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Mishal K
Department of Audiology, Dr MV Shetty College of Speech and Hearing, Mangalore, Karnataka, India

Fizza Fathima
Department of Audiology, Dr MV Shetty College of Speech and Hearing, Mangalore, Karnataka, India

Devipriya S
Department of Audiology, Dr MV Shetty College of Speech and Hearing, Mangalore, Karnataka, India

Abhirami E
Department of Audiology, Dr MV Shetty College of Speech and Hearing, Mangalore, Karnataka, India

Fajar Mohammed
Department of Audiology, Dr MV Shetty College of Speech and Hearing, Mangalore, Karnataka, India

Aravind K
Department of Audiology, Dr MV Shetty College of Speech and Hearing, Mangalore, Karnataka, India

Correspondence
Mishal K
Department of Audiology, Dr MV Shetty College of Speech and Hearing, Mangalore, Karnataka, India

A study on temporary threshold shifts in Nashik Dhol artists

Mishal K, Fizza Fathima, Devipriya S, Abhirami E, Fajar Mohammed and Aravind K

Abstract
The study aimed at understanding the temporary threshold shift in Nashik Dhol artists by conventional pure tone audiometry, after exposed with Nashik Dhol. The present study was conducted on 160 individuals within the age limit of 16 to 40 years who were exposed to noise for 4 hours continuously. And found that every individual had experienced threshold shifts in both ears due to loud noise exposure by Nashik Dhol. From the third pure tone audiometry test, the study discovered that the all participants recovered from threshold shift within 24 hours and concluded that all shifts were temporary. From the current study, it is clearly evident that exposure to loud noise can lead to a temporary threshold shift. So, by using appropriate ear protection devices, individuals can prevent noise induced hearing loss.

Keywords: Hearing threshold, temporary threshold shift, noise induced hearing loss, ear protection devices, noise exposure

Introduction
Numerous negative effects of noise on people have been documented, including irritability, reduced productivity, physiological changes in blood pressure, heart rate, and psychological distress. The obvious impairment with verbal communication caused by background noise masking and the major auditory consequence, hearing loss, are two of the more overt auditory effects. At sound levels known to be harmful to hearing, no solid evidence has been established that physiologic effects other than hearing loss can be induced. According to Miller (1971) [12], there are three main types of noise-induced hearing loss: temporary threshold shift, permanent threshold shift, acoustic trauma. In accordance to certain research, exposure times longer than 8 to 16 hours may not further enhance the amplitude of the threshold shift, at least for moderate intensity levels of noise. Hearing loss created by noise has been documented for more than 200 years. When exposed to high-level noises repeatedly, hearing loss from strong noise may result in permanent disability, even after a brief period when hearing may recover partially or completely. Over 30 million employees, according to the National Institute for Occupational Safety and Health, are exposed to unsafe noise levels. According to a 1973 research by Ewertson, Surjan, Devalv, and Palfavi, males appear to experience diminished hearing from noise at a greater rate than women do. Also, a study conducted by Peter Rabinowitz in 2000, hearing loss induced by recreational and occupational noise exposure leads to catastrophic handicap that is almost entirely avoidable. After presbycusis (age-related hearing loss), noise-induced hearing loss is the most frequent kind of sensorineural hearing deficiency. Shearing pressures induced by any sound have an effect on the stereocilia of the hair cells of the cochlear basilar membrane; when these forces are severe, they can cause cell death. Avoiding noise exposure prevents further harm development. The phenomena of conditioning-related protection, whereby earlier exposure to moderate-level, non-traumatic sound shields the ear from subsequent traumatic exposure, has been reported in a variety of mammalian species, according to a research by Naohiro Yoshida and M Charles Liberman. The mouse would be a suitable model to investigate the molecular processes behind this effect; however, prior research found no conditioning effects in this species.
Temporary threshold shift (TTS) is the term used to describe instances in which hearing thresholds improve after an initial impairment caused by noise; permanent threshold shift (PTS) is used to describe irreversible losses.

According to a research by David Kastak and Brandon L. Southall, the difference between auditory thresholds measured before and after noise exposure. According to the 2500Hz auditory threshold, the patients were subjected to octave-band noise at two different sound pressure levels: 80 and 95dB SL. The times for noise exposure were 22, 25, and 15 minutes. The threshold changes at 2500 and 3530 Hz were evaluated. The range of mean threshold movements was 2.9 to 12.2dB. After exposure to noise, the auditory system fully recovers after 24 hours. A report based on a research conducted by John H Mills, Robert M Gilbert, and Warren Y Adkins Temporary threshold alterations in people exposed to octave bands of noise during 16 to 24 hours. For 16-24 hours, groups of human subjects were exposed to a diffuse sound field to octave band noise centered at 4, 2, 1, or 0.5 kHz. Sound pressure levels were changed throughout exposure occasions. At specific points throughout an exposure, the subject was withdrawn from the noise, hearing sensitivity was evaluated, and the subject was restored to the noise. Temporary threshold shifts (TTS) increased for roughly 8 hours before reaching a plateau or asymptotic.

Cases in which hearing thresholds recover after an initial impairment caused by noise are referred to as temporary threshold shift (TTS); irreversible losses are referred to as permanent threshold shift (PTS). According to research done, Aspirin, which is known to cause reversible hearing loss after intake, synergize with noise to generate a higher transient threshold shift than would otherwise be detected. Although the effects of aspirin on permanent hearing loss have not been demonstrated, it appears prudent for audiologists to advise people who must be exposed to high levels of noise to avoid taking this drug, at least at times closely related to exposure. Long-term exposure to moderately high noise ranging from 75 to 78 dBA (Melnick, 1991) [13] to 132 dB peak SPL (Price and Kalb, 1991) [14] can cause progressive cochlear hearing loss. The sound intensity of the exposure, as well as the length of the exposure, determine the degree of hearing loss. Ward, W. D. (1960) [9] investigated Temporary threshold shift and hearing recovery after noise. This study looked at the characteristics of transient threshold shift and hearing recovery after noise exposure. It revealed information on the time course and the elements that influence TTS. A study done by R. Neitzel, S. Somers, N. Seixas, and B. Goldman in 2006 on non-occupational activities contribution to overall noise exposure of construction employees. This study looked at how non-occupational activities contributed to the total noise exposure experienced by construction employees. It emphasized the significance of taking TTS-inducing activities outside of the job into account. This study looked at prospective preventative and treatment techniques for age-related hearing loss, such as decreasing noise-induced transient threshold changes through hearing conservation programs and reducing noise exposure.

Methods

Aim

The present study aimed at assessing the temporary threshold shift in Nashik Dhol musicians before and after noise exposure.

Participant

A total of 160 Nashik Dhol artists were exposed for four hours, selected for the current study.

Inclusive Criteria

- Participants were chosen from a group of people aged 16 to 40 years.
- Participants were subjected to the noise for a total of four hours.
- Participants who underwent hearing testing within four hours of exposure.

Exclusive Criteria

- Any neurological, behavioural, or emotional issues were grounds for exclusion from the study.
- Participants who wore earplugs or any other ear protection devices during the testing.

Procedure

The test was carried over with 160 individuals whose ear canal was examined using an otoscope and made sure that ear canal was intact. The first pure tone audiometry test was performed before the exposure of Nashik Dhol. The tests were conducted in a silent room where the participants were seated properly and they were counselled on how to attend to signals received through the headphones. They were asked to raise their hands whenever the sound was heard, even if it was a low sound. The test was performed at different frequencies, 500Hz, 1Khz, 2Khz, 4Khz & 8Khz and the pure tone average was calculated from the thresholds of 500Hz, 1Khz, 2Khz. Immediately after the exposure of Nashik Dhol, second pure tone audiometry has performed in all participants and evaluated the pure tone average. The threshold shift at 4 Khz of each individual was evaluated separately by comparing the threshold of 4KHz obtained before and after the exposure of Nashik Dhol. After 24 hours of exposure to the Nashik Dhol, afresh pure tone audiometry test has performed in all participants. Statistical analysis of this data was done and compared to the previous pure tone averages.

Results

The objective of the current study was to assess the hearing threshold shift in Nashik Dhol artists before and after noise exposure. Pure tone audiometry has done before and after the exposure and evaluated the pure tone average.

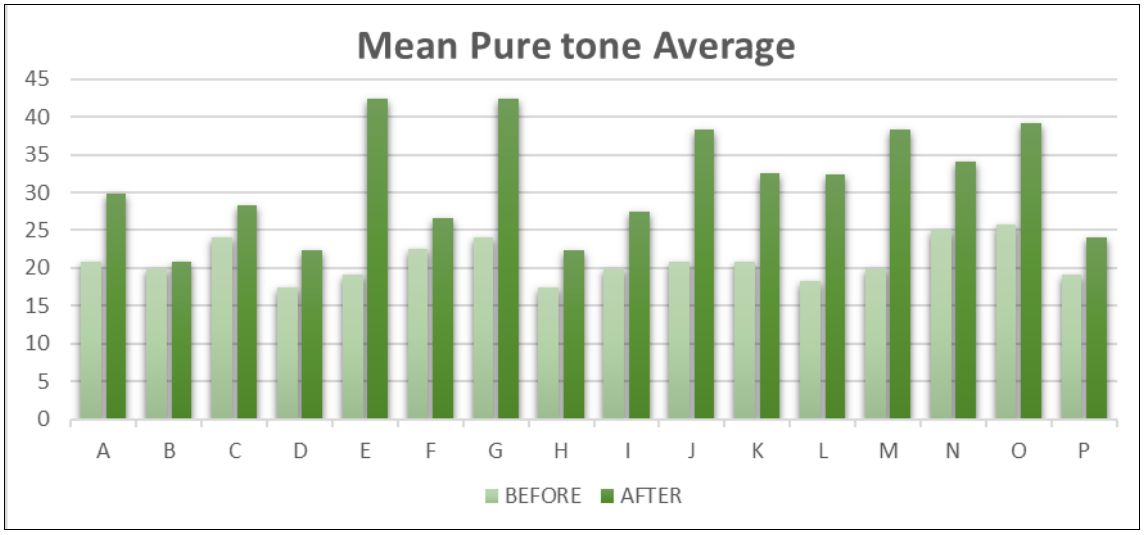

Fig A: Shows the mean pure tone average of individuals before and after the noise exposure

In the above figure A, it is visible that everyone who participated in the study has undergone a threshold shift after the noise exposure. 75% of the participants pure tone average shifted to more than 25 dBHL and experienced mild degree of hearing loss. The highest threshold shift in pure tone average was 24 dBHL and the lowest 2 dBHL.

The hearing threshold at 4 KHz compared between before and after the exposure to the Nashik Dhol separately to understand the threshold shift.

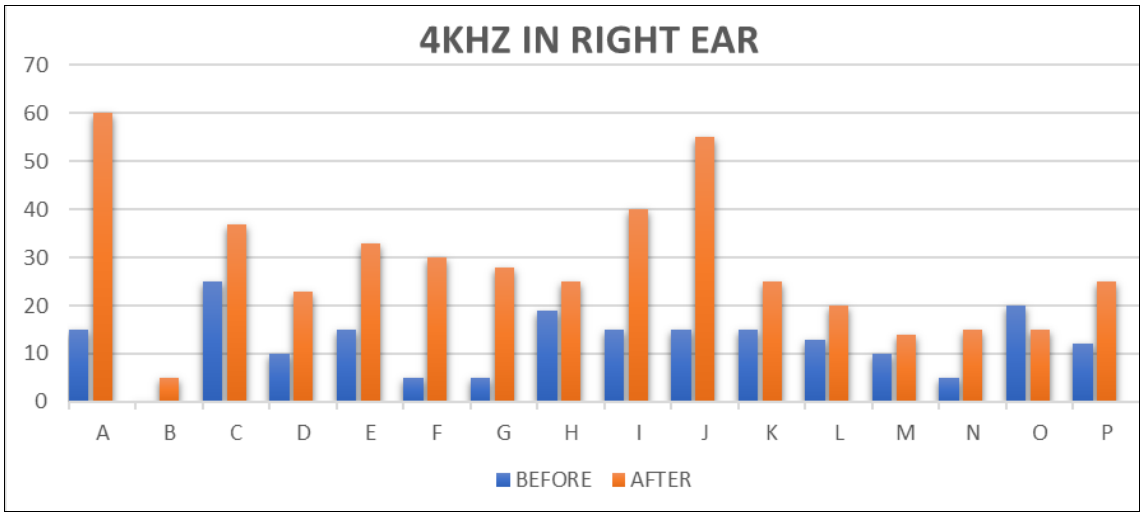

Fig B: Shows the individual's right ear hearing threshold at 4KHz before and after noise exposure

From the above figure B, it is visible that every individual who took part in the study has experienced a threshold shift in their right ear at 4KHz. The highest threshold shift was 45dBHL and the lowest is 5 dBHL.

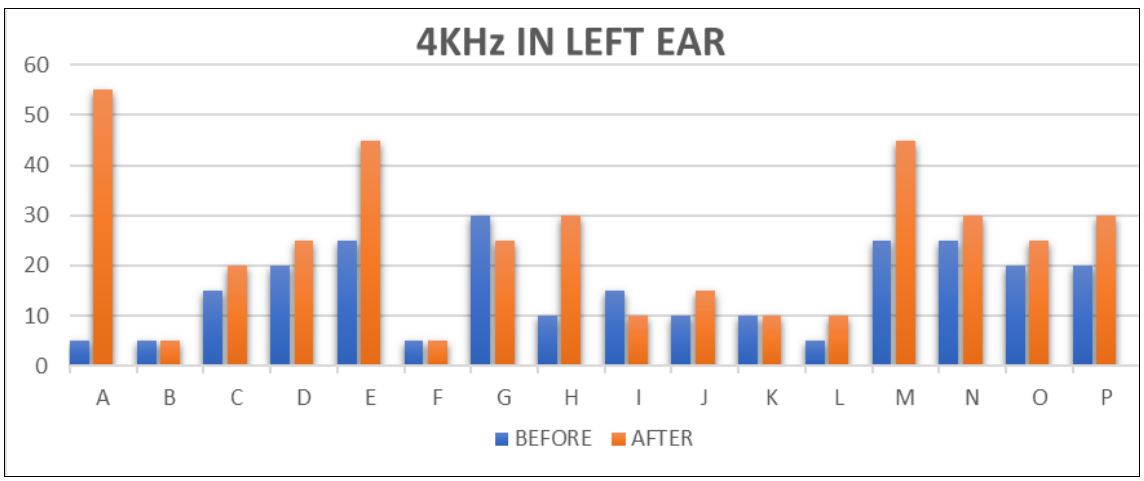

Fig C: Shows the individual's left ear hearing threshold at 4KHz before and after the noise exposure

The above figure C shows that all participants had experienced threshold shift except 30 individuals in their left ear. The highest observed threshold shift was 50 dBHL and the lowest was 5dBHL.

Table A: shows the average of threshold shifts of participants before and after noise exposure

Frequency	Threshold shift	
	Right ear	Left ear
250Hz	9.57	8.92
500Hz	15.62	10.62
1KHz	14.06	12.81
2KHz	12.5	8.43
4KHz	16.25	9.37
8KHz	11.71	8.74

The above table A shows the mean threshold shift in each frequency after the noise exposure of all participants. Comparing the left and right ears, highest threshold shifts was observed at 4 KHz in the right ear and the lowest was at 2 KHz in the left ear.

After 24 hours of exposure, third pure tone audiometry test was performed in all individuals and calculated the pure tone average. Comparisons between all three pure tone averages were tabled.

Table B: Shows the mean pure tone average of individuals before, immediately after and after 24 hours the noise exposure

	PTA 1 (Before)		PTA 2 (Immediately after)		PTA 3 (After 24 hours)	
	Right	Left	Right	Left	Right	Left
A.	20	21.6	31.6	28.3	20	21.6
B.	21.6	18.3	21.6	20	21.6	18.3
C.	28.3	20	31.6	25	28.3	20
D.	16.6	18.3	21.6	23.3	16.6	18.3
E.	16.6	21.6	28.3	51.6	16.6	21.6
F.	25	20	28.3	25	25	20
G.	18.3	30	41.6	43.3	18.3	30
H.	16.6	18.3	28.3	26.6	16.6	18.3
I.	20	20	23.3	21.6	20	20
J.	28.3	13.3	53.3	23.3	28.3	13.3
K.	20	21.6	35	30	20	21.6
L.	16.6	20	28.3	36.6	16.6	20
M.	16.6	23.3	36.6	40	16.6	23.3
N.	25	25	41.6	26.6	25	25
O.	26.6	25	45	33.3	26.6	25
P.	18.3	20	23.3	25	18.3	20

From the above table B, it can be inferred that after the exposure all individuals had threshold shifts. Within 24 hours, all the participants' threshold came down to normal. So it is evident that the threshold shifts were temporary and all participants had complete recovery.

Discussion

The above analysis has demonstrated that Nashik Dhol artists had a threshold change on conventional pure tone audiometry. 160 people were examined in this ongoing investigation before and after being exposed to noise. The individuals were exposed to loud noise for the duration of 4 hours. They did not use any type of ear protection devices (EPD) during noise exposure. They were screened again after noise exposure within 30 minutes. So, after the testing, it is clearly evident that every individual had a temporary threshold shift. A study conducted by Imam and Hannan in 2017 reported that people exposed to sound exceeding 89dB for more than 5 hours per week can suffer permanent hearing damage overtime. In addition to loud noise, a variety of other risk factors, both modifiable and immutable, can accelerate the advancement of noise-induced hearing loss. Males and females react to noise roughly equally, but boys participate in acoustic risk-taking behaviours that are much higher than those of girls. Noise might affect people differently depending on their age and history of sensorineural hearing loss.

In the current study, threshold at 4k frequency was compared separately because noise induced hearing loss mainly affected at the frequency of 4000 Hz, and it is evident that more than 50% of individuals who were tested had experienced a temporary threshold shift of greater than 20 dB in their both ears. Recent studies show that a typical audiological phenomena known as the "4K notch" occurs when a person's hearing sensitivity decreases at or around 4000 Hz. This dip, which appears as sensorineural hearing loss, is brought on by harm to the cochlea's hair cells. This frequently happens as a result of exposure to noise, and it was once thought to be uniquely symptomatic of noise exposure. Hawkins, found that the sensory neural degeneration due to noise focused on the first quadrant of the basal turn of cochlea for intermittent noise, continuous noise exposure to this quadrant is characterized by a dip of 4 KHz.

From the third audiometry test, it was inferred that the pure tone averages of all participants were came down after 24 hours. So, the all threshold shifts were temporary. Recovery from temporary threshold shifts after constant exposure to noise depends on a variety of factors that are not completely understood. Sometime recovery completes in 200-250 minutes, such rapid recovery has been observed when the threshold shift is less than 40dB and duration of exposure is less than 8 hours. To reduce these effects of noise, ear protection devices can be used. In people using EPDs, there will be a less chance of hearing loss due to noise exposure compared to others.

Conclusion

The aim of the study was to assess the temporary threshold shift in Nashik Dhol musicians before and after the noise exposure. Noise pollution impacts millions of people on a daily basis. The most common effect of this is noise induced hearing loss (NIHL). Continual exposure to noise can cause stress, increase in heart rate, sleep disturbances, cardiovascular disease along with hearing loss. From the current study, the pure tone average results of the participants show that every individual who took part in this study had experienced a temporary threshold shift in their both ears. These individuals who have experienced threshold shift retained their normal threshold within 24 hours. So, the present study concluded that exposure to Nashik Dhol for longer duration can lead to temporary threshold shifts. People who are exposed to loud noise frequently in their day-to-day life will be affected by permanent threshold shift (PTS) which will lead to permanent hearing loss.

Comparing to all octaves, most individuals experienced a higher temporary threshold shift at 4000Hz. These temporary shifts in every individual can be avoided by using ear protection devices (EPD) also known as hearing protection devices (HPD). These devices are worn in or over

the ears while exposed to hazardous noise and provide hearing protection to help prevent noise induced hearing loss (NIHL). HPD's reduce the level of noise entering the ear along with protect against other effect of noise exposure such as tinnitus and hyperacusis. So, those people who are subjected to loud noise, it is ideal to use hearing protection devices which can help them from causing noise related problems.

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