REAL EAR ATTENUATION MEASUREMENTS OF EAR PROTECTORS USING EAR PHONES: I AT THRESHOLD

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It is well known that the real ear attenuation of the hearing/ear protectors (ear plug/insert type) are measured using free-field audiometric measures. The difference in the free-field thresholds for narrow band noises at different central frequencies, measured with and without the hearing protector in the external auditory meatus of both the ears together, is considered as the real ear attenuation provided by those ear protectors. This attenuation, thus measured, determines the attenuation characteristic of the ear protectors used.

However, the purpose of the present study was to move in an untiaditional way of measurement, that is, to measure the attenuation characteristics of hearing protectors by presenting pure tones of different frequencies through the ear phones, of the audiometer, kept on the auricles of the subjects. Though, the measurement in this study looks unusual and untraditional, at present we presume that this will provide certain basis for the future research, that is going to be done by us, in this area.

At present, the attenuation measured at threshold with and without hearing protectors, has been considered to determine the efficiency of these hearing protectors. However, we have not been able to assess the efficiency of the same hearing protector at higher intensity levels using free-field measures. Present study will provide the baseline for the future research in the area of measuring attenuation characteristics of the hearing protectors, at higher intensity levels, that is, at supra threshold levels.

Present study, is first in the series of research, that is being done at the All India Institute of Speech and Hearing in India, in the area of measuring attenuation characteristics of hearing protectors using pure tones presented through ear phones. The methods developed, will be limited only to the ear plug/insert type of protectors.

Method

Subjects: 20 students of All India Institute of Speech and Hearing, in an age range of 18 to 21 years, served as the subjects for the present study. They provided forty ears in total with no otological and no audiological abnormal lities. All the ears had normal hearing.

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Material: E.A.R. ear protectors (insert type) were used, as the study aimed at measuring the attenuation characteristics of these protectors at 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 6000 Hz and 8000 Hz.

Equipment: A well-calibrated Beltone 200-C Diagnostic Audiometer with TDH-49 ear phones, kept in a sound-treated two room situation in the Department of Audiology, All India Institute of Speech and Hearing, was used to administer the pure tones through the ear phones.

Procedure: Pure tone thresholds, at 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 6000 Hz and 8000 Hz were measured with and without the ear protectors in the external auditory meati. Hughson-Westlake procedure of establishing hearing thresholds was used to determine the thresholds at all the frequencies.

The difference, between the threshold taken with the ear protector in the external auditory meatus with that of the threshold taken without the ear protector in the external auditory meatus, was considered as the amount of attenuation provided by the protector, at that frequency. That is,

Amount of attenuation in dB HL	=	Threshold with the ear protector in the external canal	—	Threshold without the ear protector in the external canal

Results

Table-A provides the range of thresholds of the ears at different frequencies with and without ear protectors in the external auditory meati and the range of attenuation provided by the protectors at different frequencies.

TABLE A

Frequencies in Hz	Threshold range without ear protector in dB HL	Threshold range with ear protector in dB HL	Range of attenuation in dB HL
250	0-20	25-50	15-40
500	0-20	25-55	15-45
1000	0-15	25-50	20-50
2000	0-20	25-55	20-55
4000	0-15	25-60	25-50
6000	0-25	30-70	30-70
8000	0-25	30-65	25-60

Table-B provides the mean thresholds of the ears at different frequencies with and without the ear protectors and the mean attenuation provided by the ear protectors at different frequencies.

TABLE B

Frequency in Hz	Mean threshold without ear protector in dB HI,	Mean threshold with ear protector in dB HL	Mean attenuation in dB HL
250	8.75	36.50	27.75
500	7.13	39.38	32.25
1000	4.75	38.25	33.50
2000	4.12	41.75	37.63
4000	5.37	46.75	41.38
6000	6.50	51.75	45.25
8000	5.63	51.63	46.00

Table-C provides the mean attenuation at all the frequencies and the standard deviations.

TABLE C

Frequencies Measures	250	500	1000	2000	4000	6000	8000
Mean Attenuation	27.75	32.25	33.50	37.63	41.38	45.25	46.00
Standard Deviation	6.22	6.61	7.52	7.50	6.02	9,01	9.17

A minimum real ear mean attenuation of 27.75 dB HL was observed at 250 Hz, whereas, the maximum of 46 dB HL was observed at 8000 Hz. Attenuation was observed to increase with increasing frequency. However, maximum attenuation of 70 dB HL was observed with a subject at 6000 Hz.

In terms of attenuation variability, observed through the standard deviation measure, it was less variable at 4000 Hz with 6.02 standard deviation. Whereas, the maximum variability was observed at 8000 Hz with a standard deviation of 9.17.

In summary, the attenuation of the ear protectors used in the present study, increased with increasing frequency from 250 Hz through 8000 Hz. The results of the present study are not compared with the results of any other study, because of two reasons. Firstly, here pure tones were used to measure the attenuation and not the narrow band noises as in other studies and secondly, the thresholds were taken through the ear phones and through the free-field measures as in other studies.

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