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A Research on Hearing Functions of Music Teachers

Ayse Sanem Sahli[1*] and Ayhan Admis[2]

[1]*Vocational School of Health Services, Hearing and Speech Training Center, Hacettepe University, Ankara, Turkey*

[2]*ENT-Audiology Department, Gaziosmanpasa University, Health Research and Application Center Hospital, Tokat, Turkey*

[*]**Corresponding author:** Ayse Sanem Sahli, Hearing and Speech Training Center, Hacettepe University, Vocational School of Health Services, Ankara, Turkey, Tel: +90 535 659 4775; E-mail: ssahli@hacettepe.edu.tr

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Abstract

Objectives: The purpose of our study is to research hearing functions of music teachers and individuals with normal hearing, to compare the audiological findings and to perform a prevention analysis for music teachers.

Methods: A total of 51 individuals with normal hearing, between the ages of 25-40, and without any health-related problems have been included. Among these, 27 of them are music teachers and 24 of them are healthy individuals with similar age characteristics (control group). After hearing anamnesis of all participants had been taken, an audiological test battery consisting of Pure Tone Audiometry (PTA), Speech Audiometry, and Acoustic-Immittance and Distortion Product Otoacoustic Emission (DPOAE) measurements was applied.

Results: As a result of the our research; Uncomfortable Loudness (UCL) was observed at lower loudness levels in music teachers when compared with control group, and 3–4 kHz frequency in DPOAE was also found to be statistically significant compared to the control group consisting of individuals with normal hearing.

Conclusion: Even though a complete hearing loss was not the case for music teachers continuing their profession for 10 years and longer, it can be observed that their cochlear sensitivity had increased when compared to the normal group. Instrument sound at high levels causes noise effect for cochlea after being exposed to it for long periods of time. Therefore, evaluation of hearing functions of music teachers at regular intervals is extremely important for early diagnosis of occupational hearing loss.

Keywords: Hearing; Function; Audiology; Assessment; Music; Teacher

Introduction

By its general definition, music is a form of sound that has gained a shape and movement. For a sound formation consisting of a shape and movement to be accepted as music, it is necessary that it creates an emotional interaction in listeners. Music is an aesthetic whole consisting of sounds combined according to a certain purpose, method and beauty concept [1]. Musical pieces are created by using frequencies approximately between 20 Hz and 4000 Hz. The highest sound of the piano is approximately 4200 Hz, and the lowest is 27.5 Hz. Naturally, all instruments used for creating music produce sounds that have frequencies in this hearing range. The human ear can perceive sound frequencies between 20–20.000 Hz. Vibrations under and above this hearing range, which is called the sonic (sound) region, cannot be detected even though they reach to our ears [2]. The human ear is limited in terms of frequency hearing range as well as sound intensity perception. The sound level that the human ear can perceive easily does not exceed 110 dB HL [3]. The most important frequencies of hearing range for human life are between 125 Hz and 8000 Hz. The most common and prominent harmful element for human ear and hearing functions in our environment is noise, and when observed from a medical viewpoint, it is the most significant sound harmful to human health [4]. If the noise continues for long periods of time or it is severe, it is known to cause hearing loss by making mechanical and metabolic changes in the cochlea. The effect of noise is mostly observed in outer hair cells [5,6]. One-third of hearing loss occurs as a result of being exposed to noise, and the most common form of hearing loss due to noise is occupational hearing loss due to working in noisy environments for a long time [7]. In the world and our country, the most common occupational disease is hearing loss due to noise [8,9].

The aim of our study was to examine hearing functions of music teachers trained professionally on music, which is one of the most important elements that develop the human brain and ear, and using instruments with high loudness level regularly and frequently and to compare the audiological findings of healthy individuals who are of similar age group and who are not at risk, and who do not have clinically hearing loss complaints.

Material and Methods

The study was carried out in Gaziosmanpasa University Medical Faculty Research and Practice Hospital, Audiology Unit of the Department of Otorhinolaryngology. All participants were asked to sign the Informed Consent Form and Voluntary Participation Form. The hearing functions of 27 music teachers between the ages of 25-40 regardless of gender and 24 healthy individuals with normal hearing at similar age range were evaluated and the audiological findings were compared. While individuals whose ear examination results were normal in both groups were included in the study; the ones with hearing loss, middle ear infection, ear surgery, acoustic trauma, ototoxic drug use, and neurological/psychiatric illness were not included. The hearing anamnesis of all participants was examined; Pure Tone Audiometry (PTA) (125 Hz–16 kHz), Speech Audiometry, Acoustic-Immittance and Distortion Product Otoacoustic Emission (DPOAE) measurements were carried out. All audiometric tests were carried out in a double-walled quiet room. Audiological Evaluation: Pure Tone Audiometry (at a frequency range of 125Hz-16 kHz) and speech audiometry tests were carried out by using Interacoustics AC-40 Clinical Audiometer, TDH 39, MX 41/AR standard headphones. High-frequency evaluations (8 kHz–16 kHz) was carried out by using Interacoustic AC-40 Audiometer and Koss HV-IA headphones. Bone pathway hearing thresholds were determined by using Radioear B-71 vibrator. Speech Audiometry tests were carried out by propagating live sound from the microphone. Speech Reception Threshold (SRT), Speech discrimination (SD), Most Comfortable Level (MCL), Uncomfortable Level (UCL) thresholds were determined. Electroacoustic impedance tests were performed with Interacoustic AZ-26 Impedance Meter. 226 Hz probe tone in the pressure range between +200 daPa and-400 daPa was used. DPOAE measurements were carried out with Madsen Capella (GN Otometrics A /S 2630 Taastrup, Denmark). There were two primer tones with a frequency of 2f1-f2 and an f2/f1 ratio of 1.22. The warning intensity for L1 was 65 dB SPL, and for L2 it was 55 dB SPL. Distortion-dependent audiogram (DP-gram) was obtained by recording in different frequency ranges between 750 Hz and 8 kHz. To obtain the distortion-dependent audiogram, a DPOAE probe was placed in the patient's external auditory canal by using earplugs appropriate for the patient. Signal-to-Noise Ratio (SGO-S/N) of the emission was evaluated at each frequency.

Statistical analysis

SPSS program (IBM SPSS Statistics 21, SPSS inc., an IBM Co., Somers, NY) was used for statistical analysis. Descriptive statistical analyses (mean, standard deviation) were carried out when study data were evaluated. The data were checked for suitability in terms of normal distribution. Independent Samples T-test was applied to the ones with normal distributions, while Mann Whitney U test was applied to the ones with no normal distribution. Statistical significance was accepted when p values were calculated as less than 0.05.

Results

Among the 27 adult music teachers, 15 of them were male, 12 were female and the average age was 33.88 ± 4.40. For the 24 individuals included in the control group, 11 of them were male, 13 of them were female and the average age was 32.56 ± 3.11. The average working times of music teachers were observed as 10 ± 3 years. The results (mean, standard deviation and p values) of the statistical evaluation of hearing thresholds in the 125 Hz to 16 kHz frequency range for the control group with normal hearing and the music teacher group were evaluated separately according to the ears and are shown in Table 1.

It has been observed that there was no statistically significant difference in the frequency range between 125 Hz-16 kHz in both groups (p>0.05). It has been observed that there was an increase in hearing thresholds in bilateral 8 Hz- 16 kHz frequency range compared to normal hearing in both study groups.

SRT, SD, MCL, UCL values were made separately according to the ears and the statistical evaluation results (mean, standard deviation and p values) are shown in Table 2.

Right (R) Left (L) Hz (Hertz)	Groups		p
	Control Group (n=24)	Music Teacher (n=27)	
	Mean ± SD	Mean ± SD	
R125 Hz	7.78 ± 4	6.67 ± 3.51	0.300
R250 Hz	5.56 ± 4.67	4.79 ± 4.54	0.557
R500 Hz	7.41 ± 4.68	7.71 ± 4.16	0810
R1000 Hz	7.04 ± 3,18	6.04 ± 4.16	0.339
R2000 Hz	8.33 ± 4.39	6.04 ± 5.31	0.098
R4000 Hz	9.44 ± 4.87	7.92 ± 5.09	0.279
R6000 Hz	9.07 ± 5.55	7.5 ± 5.71	0.324
R8000 Hz	11.68 ± 8.01	12.56 ± 10.27	0.618
R12000 Hz	14.07 ± 11.52	15 ± 15.6	0.809
R16000 Hz	19.26 ± 16.33	25.21 ± 18.85	0.233
L125 Hz	7.22 ± 3.2	6.88 ± 2.47	0.670
L250 Hz	7.04 ± 4.22	6.46 ± 3.75	0.609
L500 Hz	6.11 ± 4.87	7.5 ± 3.61	0.258
L1000 Hz	6.67 ± 4.6	5.42 ± 4.4	0.328
L2000 Hz	5.74 ± 4.54	3.75 ± 3.97	0.104
L4000 Hz	9.07 ± 5.2	8.96 ± 7.22	0.948
L6000 Hz	7.96 ± 5.76	9.58 ± 8.59	0.439
L8000 Hz	12.78 ± 8.01	11.46 ± 10.27	0.615
L12000 Hz	15.56 ± 11.04	18.33 ± 22.44	0.586
L16000 Hz	19.44 ± 13.89	23.75 ± 17.15	0.327

Table 1: The distribution of the right and left ear hearing thresholds in the frequency range of 125 Hz-16 kHz for the control group and music teacher group.

Right (R) Left (L)	Groups		p
	Control Group (n=24)	Music Teacher (n=27)	
	Mean ± SD	Mean ± SD	
R-SRT	9.44 ± 3.76	8.75 ± 4.48	0.550
L- SRT	9.44 ± 3.76	8.54 ± 4.03	0.412
R-SD	100 ± 0	100 ± 0	-
L-SD	100 ± 0	100 ± 0	-
R-MCL	49.26 ± 3.59	49.17 ± 5.04	0.940
L-MCL	49.26 ± 3.59	48.54 ± 4.03	0.505
R-UCL	108.15 ± 3.71	103.75 ± 4.95	0.001*

L-UCL	108.15 ± 3.71	103.75 ± 4.95	0.001*
SRT: Speech Reception Threshold, SD: Speech discrimination, MCL: Most Comfortable Level, UCL: Uncomfortable Level			

Table 2: Distribution of right and left ear SRT, SD, MCL, UCL values of the control group and music teacher group.

SRT, SD, and MCL were evaluated at normal limits for both groups and no statistically significant difference was observed (p>0.05). Uncomfortable Level (UCL) was observed at lower intensity levels for music teachers and it was observed to be statistically significant (p<0.05). DPOAE Signal-to-Noise Ratios (SGO-S/N) in the frequency range of 750 Hz-8 kHz were carried out separately according to the ears and the statistical evaluation results (mean, standard deviation and p values) are shown in Table 3.

Right (R) Left (L)	Groups		P
	Control Group (n=24)	Music Teacher (n=27)	
	Mean ± SD	Mean ± SS	
R750	3.59 ± 3.4	3.93 ± 3.37	0.725
R1000	7.13 ± 3.02	7.25 ± 3.33	0.886
R1500	9.61 ± 3.18	11.43 ± 4.25	0.088
R2000	9.46 ± 3.16	10 ± 4.75	0.636
R3000	12.07 ± 4.23	9.1 ± 3.97	0.313
R4000	13.29 ± 5.47	10.44 ± 3.72	0.037*
R6000	13.03 ± 6.24	11.49 ± 5.41	0.354
R8000	10.95 ± 5.86	11.99 ± 5.33	0.513
L750	5.63 ± 3.94	4.88 ± 3.56	0.479
L1000	7.84 ± 2.88	7.23 ± 3.2	0.476
L1500	7.18 ± 2.8	7.37 ± 4.06	0.843
L2000	7.95 ± 3.7	8.16 ± 4.32	0.849
L3000	11.51 ± 4.45	8.51 ± 2.39	0.005*
L4000	12.05 ± 4.82	12.13 ± 5.46	0.960
L6000	12.49 ± 4.61	14.87 ± 19.58	0.541
L8000	10.84 ± 4.53	12.17 ± 5.07	0.327

Table 3: DPOAE Signal-to-Noise Ratios of the right and left ear of the control group and music teacher group.

S/N ratios of 6 dB and above were observed at least in five frequencies in the individuals of the music teaching and control group. The right ear 4 kHz (10.44 ± 3.72) and the left ear 3 kHz (8.51 ± 2.39) S/N ratio in music teachers were observed to be lower when compared with the individuals in the control group and were evaluated to be statistically significant (p<0.05). Other S/N ratios were compared with each other and it was observed that there was no significant difference (p>0.05). Middle ear pressure in the control group and music teachers with normal hearing, static impedance values and acoustic reflexes were determined at normal limits and no statistically significant difference was observed (p>0.05).

Discussion

In our study, the significant difference in DPOAE values at a frequency of 3 kHz and UCL amplitude being observed at lower levels were interpreted as the fact that music teachers were influenced by the high intensity (85 dB and above) of the musical instruments they regularly used, and that the music could increase the cochlear sensitivity over time. The increase in pure tone threshold values at 12-16 kHz in both groups was evaluated as threshold loss occurring due to age. Plontke et al. stated that the approximate noise level of music instruments was at 75-105 dB (A), and that sounds higher than 75 dB (A) had adverse effects on the human body, especially the auditory system [10]. According to Fligor and Cox, exposure to loud noise or continuous music is a risk factor for hearing loss due to noise [11]. Besides that, according to Taylor et al., there is a relation between long-term daily noise exposure and hearing loss and configuration [12]. Hearing sensitivity is reduced as a result of noise affecting auditory structures and hearing function. The effect of noise on hearing and hearing functions may be temporary or permanent. Loudness level, duration, and spectrum of noise and sensitivity of the inner ear affect the amount of temporary or permanent threshold changes [13,14]. Apart from all the anatomical structures in the cochlea; they affect vascular mechanism, nerve endings and contact areas. Neural deterioration begins with or after damage to hair cells [15]. Noise has a wide frequency range whose center frequency is 3200 Hz. Sataloff stated that depending on the frequency spectrum of the first indications of hearing loss due to noise, its effect on the audiogram started at maximum 2-6 kHz and in the shape of "V" [16]. Then the hearing loss begins to become evident towards low and high frequencies.

Koelsch et al. investigated the functional neuroanatomy of music perception in children and adults [17]. As a result of the study, they concluded that music studies carried out on children and adults lead to strong activations in the frontal and temporal frontal region of the brain [17]. According to the studies that have been carried out, children that were educated at an early age with music become more comfortable, peaceful, easygoing and confident [18]. It is known that music has a positive effect on the fields such as language, mathematics, focus, and attention and that it increases success [18]. However, beside these positive effects, when the results of our study are examined, it can be seen that music can create a noise effect in the auditory system. As a result, even if there is no significant hearing loss in the individuals teaching music teacher for an average of 10 ± 3 years, when compared to the control group with normal hearing, it was observed that there were significant differences in the frequencies of 3-4 kHz, which are the frequencies that increased the cochlear sensitivity and the noise started to have an effect. This lead to the thought that music has aurally created a noise effect in the cochlea. It is thought that findings in our study may help in the early diagnosis of occupational hearing loss in this group. Since our study is conducted on a limited number of cases, it would be useful to study larger group cases for more precise information. Although there are some occupational groups such as aviators and forest workers who are related to occupational hearing loss in our country [19,20]; there has not been a comprehensive study related to the subject yet. Pre-awareness of risk factors will be helpful in shaping hearing protection programs.

References

1. Ucan A (1996) Human and Music, Human and Art Education. 2nd Edition, Musical Encyclopedia Publications, Ankara.
2. Zeren A (1997) Music Physics. Pan Publishing, Ankara.
3. Belgin E (2014) Audiologic Evaluation (Chapter 21) Ear Nose Throat Diseases and Head and Neck Surgery, Ed. Muharrem Gerceker, Academician Medical Bookstore.
4. Kemaloglu YK, Tutar H (2013) Noise induced hearing loss and acoustic trauma Turkiye Klinikleri. J ENT - Special Topics 6: 44-54.
5. Dobie RA (1993) Noise-Induced Hearing Loss. Head and Neck Surgery Otolaryngology. JB Lippicott Company Philadelphia 2: 1782-1792.
6. Alberti PW (2000) Occupational Hearing Loss. Otolaryngology Head and Neck Surgery. Editor: Ballenger JJ, Snow JB. Fifteenth Edition. Nobel Medicine Bookstore pp: 1087-1101.
7. National Institutes of Health (1990) Noise and Hearing Loss, Consensus Development Conference Statement. Conn Med 8: 1-24.
8. Kurra S (1991) Noise, Turkey's Environmental Problems. Broadcast Environment Foundation of Turkey, Ankara pp: 447-484.
9. National Institutes of Health (2008) National Institute on Deafness and Other Communication Disorders (NIDCD). NIH ALMANAC.
10. Plontke S, Zenner HP (2004) Current Aspects of Hearing Loss from Occupational and Leisure Noise. GMS Curr Top Otorhinolaryngol Head Neck Surg 3: 233-325.
11. Fligor BJ, Cox C (2004) Output Levels Of Commercially Available Portable Compact Disc Players And Potential Risk To Hearing. Ear and Hear 25: 513-527.
12. Taylor W, Pearson J, Mair A, Burns W (1965) Study of Noise and Hearing in Jute Weaving. J Acoust Soc Am 38: 113-120.
13. Hirs IJ, Bilger RC (1995) Auditory Threshold Recovery after Exposure to Pure Tones. J Acoust Soc Am 55: 117-121.
14. Mills JH, Gilbert RM, Adkins WY (1979) Temporary Threshold Shifts In Humans Exposed To Octave Band Noise For 16-24 Hours. J Acoust Soc Am 65: 1238-1248.
15. Donahue AM, Ohlin WD (1993) Noise And The Impairment of Hearing. Ed: Davis LB, Qick CM, Occupational Health, the Soldier and Industrial Base, Part III: Disease and Environment pp: 202-252.
16. Sataloff RT, Sataloff J (2006) Occupational Hearing Loss. Newyork: Taylor and Francis pp: 1-3.
17. Koelsch S, Fritz T, Schulze, K Alpsop D, Schlaug G (2005) Adults And Childen Processing Music: An FMRI Study. Neuroimage 25: 1068-1076.
18. Deleverova B (2006) Analysis of the Effects of Music on the Development of Children Aged 0-3 Years. Graduate Thesis, Institute of Educational Sciences, Gazi University, Ankara.
19. Buyukcayir C (2005) Hearing Loss in Turkish Aviators. Military Medicine 170: 572-576.
20. Tunay M, Melemez K (2008) Noise Induced Hearing Loss of Forest Workers in Turkey. Pakistan Journal of Biological Sciences 11: 2144-2148.