Original Article

Relationship of Ear Phone Usage and Recreational Noise Induced Hearing Loss Based on Audiogram Assessment

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ABSTRACT

INTRODUCTION: Over the last two decades the use of personal music player (PMP) with headphones/earphones has increased tremendously. Those people using headphones/ earphones on regular basis belongs from all age groups. They become accustomed to use headphones/earphones at high volumes and over long periods of time which may be implicated in ongoing permanent hearing loss in these individuals. Both the intensity and duration of noise exposure determines the potential for damage of the hair cells of the inner ear. The study population was the university students using such devices, however audiogram performed only in participants using these devices for more than 1 hour a day, at moderate to high volumes.
OBJECTIVE: To identify association of sensorineural hearing loss and noise exposure from a personal music player with head phones/earphones among the young university students.
MATERIAL AND METHODS: This prospective study conducted at Dow International Medical College, DUHS from January 2015 to April 2015. All Final year students were invited for the survey. Informed consent was taken from each participant. Data was collected regarding the duration and hours of use of personal music players. To detect degree of the change in hearing threshold, Audiograms assessment done on 56 participants from high risk group. The data was analyzed using SPSS16.
RESULT: The majority of earphone users are young adults. The audiogram showed mild hearing loss in frequencies over 0.5- 8 kHz.
CONCLUSION: There is mild hearing loss in the high risk group, therefore adequate counseling, for these individuals, regarding change of their listening habits is necessary if further hearing loss is to be prevented.

KEY WORDS: Audiogram, recreational hearing loss, earphone, over the ear head phone, personal music player.

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INTRODUCTION

Today the teenagers and young adults are in the habit of using Personal Music Player (PMP) on daily basis[1-4]. In the past decade the use of ear phones/ Head phones for listening to music has also increased. The exposure to loud sound has been documented to lead to noise induced hearing loss (NIHL) in high risk groups such as the military, air line industry maintenance staff and music industry[5,6]. The recreational use of PMP is now also been associated with hearing loss if used for longer duration[7,8].

Cochlea contains limited number of hair cells which are incapable to regenerate once damaged resulting in permanent hearing loss[9,10]. Most of music lovers are unaware that they are putting themselves at risk of sensorineural hearing loss. High intensity sounds can engender permanent hearing loss at chronic exposures of an average 85 decibels or higher[11-13]. Most people become accustomed to use head phones/ earphones at high volumes or increase their volumes after some time of prolonged use; which may indicate an on going permanent hearing loss in those individuals[14-16]. Both the intensity and duration of noise exposure; determine the potential for damage to the hair cells of the inner ear[17,18].

In a survey Chung JH et al concluded that young individuals consider recreational noise induced hearing loss a low priority health risk[19] As the life span is increasing the world over; due to better and preventive medicine; more people will be required to use hearing

aids. The individual who are using PMP are at an increased risk of hearing disability at a younger age.

The hearing loss mandating use of hearing aids at a younger age ; will add burden to already stretched resources of our country. In a survey conducted on 400 individuals documented that 47% of young adults were using PMP for 1-8 hours and 13% for more than 8 hours. Level of awareness for this problem was 84% yet only 23% were using hearing protective devices and 57% were taking a break while listening to music with earphones/ headphones[20]. In a large Scandinavian study documented a decrease in hearing by 15 db in 15% of participants[21]. Another study documented increase in hearing threshold level of young adolescents[15]. We aim to document any change in hearing threshold level related with excessive listening to recreational music with personal music players (PMP) with ear phone / head phones and to increase the level of awareness about recreational Noise Induced Hearing Loss (NIHL) among the young adults. The audiometric correlation between recreational NIHL and Pure Tone Audiogram (PTA) has not been studied previously in Pakistan.

According to recommendation of "Brian J. Fligor and L. Clarke Cox, recreational NIHL can be avoided by listening recreational music for one hour by earphone/ headphone with up to 60% of volume"[6]. Therefore, the **RISK GROUP** for current study was defined as, those using audio devices for more than 1 hour at moderate to high volumes.

Objective: To document hearing loss related to excessive listening to recreational music with ear phone/ head phones.

MATERIAL & METHODS

This prospective descriptive, cross sectional survey study was conducted at Dow International Medical College, DUHS for a period of 04 months from January 2015 to April 2015. We invite all final year MBBS students (n=100) for this study; out of these 78 consented to participate; out of these 56 individuals were identified as belonging to the high risk group, constituted study population. therefore sample collected was of 56 individuals. Convenient Sampling technique was used. Data collected through self administered questionnaire consisting of 25 questions. Prior to hearing assessment, Otoscopy done to rule out any wax or perforation in the tympanic membrane. Those participants having any upper respiratory tract infection or any other ontological disorder were also excluded from the study. The participants underwent hearing assessment with Pure tone audiogram (PTA) in a custom built Audiology room equipped with Siemens sg28 Audiometer (PTA device) in the premises of the University. Hearing thresholds were established at standard frequencies (0.25,0.5,1.0,2.0,3.0,4.0,6.0 and 8.0 kHz for both ears

Statistical analysis was done using SPSS 16.0. Frequencies and student t-test with p-values were evaluated for the related data. Pearson Chi-Square test was applied to obtain p-values. A value of < 0.05 was considered significant.

Inclusion Criteria:

- Users of audio devices for more than one hour per day
- Adolescents and adults

High risk group - Those using PMP for more than 1 hour at moderate to high volumes

Exclusion Criteria:

- Non users of PMP with ear phones.
- Those using their audio devices for less than one hour
- Those participants having any upper respiratory tract infection

Working Definitions:

High Risk group:

Recreational NIHL as up to one hour per day for earphones with up to 60% of volume with an insert type earphone. The volume are classified as 10, 20, 30, 40 upto100% . According to portsnuff an individual can safely listen to the iPod for 4.6 hours at 70 percent of full volume per day[22-24].

Definition of mild hearing loss:

Slight impairment is defined as 26-40 dBHL (better ear) Able to hear and repeat words spoken in normal voice at 1 meter distance[25-27].

Definition of tinnitus:

A sound in one ear or both ears, such as buzzing, ringing or whistling, occurring without an external stimulus and usually caused by a specific condition, such as an ear infection, the use of certain drugs, a blocked auditory tube or canal, or a head injury[28].

Ethical Consideration:

The manuscript is prepared in accordance with the "Uniform Requirements submitted to the Biomedical Journals" published in the British Medical Journal 1991; 302:334-41, revised in February, 2006. Informed consent was taken from each individual before filling out the questionnaires and pure tone audiogram was performed. Pure tone audiogram is a routine procedure done in out patient department and therefore Institutional review was not sought.

RESULTS

The 56 participants were enrolled with with equal proportion of male and female participants. Age of the participants ranged between 15-29 years with a mean age of 21.5 years. Seventeen (33.4%) were using head phones; 33(58.9%) were using earphones and 6 (10.7%) were using both devices for listening to recreational music. When asked for the duration of using their listening devices 3(5.4%) used it for up to one hour, 6(10.7%) used it for 1-2 hour, 11(19.6) for 3-4 hours, 36(64.3%) for 5-6 hours. Table I gives the demographic details of the study population and their responses to the questions asked.

It is imperative to note that 36(64.3%) users were using their devices for more than 5-6 hours daily which is quiet high. Out of these 10 (17.9 %) were having a subjective feeling of hearing loss and in 13 (23.2 %) people had actually mentioned to them about their decreased hearing. Tinnitus was felt by 22 (39.3%) of users.

Table II gives the audiometric findings of the participants. Most of these young adults (73.2%) were having mild hearing loss (MHL) in the speech frequencies of 0.5- 8.0 kHz. It is almost the same for both the ears. About 5.4% & 3.6% were having problem in the higher frequencies of 4K & 8K respectively. It was also noticed that these findings were higher in the right ear. Table III. gives the association of student's responses regarding noise and their PMP uses and hearing level. When compared with the pattern of usage of earphone versus headphone; the Mild Hearing Loss (MHL) is associated in 13(23.2 %) with headphone users and in 22(39.2 %) in earphone users.

In those individuals who were having a subjective feeling of hearing loss, 8(80%) out of 10 had documented mild hearing loss. In those individuals who were told by others that they may have some hearing loss; 9 (69.2%) out of 13 had documented mild hearing loss.

It is also an important finding that 31(73.8%) of participants with mild Hearing loss had some prior knowledge about hearing loss and its association with music listening devices. When age was compared with speech perception level (SPL) the *p-value* calculated was 0.*045* which is significant. When the volume of PMP was compared with the subjective feeling of dizziness or vertigo the *p-valve* is 0.024. The habit of taking a break while listening to PMP was found to be significantly related to SPL in left ear with a *p-value* of 0.010, whereas as that for right eat was 0.596. The chi -square test for other different variables was not significant.

TABLE I: FREQUENCY DISTRIBUTION OF STUDENTS CHARACTERISTICS AND RESPONSES REGARDING NOISE AND THEIR AUDIO DEVICE USES (n=56)

Characteristics of Students	Frequency	Percentage
Age Years (Mean ±SD)	21.55±2.366	
Gender		
Male	28	50.0
Female	28	50.0
What type of hearing device do you use?		
Over the ear Headphones	17	30.4
Insert type Earphones	33	58.9
Both	6	10.7
How long have you been using your device?		
1 hour	3	5.4
1-2 hours	6	10.7
3-4 hours	11	19.6
5-6 hours	36	64.3
Are people around you usually able to hear your music device?		
Yes	17	30.4
No	28	50.0
Don't know	11	19.6
Have you ever experienced difficulty in hearing?		
Yes	10	17.9
No	33	58.9
People mention it to me	13	23.2
Have you experienced ringing, buzzing, or roaring sounds in your ears?		
Yes	22	39.3
No	34	60.7
Have you experienced vertigo or dizziness?		
Yes	11	19.6
No	45	80.4
Have you ever heard, read, or seen anything about Noise Induced Hearing Loss related to music players		
Yes	42	75.0
No	14	25.0
Hearing threshold level		
Normal Hearing	16	28.6
Mild Hearing Loss –right ear	42	75.0
Mild Hearing Loss –left ear	22	39.2

TABLE II: FREQUENCY DISTRIBUTION OF STUDENTS HEARING LEVEL (n = 56)

Hearing Level	Normal Hearing (-10 to 25 dBHL)		Mild Hearing Loss (26 to 40 dBHL)	
Hearing Frequency	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Speech perception level of Right Ear	48	85.7	8	14.3
Speech perception level of left Ear	53	94.6	3	5.4
Frequency 250Hz Right Ear	50	89.2	6	10.7
Frequency 500Hz Right Ear	41	73.2	15	26.8
Frequency 1K Hz Right Ear	53	94.6	3	5.4
Frequency 2K Hz Right Ear	51	91.1	5	8.9
Frequency 4KHz Right Ear	53	94.6	6	10.7
Frequency 8KHz Right Ear	54	96.4	7	12.5
Frequency 250Hz Left Ear	52	92.8	4	7.1
Frequency 500Hz Left Ear	44	78.6	12	21.4
Frequency 1KHz Left Ear	53	94.6	3	5.4
Frequency 2KHz Left Ear	56	100.0	0	0.0
Frequency 4KHz Left Ear	55	98.2	1	1.8
Frequency 8KHz Left Ear	54	96.4	2	3.6

TABLE III: ASSOCIATION OF STUDENTS RESPONSES REGARDING THEIR AUDIO DEVICE USES AND HEARING LEVEL

Hearing Level	Normal Hearing (-10 to 25 dBHL)		Mild Hearing Loss (26 to 40 dBHL)	
Characteristics of students	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Age Years (Mean±SD)	21.44±1.78		21.60± 2.58	
What type of hearing device do you use?				
Over the ear Headphones	4	7.1	13	23.2 %
Insert type Earphones	11	19.6 %	22	39.2 %
Both	1	1.7 %	5	8.9%
How long have you been using your device?				
1 hour	2	66.6	1	33.3%
1-2 hours	2	33.3	4	66.6%
3-4 hours	4	36.3	7	63.6%
5-6 hours	8	22.2	28	77.7%
Are people around you usually able to hear your music device?				
Yes	5	29.4%	12	70.6%
No	9	32.1%	19	67.9%
Don't know	2	18.2%	9	81.8%
Have you ever experienced difficulty in hearing?				
Yes	2	20.0%	8	80.0%
No	10	30.3%	23	69.7%
People mention it to me	4	30.8%	9	69.2%
Have you experienced ringing, buzzing, or roaring sounds in your ears?				
Yes	5	22.7%	17	77.3%
No	11	32.4%	23	67.6%
Have you experienced vertigo or dizziness?				
Yes	1	9.1%	10	90.9%
No	15	33.3%	30	66.7%
Have you ever heard, read, or seen anything about Noise Induced Hearing Loss related to music players				
Yes	11	26.2%	31	73.8%
No	5	35.7%	9	64.3%

DISCUSSION

The prevalent use of PMP and other devices for listening to music is a potential risk factor for healthy individuals to develop hearing loss at an earlier age as compared to their ancestors. Multiple studies have been conducted to document the degree of hearing loss[17,20,21]. Various studies have documented the Occupational noise induced hearing loss in Pakistan[20-32] but studies related to hearing loss related to recreational use of Mp3 players with earphones is not available. However, Zia S et al have documented that the level of awareness about recreational use of PMP in the university going students as 80%. Despite having knowledge about this potential health risk only 57% are giving a gap while listening to music with earphones[20,33,34]. The audiometric correlation between NIHL and PTA has not been studied in any other study coming from Pakistan. In our study 42(75%) of participants using PMP were having MHL. In a larger study done by Kim MG et al on 490 adolescents documented the Hearing loss in 94.3% of participants using PMP with earphones (insert type)/ headphones[1]. Neitzel RL et al had reported that recreational noise exposure is more dangerous than occupational exposure[15]. Another study based on otoacoustic emmisions documented an increase in hearing loss over a three period with continued exposure[35].

When age is compared with speech perception level (SPL) of right ear the *p-valve* is 0*.046* and that of left ear is 0*.883*. This finding is significant as most of the right handed people have a predisposition of using their right ear for listening as well. We could not find any similar comparison in any other study.

The occupational hearing loss in musicians has been documented to be 21.7% by Santoni CB and Fiorini AC[36]. It ranges from 5-52% among musicians[37,38]. When we use the earphone to listen to music, the volume of noise exposure increases by 7-9 db[1]. In our study the users of over the ear Head phones were associated with MHL in 13(76.5%) participants. Whereas those using insert type earphones had MHL in 22 (39.2%) of individuals. The possible explanation could be the higher volumes used by these individuals in an effort to dampen the background noise. Sulaiman AH reported MHL in 7.3% individuals in his study of 177 adolescent school students[38]. However the *p-valve* for these variables was 0*.445* for right ear and 0 *.788* for left ear which is not significant.

The duration of using earphones beyond one hour in our study is 96% which is much higher than a study done by Ineke V et al which demonstrated it to be 32.8% [39]. The reason for this high rate may be that even though these participants are university going and 75% have some knowledge about NIHL; they are not practicing the hearing protective measures and active guidance needs to be given in school[11,12,40-44].

Eight (80%) out of the 10 participants having subjective feeling of hearing loss were having MHL. In 9 (69.2%) of 13 participants in which people had actually mentioned to them about their decreased hearing had documented MHL. Tinnitus is also an important symptom of ongoing cochlear damage as mentioned by Ineke V et al in his study[39]. Eighteen (81.8%) out of 22 who were having tinnitus were also having MHL in our study. When the volume of PMP was compared with the subjective feeling of dizziness or vertigo the *p -value* is 0.024. This could be an indirect evidence of collective cochlear damage. Tinnitus has been associated with high frequency hearing loss which is related to noise exposure[15]. This has also been reported by Sulaiman AH as 20.9% [38].

Our study demonstrated that the number of young participants actually having high tone loss (4K & 8K Hz) which is the feature of NIHL was 5.4% & 3.6% in both ears. Another finding is that most of the individuals (75%) are having MHL in lower frequencies of 250 kHz & 500 kHz. The possible explanation might be that cochlea is most sensitive to sound at frequencies of 500 KHz - 2000 KHz. These are important for understanding speech. This might also be part of temporary threshold shift associated with prolonged high intensity noise exposure. This is higher than the study done by Samit S et al showing a 10% loss in 500 KHz but for 4 KHz the findings are identical [44] . The reason for this low tone Hearing loss could be that these are young patients and the plasticity of neurons is higher in this age; with temporary threshold shift reverting back to near normal levels[45]. This becomes permanent as the noise exposure becomes chronic[11]. This is demonstrated in table No.3; those using their ear phones /head phones for 3-4 hours had MHL in 11 (19.6%) and for 5-6 hours 36 (64.2%) were having MHL. Samit S et al demonstrated no statistically significant hearing loss in his study of 94 university going students and faculty[44]. However another study demonstrated hearing loss in 94% of participants[1].

CONCLUSION

Our study demonstrated that there is a link between recreational noise induced hearing loss in higher frequencies. Adequate counseling should be given to

these individuals so that they may change their listening habits to prevent any further increase in hearing loss in future. Mass media campaigns need to be arranged in order to increase the awareness about this increasing health problem.

LIMITATION

Small sample size, sampling technique, inadequate follow-up are limiting factors to generalize the finding of the current study.

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