Biomedical Sciences and Clinical Medicine 2024;63(1):1-7.
doi: 10.12982/BSCM.2024.01
https://heo1.tci-thaijo.org/index.php/CMMJ-MedCMJ/index

BSCM
Biomedical Sciences and Clinical Medicine

Original Article

Open Access

A Method for Teaching "Safe Listening" Integrated with Early Clinical Exposure for Third-Year Medical Students

Suwicha Kaewsiri Isaradisaikul, Pattira Rungruangsarn and Thita Chantachote

Department of Otolaryngology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand

Correspondence:
Suwicha Kaewsiri Isaradisaikul, MD, Department of Otolaryngology, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand.
E-mail: suwicha.kaewsiri@cmu.ac.th

Received: May 10, 2023;
Revised: November 9, 2023;
Accepted: November 28, 2023

© The Author(s) 2024. Open Access

This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made.

ABSTRACT

OBJECTIVES The primary objective of this study is to describe a method for teaching "Safe Listening" integrated with early clinical exposure (ECE). Additionally, the study aims to assess preferred listening levels (PLLs), expected output levels, and classroom noise levels.

METHODS Retrospective cross-sectional study. After pre-activity instruction, medical students were grouped into classrooms. The noise level in each classroom was measured using a sound meter application both in quiet situations and during conversations while the medical students were listening to their personal listening devices (PLDs). A calibrated finger rub auditory screening test and a tuning fork test were conducted and PLLs were recorded. The students discussed the findings and rated their satisfaction with the process at the end of the activity.

RESULTS The average PLL of the 171 third-year medical students was 59.00 ± 7.38 dBA. The classroom noise level was 49.66 ± 8.45 dBA in quiet periods, and 77.51 ± 10.05 dBA during conversation and while listening to PLDs via earphones. In quiet periods, 97.65% of the students could hear finger rub in both ears. The average satisfaction score after the activity was 82.57 ± 13.14%.

CONCLUSIONS Practice with hearing tests and self-checks of PLLs introduced exposure to clinical learning together with awareness of safe listening. PLLs of medical students and satisfaction with the activity were in the favorable range.

KEYWORDS early clinical exposure, medical education, safe listening, preferred listening level

INTRODUCTION

To help bridge the gap between preclinical and clinical medical training, early clinical exposure (ECE) is a well-documented teaching-learning method for helping medical students transfer basic scientific knowledge into a clinical context (1, 2). ECE helps medical students improve their academic performance, develop communication skills, increases their motivation towards self-directed learning, enhances their appreciation of medical professionalism, fosters emotional development and empathy, helps develop an empathic and holistic attitude, and increases understanding of working in a team (1-3).

A variety of clinical teaching-learning activities in the preclinical period can be conducted as ECE,

The study was presented in a short communication session in Asia Pacific Medical Education Conference (APMEC), Singapore, on 22 - 23 May 2023

e.g., observation, small group teaching, clinical bedside teaching, supervision and feedback, self-learning, and case-based learning. Settings in ECE are divided into three groups: classroom, hospital-based, and community settings. The classroom setting is the basic and most convenient form of ECE. Strategies used in the classroom setting include the arrangement of patients in the classroom, preparation of case scenarios, and discussion of clinical materials (1-4).

During the COVID-19 pandemic, all preclinical courses were switched to an online mode. As a result, medical students have had increased earphone usage and increased listening time via personal listening devices during online study. The author considered that medical students should be aware of their hearing health and that they would benefit from clinical experience with hearing tests.

Safe listening refers to listening behavior that does not put hearing at risk of irreversible hearing damage (5). More than one billion young people put themselves at risk of permanent hearing loss by listening to loud sounds (6). In 2015, the World Health Organization (WHO) launched the Make Listening Safe initiative that aims to promote safe listening and reduce the risk of hearing loss due to loud recreational sounds. The "Make Listening Safe Workgroup" is a group working on promoting and supporting programs and materials for safe listening. Its goal is to "create a world where nobody's hearing is put in danger due to unsafe listening" (7). In 2019, the WHO published the WHO-ITU Global standard for safe listening devices and systems which offers recommendations related to safe listening features on personal audio devices. In 2022, WHO published the "mSafeListening Handbook" which provides evidence-based information for the promotion of safe listening behaviors and prevention of hearing loss as well as guidance on how to develop, integrate, implement and evaluate a national mSafeListening program (6). Awareness of self-listening levels is the first step to reducing the risk of sound exposure to loud noise. "Increasing awareness of the importance of safe listening and changing behavior for the target group (young people)" is one of the main objectives of the Make Listening Safe Workgroup (7).

Self-reported preferred listening level (PLL) is a comfortable listening level (0-100%) of the maximum volume setting of a personal listening device (PLD). The formula to convert self-reported PLD volume to decibels (expected output) is 0.53 x% + 34, where "x" is a 10-100 scale for setting volume levels (8).

Teaching "safe listening" integrated with ECE activities should help medical students to learn about hearing screening and the effects of environmental noise on listening levels and checking an individual's PLL as a way of raising awareness of safe listening. This study aimed (1) to describe an ECE activity integrating safe listening content and (2) to assess PLLs, expected output levels, and classroom noise levels.

METHODS

This retrospective cross-sectional observational study was approved by the Ethical Committee of the Faculty of Medicine, Chiang Mai University (CMU), the first regional medical school in Northern Thailand (study code ENT-2565-09065). Data was self-recorded in a data collection form by the enrolled students during the in-class activity. This ECE activity was set up for the third-year preclinical medical students at the end of the 2021 semester prior to exposure to the first-year clinical experience. Prior to the activity, instructions and orientation were provided in a guiding document. All third-year preclinical medical students were recruited. The students were divided into small groups of nine to ten students per group. Each group performed the ECE activity in a separate classroom. The classroom size was 3.62 x 3.97 x 3.0 m (width x length x height). The on-site activity was supervised by the coursework instructor (the first author) under COVID-19 precautions. One fifth-year medical student was assigned as a teaching assistant in each classroom. All students brought their PLDs and earphones. They were told to download a sound meter application before attending the class. The smartphone application was either "Sound Meter" in the android system or "NIOSH Sound Level Meter" in the IOS system. After the students were in the classroom, they were paired and the ECE activity started. The 30-minute activity was split into three ten-minute periods.

In the first ten minutes of the ECE activity the following steps were conducted in a quiet environment as follows:

1. The noise level in the classroom was measured using the sound meter application.

2. A screening hearing test was performed using the calibrated finger rub auditory screening test (CALFRAST) (9).

3. The Weber test was performed both with and without pressure on the right tragus. Closure of the right ear canal created the right conductive hearing loss.

4. The PLL was recorded while listening to the "Med CMU" song (downloaded from YouTube at https://www.youtube.com/watch?v=D3hu__krFeY) via their PLDs and earphones.

5. The level of loudness (too soft, comfortable, too loud) was recorded while listening to the "Med CMU" song at 60% of maximum volume which is the upper limit for safe listening.

In the second ten minutes, the students held a conversation. The activity included the following steps:

1. The noise level was measured in the classroom using the sound meter application with and without wearing earphones at PLL.

2. The screening hearing test was performed with CALFRAST while wearing earphones and listening to the Med CMU song at PLL. This step aimed to initiate appreciation of how the signal-to-noise ratio can affect hearing ability.

In the final ten minutes, the students discussed the findings among themselves and rated their satisfaction with the activity. Two opened-end questions were then given for the students to answer on a data collection form: "What you have learned today?" and "Please give your comments and feedback".

RESULTS

Of the 224 third-year medical students, 221 (98.7%) were enrolled in the class and were divided into 24 small groups. The completed data of 171 students were analyzed.

The sound meter applications were NIOSH 147 (86.0%), and Sound Meter 24 (14.0%). The types of earphones used in the class were earbud 101 (59.06%), in-ear 58 (33.92%), supra-aural 2 (1.17%), and noise-cancellation 10 (5.85%). While listening to the Med CMU song at a listening level of 60% of maximum volume, the students reported whether the level was too soft 7 (4.09%), comfortable 53 (30.99%), or too loud 111 (64.91%). PLL while listening to the Med CMU song with their listening devices with earphones. Expected output levels were calculated using a formula proposed by Williams et al. (8) as shown in Table 1 and Figure 1. The PLL is a 0-100 scale, where 100% is equal to the maximum volume of a PLD. The expected output levels among the four different types of earphones showed no differences (p-value = 0.73). Classroom noise level and CALFRAST results in the three situations are shown in Table 2.

The average satisfaction rating of the in-class activity was 82.57 ± 13.14% (mean ± SD), with a range of 50-100. In the opened-ended questions, the student's reflections about "What did you learn today?" included:

- How to perform a physical examination and screening hearing tests using the CALFRAST and Weber tests in the clinical year.

Table 1. Preferred listening levels and expected output using a personal listening device with earphones

Type of earphone (number of students)	Preferred listening level (%) Mean±SD (range)	Expected output level (dBA) Mean±SD (range)
Earbud (101)	47.32±13.79 (10-76)	59.08±7.31 (39.30-74.28)
In-ear (58)	47.62±13.69 (25-90)	59.24±7.25 (47.25-81.70)
Supra-aural (2)	50.00±28.28 (30-70)	60.50±14.99 (49.90-71.10)
Noise-cancellation (10)	42.40±15.73 (25-70)	56.47±8.34 (47.25-71.10)
Average (171)	47.16±13.90 (10-90)	59.00±7.38 (39.30-81.70)

Table 2. Classroom noise level and CALFRAST results in the three situations

	Quiet	Conversation	Conversation and listening to the song
Classroom noise level (dBA) Mean ± SD (range)	49.66±8.45 (35-72)	71.88±9.43 (40-95)	77.51±10.05 (45-95)
CALFRAST results (% heard in both ears)	97.65	-	52.05

CALFRAST, calibrated finger rub auditory screening test

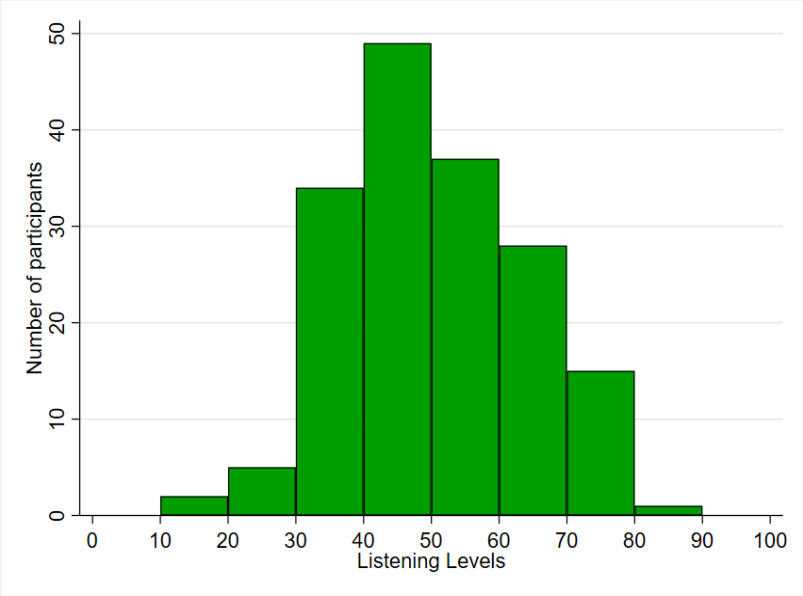

Figure 1. Histogram of Preferred Listening Levels

- How to perform the tuning fork test while pressing the tragus created conductive hearing loss.
- How to use smartphone sound meter applications to check environmental noise levels.
- How to check their PLLs: they need to speak louder in a noisy environment and while using earphones via the PLDs. They should reduce their listening level. They should limit their use of earphones. They were concerned about loss of hearing if they listened to sound that is too loud.

Positive comments and feedback included:

- They enjoyed participating in the ECE activity.
- They were excited to have had new experiences during the ear and hearing examination.
- They felt the activity should be continued the next year.

Negative feedback included:

- The classroom was too small, there were too many students in the classroom, and the classroom was too noisy.
- The activity time was too short: 10-15 minutes is need.
- The broken air-conditioner (in one classroom) was disruptive.
- There were not enough tuning forks.
- The online pre-activity instruction should be more explicit and should not be conducted too close to the on-site activity.
- A post-activity summary should be included.

DISCUSSION

Medical students are future doctors or healthcare providers. They are expected to be role models and to exemplify healthy lifestyle behaviors for patients (10). If they exemplify the health advice they give to patients, that should provide greater motivation for their patients to follow their counseling (11). In 1998, the WHO Regional Office for Europe published guidance on establishing and developing a health-promoting university (12). The ASEAN University Network (AUN) Health Promotion Network also published the AUN Healthy University Framework in 2017 (13). In the past, healthy university policies have been mainly focused on smoking, alcohol or drug use, diet, exercise, and stress. Hearing health promotion policies should also be initiated in medical schools and health science faculties.

To follow the social distancing policy during the COVID-19 outbreak, online teaching was required. Increased use of earphones via the PLDs amplified the risk of noise-induced hearing loss (NIHL). Damage to hair cells in the inner ear by noise is irreversible. WHO has estimated that 430 million people live with disabling hearing loss requiring rehabilitation services. Globally, more than one billion young people put themselves at risk of permanent hearing loss by listening to loud sounds (6). The US National Health and Nutrition Examination Survey reported the prevalence of hearing loss in 4,305 adolescents 12-19 years

of age. Between the years 1988-1994 and 2005-2006, the overall prevalence of exposure to loud noise or listening to music through headphones in the previous 24 hours increased significantly from 19.8% to 34.8% (14). Younger people more frequently listen to music at a higher volume than do to older people (15). If possible, conventional audiometry should be performed to compare the prevalence of NIHL before and after the increased use of PLDs in online teaching during the COVID-19 outbreak. Difficulty in communication due to hearing loss impacts individuals, their families, society, and the economy. Hearing loss is an invisible handicap. If people at risk were aware of their self-listening level, they would try to reduce their exposure to loud sounds and would consider adopting safe listening behavior. Detection and identification of high-risk noise exposure affecting by young people is very important for primary prevention. Medical students, as young future doctors, should be the first target group for the implementation of safe listening programs and should be enrolled in a hearing health promotion team.

In this study, the average PLL (47.16 ± 13.9%) and expected output level (59.00 ± 7.38 dBA) from PLDs of third-year medical students in a noisy situation were lower than in previous reports. Paping et al. reported two studies of Generation R, population-based prospective cohort studies from fetal life until young adulthood in Rotterdam, the Netherlands. The mean PLL from postal questionnaires of 237 subjects (aged 12-15 years) was 54.5 ± 18.1% (16). The mean PLL from the PLDs of 314 subjects (aged 13 years 7 months ± 5 months), measured using a newly developed smartphone application, was 55.0 ± 17.9% (17). The mean PLLs of 183 middle school students and 233 high school students in Ulsan, Korea reported by Lee et al. (2021) was 70.13 ± 8.01 dB (18). Gilliver et al. reported the mean self-reported PLD listening volume from an online survey of 5,371 Australians aged > 15 years (mean age 31.4 years) to be 53.3 ± 21.1% (19). Portnuff et al. reported the PLL of 29 normal-hearing subjects (aged 13-17 years) in Denver, Colorado, USA, using earbuds, in-ear, and supra-aural earphones. The mean comfortable PLL collected from the subjects' questionnaire was 55 ± 17.2%. The average PLL across earphone types under 70 dB under pink noise conditions in the laboratory was 79.3 ± 5.2 dBA (20). Although there was no difference in expected output levels of PLLs among four different types of earphones in this study, the lowest PLLs were observed with the use of noise cancellation earphones.

Contrary to Hoshina et al., they found that canal earphones with noise canceling showed the lowest PLLs among the three earphone types used by 23 subjects (age 20-40 years) (21). This difference may have resulted from the activity in the present study having been conducted in small classrooms with the doors closed. Even though the average PLL was lower than 60% and 95.9% of the third-year medical students reported the sound at a level of 60% of maximum volume being comfortable or too loud while listening to the song, the students may require louder PLLs outside the classroom. Safe listening behavior should be encouraged.

The average satisfaction score after the in-class activity in this study was high. The authors encourage medical educators to apply this ECE teaching method integrated with self -directed learning about safe listening for their settings. Before setting up the activity, the instructor and the faculties involved should consider classroom size, classroom condition, number of students in each classroom, number of tuning forks needed, appropriate length of time for the activity, clarification of pre-activity instructions, and a review of post-activity conclusions.

This study had limitations. It was a cross-sectional study of 171 third-year medical students at CMU in northern Thailand. Although this was a retrospective study, pre-activity instruction was provided and data were collected using data collection forms. The ECE activity was performed in small classrooms with only nine to ten students in a room. The results may not apply in larger populations or in an environment outside classrooms, in other preclinical and clinical classes in other medical schools or with other faculties. The environmental sound was measured by two applications, "Sound Meter" in the android system and "NIOSH Sound Level Meter" in the IOS system, without the use of a standard sound level meter. However, both applications are validated smartphone-based applications that can be used for measuring ambient noise levels. Both applications are listed as validated sound-level apps in the WHO ear and hearing survey handbook (22). The SoundMeter app showed good agreement in

A-weighted sound levels, with a mean difference of -0.52 dBA from the reference values and mean differences within ± 2 dBA of the reference measurements (23). The use of smartphone applications is appropriate for implementation of this ECE activity in other safe-listening initiation programs in other settings. In conducting this ECE activity, the authors planned to instill awareness of listening levels and classroom noise levels that can affect audibility. The students should understand the methods for measuring noise levels and monitoring their PLLs. This study did not focus on the accuracy of the noise level or compare the noise levels measured using the application and those measured using a standard sound level meter. The classroom noise levels shown in Table 2 do not indicate the actual noise levels. To obtain accurate noise level measurements, calibration of the applications should be performed before measuring.

CONCLUSIONS

The majority of the students were satisfied with this ECE activity and requested that the activity be continued the next semester. The students appreciated gaining new experience with hearing tests and measuring PLLs and noise levels in quiet and noisy environments. Increasing the room size, decreasing the number of students per group, clarifying the pre-activity and post-activity summarization and provision of a sufficient number of tuning forks should improve student satisfaction. Even though the average PLL was lower than that in previous reports and was less than 60% of the maximum volume, awareness of safe-listening behavior should be encouraged and hearing health promotion should be initiated as a primary hearing loss prevention program. Using a low level of PLL encourage medical students to be a good role model of healthy hearing behavior.

ACKNOWLEDGEMENTS

The authors thank Mr. Phatsaworn Sangthongluan for the statistical analysis.

FUNDING

None

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Basukala A, Chaudhary K. Early clinical exposure in preclinical years of medical school. JNMA J Nepal Med Assoc. 2021;59:1072-4.
2. Tayade MC, Latti RG. Effectiveness of early clinical exposure in medical education: settings and scientific theories - review. J Educ Health Promot. 2021;10:117. PubMed PMID: 34084864.
3. Liu CI, Tang KP, Wang YC, Chiu CH. Impacts of early clinical exposure on undergraduate student professionalism-a qualitative study. BMC Med Educ. 2022; 22:435. PubMed PMID: 35668444.
4. Simmenroth A, Harding A, Vallersnes OM, Dowek A, Carelli F, Kiknadze N, Karppinen H. Early clinical exposure in undergraduate medical education: A questionnaire survey of 30 European countries. Med Teach. 2023;45:426-32.
5. World Health Organization. Safe listening devices and systems: a WHO-ITU standard. Geneva [Internet]. 2021 [cited August 3, 2023]. Available from: https://apps.who.int/iris/handle/10665/280085
6. World Health Organization and International Telecommunication Union. Be he@lthy, be mobile: a handbook on how to implement mSafeListening. Geneva [Internet]. 2022 [cited July 7, 2022]. Available from: https://www.who.int/publications/i/item/9789240044784
7. Laureyns M. Make Listening Safe. The Hearing Journal. 2022;75:6.
8. Williams W, Purnell J, Parnell J, Samuels S, Tsitsos C, Arcondoulis EJ, et al. The statistical distribution of expected noise level output from commonly available personal stereo players. Acoustics Australia. 2010;38:119-22.
9. Torres-Russotto D, Landau WM, Harding GW, Bohne BA, Sun K, Sinatra PM. Calibrated finger rub auditory screening test (CALFRAST). Neurology. 2009;72:1595-600.
10. Tavolacci MP, Delay J, Grigioni S, Dechelotte P, Ladner J. Changes and specificities in health behaviors among healthcare students over an 8-year period. PLoS One. 2018;13:e0194188. PubMed PMID: 29566003.
11. Lobelo F, Duperly J, Frank E. Physical activity habits of doctors and medical students influence their counselling practices. Br J Sports Med. 2009;43:89-92.
12. Tsouros AD, Dowding G, Thompson J, Dooris M. Health promoting universities: concept, experience and framework for action. Target 14 World Health Organization. Regional Office for Europe [Internet]. 1998 [cited October 8, 2022]. Available from: https://apps.who.int/iris/handle/10665/108095
13. AUN-Health Promotion Network Mahidol University. AUN Healthy University Framework [Internet]. 2017 [cited October 8, 2022]. Available from: https://mahidol.ac.th/temp/2019/04/Healthy-University-Framework.pdf
14. Henderson E, Testa MA, Hartnick C. Prevalence of noise-induced hearing-threshold shifts and hearing

loss among US youths. Pediatrics. 2011;127:e39-46. PubMed PMID: 21187306
15. Portnuff CD. Reducing the risk of music-induced hearing loss from overuse of portable listening devices: understanding the problems and establishing strategies for improving awareness in adolescents. Adolesc Health Med Ther. 2016;7:27-35.
16. Paping DE, Vroegop JL, Koenraads SPC, le Clercq CMP, Goedegebure A, Baatenburg de Jong RJ, et al. A smartphone application to objectively monitor music listening habits in adolescents : Personal listening device usage and the accuracy of self-reported listening habits. J Otolaryngol Head Neck Surg. 2021;50:11. PubMed PMID: 33588927.
17. Paping DE, Vroegop JL, Geleijnse G, le Clercq CMP, Koenraads SPC, van der Schroeff MP. Objective Measurement of Listening Device Use and Its Relation to Hearing Acuity. Otolaryngol Head Neck Surg. 2022; 166:515-22.
18. Lee HJ, Jeong IS. Personal listening device use habits, listening belief, and perceived change in hearing among adolescents. Asian Nurs Res (Korean Soc Nurs Sci). 2021;15:113-20.
19. Gilliver M, Nguyen J, Beach EF, Barr C. Personal listening devices in australia: patterns of use and levels of risk. Semin Hear. 2017;38:282-97.
20. Portnuff CD, Fligor BJ, Arehart KH. Teenage use of portable listening devices: a hazard to hearing? J Am Acad Audiol. 2011;22:663-77.
21. Hoshina T, Fujiyama D, Koike T, Ikeda K. Effects of an active noise control technology applied to earphones on preferred listening levels in noisy environments. J Audiol Otol. 2022;26:122-9.
22. World Health Organization. WHO ear and hearing survey handbook. Geneva [Internet]. 2020 [cited July 7, 2022]. Available from: https://www.who.int/publications/i/item/9789240000506
23. Kardous CA, Shaw PB. Evaluation of smartphone sound measurement applications. J Acoust Soc Am. 2014;135:EL186-92. PubMed PMID: 25236152