

Hearing protective devices and its role in Noise induced hearing loss: An interventional study

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Abstract

This Quasi experimental study was conducted with the objective to determine the effectiveness of preventive measures including awareness programme and use of hearing protective devices (HPDs) for the prevention and control of Noise Induced Hearing Loss among Oil and Gas field workers from January 2015 to March 2016. A total of 120 workers were selected by convenient sampling, and subjected to pure tone audiometry (PTA) to obtain hearing thresholds followed by intervention with HPDs and retesting a year later.

The Mean pure tone thresholds on first visit was 21.19 ± 11.60 dB in right and 24.66 ± 13.26 dB in left ear, while means at second visit (after one year) were 20.65 ± 10.44 dB and 21.45 ± 11.74 dB for the right and left ears respectively with statistically significant difference ($p=0.001$) for the left ear on t-test. However the difference of frequency and percentage of the participants with normal and reduced hearing at both visits was significant (chi square $P=0.001$). Hearing protective devices (HPDs) are an effective means to prevent NIHL in workers of oil and gas fields.

Keywords: Hearing protective devices, Noise induced hearing loss, Pure tone audiometry.

<https://doi.org/10.5455/JPMA.4768>

Introduction

Exposure to noise often causes annoyance, sleep disturbance, hypertension, cardiovascular issues, cognitive issues as well as hearing loss.^{1,2} Frequency of Noise-induced hearing loss (NIHL) due to workplace noise has a wide range with studies reporting prevalence as high as 38%.³

NIHL usually develops slowly and gradually with years of noise exposure and also depends on factors like, work

related stress factors, and personal habits.¹ Both genetic and environmental factors are known to be involved in causation of NIHL.¹ Studies show harmful effects of occupational noise for the unprotected workers⁴ and health care providers must advocate hearing conservation measures for workers.⁵ However, there is no consensus on a single preventive method and different preventive and protective strategies and gadgets have been advocated.⁶⁻⁸ Some pharmacological agents have been suggested to decrease the frequency of this disorder like Ebselen, which has been noted to be an effective and safe agent for prevention of NIHL.⁹ Hearing protectors are a common simple way to reduce noise exposure combined with strict legislation,¹⁰ however awareness of effect of noise on hearing needs to be emphasized.¹¹ Regular monitoring of noise levels and hearing threshold are of great significance as part of effective hearing prevention programmes.¹

There is dearth of literature on NIHL from Pakistan with few studies advocating conservation, however with no noticeable work on effectiveness of preventive measures.^{12,13} Therefore, the current study was designed to determine the effectiveness of awareness programme and Hearing Protective Devices (HPDs) including ear muffs and ear plugs in controlling NIHL. This has significant importance since no such study from Pakistan is available in literature and because highlighting of preventive and mitigation measures is essential to develop and enforce standards and regulations for noise sources especially to control and regulate noise exposure to allowable limits for workers.

Methodology

This is a Quasi-experimental study aims to determine the effectiveness of preventive measures including awareness programme and use of hearing protective devices (HPDs) for the prevention and control of Noise Induced Hearing Loss among Oil and Gas field workers, conducted over a period of 15 months from January 2015-March 2016. Following consent, a sample size of 120, was calculated

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using standard formula with 5% level of significance and 80% power of test.¹⁴ These were male, aged 20-45, were recruited from three oil and gas fields in Sindh, by convenient sampling technique. These included workers, from production and maintenance departments, who were exposed to high intensity noise of different types at the plant area, neighbouring airstrip, rigs, compressor/s generator etc. Executive/ managerial/ office staff; cases with hard impacted wax; unilateral hearing loss, ear diseases and those who did not turn up for post intervention assessment were excluded from the study.

Pre-Intervention assessment comprised of history and examination including otoscopy to rule out obstructive and inflammatory pathologies of the ear. This was followed by Pure Tone Audiometry to record pre-intervention pure tone hearing thresholds using Diagnostic Audiometer Pinnacle Kosmic 103, followed by Intervention.

Intervention Procedure: This included Group awareness sessions with the help of lectures, literature and videos to impart information and training regarding NIHL, its prevention and use of Hearing Protective Devices (HPD's); and provision of HPDs including ear plugs and ear muffs for use in designated noisy work environment for a year. During this one year, workers were allowed to work 12 hours daily for 21 days followed by a rest period of 21 days, away from the noisy environment.

Post-Intervention assessment was done a year later with pure tone hearing thresholds of all participants rechecked and recorded.

SPSS 20.0 was used for data analysis and statistical tests. Continuous variables like age was presented by Mean $\pm$ SD. Variables specially studied included means and standard

Table-1: Mean Hearing Thresholds (dB) of both Ears Before Intervention (First Visit) and After Intervention (Second Visit) (Paired t-test) (n=120).

Ear	Visit	Mean $\pm$ SD	p-value
Right Ear	First visit	21.19 $\pm$ 11.60	0.548
	Second visit	20.65 $\pm$ 10.44	
Left Ear	First visit	24.66 $\pm$ 13.26	0.001
	Second visit	21.45 $\pm$ 11.74	

deviation of hearing thresholds of pre-intervention and post-intervention visits. Paired sample t-test was applied to authenticate the experimental test results. Also, the number and percentage of the participants with different threshold of hearing/ hearing loss were recorded for both ears at both visits and compared through chi square test to know whether there was any statistically significant difference. The p value of less than 0.05 was considered significant.

Results

Our study population comprised of N=120 male workers, including 56(46.67%) workers from maintenance department and 64(53.33%) from production department, with a mean age of 36.82 $\pm$ 6.20 years.

Table 1, shows the comparison of mean hearing thresholds and standard deviation of both the ears on first visit (pre-intervention) and second visit (post-intervention) following intervention. The mean value on first visit was 21.19 $\pm$ 11.60 dB in right ear and 24.66 $\pm$ 13.26 dB in left ear and mean value on second visit, in right ear was 20.65 $\pm$ 10.44 dB and in the left ear 21.45 $\pm$ 11.74 dB. The paired sample t test was applied to compare the difference of hearing thresholds of each ear, separately, before and after intervention. Though improvement was noted for the left ear being 0.001, however the p value was not statistically

Table-2: Comparison of participants with different levels of hearing for Right and Left Ear: Chi-square test (n=120).

a) Comparison of Level of Hearing For Right Ear		Final Report Second Visit Right Ear				Total	p-value
	(0-25 dB)	(26-40 dB)	(41-55 dB)	(56-70 dB)			
Final Report First Visit Right Ear	(0-25 dB)	86	2	1	0	89	0.001
	(26-40 dB)	7	10	4	1	22	
	(41-55 dB)	2	3	2	0	7	
	(56-70 dB)	0	0	0	1	1	
	(71-90 dB)	1	0	0	0	1	
Total		96	15	7	2	120	
b) Comparison of Level of Hearing For Left Ear		Final Report Second Visit Left Ear				Total	p-value
	(0-25 dB)	(26-40 dB)	(41-55 dB)	(56-70 dB)			
Final Report First Visit Left Ear	(0-25 dB)	77	5	0	0	82	0.001
	(26-40 dB)	7	8	6	0	21	
	(41-55 dB)	3	4	7	1	15	
	(71-90 dB)	2	0	0	0	2	
	Total	89	17	13	1	120	

(Note: Decibel = dB, Normal = 0-25 dB, Mild HL = 26-40 dB, Moderate HL = 41-55 dB, Moderately Severe = 56-70 dB, Severe HL = 71-90 dB, Profound HL = > 90 dB).

significant for the right ear being 0.548, thus indicating insignificant difference for right ear between average hearing thresholds before and after intervention.

Discussion

NIHL is most common occupational problem worldwide including Pakistan.¹² In the present study, significant improvement due to intervention including awareness programme and HPDs was noted (Table 1,2). Similarly, Salmani M et al reported that training for proper use of ear plugs helps in hearing conservation,¹⁵ while Tikka C et al noted only moderate level of evidence that training for proper HPD insertion reduced NIHL as a short term effect.⁸ Smith PS et al reported improvement due to educational intervention and HPDs using fit-testing.¹⁶ Thus a number of authors have stressed on the need of noise prevention and strategies for mitigation.¹

Use of hearing protective devices (HPDs) is feasible and can play pivotal role in preventing NIHL with inconsistent use being a problem of our country and developed countries. Similarly in the current study, workers with mild degree of hearing loss at high frequency (esp. at 4 KHz) were not even aware of their hearing loss. This may be due to sparing of speech frequencies i.e. between 0.5-1 KHz, and general lack of awareness of the impact of noise on hearing. No local study examined role of HPD's for prevention of hearing loss in oil and gas field workers, however preventive role of silencers for rickshaw's,¹⁷ preventive measures from aircraft engine noise,¹³ use of HPD's and ban on non-certified air craft operations¹⁸ has been advocated.

In the current study the awareness programme and provision of HPD's, resulted in a significant use of HPDs resulting in hearing conservation and prevention even in absence of legislation. Similarly Tikka et al reported that there was low quality evidence that strict legislation could reduce noise level at work place.⁸

Limitations of the Study

Limitations and weaknesses of the study included lack of sound proof cabin for audiometry and the fact that selection/ provision of participant workers was done by the organization.

Conclusion

Hearing protective devices (HPDs) are an effective means to prevent NIHL in workers of oil and gas fields.

Recommendations: Hearing screening and use of hearing protective devices (HPDs) should be made part of standard operating procedures for the workers, working in noisy environments.

Acknowledgement: Contribution of Dr. Saba Irfan, and Dr. Sadaqat for helping us in this research and Dr. Tariq Ijaz, Chief Medical Expert of the organization for allowing us to conduct this research work.

Disclaimer: None

Conflict of Interest: None

Sources of Funding: None

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