A Study of Hearing Thresholds at Speech and High Frequencies in Textile Workers

Dr Jayesh D Solanki, Dr Hemant B Mehta, Dr Pradyna A Gokhale, Dr Chinmay J Shah

Department of Physiology, Govternment Medical college, Bhavnagar, Gujarat, India.

Abstracts: Present study was carried out on 50 textile workers (34 males and 16 females) of Kumbharwada, Bhavnagar. All were exposed to high intensity industrial noise in plastic weaving Textile industry. Other causes of Hearing loss apart from Occupational Noise Induced Hearing Loss (ONIHL) were ruled out. Detailed occupational history and complaints related to hearing were inquired. Each subject was evaluated by Pure Tone Audiometry. Hearing thresholds at speech frequencies and high frequency were tested in silent room after 16 hours from termination to last exposure. The result was compared by statistical analysis that revealed more hearing loss at high frequency as compared to speech frequencies. The magnitude and degree of hearing loss seemed to increase with duration of exposure. [Solanki J D et al NJIRM 2011; 2(4) : 49-52]

Key Words: Audiometry, Frequency, Hearing loss, Intensity, Noise.

Author for correspondence: Dr Jayesh D. Solanki, Department of Physiology, Govt. Medical College, Bhavnagar, Gujarat, India. Email address: - drjaymin_83@yahoo.com

Introduction: Noise is perhaps the most common culprit as an occupational and environmental hazard.[1] Noise induced hearing loss (NIHL) is the second most common form of acquired hearing loss after age-related loss (presbycusis), with studies showing that people who are exposed to noise levels higher than 85 db suffered from NIHL.[2] Worldwide, 16% of the disabling hearing loss in adults is attributed to occupational noise, ranging from 7 to 21% in the various sub regions.[3] The effects of the exposure to occupational noise are higher in the developing regions.[4] Exposure to chronic noise primarily damages organ of Corti .[5] It can also damage hair cells, cochlear blood vessels, stria vascularis and nerve endings. There are many industries in which the risk of developing ONIHL is very high as the average sound level is about 106 dBA. Plastic weaving factories are noisy places which put workers more prone to development of hearing loss. In the plastic weavers (Textile workers) the effect of ONIHL is more as compared to pulmonary diseases. Till date, no definitive treatment of ONIHL is possible[6] once it develops but it is 100% preventable. Present study tried to compare hearing at low and high frequencies and to find why the early stage of ONIHL is asymptomatic.

Material and Methods: After approval from college Institutional Review Board, 50 weavers working for minimum 8 hours/day were selected randomly from 5 different factories from industrial area of Bhavnagar. Sample size was determined by using software Raosoft keeping Confidence level 95% and margin of error 15%. It included 34 males and 16 males with minimum 5 years of exposure with no interruption in job. Written consent of participants was taken before procedure. Depending on the duration of exposure to noise they were divided in to three groups: up to 10 years, 10-20 years and more than 20 years. Detailed personal data, occupational history and medical history was collected in pre designed performa. All other causes of hearing loss were ruled out before including participants in the study. They were tested for Air conduction of pure tones for each ear separately after explaining the procedure. A silent room was chosen for audiometry and readings were taken on weekends after at least 16 hours following last exposure to noise in order to rule out temporary threshold shifts. ALPS Manual Pure Tone Audiometer was used to evaluate hearing. Thresholds were measured at Speech frequencies 500 Hz, 1000 Hz & 2000 Hz and then at High frequencies of 4000 Hz, 6000 Hz and 8000 Hz. Intensities presented had sensitivity of 2.5 dB. The data was analysed by software Sigmastat 2.0 and statistical significance of results were checked by Chi square test and results were considered statistically significant when p value was less than 0.001.

Result: Weavers exposed to industrial noise were undertaken for pure tone audiometry. Comparison was done between hearing thresholds at low speech frequencies and at high frequencies in

three groups based on duration of exposure to noise. The degree of hearing loss and effect of duration of exposure were correlated.

Result shows raised hearing threshold at all frequencies that increase with increase in duration of exposure as shown in Table I.

Table I : Distribution of workers according to average hearing threshold at various frequencies with regard to duration of exposure

Duration of exposure	Hearing thresholds	Frequencies (in Hertz)							
		250	500	1000	2000	3000	4000	6000	8000
< 10 years	Mean	26.5	24.15	24.65	24.5	29.9	34.0	34.5	26.2
	SD	10.5	10.31	07.81	09.09	11.95	12.45	11.6	12
10-20 years	Mean	34	34.75	30.75	32.5	38.5	45.13	54.15	38.3
	SD	12.5	14.7	12.4	11.4	10.8	15.45	18.85	19
> 20 years	Mean	37.5	35.5	39.5	40.25	48.5	49.5	64.0	52.5
	SD	17.5	13.8	9.45	11.95	13.97	16.15	17	13.5

Difference observed is statistically significant.($p<0.001$)

Average threshold at speech frequencies was lower than that of higher frequencies and shows less increase with increase in duration of exposure as shown in Table II.

Table II: - Comparison between hearing thresholds for low and high frequency with regard to duration of exposure

Duration of exposure	Hearing thresholds	For low frequency	For high Frequency
< 10 years	mean	25.10	31.10
	SD	13.18	15.16
10-20 years	mean	33.00	44.57
	SD	09.65	16.03
> 20 years	mean	38.19	53.63
	SD	09.43	12.00

The difference observed between two frequencies was statistically significant.

While inquiring degree of hearing loss, it was absent to mild for speech frequencies but mild to severe for higher frequencies. Prevalence of moderate to severe hearing loss was 54% at higher frequencies as compared to just 18% at lower speech frequencies as shown Table III.

Table III: - Comparison of degree hearing loss at High frequencies & speech frequencies

	Degree of hearing loss				
	Absent	Mild	Moderate	severe	Profound
High frequencies	12	11	21	6	0
Speech frequencies	15	26	9	0	0

$\chi 2$ with Yates correction=31.12, df=2,($p<0.05$), Difference observed is statistically significant.

At speech frequency, hearing loss was absent in 30%,mild in 52% ,moderate in 18% subjects while At High frequency, hearing loss was absent in 24%,mild in 22% , moderate in 42%,severe in 12% subjects as shown Table IV and V.

Table IV: - Distribution of workers according to prevalence of hearing loss at speech frequencies with respect to duration of exposure

Duration of exposure in years	Number of workers	Hearing loss	
		Present	Absent
		No. (%)	No. (%)
< 10 years	20	10(50)	10(50)
10-20 years	20	15(75)	5(25)
> 20 years	10	20(100)	0(0)

Difference observed is statistically significant. ($p<0.001$)

Table V: - Distribution of degree hearing loss at high frequency with respect to duration of exposure

		Degree of hearing loss

Duration of exposure in years	Number of workers	Absent No. (%)	Mild No. (%)	Moderate No. (%)	severe No. (%)	Profound No. (%)
< 10 years	20	10(50)	9(45)	1(5)	0(0)	0(0)
10-20 years	20	5(25)	10(50)	5(25)	0(0)	0(0)
> 20 years	10	0(0)	7(70)	3(30)	0(0)	0(0)

Difference observed is statistically significant. (p<0.001)

Discussion: Present study tested hearing profile of workers exposed to high intensity of occupational impact noise. They all were exposed to noise equal to an average SPL of 85 dB(A) or higher for an eight-hour period.[7] Low frequencies showed better thresholds than high frequencies. Both showed worsening with increased duration of exposure owing to cumulative damaging effects of noise on Organ of Corti[8]. Among the high frequencies major effect was at 6000 Hz than 4000 Hz. This id due to the fact that noise in textile industries is due to metal to metal impact which affects higher octave of frequencies.[9]

The hearing loss observed in our case fulfilled Dobie's criteria of NIHL.[10] NIHL develops slowly after many years of exposure. Susceptibility varies quite widely, but 10 years or more of exposure is generally required for significant hearing loss to occur. Hearing loss-related symptoms, such as trouble in normal and telephone conversation, turning up the radio/television volume and tinnitus, usually occur in the early stages of NIHL.[10] However as speech frequencies are affected least the deficit remains unnoticed.

This result is in line with previous such studies done in India on Tractor driving farmers[11], heavy engineering industry workers[12], drug and pharmaceutical company workers[13], traffic policemen[14] and various mine workers[15]. In a textile mill weavers study, the sound levels were around 102-104 dBA and the hearing acuity of the textile weavers was found to be poor. NIHL at 4000 Hz was as high as 30 dB in the age range 25-29 years, 40 dB in the age range 30-34 years and 45 dB in the age range 35-39 years.[16]

In early stage of the disease the hearing loss was absent or mildly affected. This explains why early stages of ONIHL often remain unnoticed. There is minimal damage at speech frequencies hence there is not much difficulty in normal day to day hearing. Routine periodic audiometric testing should be used to screen out asymptomatic cases of hearing loss and proper preventive measures should be taken. Present study also sensitized the workers to use hearing protective devices. For further support of the results larger sample size is required.

Conclusion: Present study highlighted the problem of Noise Induced Hearing loss in textile weavers that is concentrated mainly at higher frequency .Lesser affection at speech frequency makes this preventable disease unnoticed in early phase. However, the damage proved mild to moderate due to continuous nature of noise and further suggesting a definite role of properly implicated protective measures for workers exposed.

Acknowledgement: I am thankful to Department of ENT for allowing me to learn the procedure of Audiometry. I pay my thanks to Department of Physiology, Government Medical College, Bhavnagar for their help at every step of the study. I am also thankful to the President of Weavers Association, Kumbharwada, Bhavnagar for their permission and support. At last I am thankful to all the workers for their participation. I pray god for their betterment.

References:

1. Sataloff, R.T., Sataloff J. Occupational Hearing Loss, Second Edition, Revised and Expanded. Marcel Dekker, Inc., 1993.
2. Rabinowitz P,Rees T.Occupational hearing loss. In:Rosenstock L,Cullen M,Brodkin C,Redlich C Editors.Textbook of clinival occupational and environmental medicine. 2nd ed. Philadelphia, USA : Elsvier Saunders ;2005. p.426-36.
3. Nelson DI,Nelson RY,Concha Barrientos M,Fingeruhut M. The global burden of occupational noise induced hearing loss.Am J Ind Med 2005;48;446-58.

4. Report of informal consultation on prevention of noise induced hearing loss held on 28-30 October 1997. Geneva. WHO.
5. Crowe SJ,Guild SR & Polvogt LM.observation on the pathology of high tone deafness .Bull Johns Hopkins Hosp.1934;54:315-379.
6. Dobie RA. The relative contributions of occupational noise and aging in individual cases of hearing loss. *Ear Hear*. Feb 1992;13(1):19-27.
7. Morata TC, Dunn DE, Kretschmer LW, Lemasters GK, Keith RW. Effects of occupational exposures to organic solvents and noise on hearing. Scand J Work Environ Health 1993;19:245-54.
8. Pourbakht A, Yamasoba T. Cochlear damage caused by continuous and intermittent noise exposure. *Hear Res*. Apr 2003;178(1-2):70-8.
9. Boettcher FA, Henderson D, Gratton MA, Danielson RW, Byrne CD. Synergistic interactions of noise and other ototraumatic agents. *Ear Hear*. Aug 1987;8(4):192-212.
10. Dobie RA. A method for allocation of hearing handicap. *Otolaryngol Head Neck Surg*. Nov 1990;103(5 (Pt 1)):733-9.
11. Kumar A,Mathur NN,Varghese M,Mohan D,Singh JK,Mahajan P.Effect of tractor driving on hearing loss in farmers of India.Am J Ind Med 2005:47:341-8.
12. Raja S,Ganguly G. Impact of exposure to noise on the hearing acuity employees in heavy engineering industry.Indian J Med Res 1983;78:100-13.
13. Bhattacharya SK,Tripathy SR,Kashyap S.Heat and noise problem in a drug and pharmaceutical firam in India.Indian health;1990:28:203-7.
14. Society to Aid the Hearing Handicapped (SAHI).Available from http: /www.sahiearcare.org/trafficpolice.
15. World Health Organization.Prevention of Blindness and deafness(internet).
16. Bhattacharya SK,Saiyed HN,Roy A,Chatterjee SK.Hearing acuity in weavers of a textile mill.Ind J Med Res 1981;74:779-85.