Research Article

The Impact of Hearing Preservation Education on the Young Adults' Listening Behavior

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Highlights

- Education enhances students' awareness of safe personal listening device usage
- Education motivates them to revise their listening behavior

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ABSTRACT

Background and Aim: High-level sounds in recreational activities are known as one of the leading causes of developing noise-induced hearing loss, particularly in adolescents and young adults. Thus, this study aimed to explore the practicality of a hearing preservation education program in modifying listening behaviors concerning recreational noise exposure and Personal Listening Device (PLD) use in adolescents and young adults.

Methods: Two hundred students, both male and female (n=100, each) between 15 and 18 years old were chosen to participate. These students engaged in the hearing preservation education program and filled in pre-education, post-education, and follow-up questionnaires. The questionnaire assessed the students' awareness, intention, attitudes, and motivation concerning recreational noise exposure and safe PLD usage. The materials were prepared by an expert panel of audiologists and then remarked as comprehensible by teachers of the target age group.

Results: There were significant differences in preferred volume levels and preferred listening levels of PLD, as well as the duration of PLD usage among pre-education, post-education, and follow-up questionnaire measurements ($p<0.001$). Notably, education significantly altered the students' awareness, intention, attitudes, and motivation concerning recreational noise exposure among the three experimental conditions ($p<0.001$).

Conclusion: Providing a fundamental guide and effective education to adolescents and young adults will help them to use PLD safely, expand their awareness and knowledge, and consequently revise their attitudes and listening behaviors.

Keywords: Noise-induced hearing loss; personal listening device; recreational noise; hearing preservation; young adult and adolescent

Introduction

Exposure to high-intensity sounds that are frequently annoying or unwanted is commonly referred to as noise [1, 2]. Noise exposure influences the structures housed in the cochlea, specifically the Outer Hair Cells (OHCs) [3]. Hence, extreme noise exposure destructs a large number of OHCs and leads to Noise-Induced Hearing Loss (NIHL) that appears an unrepairable and permanent loss of hearing [3]. NIHL results in undesirable effects like communication issues, tinnitus, hyperacusis, depression, and decreased psycho-social activity [3-5].

Several investigations propose that high-level sounds from recreational activities (e.g. personal listening devices) are one of the leading causes of NIHL development, particularly in adolescents and young adults [3, 6, 7]. Nearly, one billion adolescents and young adults are in danger as a result of risky recreational listening behaviors [8]. However, these investigations reported that the majority of adolescents and young people are unaware of these self-created impairments [9-11]. For example, Lee et al. calculated the number of participants subjected to the higher than 85 dB A for eight hours a day by considering the number of hours consumed listening to music regularly [12]. Their findings demonstrated that one in every six young people in Singapore is in danger of establishing entertainment NIHL from music played through earphones [13]. Hutchinson Marron et al. specified the use and intelligence of harmless ranges on Personal Listening Devices (PLDs) among 180 university students [7]. These investigators reported that forty-four students listened at higher than 80 dB A free-field equivalent levels and merely 7% of them were well-informed about their detrimental effects [7]. Muchnik et al. measured the possibility of hearing loss in young participants as a result of the usage of PLDs [14]. Their findings declared that the majority of the listeners described high or extremely high volume settings, as well as a lack of understanding of the negative repercussions of listening to loud music [14]. Danhauer et al. plotted and employed an 83-segment questionnaire to study college students' information about opinions, as well as their priorities for hearing safety and usage of PLDs [13]. These investigators reported that some of these students are at high risk of hearing loss since they wore headphones and listened to their iPods at very high volumes for long periods [13]. Thus, preparing information and awareness about the consequences of recreational noise exposure would be the primary goal of reducing NIHL among young people and adolescents [1, 3, 15].

Hearing preservation education typically includes information on the implications of hearing loss, hence raising awareness of the dangers of extreme noise exposure through leisure activities [16, 17]. As a result, there have already been several calls for hearing preservation programs to be implemented in schools in many nations [3, 5, 18, 19]. In addition, the advantages of several of these programs have been evaluated via the application of a pre-and post-education questionnaire [5, 20, 21]. Nevertheless, in contrast to other countries, far less research has been done in Iran on the issue of incorporating hearing conservation education for school-aged children. In addition, none of these educational programs have been widely accepted and used for specific age groups yet. Therefore, many Iranians, notably young adults and adolescents, are being exposed to noise that may lead to NIHL with no widely accepted protective program. This issue will, in turn, result in poor academic functioning and economic consequences, like high healthcare expenses and particular education demands for young Iranian individuals with NIHL.

According to these concerns, this study aimed to develop a hearing protection educational program and specify its effect, on students' preferred volume levels, preferred listening levels (PLLs), and duration of PLD use. Furthermore, the effect on students' awareness of, intention for, attitudes towards, and motivation for hearing well-being and fear of exposure to loud sounds were also determined. These issues were addressed in the current study via the application of a pre-, post-, and follow-up education questionnaire in students aged between 15 and 18 years old.

Methods

Participants

Two hundred healthy students (one hundred girls and one hundred boys; 15-18 years old Mean(SD): age 16.27(1.03) cooperated in the present study. This sample size was resolved based on a statistical formula after the pilot study. All students had normal hearing thresholds bilaterally (pure tone thresholds≤20 dB HL from 500 to 4000 Hz), normal otoscope examination (without impact cerumen, obstruction or foreign body in the ear canal), normal immittance measures (type An tympanogram measured using 226 Hz probe tone at a pressure range from +200 dapa down to –400 dapa) and were frequent PLDs users. In this study, multi-stage random sampling was performed. From all the educational areas in Tehran, several areas were randomly selected by lottery. To reduce the effect of culture, the number of selected

educational areas was large enough so that the provided sample was not just from a cultural context. Then a list of girls' and boys' schools in each selected educational area was prepared. One girls' school and one boys' school were randomly selected from each educational area through a lottery.

Study design

All students were asked to fill in a questionnaire and attended a meeting about music-induced hearing loss and hearing protection. Then, the students received the questionnaire immediately after the program. The questionnaire included 15 Likert scale questions to take information concerning the students' preferred volume levels, PLLs for listening to music via PLD, duration of PLD use and complaints after PLD use (ear fullness, pain, hearing loss, vertigo, headache, tinnitus, no symptom and other symptoms). Furthermore, it evaluated awareness, intention, attitudes, motivation, and fear concerning recreational noise exposure. To determine the stabilization of educational concepts in the present study, we re-assessed the questionnaire information at a one-month interval.

The educational material included information about the origin of noise and its effect on the hearing system, epidemiology, mechanism of injury, symptoms of hearing loss, preventive recommendations; etc. The whole questionnaire as well as the educational content were developed and revised by five expert audiologists, and reviewed by two teachers.

To assess the students' PLLs, five popular and favorite pop music for teenagers were chosen. The students were asked to select one track and set the volume to their preferred level. Afterward, the mean output level of the Sony SOY-1612 Bluetooth headphones was determined using a 6 cc coupler and sound level meter (B&K2250L software, Denmark) when selected music was played through an ASUS VivoBook Max X441SC notebook. Note that the volume of the headphones as well as the media player program was locked throughout the experiment. Thus, the sound intensity level was only adjustable via the notebook. Finally, the percentage of preferred volume was defined in terms of dB SPL. According to the percentage of preferred or selected volume, the mean level of playing music could be estimated in dB SPL.

Statistical analysis

Statistical analysis was fulfilled through the SPSS version 17 software package. To define the impact of educational programs on quantitative data (students' preferred volume levels), a repeated measure ANOVA was run with a factor of condition (pre-education/post-education/follow-up) and Bonferroni correction (α=0.05) was completed for post hoc comparisons. To analyze qualitative data (e.g. students' PLLs, duration of PLD use.), the k-related samples Friedman test was employed in three experimental conditions (pre-education, post-education, and follow-up). A Wilcoxon Signed Ranks Test was employed to contrast students' responses to the qualitative measures of the questionnaire in pre-education and post-education conditions, pre-education and one month following education conditions, and post-education and one month following education conditions.

Results

Repeated measures ANOVA on students' preferred volume levels exhibited a significant effect of educational programs ($F=390.210$, $p<0.001$). According to the post hoc comparisons, students' preferred volume levels were significantly different among the pre-education and post-education conditions ($p<0.001$), pre-education and follow-up conditions ($p<0.001$), as well as post-education and follow-up conditions ($p<0.001$).

Table 1 demonstrates the students' preferred loudness levels for music pre-education, post-education, and one month after education. The k-related samples Friedman test exhibited a statistically significant effect of education on student PLLs ($p<0.001$). According to the Wilcoxon Signed Ranks test, students' PLLs were significantly reduced among pre-education and post-education conditions ($p<0.001$) as well as pre-education and follow-up conditions ($p<0.001$).

Table 1 indicates how long the students were utilizing the PLD pre-, post-, and one month after education. These findings revealed a significant effect of educational content on the duration of PLD use ($p<0.001$). The k-related samples Friedman test findings revealed a significant effect of educational content on the duration of PLD use ($p<0.001$). According to the Wilcoxon Signed Ranks test, the duration of PLD use was significantly different among pre-education and post-education conditions ($p<0.001$), pre-education and follow-up conditions ($p<0.001$) as well as post-education and follow-up conditions ($p<0.001$).

Table 1. The students' preferred listening levels for music and duration of personal listening device use: pre-education, post-education, and one month after education

Question	Response	No.(%)		
		Pre-education	Post-education	Follow-up
What is your preferred volume level for listening to music?	Very slow	1 (0.5)	3(1.5)	1(0.5)
	Slow	0(0.0)	8(4.0)	6(3.0)
	Medium downward	7(35.5)	20(10.0)	39(19.5)
	Medium	22(11.0)	78(39.0)	95(47.5)
	Medium upward	62(31.0)	64(32.0)	41(20.5)
	Loud	79(39.5)	23(11.5)	12(6.0)
	Very loud	29(14.5)	4(2.0)	4(2.0)
How many hours during the day do you listen to music using a personal listening device?	Less than an hour	9(4.5)	24(12.0)	72(36.0)
	One to three hours	43(21.5)	89(44.5)	101(50.5)
	Three to five hours	107(53.5)	70(35.0)	20(10.0)
	Five to seven hours	29(14.5)	13(6.5)	5(2.5)
	More than seven hours	12(6.0)	4(2.0)	0(0.0)

Table 2 shows the findings for the students' awareness of hearing protection procedures, hearing loss, and other risks posed by listening to loud music via PLDs or exposure to noisy environments in three experimental conditions. The k-related samples Friedman test exhibited a statistically significant effect of education on students' awareness ($p<0.001$). According to the Wilcoxon Signed Ranks Test, students' awareness was significantly differ-

Table 2. The students' awareness in pre-education, post-education, and follow-up conditions

Question	No.(%)			
	Response	Pre-education	Post-education	Follow-up
Do you think listening to loud music hurts your hearing?	I do not know	24 (12.0)	0(0.0)	0(0.0)
	I know a little	90(45.0)	1(0.5)	3(1.5)
	I almost know	86(43.0)	40(20.0)	40(20.0)
	I know a lot	0(0.0)	76(38.0)	72(36.0)
	I know completely	0(0.0)	83(41.5)	83(41.5)
Do you think being in noisy environments (such as concerts, stadiums, etc.) can damage your hearing?	I do not know	53(26.5)	0(0.0)	0(0.0)
	I know a little	76(38.0)	2(1.0)	2(1.0)
	I almost know	69(34.5)	57(28.5)	50(25.0)
	I know a lot	2(10.0)	79(39.5)	77(38.5)
	I know completely	0(0.0)	62(31.0)	69(34.5)
Do you know about hearing protection procedures and other loud noise-related injuries?	I do not know	60(30.0)	0(0.0)	0(0.0)
	I know a little	91(45.5)	1(0.5)	2(1.0)
	I almost know	47(23.5)	60(30.0)	51(25.5)
	I know a lot	2(1.0)	76(38.0)	83(41.5)
	I know completely	0(0.0)	63(31.5)	62(31.0)

Table 3. The students' intentions to change listening habits and attitudes towards personal listening device use in pre-education, post-education and follow-up conditions

Question	Response	No.(%)		
		Pre-education	Post-education	Follow-up
Do you want to change your listening habits?	Don't want	111(55.5)	0(0.0)	0(0.0)
	A little inclined	66(33.0)	8(4.0)	6(3.0)
	Relatively inclined	22(11.0)	93(46.5)	89(44.5)
	Very inclined	1(0.5)	70(35.0)	69(34.5)
	Totally inclined	0(0.0)	29(14.5)	34(17.0)
How important is it for you to reduce your exposure to loud noises?	No matter	46(23.0)	0(0.0)	0(0.0)
	A little important	96(48.0)	4(2.0)	4(2.0)
	Relatively important	51(25.5)	64(32.0)	58(29.0)
	Very important	6(3.0)	80(40.0)	75(37.5)
	Quite important	1(0.5)	52(26.0)	61(30.5)

ent among pre-education and post-education conditions ($p<0.001$) as well as pre-education and follow-up conditions ($p<0.001$).

In determining the students' intentions to change listening habits, the k-related samples Friedman test exhibited a statistically significant effect of education on students' intentions ($p<0.001$) (Table 3). According to the Wilcoxon Signed Ranks test, students' intentions were significantly different among pre-education and post-education conditions ($p<0.001$) as well as pre-education and follow-up conditions ($p<0.001$).

Table 3 shows the findings for the students' attitudes toward PLD use in three experimental conditions. The k-related samples Friedman test exhibited a statistically significant effect of education on students' attitudes ($p<0.001$). According to the Wilcoxon Signed

Table 4. The students' motivation for reducing and fear for being exposed to loud environmental sounds in pre-education, post-education and follow-up conditions

Question	Response	No.(%)		
		Pre-education	Post-education	Follow-up
Do you tend to reduce the loud sounds you are exposed to?	Don't want	43(21.5)	0(0.0)	0(0.0)
	A little inclined	100(50.0)	3(1.5)	2(1.0)
	Relatively inclined	49(24.5)	53(26.5)	48(24.0)
	Very inclined	5(2.5)	85(42.5)	83(41.5)
	Totally inclined	3(1.5)	59(29.5)	65(32.5)
Does being exposed to loud ambient noises (such as car horns, etc.) make you afraid?	Not at all	87(43.5)	19(9.5)	20(10.0)
	A little	78(39.0)	71(35.5)	61(30.5)
	Relatively	31(15.5)	76(38.0)	81(40.5)
	Much	3(1.5)	31(15.5)	26(13.0)
	Very much	1(0.5)	3(1.5)	10(5.0)

Ranks test, students' attitudes were significantly different among pre-education and post-education conditions ($p<0.001$) as well as pre-education and follow-up conditions ($p<0.001$).

The students' motivation for reducing loud sounds in three experimental conditions is displayed in Table 4. The k-related samples Friedman test exhibited a statistically significant effect of education on students' motivations ($p<0.001$). According to the Wilcoxon Signed Ranks test, students' motivations were significantly different among pre-education and post-education conditions ($p<0.001$), pre-education and follow-up conditions ($p<0.001$) as well as post-education and follow-up conditions ($p<0.001$).

Finally, Table 4 indicates the results for how the students ranked their fear of being exposed to loud environmental sounds. The k-related samples Friedman test exhibited a statistically significant effect of education on students' fear ($p<0.001$). According to the Wilcoxon Signed Ranks test, students' fear was significantly different among pre-education and post-education ($p<0.001$), pre-education and follow-up ($p<0.001$) as well as post-education and follow-up conditions ($p=0.008$).

Discussion

Hearing loss is a serious threat of noise contamination that takes place in pleasant forms such as recreational activities [3, 7]. Recently, there has been increased concern regarding NIHL induced by recreational noise exposure in adolescents and young adults [3, 12, 13]. As a result, adolescents and young adults may unknowingly encounter the hazards of noise [3]. Providing primary hearing wellness as well as hearing preservation education could help them avoid poor hearing healthcare consequences [13, 22-25]. According to the findings of this research, hearing preservation education had a substantial favorable impact on our participants' hearing health behaviors as well as their ability to use PLD safer.

In the present study, the students' preferred volume level, PLLs, and daily PLD usage were reduced immediately post-education as well as one month after the program. It means that our program has discouraged young people from improper PLD use. Santana et al. investigated the behavior of 58 students with an age range of 10 to 17 years regarding the intensity level of PLD use after an educational lecture [22]. According to their findings, the students' preferred intensity level during listening to music via earphones was significantly reduced after an educational lecture [22]. Danhauer et al. reported that 84% of their participants were ready to modify their PLLs and shorten their PLD usage length following hearing protection programs [13]. Therefore, developing appropriate educational guidelines will finally favor the impact on hearing health. Accordingly, Portnuff et al. revealed that 90 minutes per day of PLD use reduced the risk of hearing loss [23]. Similarly, according to Fligor and Cox's safe PLD use guidelines, daily PLD use should be limited to one hour or shorter, employing supra-aural type headphones with the gain control set to 60% of maximum [4]. The current study's finding, combined with earlier studies on the efficacy of the programs, proposes that hearing preservation education is critical for reducing the risk of NIHL [5, 13, 24].

In determining the influence of hearing protection education on students' awareness, intention, attitudes, and motivation for hearing well-being and safe PLD use, a significant difference was discovered between pre-, post-and follow-up conditions. These results are in agreement with prior investigations into the influence of the programs for combat NIHL among young adults and adolescents [3, 5, 17, 25]. According to these investigations, hearing preservation programs caused a favorable improvement in participants' attitudes toward, awareness of, and understanding of hearing health habits. Keppler et al. investigated the impacts of a hearing education program on 78 participants with an age range of 18 to 30 years after nearly 6 months [17]. These authors revealed that the participants' recreational noise exposure, beliefs and attitudes concerning noise disposal, hearing loss, as well as hearing protection device usage were significantly different between pre- and post-training sessions [17]. Gilles and Paul investigated the usefulness of a preventive campaign for NIHL in 547 students with an age range of 14 to 18 years [26]. Their findings exhibited that the students had a more unfavorable attitude toward the noise and a more favorable attitude toward hearing protection applications after the preventive campaign [26]. Taljaard et al. determined the effectiveness of a preservation education program for NIHL in enhancing knowledge of the detrimental effect of PLDs on hearing health and in modifying the listening behavior of 318 students with an age range of 9 to 13 years [27]. They implemented their study in three experimental sessions (pre-education session, immediately post-education session, and three months after the education session) [27]. These investigations reported significant differences in their participants' knowledge of hearing health and listening behavior between three experimental sessions [27]. Dell and Holmes investigated the impact of a hearing conservation program in improving knowledge and attitudes concerning high-intensity sound or noise expo-

sure in 64 children aged 12 to 14 [3]. Their results demonstrated that an alteration in pro-noise attitudes among adolescents was assisted by awareness and knowledge of a hearing conservation program [3]. Griest et al. assessed the usefulness of the dangerous decibels instructional program in improving participants' knowledge, attitudes and planned behaviors toward hearing as well as hearing loss prohibition [5]. These authors reported that participants' knowledge and attitudes significantly improved concerning hearing as well as hearing loss prohibition [5]. Chung et al. reported that if given proper hearing protection programs, teenagers and young adults can be motivated to improve their hearing health behaviors [25]. These findings in accordance with the Health Belief Model will finally have a favorable impact on hearing-associated health behaviors. In general, the results of the present study revealed that developing an educational program for a specific group could change listening behaviors.

A limitation of the current investigation is that the post-education and follow-up education testing were implemented relatively short after the hearing preservation program was presented. As a result, a future goal would be to investigate the long-term impacts and we suggest educating the parents, either.

Conclusion

The findings of this study added to the limited literature on the benefits of hearing preservation education in modifying pro-noise behaviors and ensuring safe PLD utilization. In particular, this is the first national study, focusing on hearing preservation education and educational retention monitoring among young adults and adolescents.

Ethical Considerations

Compliance with ethical guidelines

This study was accepted via the Ethics Committee of Iran University of Medical Sciences, Tehran, Iran (Code: IR.IUMS.REC1396.1268).

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Authors' contributions

SJS: Developed educational content, and performed the analysis; NR: Developed educational content, and performed the analysis; MS: Contributed to data collection; SS: Interpretation the results, and drafted the manuscript; AP: Had the project's main idea, supervised the project, and revised the manuscript.

Conflict of interest

There are no competing interests declared by the authors.

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