

Attitudes and Practices of Hearing Protection Used by Israeli College Music Students*

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Abstract: Music students are frequently exposed to music at an intensity and duration that may be harmful to their hearing. Academic music students may develop hearing loss and related effects like: tinnitus, hyperacusis, and a feeling of blockage/opacity that are common after noise exposure. The damage caused by exposure to music is usually cumulative, the results of which (hearing loss and tinnitus) are only experienced at a later stage. Using hearing protection devices (HPD), such as earplugs, has been found to be helpful for hearing preservation in noisy environments. Various studies have shown that instruction on the use of HPD in noisy and loud music environments can increase the use of HPD, and avoid harmful exposure. This current study appears to be the first of its kind, and examines the attitudes and practices of music students in Israel regarding the use of HPD that can contribute to hearing conservation. The majority of music students in Israel do not use HPD. Findings of the study indicate that music students do not receive formal instruction on hearing protection from loud noise and music. Since damage to the auditory system from noise and loud music exposure can be irreversible, an educational program for music students is needed regarding hearing protection. It is recommended that the educational programs take place as part of the music school programs, to prevent exposure without the proper protection and prevent damage.

Keywords: hearing preservation, hearing protection, earplugs, hearing loss, music students

Introduction

Hearing loss resulting from extended exposure to noise has been labeled “noise-induced hearing loss” (NIHL). The term “noise-induced *occupational* hearing loss” refers to hearing loss due to noise exposure in the workplace. The definition requires: a) at least two years of work in a noisy work environment; or b) a working environment where the noise level is 85 dB and above for at least thirty days. However, findings suggest that exposure to a working environment with a noise level of 80 dB already poses a risk of hearing loss.¹ Music students are a population that meets this definition,² since music students are exposed to loud noise / music for extended periods of time.³ Using National

* The authors would like to thank Shunit Agayoff and Shany Zilinsky for their assistance in collecting the data used in this article.

¹ Jos Verbeek, et al., “Interventions to Prevent Occupational Noise-Induced Hearing Loss: A Cochrane Systematic Review,” *International Journal of Audiology*, 53/2 (March 2014): 84–96. <https://doi.org/10.3109/14992027.2013.857436>.

² Bronwen J. Ackermann, et al., “Sound Practice: Improving Occupational Health and Safety for Professional Orchestral Musicians in Australia,” *Frontiers in Psychology*, 5 (September 2014): 1–11. <https://doi.org/10.3389/fpsyg.2014.00973>.

³ Brian C.J. Moore, *An Introduction to the Psychology of Hearing* (New York: Academic Press, 2012), pp. 2–20.

Institute for Occupational Safety and Health (NIOSH) recommendations, the noise exposure of classical music students was measured for a full day. The findings indicated that nearly half (49 percent) of the music students exceeded a 100 percent noise level for at least one of the two days of the study.⁴

Consequently, due to their music exposure in addition to environmental noise exposure, these students may develop hearing loss and related adverse effects, such as tinnitus, hyperacusis, and a feeling of opacity.⁵

In a cross-sectional study, 125 musicians from Iran, with at least five years of music work experience, exhibited an audiometric notch in one or both ears and bilateral notches were present in 42.4 percent of the participants. The history of tinnitus after performance and ear pain during performance was reported by 64 (51 percent) and 35 (28 percent) individuals, respectively. It is important to note that less than 2 percent of the participants used hearing protection devices.⁶

In younger musicians in Brazil, Maia and Russo observed no hearing impairment in behavioral audiometric testing in the first years of exposure; however, the results of the Transient Evoked Otoacoustic Emissions testing (TEOAE), which evaluates the outer hair cells in the inner ear, showed negative results in most of the music students.⁷ The researchers hypothesized that the adverse effects indicated in the latter test were indicative of structural and functional alteration of the cochlea—among other causes, partly due to the exposure to musical noise. TEOAE testing has been found to be more sensitive to gradual structural changes within the inner ear than behavioral hearing testing. The enhanced sensitivity may thus explain why the TEOAE test produces negative results not yet reflected in behavioral hearing tests.⁸ The damage caused by exposure to music is usually accumulative, the effects of which can be hearing loss and tinnitus that are sometimes experienced only at a later time, even years after exposure.⁹

⁴ Nilesh J. Washnic, Susan L. Phillips, & Sandra Teglas. “Student’s Music Exposure: Full-Day Personal Dose Measurements,” *Noise and Health*, 18/81 (March–April 2016): 98–103. <https://doi.org/10.4103/1463-1741.178510>.

⁵ Maria H. Mendes, Thais C. Morata, & Jair M. Marques. “Acceptance of Hearing Protection Aids in Members of an Instrumental and Voice Music Band,” *Brazilian Journal of Otorhinolaryngology*, 73/6 (November–December 2007): 785–92. [https://doi.org/10.1016/S1808-8694\(15\)31175-7](https://doi.org/10.1016/S1808-8694(15)31175-7).

⁶ Gholamreza Pouryaghoub, Ramin Mehrdad, & Saeed Pourhosein. “Noise-Induced Hearing Loss among Professional Musicians,” *Journal of Occupational Health*, 59/1 (January 2017): 33–37. <https://doi.org/10.1539/joh.16-0217-OA>.

⁷ Juliana F.R. Maia, & Leda P.C. Russo, “Study of Hearing of Rock-And-Roll Musicians,” *Pro-Fono Revista de Atualizacao Cientifica*, 20/1, (January–March 2008): 49–54. <https://doi.org/10.1590/s0104-56872008000100009>.

⁸ Eric H. Høydal, et al., “Transient Evoked Otoacoustic Emissions in Rock Musicians,” *International Journal of Audiology*, 56/9 (September 2017): 685–91. <https://doi.org/10.1080/14992027.2017.1321788>.

⁹ Kris Chesky, et al., “Attitudes of College Music Students towards Noise in Youth Culture,” *Noise and Health*, 11/42 (2009): 49–53. <https://doi.org/10.4103/1463-1741.45312>.

Besides avoiding it altogether, using HPD is an effective way to diminish the damage caused by exposure to music. There are different types of HPD available. There are disposable earplugs, which are widely used in factories by industrial workers; these earplugs create an uneven attenuation between the different frequencies.¹⁰ For musicians, there are specialized types of earplugs, namely, custom-made earplugs. This special custom-made earplug may be a better fitting for music practitioners since the attenuation between the different frequencies is uniform, and is therefore more likely to preserve the naturalness of the sound of music.¹¹ Using HPD is helpful for hearing preservation in noisy environments.¹² Earplug use has also been found to be effective in preventing temporary hearing loss after loud music exposure.¹³

Various studies have shown that education about the damage that can be caused to hearing by loud music increased the use of protective measures and avoidance of harmful exposure to loud music.¹⁴ Additional studies support the conclusion that educational programs effectively raise awareness both of the consequences of noise exposure and using HPD. For example, Auchter and Le Prell¹⁵ examined the efficiency of an educational intervention program on awareness and the use of earplugs among high school orchestra players. The study demonstrated that the program produced a significant improvement: before participating in the program, 23 percent of participants reported that they had previously used earplugs. After participating in the program, 62 percent of participants reported using earplugs—at least sometimes. Another study on orchestral musicians from Australia showed improvement of participants reporting use of earplugs after hearing conservation practice.¹⁶

In Olsen, et al., of the ninety college instrumental music students from Texas University who participated, 77 percent had never received any training about hearing

¹⁰ Alessandra G. Samelli, et al, “The Study of Attenuation Levels and the Comfort of Earplugs,” *Noise Health*, 20/94 (May–June 2018): 112–19. https://doi.org/10.4103/nah.NAH_50_17.

¹¹ Annelies Bockstael, Hannah Keppler, & Dick Botteldooren, “Musician Earplugs: Appreciation and Protection,” *Noise and Health*, 17/77 (July–August 2015): 198–208. <https://doi.org/10.4103/1463-1741.160688>.

¹² Ibid.

¹³ Geerte G.J. Ramakers, et al., “Effectiveness of Earplugs in Preventing Recreational Noise-Induced Hearing Loss: A Randomized Clinical Trial,” *JAMA Otolaryngology Head & Neck Surgery*, 142/6 (January 2016): 551–58. <https://doi: 10.1001/jamaoto.2016.0225>.

¹⁴ Susan E. Griest, Robert L. Folmer, & William H. Martin, “Program Effectiveness of Dangerous Decibels, School-Based Hearing Loss Prevention,” *American Journal of Audiology*, 16 (December 2007): 165–81. [https://doi.org/10.1044/1059-0889\(2007/021\)](https://doi.org/10.1044/1059-0889(2007/021)).

¹⁵ Melissa Auchter, & Colleen G. Le Prell, “Hearing Loss Prevention Education Using Adopt-a-Band: Changes in Self-Reported Earplug Use in Two High School Marching Bands,” *American Journal of Audiology*, 23/2 (June 2014): 211–26. https://doi.org/10.1044/2014_AJA-14-0001.

¹⁶ Ian O’Brien, Bronwen J. Ackermann, & Tim Driscoll, “Hearing and Hearing Conservation Practices among Australia’s Professional Orchestral Musicians,” *Noise and Health*, 16/70 (May–June 2014): 189–95. <https://doi.org/10.4103/1463-1741.134920>.

health and only a small percentage of students used HPD.¹⁷ In Israel there is no information about music students' knowledge, attitudes about hearing protection, or their practices regarding the use of HPD.

Study objectives: The purpose of this study was to examine the knowledge and attitudes of academic music students in Israel regarding hearing protection, and whether they use these devices, in practice, to protect their hearing.

Subjects

Using the “snowball” method, 147 students were recruited, 14 of whom were removed from the study because their age was over 35 years. Therefore, the analysis included 133 students from various academic music programs in Israel, 76 men and 57 women, aged 19–35 years ($M= 25.7$ years; $SD= 3.6$), with no reports of current medical conditions or chronic illnesses. None of the students was taking medication or was known to have a *congenital* or *sensory neural* hearing impairment; none of the female subjects was pregnant.

Musical instrument types: The music students played various instruments: 26 the guitar, 23 the piano, 15 are singers, 15 play percussion instruments, 7 the flute, 6 the saxophone, 6 the clarinet, 4 the violin, 4 the contrabass, 4 the trumpet and other musical instruments. The students practice and perform in different settings: 32 play in musical ensembles, 37 in an orchestra, 10 in musical bands, 6 play rock music, and 5 sing in choirs.

Duration of playing: The number of music-playing years among the subjects ranged from one year to thirty years.

Playing hours per week: The weekly time spent playing music varies for the students from a half hour weekly to forty-five weekly hours. This includes personal music, professional rehearsals, music lessons, and other musical sessions. Figure 1 shows the percentages of the weekly play hours for music students.

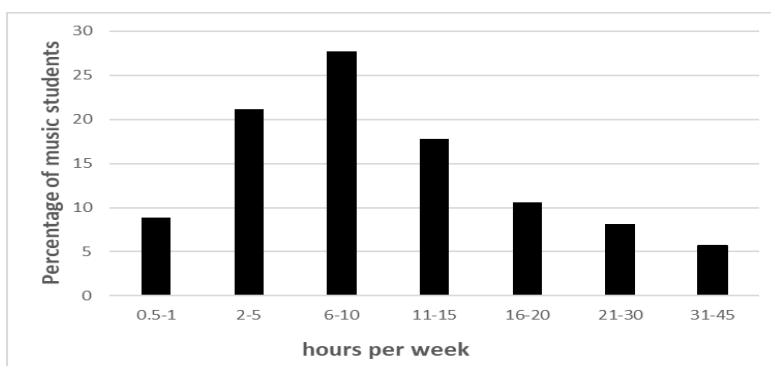


Figure 1: Number of weekly hours spent playing music per week

¹⁷ Anna D. Olson, et al., “Hearing Health in College Instrumental Musicians and Prevention of Hearing Loss,” *Medical Problem Performing Artists*, 31/1 (March 2016): 29–36.
<https://doi.org/10.21091/mppa.2016.1006>.

Method

Questionnaire

A questionnaire that was designed and adapted into Hebrew for this study was developed based on the questionnaires used by Callahan, et al.,¹⁸ Laitinen and Poulsen,¹⁹ and O'Brien and Beach.²⁰ The questionnaire contains fifty open and closed questions on various topics that included: a) general demographic details (age, gender, music playing experience); and b) attitudes and practices regarding the use of HPD (What HPD do you usually use while playing music? What is the difficulty with using HPD?).

Procedure

After receiving approval from the Ethics Committee, the questionnaire was sent to the students via social networks on the Internet (mainly Facebook), such that its completion constituted their consent to the study. Completion of the questionnaire took approximately ten minutes.

Results

The degree of use of HPD

The results indicated that 50.4 percent of the college music students who participated in this study stated that they *never* used HPD. Of the 49.6 percent of students who used HPD, approximately half reported that they have not yet become accustomed to them, but use them nonetheless (18 percent), or that since they were not able to get used to them, they stopped using them (8.3 percent). For the remaining group (23 percent): 6 percent reported it taking years to become accustomed to the HPD, for 4.5 percent it took months, 4.5 percent reported it taking weeks to become accustomed to them, and for 8.3 percent it took from the beginning of learning music to become used to them (Figure 2).

¹⁸ Ashleigh J. Callahan, et al., "Collegiate Musicians' Noise Exposure and Attitudes on Hearing Protection," *Hearing Review*, 18/6 (January 2011): 36–44.

¹⁹ Heli Laitinen, & Torben Poulsen, "Questionnaire Investigation of Musicians' Use of Hearing Protectors, Self-reported Hearing Disorders and their Experience of their Working Environment," *International Journal of Audiology*, 47/4 (April 2008): 160–68. <https://doi.org/10.1080/14992020801886770>.

²⁰ Ian O'Brien, & Elizabeth Beach, "Hearing Loss, Earplug Use, and Attitudes to Hearing Protection among Non-Orchestral Ensemble Musicians," *Journal of the Audio Engineering Society*, 64/3 (2016): 132–37. <https://doi.org/10.17743/jaes.2015.0096>.

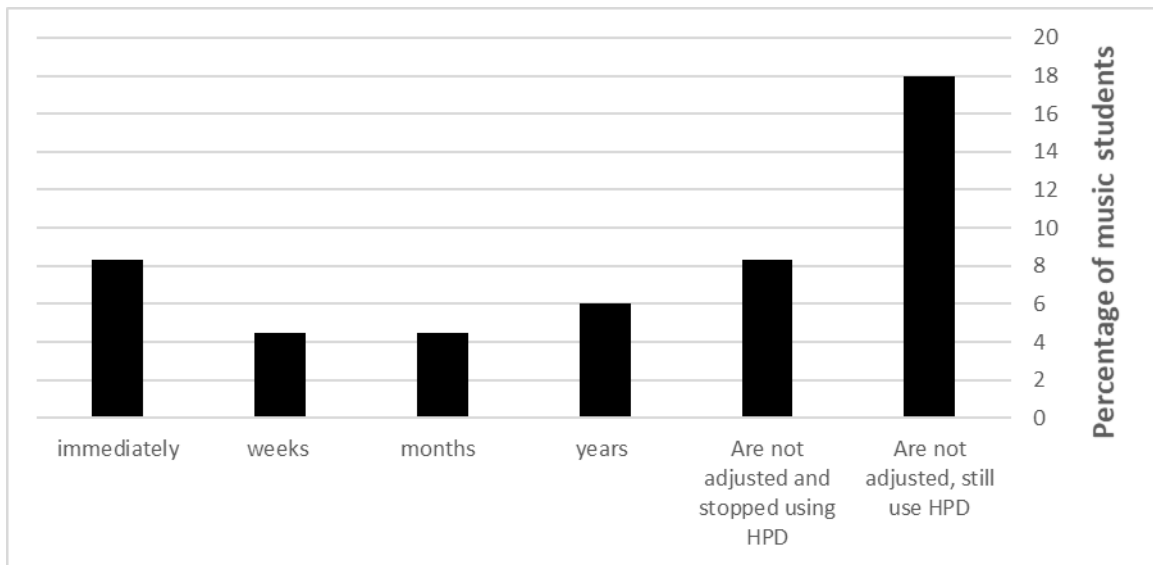


Figure 2: Time of adjustment and use of HPD

The degree of use of HPD in different exposure situations

The degree of use of HPD was asked in four different musical exposure situations: 1) while teaching music; 2) while performing; 3) while rehearsing with other musicians, and 4) while rehearsing alone. Figure 3 shows the degree of use of hearing protection in the various exposures to music. In all circumstances, the majority of the students did not use HPD.

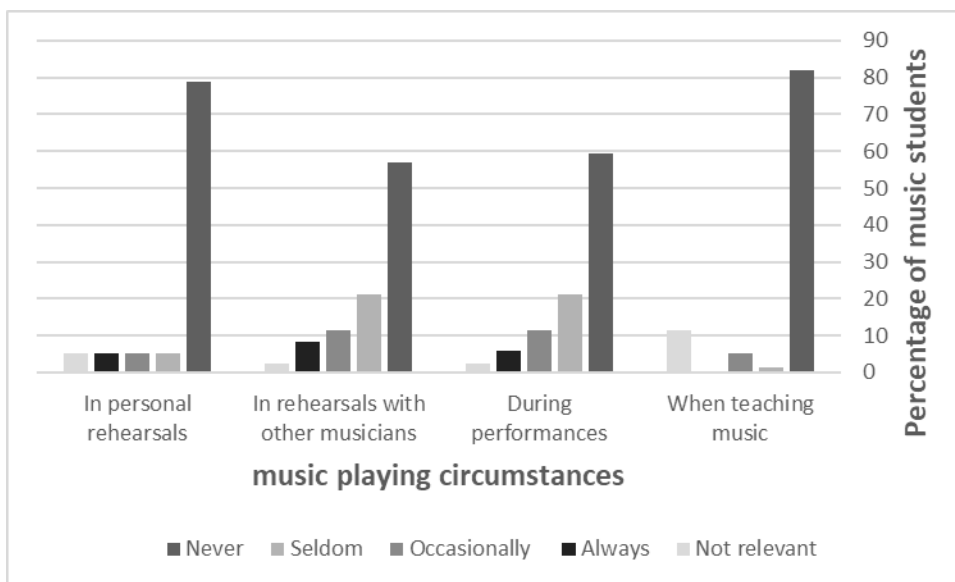


Figure 3: Use of hearing protection aids in various exposures to music

Types of hearing protection:

Examining the music students who reported using HPD, the highest percentage used earplugs that were custom made especially for musicians (39.3 percent) followed by disposable, one-time use earplugs (37.7 percent). Fewer students used standard custom-made HPD (8.9 percent), or cotton wool balls (5.4 percent), while 8.7 percent used other HPD, which included: headphones, swimming earplugs, and ear monitors.

Source of recommendation to use HPD to prevent hearing loss

In regards to the education about and recommendation of HPD use, a significant proportion of students (37.5 percent) received no recommendations at all concerning hearing protection, and reported that they had understood the need for HPD independently. 26.8 percent received the recommendation from other musicians, 19.6 percent from their music teachers, 10.7 percent from their friends, and 1.8 percent were recommended HPD by an audiologist, 1.8 percent by their parents, and 1.8 percent by an audiology student.

Problems reported when using HPD

Students who use HPD were found to have a variety of issues when using them, as illustrated in Figure 4. These issues included reports of difficulty hearing other musicians' instruments, pressure in the ear, dizziness, and ear infections, apparent voice change, changes in sounds of musical instruments, and pain or discomfort in the ear.

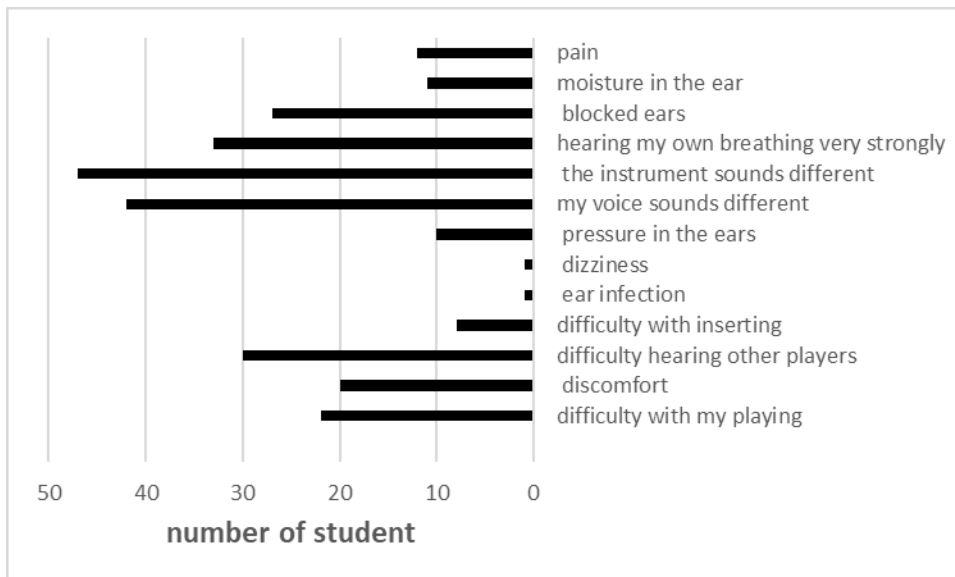


Figure 4: Difficulties with using HPD

Notably, a significant percentage (38.1 percent) of the subjects indicated that one or more of the listed symptoms caused them to stop using HPD.

Decreased intensity of the musical instrument

The majority of the music students (65 percent) play on instruments whose volume can be lowered, like electric guitar, electric piano. Among the music students in this group, it was found that, in practice, the number of students who actually lowered the volume of their instrument was small (35 percent) (Figure 5).

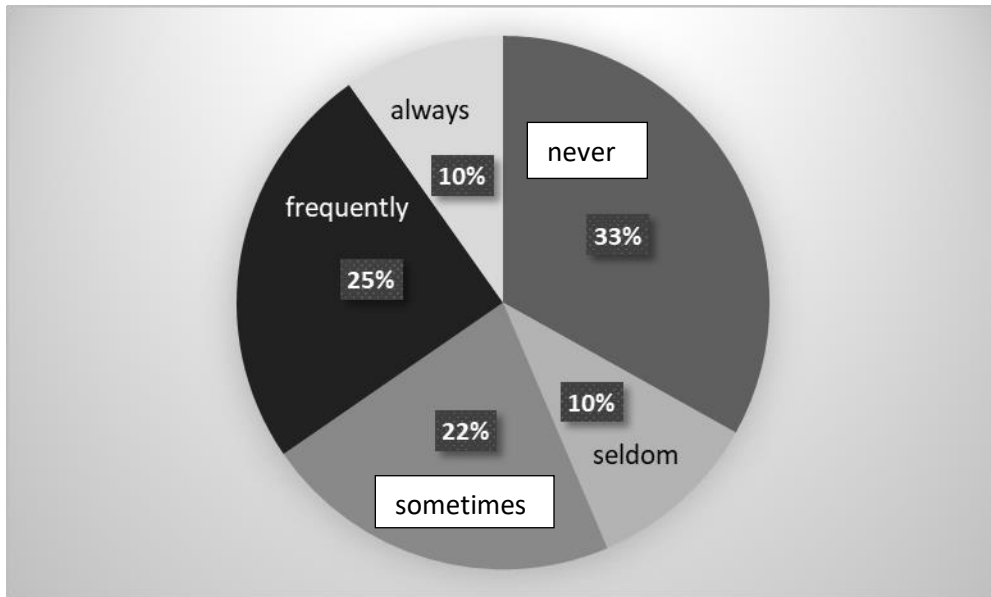


Figure 5: Frequency of students decreasing the intensity of their musical instruments

Discussion

Damage from high intensity noise to the auditory system, including the ear and hearing, is cumulative and irreversible. One of the high risk populations are musicians and music students, who spend many hours listening to music at high intensities.²¹ One of the ways to prevent this damage is by the use of HPD. To use protection, one must firstly be aware of the potential damage to which they are exposed, and secondly the possibility of prevention.²²

This study investigated the knowledge and attitudes of music students in Israel regarding hearing protection and the practical use of HPD to protect their hearing.

With regard to the use of HPD, the results demonstrate that our participants rarely used HPD; this finding is similar to the findings across the world.²³ The results also

²¹ B.J. Ackermann, et al., "Sound Practice," 5: 1–11.

²² Elizabeth F. Beach, & Ian O'Brien, "In Their Own Words: Interviews with Musicians Reveal the Advantages and Disadvantages of Wearing Earplugs," *Medical Problems of Performing Artists*, 32/2 (June 2017): 101–110. <https://doi.org/10.21091/mppa.2017.2017>.

²³ M.H. Mendes, et al., "Acceptance," 73: 785–92.

indicate that there are variations in the percentage of use between different exposure settings. In quieter situations, such as personal rehearsals and music lessons, the vast majority of our participants never used HPD (78.9 percent and 81.9 percent, respectively). In contrast, in noisier situations, such as performances and rehearsals with additional players, the percentage of use of HPD increased. However, even in the noisier situations, more than *half of the participants* did not use HPD at all. From these results it can be hypothesized that academic music students are not sufficiently aware of the potential damage to their hearing from their music exposure. This can be seen as well from the students' responses to their source of recommendation for the use of HPD.

The majority response was that they had understood the need to use HPD independently (37.5 percent), while a significant percentage reported that they had received advice from other musicians (26.8 percent). That is, the majority of the music students participating in our current study received no recommendations or instructions from health care professionals. Laitinen and Poulsen showed that Danish musicians playing in symphony orchestras rarely use hearing protectors—and not always correctly when they do.²⁴ It was their recommendation that education was needed to change the musicians' opinion of hearing conservation and hearing protectors. This education must be directed both at the musicians and the administration of the symphony orchestras. We also found that there was no one individual who educated the music students about the effects of noise exposure and damage, nor was there any one person who guided them on how and what HPD to use. Auchter and Le Prell showed that a well-organized educational program in Australia was required for the music student population regarding noise exposure damage and methods for hearing protection, and that this program has been found to be effective in increasing HPD use.²⁵

The main reason for not using hearing protection, as found in the current study—similar to other studies²⁶—lies in the fact that HPD are often perceived by music students as being detrimental to their music ensemble music making, which is both necessary in their studies and professional music development, as well as leading to a variety of disorders and problems when using them. For example, 65.2 percent of our subjects indicated that they had difficulty hearing the other players when using the HPD. In addition, 78.3 percent reported that, when using the HPD, the sound of their instruments sounded different to them. Perception of the sound quality of one's instrument is crucial for a musician's performance.

Another way to decrease noise exposure beyond HPD use is to limit the hours of exposure and/ or the intensity of the noise or music heard. Since recitals are inherent to

²⁴ Laitinen & Poulsen, "Questionnaire," 47: 160–68.

²⁵ Auchter & Le Prell, "Hearing Loss," 23: 211–26.

²⁶ Callahan, et al., "Collegiate," 18: 36–44.

music studies and in many acoustic instruments it may be impossible to decrease performance intensity, it is important to take breaks, and to limit smoking²⁷ and alcohol consumption,²⁸ which increases the negative impact of noise exposure. In the current study, although the majority of music students (68.4 percent) could decrease the intensity of their instruments (i.e. electric guitar, electric piano) only about 35 percent did so. These findings reinforce the fact that if we improve the awareness of the students, they can reduce the volume of their instrument at least when practicing, and they would be able to reduce their noise exposure and protect their hearing.

Conclusion

The current study found that Israeli music students, similar to their peers around the world, do not use HPD as much as they probably should due to their loud music exposure for long periods of time. We believe that issues that prevent musicians from using HPD, as reported in the current study, like difficulty hearing the other players and the quality of the sound of their instruments can be successfully addressed using specific custom-made HPD intended for musicians (less than 40 percent used them in this group of musicians) and with correct instruction how to use them. It appears that there is no existing educational program regarding hearing preservation for Israeli music students. Since loud noise and music can cause irreversible damage, a well-organized educational program is required for the music student population regarding noise exposure damage and ways to protect their hearing, which has been found to be effective in increasing HPD use. We suggest that the educational program be carried out at an early age when music studies begin and, concomitantly, at the commencement of music learning programs for young adults and students, before irreversible damage is done to the auditory system. Furthermore, we propose that it may be possible to offer instruction to music teachers through the services of an educational audiologist in the conservatory, so that the teachers could further transmit the dangers of overexposure to (loud) music and enable and encourage students' awareness and use of the various HPD options.

In addition, since we found that most music students play their instruments daily as part of their training; this population should be made aware of the hearing impairments that may be caused by listening to their own and others' instruments when played at a

²⁷ Li Xiaowen, et al., "Association between Smoking and Noise-Induced Hearing Loss: A Meta-Analysis of Observational Studies," *International Journal of Environmental Research and Public Health*, 17/4 (February 2020): 1201. <https://doi.org/10.3390/ijerph17041201>.

²⁸ Jin-A Park, & Michelle J. Sub, "Hazardous Alcohol Consumption and the Risk of Hearing Impairment in Adults based on the Korean National Health and Nutrition Survey: A Retrospective Study," *Journal of Audiology and Otology*, 23/2 (April 2019): 63–68. <https://doi.org/10.7874/jao.2018.00241>.

loud intensity and without protection for long periods of time. Specifically, music teachers should emphasize that the damage to the auditory system and hearing in most cases is cumulative, and that the harmful effects can sometimes be experienced only after an extended period of time. We believe that having a formal education and hearing preservation counseling can prevent many music students and musicians from noise induced hearing loss. Further research following the use of HPD use after educational intervention programs can be helpful. It is important to better understand the factors, the facilitators, and the barriers to HPD use in order to address them in educational programs. It is also important to note that since the participants volunteered for this study, they may misrepresent the greater population of music students. A study including the attitudes and practices of music teachers could also be beneficial.