population [9]. Broader education on the appropriate use of PLDs and the effect of noise on hearing is essential [43], especially given the worldwide sales of 25.6 million portable music players in 2005, which was an increase of 409% from the previous year [44]. For detailed results, see Appendices H and I.

3.1.9. Comparison of Responses for PLDHQ and PLDHQ-K

Although most of our questions received responses similar to those for the PLDHQ, four items (Q9 along with 11, 13, and 15, Q37, Q62, and Q65) showed a prominent difference between the two questionnaires, as shown here in Figure 1.

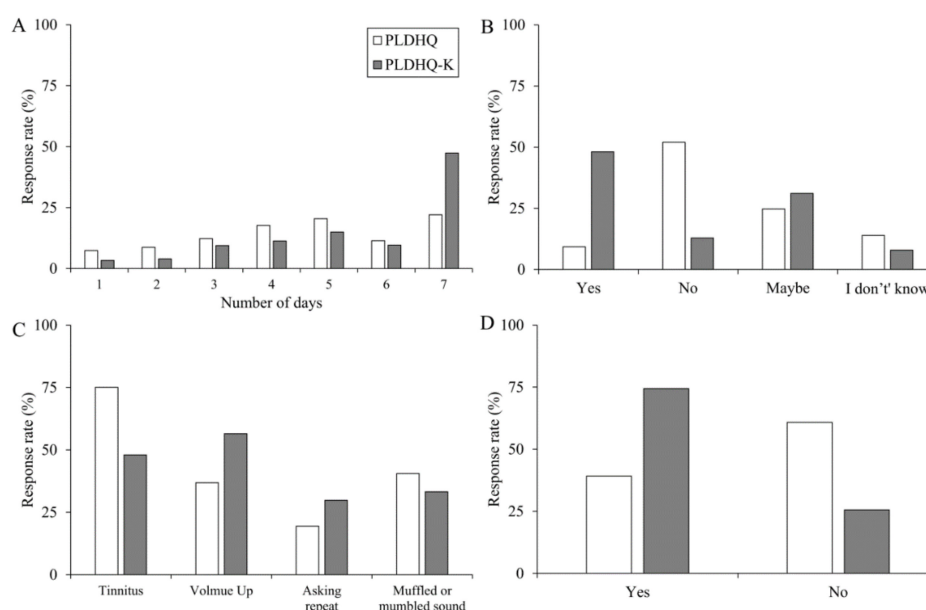


Figure 1. Data comparison of the original Personal Listening Device and Hearing Questionnaire (PLDHQ) and the current Korean version (PLDHQ-K): (A) How many days do you use your PLDs in a week? (Q37), (B) If you already have a hearing loss, do you think that your use of PLDs is one of its causes? (Q65), (C) Questions regarding signs of hearing loss (Q9, 11, 13, and 15), (D) Do you want to study more about the potential hearing loss associated with using PLDs? (Q62).

For the number of days in a week that PLDs were used, approximately 50% of the Korean students reported always using them in a week (Q37, Figure 1A). This use is relatively higher at 25.3% than for U.S. students. Also, approximately 50% of the Korean college students responded that if they had a hearing loss, its cause would be PLDs (Q65, Figure 1B), but only 38.78% of U.S. college students reported this response. This discrepancy is presumed to stem from the time difference of about 10 years between the study and the increased penetration and accessibility of PLDs. In modern life where the smartphone lets people listen to music and watch video clips anywhere. Figure 1C shows the response rate for the question about a sign of hearing loss (Q9, 11, 13, and 15). In the case of the Korean college students, increasing the volume steps of TV or radio (56.49%) and having tinnitus (47.97%) had a relatively higher response, whereas only tinnitus showed a dominant pattern over other responses (75.05%) in the PLDHQ. For the question about learning and its association with PLD use and hearing loss, Figure 1D presents a different pattern between the two groups of college students. There were more ‘yes’ responses for the Koreans and more ‘no’ responses for the U.S. college students. Zogby (2006) explained this difference between responses by suggesting that African Americans (72%) were more likely than Hispanics (56%) and whites (48%) to report that they had some symptoms of hearing loss and to know the positive methods for hearing conservation [8]. Thus, it is better to apply a different approach for effective education for each culture and country.

3.2. The Regression Model

The results of the Kaiser–Meyer–Olkin (KMO) and Bartlett’s tests were acceptably high at 0.835 ($p < 0.001$) for the first hypothesis (H-1), meaning the data were suited for PCA using the varimax rotation method. The eigen values were 27.796, 19.111, and 15.704 for the three factors that contributed to their relationship. Because the PCA’s results demonstrated the factors and eigen vectors for each item, linear regression analysis was applied after conducting the PCA. Table 2 shows the results of multiple regression analysis for the first hypothesis.

Table 2. Summary of the multiple regression analysis for the first hypothesis.

Model	R ²	Adjusted R ²	Durbin-Watson
Q10	0.064	0.061	2.120
Q49	0.166	0.164	2.063
Q50	0.153	0.152	2.033
Q51	0.239	0.236	2.027
Q52	0.209	0.207	1.967
Q53	0.175	0.172	2.035

Note. Q: Question.

Figure 2 presents the results of the regression model and demonstrates that frequent use of the PLD and the high volume levels of the PLD affected the hearing condition in 1009 respondents. Although both factors, namely, usage frequency (Q 39 and 40) and level of volume (Q 42 and 48), significantly affected current hearing problems, the volume level of PLD usage, especially Q48, strongly supported hearing problems for PLD users with higher standardized regression coefficients (0.338–0.394, $p < 0.001$). Regardless, the interpretation should be different when considering the relationship between the factors and hearing problems. In terms of use time (Q39), the significance values mean the tendency of respondents that use PLDs for 0.5 to 4 h per day was less experience of tinnitus and less need to ask someone to repeat. The frequency of use was also significant and correlated with more questions of hearing problems (Q40). However, because the responses of Q40 were dichotomous regarding low-or high-use frequency, it should be carefully interpreted; the respondents used PLDs more than 4 h a day 1~3 times (36.7%) or more than 21 times (23.4%) in a year. In addition, the use time and frequency factor provided a weaker explanation at 0.072~0.127 than did the volume of PLDs. This relatively weak explanation is presumed to be due to the dichotomous response of Q40. Despite the dichotomy, the frequency of long-term use and hearing problems were not related. In other words, the use time and frequency of using PLDs among Korean college students was considered too insignificant to cause them to experience hearing problems (signs of actual hearing loss).

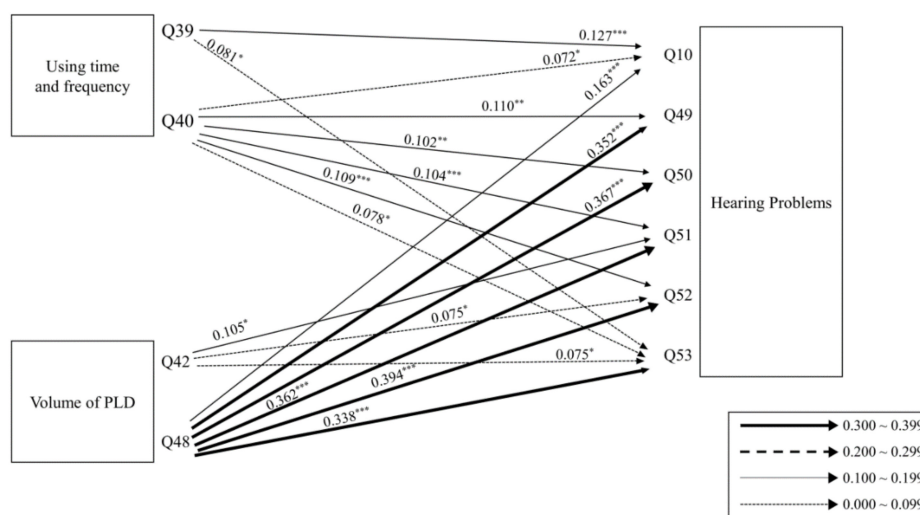


Figure 2. Path result for the first hypothesis based on a multiple regression model. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Although the volume of PLDs was statistically strong, it was also interpreted similarly to use time and frequency. For Q42, more than half of the respondents said that they usually set a ‘medium’ level volume. These results, understandably, are associated with less experience of hearing problems. Also, those respondents whose family, friends, or others had not warned them to turn down the volume of their PLD (Q48) were associated with less experience of hearing problems. In other words,

Korean college students do not use volumes high enough to experience signs of hearing loss. As shown in Figure 2, both factors (use time and frequency and volume of PLDs) were significantly related to hearing problems. However, with more insightful interpretation of the relevance of each item, one can say that Korean college students indicated that they did not overuse PLDs until they began to experience actual hearing problems that mean signs of hearing loss such as tinnitus, increased volume, and muffled sound, especially after using PLDs.

For the second hypothesis (H-2), the KMO and Bartlett’s measure was 0.702 ($p < 0.001$). Four factors were confirmed, and their eigenvalues were 19.251, 11.607, 10.097, and 9.068. The results of multiple regression analysis for H-2 are shown in Table 3. Figure 3 demonstrates that the amount of respondents’ knowledge (Q9, 13 and 15) regarding hearing loss supports the positive and/or temperate attitudes toward hearing conservation. In detail, these positive attitudes revealed two subgroups of informational and technical restrictions. The informational restriction can be explained as positive acceptance of the capability of being restricted based on knowledge or information (Q56, 59 and 60), whereas the technical restriction focused on acceptance of the capability being restricted based on volume control function/software (Q24 and Q26). Statistically, in the Figure 3 model, the respondents who knew that they were experiencing tinnitus (Q9) or that increasing the volume steps (Q15) was a symptom of hearing loss thus preferred the technical restriction (Q24; 0.154, $p < 0.001$) and the information restriction (Q56; 0.186, $p < 0.001$), respectively, and had a positive attitude toward hearing conservation. However, the respondents of Q15 also partially supported Q61 (0.116, $p < 0.001$) with a temperate attitude toward hearing conservation.

Table 3. Summary of the multiple regression analysis for the second hypothesis.

Model	R ²	Adjusted R ²	Durbin-Watson
Q56	0.068	0.065	1.958
Q59	0.026	0.024	2.024
Q60	0.019	0.017	1.953
Q24	0.032	0.030	2.021
Q26	0.019	0.017	2.072
Q61	0.014	0.013	1.986

Note. Q: Question.

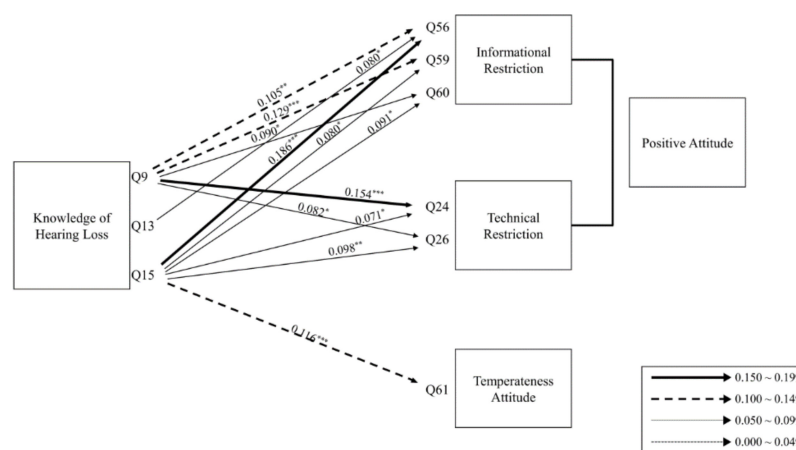


Figure 3. Path results for the second hypothesis based on the multiple regression model. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In terms of the relationship between the amount of knowledge about hearing loss and attitudes toward hearing conservation, the more subjects there were with knowledge of hearing loss, the more positive became the attitude toward informational and technical restriction [21]. Thus, the subjects who were knowledgeable about hearing loss were receptive to restrictions. In addition, the subjects with a

temperate attitude also thought that media, such as newscasts and newspapers, did not overstate the risk of hearing loss caused by PLD use. In short, Korean college students were knowledgeable about hearing loss and had a receptive attitude toward restrictions for hearing conservation.

4. Conclusions

The Korean college students were aware of their listening levels and partially knew the maximum amount of time that they could listen at their chosen levels without risking hearing loss. Based on these current results, educational programs should provide more information on the effective actions necessary to minimize risk for hearing loss, while also increasing the public's knowledge and consequently changing both people's attitudes and listening habits. It is also crucial to develop appropriate standards and safe recommendations for daily music exposure in future studies that can confirm the longitudinal effect. We believe that these studies can provide further insights into the information educational institutions need to help establish a preventive program that can target the inappropriate use of PLDs effectively.

Author Contributions: S.Y. conducted data collection, analysis and wrote the manuscript. C.K. analyzed the data with statistical and interpreted the data. W.H. provided concepts and developed the research design and directed the study. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

H-1	Hypothesis 1
H-2	Hypothesis 2
KMO	Kaiser–Meyer–Olkin
NIOSH	National Institute for Occupational Safety and Health
NIHL	Noise Induced Hearing Loss
OSHA	Occupational Safety and Health Administration
PCA	Principal component analysis
PLDHQ	Personal Listening Device and Hearing Questionnaire
PLDHQ-K	Korean version of the PLDHQ
PLDs	Personal Listening Devices
PLLs	Preferred Listening Levels
WHO	World Health Organization

Appendix A

Table A1. Self-evaluation of one's hearing status and personal experience of noise exposure.

Item Number	Response	Number of Respondents (%)
Q5. How often are you exposed to noisy environments?	Never	21(2.1)
	Rarely	210(20.8)
	Sometimes	476(47.2)
	Frequently	240(23.8)
	Always	62(6.1)
	Total	1009

Table A1. Cont.

Item Number	Response	Number of Respondents (%)	
Q17. Mark your current hearing condition as 1–10 (1: the worst hearing level, 10: the best hearing level)	1	2(0.2)	
	2	6(0.6)	
	3	41(4.1)	
	4	79(7.8)	
	5	114(11.3)	
	6	151(15)	
	7	247(24.5)	
	8	245(24.3)	
	9	93(9.2)	
	10	31(3.1)	
	Total	1009	
Q35. Do you think you have some difficulties when hearing?	Yes	119(11.8)	
	No	540(53.5)	
	Maybe	229(22.7)	
	I don't know	121(12)	
	Total	1009	
Q36. If you have hearing difficulties, what is their cause?	Ear infections	77(7.7)	
	Fever	9(0.9)	
	Noise	150(14.9)	
	Trauma	8(0.8)	
	Drugs	1(0.1)	
	Birth defects	28(2.8)	
	PLD use	306(30.4)	
	Do not have any	323(32.1)	
	Unknown	104(10.3)	
	N/A	3	
	Total	1006	
Q65. If you already have hearing loss, do you think that using PLDs is one of the causes?	Yes	485(48.1)	
	No	130(12.9)	
	Maybe	314(31.1)	
	I don't know	80(7.9)	
	Total	1009	

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

Appendix B

Table A2. Knowledge of factors triggering hearing loss and hearing loss prevention.

Item Number	Response	Number of Respondents (%)	
Q6. Do you think that people with hearing loss no longer need to worry about hearing loss from hazardous noise?	Yes	100(9.9)	
	No	728(72.2)	
	Maybe	131(13)	
	I don't know	50(5)	
	Total	1009	
Q7. Do you think that inserting cotton in the ears can prevent hearing loss caused by loud noise?	Yes	166(16.5)	
	No	370(36.7)	
	Maybe	337(33.4)	
	I don't know	136(13.5)	
	Total	1009	
Q8. Do you think that noise-induced hearing loss can be prevented in advance?	Yes	668(66.2)	
	No	97(9.6)	
	Maybe	198(19.6)	
	I don't know	46(4.6)	
	Total	1009	

Table A2. Cont.

Item Number	Response	Number of Respondents (%)	
Q9. Do you think tinnitus (or ringing in the ears) is a symptom of overexposure to hazardous noise?	Yes	484(48)	
	No	140(13.9)	
	Maybe	275(27.3)	
	I don't know	110(10.9)	
	Total	1009	
Q11. If you do not hear another person's voice correctly or you ask for repeats saying "huh?" or "what?" is this a symptom of hearing loss?	Yes	301(29.8)	
	No	339(33.6)	
	Maybe	282(28)	
	I don't know	87(8.6)	
Q13. Do you think it is a sign of hearing loss if people's voices sound muffled or as if people are mumbling?	Yes	335(33.2)	
	No	266(26.4)	
	Maybe	309(30.6)	
	I don't know	99(9.8)	
Q15. Do you think raising the volume of a TV or a radio is a symptom of hearing loss?	Yes	570(56.5)	
	No	155(15.4)	
	Maybe	244(24.2)	
	I don't know	40(4)	
	Total	1009	

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

Appendix C

Table A3. Selection and PLD preferences.

Item Number	Response	Number of Respondents (%)	
Q18. Do you currently use a PLD, such as a smartphone or MP3 player?	Yes	985(97.6)	
	No	24(2.4)	
	Total	1009	
Q19. If you have a PLD, what kind of device is it?	Smartphone	946(93.8)	
	MP3 player	26(2.6)	
	Tablet	9(0.9)	
	Notebook	8(0.8)	
	Other	20(2)	
	Total	1009	
Q20. If you have a PLD, how did you get it?	Given to me (choose)	115(11.4)	
	Given to me (not choose)	50(5)	
	I purchased it	810(80.3)	
	Do not own one	24(2.4)	
	Other	10(1)	
	Total	1009	
Q21. Considering your current financial status, is it easy for you to purchase a PLD?	Yes	471(46.7)	
	No	301(29.8)	
	Maybe	187(18.3)	
	I don't know	50(5)	
	Total	1009	
Q22. How many of your friends use PLDs? Check a percentage.	Less than 25%	36(3.6)	
	26–50%	62(6.1)	
	51–75%	133(13.2)	
	76–100%	778(77.1)	
	Total	1009	

Table A3. Cont.

Item Number	Response	Number of Respondents (%)	
Q23. If you could choose any PLDs in the store, which kind of PLD would you prefer?	Smartphone	812(80.5)	
	MP3 player	62(6.1)	
	Tablet	72(7.1)	
	Notebook	47(4.7)	
	Other (please specify)	16(1.6)	
	Total	1009	
Q29. Which manufacturer of PLDs do you currently use?	Samsung	518(51.4)	
	LG	99(9.8)	
	Apple	355(35.2)	
	SONY	7(0.7)	
	Lenovo	2(0.2)	
	Other (please specify)	28(2.8)	
Total	1009		
Q30. What kind of PLD did you use before using your current one?	Smartphone	708(70.2)	
	MP3 player	236(23.4)	
	Tablet	18(1.8)	
	Notebook	31(3.1)	
	Other (please specify)	16(1.6)	
	Total	1009	
Q31. What type of earphones do you usually use to listen to music on your PLD?	Earbuds	672(66.6)	
	Canal earphone	274(27.2)	
	Headset	34(3.4)	
	Custom earpieces	6(0.6)	
	Other (please specify)	23(2.3)	
	Total	1009	
Q32. Would you consider purchasing customized earphones or headphones for your PLD to reduce background noise (e.g., vehicle, conversation, other noise)?	Yes	471(46.7)	
	No	317(31.4)	
	Maybe	140(13.9)	
	I don't know	81(8)	
	Total	1009	
	Q33. How much would you be willing to pay for a customized earphone or headphone?	Under \$25	466(46.2)
\$26-\$50		347(34.4)	
\$51-\$100		97(9.6)	
Over \$100		99(9.8)	
Total		1009	

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

Appendix D

Table A4. Use patterns for PLDs.

Item Number	Response	Number of Respondents (%)	
Q34. How long have you been using a PLD?	Less than 1 year	105(10.4)	
	1 to 2 years	127(12.6)	
	More than 2 years	777(77)	
	Total	1009	
Q37. How many days do you use your PLD each week? Check the number of days that apply.	1	34(3.4)	
	2	40(4)	
	3	95(9.4)	
	4	114(11.3)	
	5	151(15)	
	6	97(9.6)	
	7	478(47.4)	
	Total	1009	
Q38. How many hours do you use a PLD continuously each time you use one?	Less than 1/4	35(3.5)	
	1/4 to 1/2	153(15.2)	
	1/2 to 1	352(34.9)	
	1 to 2	299(29.6)	
	3 to 4	94(9.3)	
	More than 4	76(7.5)	
Total	1009		

Table A4. Cont.

Item Number	Response	Number of Respondents (%)	
Q39. How many hours do you usually use a PLD on the days when you do use your PLD?	Less than 1/4	34(3.4)	
	1/4 to 1/2	66(6.5)	
	1/2 to 1	212(21)	
	1 to 2	291(28.8)	
	3 to 4	231(22.9)	
	More than 4	175(17.3)	
	Total	1009	
Q40. How many times a year do you use a PLD in one place for more than four hours?	1 to 3	379(37.6)	
	4 to 6	188(18.6)	
	7 to 10	121(12)	
	11 to 20	85(8.4)	
	21 or more	236(23.4)	
	Total	1009	
Q41. If you can set the volume of your PLD from 1 to 10, at which level do you typically set it?	1	22(2.2)	
	2	56(5.6)	
	3	112(11.1)	
	4	148(14.7)	
	5	172(17.1)	
	6	193(19.1)	
	7	170(16.9)	
	8	96(9.5)	
	9	24(2.4)	
	10	16(1.6)	
	Total	1009	
Q42. Of the five responses, how do you consider the volume level on your PLD?	Very soft	28(2.8)	
	Soft	148(14.7)	
	Medium	535(53)	
	Loud	267(26.5)	
	Very loud	31(3.1)	
	Total	1009	
Q43. When you listen to your favorite music, do you increase the volume on your PLD?	Yes	467(46.3)	
	No	357(35.4)	
	Maybe	161(16)	
	I don't know	24(2.4)	
	Total	1009	
Q44. In noisy background conditions, do you increase the volume on your PLD?	Yes	771(76.4)	
	No	127(12.6)	
	Maybe	100(9.9)	
	I don't know	11(1.1)	
	Total	1009	
Q45. When you are exercising, do you increase the volume on your PLD?	Yes	451(44.7)	
	No	380(37.7)	
	Maybe	137(13.6)	
	I don't know	41(4.1)	
	Total	1009	
Q46. During which activities do you usually use a PLD (can select multiple responses)?	Studying	482(13.8)	
	Walking/jogging	605(17.3)	
	Driving	154(4.4)	
	Biking	115(3.3)	
	Skiing/snowboarding	11(0.3)	
	Working	192(5.5)	
	Exercising	431(12.3)	
	During class	33(0.9)	
	Relaxing	633(18.1)	
	Riding on planes	149(4.3)	
	Public transport	646(18.5)	
	Other	44(1.3)	
	Total	3495	
Q74. When listening to music, do you adjust the volume of your PLD to minimize the inconvenience of others nearby?	Strongly agree	388(38.5)	
	Moderately agree	346(34.3)	
	Neutral	174(17.3)	
	Moderately disagree	68(6.8)	
	Strongly disagree	32(3.2)	
	N/A	1	
	Total	1009	

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

Appendix E

Table A5. Different reasons for using PLDs.

Item Number	Response	Number of Respondents (%)	
Q68. Do you agree that the main reason why you use a PLD is to listen to music?	Strongly agree	559(55.4)	
	Moderately agree	302(39.9)	
	Neutral	113(11.2)	
	Moderately disagree	28(2.8)	
	Strongly disagree	7(0.7)	
	Total	1009	
Q69. Do you often use a PLD to help you relax?	Strongly agree	225(22.3)	
	Moderately agree	379(37.6)	
	Neutral	216(21.4)	
	Moderately disagree	136(13.5)	
	Strongly disagree	53(5.3)	
	Total	1009	
Q70. Do you often use a PLD to isolate yourself from others?	Strongly agree	161(16)	
	Moderately agree	305(30.2)	
	Neutral	204(20.2)	
	Moderately disagree	218(21.6)	
	Strongly disagree	121(12)	
	Total	1009	
Q71. Do you often use a PLD as a fashion item?	Strongly agree	33(3.3)	
	Moderately agree	71(7)	
	Neutral	114(11.3)	
	Moderately disagree	312(30.9)	
	Strongly disagree	479(47.5)	
	Total	1009	
Q72. Do you often use a PLD to focus on something specific, such as study or work?	Strongly agree	187(18.5)	
	Moderately agree	365(36.2)	
	Neutral	219(21.7)	
	Moderately disagree	138(13.7)	
	Strongly disagree	100(9.9)	
	Total	1009	
Q73. Do you intend to use your PLD as a form of rebellion (e.g., to escape from having conversation with others)?	Strongly agree	56(5.6)	
	Moderately agree	176(17.4)	
	Neutral	166(16.5)	
	Moderately disagree	248(24.6)	
	Strongly disagree	363(36)	
	Total	1009	
Q75. Do you often use a PLD when you feel bored?	Strongly agree	375(37.2)	
	Moderately agree	408(40.4)	
	Neutral	157(15.6)	
	Moderately disagree	44(4.4)	
	Strongly disagree	25(2.5)	
	Total	1009	
Q76. Do you often use a PLD because of its convenience?	Strongly agree	437(43.3)	
	Moderately agree	371(36.8)	
	Neutral	149(14.8)	
	Moderately disagree	37(3.7)	
	Strongly disagree	15(1.5)	
	Total	1009	
Q77. Do you use a PLD often because you are a "high-tech enthusiast?"	Strongly agree	120(11.9)	
	Moderately agree	137(13.6)	
	Neutral	223(22.1)	
	Moderately disagree	300(29.7)	
	Strongly disagree	229(22.7)	
	Total	1009	

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

Appendix F

Table A6. Effects on hearing from PLD use.

Item Number	Response	Number of Respondents (%)	
Q10. How often do you experience tinnitus?	Never	181(17.9)	
	Rarely	408(40.4)	
	Sometimes	358(35.5)	
	Frequently	53(5.3)	
	Always	9(0.9)	
	Total	1009	
Q12. How often do you ask for repeats and say "huh?" or "what?" because you do not hear what other persons have said correctly?	Never	49(4.9)	
	Rarely	275(27.3)	
	Sometimes	516(51.1)	
	Frequently	153(15.2)	
	Always	16(1.6)	
	Total	1009	
Q14. How often do you hear people's voices sounding muffled or as though they are mumbling?	Never	201(19.9)	
	Rarely	467(46.3)	
	Sometimes	286(28.3)	
	Frequently	51(5.1)	
	Always	4(0.4)	
	Total	1009	
Q16. How often do you increase the volume of TV or radio to have it loud enough?	Never	61(6.1)	
	Rarely	323(32)	
	Sometimes	478(47.4)	
	Frequently	123(12.2)	
	Always	24(2.4)	
	Total	1009	
Q47. When you are using a PLD, can other people around you hear your PLD's sound?	Yes	121(12)	
	No	671(66.5)	
	Maybe	122(12.1)	
	I don't know	95(9.4)	
	Total	1009	
Q48. Have family, friends, or strangers warned/asked/demanded that you to turn down the volume of your PLD?	Never	449(44.5)	
	Rarely	344(34.1)	
	Sometimes	184(18.2)	
	Frequently	26(2.6)	
	Always	6(0.6)	
	Total	1009	
Q49. After using a PLD, have you ever experienced tinnitus?	Never	454(45)	
	Rarely	347(34.4)	
	Sometimes	183(18.2)	
	Frequently	20(2)	
	Always	4(0.4)	
	N/A	1	
Total	1009		
Q50. After using a PLD, have you ever felt like your ears were full or fuzzy?	Never	448(44.4)	
	Rarely	321(31.8)	
	Sometimes	209(20.7)	
	Frequently	28(2.8)	
	Always	3(0.3)	
	Total	1009	
Q51. After using a PLD, have you ever increased the volume son your TV or radio to hear it better?	Never	379(37.6)	
	Rarely	297(29.4)	
	Sometimes	259(25.7)	
	Frequently	68(6.7)	
	Always	6(0.6)	
	Total	1009	

Table A6. Cont.

Item Number	Response	Number of Respondents (%)
Q52. After using a PLD, have you ever felt that people nearby are mumbling, or their voices sound muffled?	Never	450(44.7)
	Rarely	353(35)
	Sometimes	173(17.2)
	Frequently	32(3.2)
	Always	0(0)
	N/A	1
	Total	1009
Q53. After using a PLD, have you ever asked someone to repeat by saying "huh?" or "what?" because you did not correctly hear what others said?	Never	306(30.3)
	Rarely	317(31.4)
	Sometimes	284(28.2)
	Frequently	92(9.1)
	Always	10(1)
	Total	1009
Q67. Have you ever realized you were in a dangerous situation while using a PLD (e.g., when crossing the road, or had an absence of attention while driving)?	Strongly agree	49(4.9)
	Moderately agree	174(17.2)
	Neutral	367(36.4)
	Moderately disagree	276(27.4)
	Strongly disagree	143(14.2)
	Total	1009

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

Appendix G

Table A7. Opinions about using PLDs.

Item Number	Response	Number of Respondents (%)
Q54. At what age do you give permission to others to regularly listen to music?	Younger than 5 years	12(1.2)
	5 to 10 years	63(6.2)
	11 to 13 years	320(31.7)
	14 to 16 years	386(38.3)
	Older than 16 years	158(15.7)
	I don't know	70(6.9)
	Total	1009
Q55. Do you think that it is dangerous to use PLDs in some situations (e.g., driving, biking, snowboarding)?	Strongly agree	562(55.7)
	Moderately agree	276(27.4)
	Neutral	107(10.6)
	Moderately disagree	44(4.4)
	Strongly disagree	20(2)
	Total	1009
Q56. Do you think that using PLDs at loud listening levels can damage hearing?	Strongly agree	609(60.4)
	Moderately agree	305(30.3)
	Neutral	70(6.9)
	Moderately disagree	16(1.6)
	Strongly disagree	8(0.8)
	N/A	1
Total	1009	
Q57. Do you believe that it is unimportant to follow the manufacturer's warnings about the safe use of PLDs (less listening time at a high volume)?	Strongly agree	118(11.7)
	Moderately agree	218(21.6)
	Neutral	293(29)
	Moderately disagree	244(24.2)
	Strongly disagree	136(13.5)
	Total	1009
Q58. Do you refuse to change your use patterns for PLDs, even though scientific evidence suggests that using a PLD at high volumes can cause hearing loss?	Yes	150(14.9)
	No	484(48)
	Maybe	268(26.6)
	I don't know	107(10.6)
	Total	1009

Table A7. Cont.

Item Number	Response	Number of Respondents (%)	
Q59. Do you think that PLDs should carry a warning like cigarettes do, such as, "Listening to loud music for a prolonged time can damage your hearing?"	Strongly agree	247(24.5)	
	Moderately agree	375(37.2)	
	Neutral	243(24.1)	
	Moderately disagree	102(10.1)	
	Strongly disagree	42(4.2)	
	Total	1009	
Q60. To reduce the risk of hearing loss, do you think people should decrease the volume steps on their PLDs rather than only limiting their listening time?	Strongly agree	259(25.7)	
	Moderately agree	439(43.5)	
	Neutral	269(26.7)	
	Moderately disagree	38(3.8)	
	Strongly disagree	4(0.3)	
	Total	1009	
Q66. If you are concentrating on using your PLD, do you fear you may not be aware of situations that are dangerous to you or others?	Yes	713(70.7)	
	No	112(11.1)	
	Maybe	137(13.6)	
	I don't know	47(4.7)	
	Total	1009	

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

Appendix H

Table A8. Knowledge and attitude toward regulation of PLDs.

Item Number	Response	Number of Respondents (%)	
Q24. Do you think PLD manufacturers, such as Apple and Samsung, should include a volume limit function to prevent hearing loss?	Yes	565(56)	
	No	228(22.6)	
	Maybe	164(16.25)	
	I don't know	52(5.15)	
	Total	1009	
Q25. Do you know that on 29 March 2006, Apple announced software on their web page to limit a PLDs' maximum volume steps, with some specific sound loudness information, a caution against listening to loud music for a long period, how to prevent hearing loss from iPod use, and other key information. Are you aware of their communication?	Yes	157(15.6)	
	No	659(65.3)	
	Maybe	63(6.2)	
	I don't know	130(12.9)	
	Total	1009	
Q26. Would you use software for volume control from a PLD manufacturer like Apple or Samsung for you or your child?	Yes	563(55.8)	
	No	183(18.1)	
	Maybe	175(17.3)	
	I don't know	88(8.7)	
	Total	1009	
Q27. Do you agree with the experts who recommend using PLDs at a volume no higher than 60% less than 60 min a day (referred to as the "60-60 rule")?	Strongly agree	194(19.3)	
	Moderately agree	431(42.8)	
	Neutral	287(28.5)	
	Moderately disagree	84(8.3)	
	Strongly disagree	12(1.2)	
	N/A	1	
	Total	1009	
Q28. Do you think that special recommendations like the "60-60 rule" are a violation of the public's right to privacy?	Yes	114(11.3)	
	No	599(59.4)	
	Maybe	151(15)	
	I don't know	145(14.4)	
	Total	1009	

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

Appendix I

Table A9. Type of education preference for hearing conservation.

Item Number	Response	Number of Respondents (%)	
Q61. Do you think that newscasts, newspapers, and other media have overstated the risk of hearing loss from PLD use?	Yes	81(8)	
	No	608(60.3)	
	Maybe	113(11.2)	
	I don't know	207(20.5)	
	Total	1009	
Q62. Do you want to study and learn more about the potential hearing loss associated with using PLDs?	Yes	751(74.4)	
	No	258(25.6)	
	Total	1009	
Q63. If you want to study additional information on how to use PLDs to avoid hearing loss, how would you like to receive it?	E-mail	241(23.9)	
	Web sites	138(13.7)	
	From doctors	89(8.8)	
	From experts	155(15.4)	
	From friends, family	29(2.9)	
	TV	227(22.5)	
	Radio	5(0.5)	
	Manufacturer warning	84(8.3)	
	Print	14(1.4)	
	Other	27(2.7)	
Total	1009		
Q64. Whose advice would you seek about safe PLD use and hearing loss?	Doctor	369(36.6)	
	Manufacturer	60(6)	
	Audiologist	101(10)	
	Expert	424(42)	
	Family	19(1.9)	
	Friends	29(2.9)	
	Other	7(0.7)	
Total	1009		

Note. The parentheses are a percentage of the total that were asked for each question. Also, items with 50% and higher response rate are graphically marked as darker gray. Q: Question.

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