EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 12/ March 2015

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Noise Induced Hearing Loss (NIHL) in Bore Well Personnel in India

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Abstract:

Noise pollution and allied health problems are seen in all ages worldwide. This is due to an increase in mechanization in industries and transportation as well as home appliances which produce high levels of noise. Noise induced hearing loss (NIHL) is a common health complaint found in industrial workers. The present research work describes NIHL in bore well personnel in India. Noise levels were measured at bore well digging sites in different locations in India and the standard noise level value calculated at respective locations. Presence of NIHL among workers was ascertained by audiometric findings. Eighty-seven workers from 20 locations participated in the study. Standard noise level (Leq) in the above locations was 111dB. NIHL prevalence was 57% among bore well personnel. NIHL is a permanent and disabling condition. Hearing conservation programs are necessary to reverse the trend of NIHL in India. These include the provision of ear plugs to prevent hearing problems in industrial workers.

Key words: Noise induced hearing loss, noise pollution, bore well workers, ear plugs.

Introduction

Noise is defined as undesirable sound produced by natural or human activities[1]. It is now well realized that noise pollution has become a steadily increasing problem worldwide. Exposure to loud noise can produce a temporary hearing loss. Prolonged exposure, however, causes irreversible damage to the sensitive hair cells in the inner ear[2]. These work by converting sound energy into electric signals which travel to the brain. The resulting hearing impairment is known as noise induced hearing loss (NIHL) – a common complaint in certain occupations where noise pollution is a frequently encountered hazard[3,4].

Occupational NIHL, also known as industrial deafness, refers to a hearing impairment resulting from exposure to excessive noise at work. Occupational NIHL is a common illness found in industrialized countries[5]. Gierke & Johnson reported that, 90% of loud noise exposures have higher risk associated with Noise Induced Hearing Loss (NIHL)[6]. The most common cause of NIHL is occupational noise exposure. It is estimated that 9 million American laborers are exposed to potentially hazardous levels of noise in the workplace[7]. NIHL can occur when the noise level is above 80dB for a prolonged period[7]. Initial exposure to loud noise produces a temporary threshold shift (TTS). Hair cells and supporting cells in the inner ear disintegrate and ultimately are destroyed. People suffering from TTS may notice a transient loss of hearing which returns to normal levels after the offending noise source is withdrawn. Industrial workers are often subjected to high levels of noise for several hours each day. Continuous exposure to 90dB for eight hours per day has been shown to represent a high risk of developing NIHL[8]. NIHL prevalence may be as high as 50% among those exposed to 95dB over a long time period[9]. The American College of Occupational Medicine Noise and Hearing Conservation Committee envisaged that 10-15

years' chronic exposure the noise leads to NIHL. Industrial noise exposure almost always produces a bilateral symmetric hearing loss. There are very few studies focused on NIHL among industrial workers specifically related to unorganized industrial sectors in India. A previous study involving saw mills and printing presses found that the average noise intensity in these industries exceeded 90 dB[10]. Mechanical operations like cutting, sizzling, pressing, binding and rolling were common noise sources.

Currently in India, failure of the monsoon has forced the construction of many more bore wells. These machines can produce noise between 95-150dB[11]. There are 10 to 20 workers continuously working to assist the fixing and detachment of pipes, and all are at substantial risk of NIHL. Therefore the present research work aimed to describe NIHL prevalence among bore well workers.

Materials and methods

Study area: The present study was conducted in Maharashtra State, India. Bore well machines are commonly found in the villages; especially in the summer months. Therefore researchers roamed in search of such machines in different districts in the Maharashtra State between March and June 2012.

Noise level measurement: Noise levels were recorded using a noise level measurement meter, model: SL-4010 (Range 0-130dB) in selected bore wells in different locations around Maharashtra State. Measurement of noise levels were performed for periods of 20-30seconds within 45 minutes. Six measurements were taken, and used to calculate the mean noise value[10].

Leq: **Leq** is the equivalent sound pressure level taking into account fluctuations in noise. It represents the standard value of noise at a particular location. In this study attempts

were made to envisage the Leq value at different bore well sites. The **Leq** value was calculated using the following equation:

$$\mathbf{Leq=10\ log\ \sum^{i=u}\ (10)\ Li/10ti}$$

Where,

i = Number of observations,

Li= Sound level at particular observation,

ti= time interval

Audiometric test: Audiometry is the technique used to identify the nature of hearing loss and to determine hearing threshold levels. Pure-tone audiometric tests were carried out on 87 workers usinga Kamplex Audiometer (Model-27) Hearing acuity was measured at 5dB intervals over a range of octave brand frequency from 500-800Hz in left and right ear. Various stimuli of different frequencies and intensities were passed to each ear using ear phones. Each worker was instructed by an audiologist to respond with each tone, pointing if the tone was heard. Hearing was considered normal if the threshold level was less than or equal to 25dB in individuals with a characteristic notch at 4 KHz [10]. The degree and type of hearing loss were determined using Goodman's test[13]. All audiometric tests were conducted in quiet areas, and at the beginning of a worker's shift. This allowed those whose hearing had fatigued some recovery time after being away from noise.

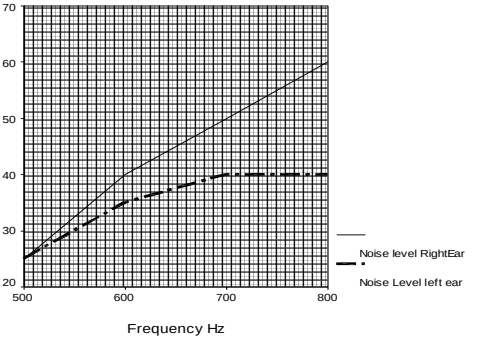

Figure 1 Audiogram graph of right ear and left ear

Results

Table 1: Noise level & Leq value at different bore wells in the study region.

Name of bore well company & state	Location of data collection	Number of samples	Noise level (dB)							Leq
			I	II	III	IV	V	VI	Average	
Balaji, Karnataka	Akluj, Dist.-Solapur	4	101.6	99.3	100.9	101.0667	101.6	99.3	100.9	110.2
Laxminarayan, Andhra Pradesh	Moregaon, Dist.- Baramati	4	107.3	102.5	104.2	103.2	107.3	102.5	104.2	113.8
Avadhut, Andhra Pradesh	Paranda, Dist.- Osmanabad	5	100.1	101.5	103.2	101.8	100.1	101.5	103.2	112.8
Surya, Tamil Nadu	Kadegaon, Dist. Sangali	6	105.2	107.4	101.3	104.5	105.2	107.4	101.3	110.9
Deccan, Maharashtra	Vaduj, Dist-Satara	7	106.7	101.1	99.8	102.6	106.7	101.1	99.8	109.1
Padmavati, Tamil Nadu	Bhogawati, Dist- Kolhapur	5	101.1	100.7	101.1	101.8	101.1	100.7	101.1	110.4
Venkatesh, Andhra Pradesh	Sinnar, Dist. Nashik	6	102.3	104.7	101.5	101.9	102.3	104.7	101.5	110.6
Madurai Kamraj, Tamil Nadu	Srirampur, Dist- Ahamednagar	4	101.1	100.3	102.1	100.2	101.1	100.3	102.1	111.6
Datta Digambar, Maharshtra	Vaijapur, Dist- Aurngabad	4	104.2	97.0	103.3	102.5	104.2	97.0	103.3	112.9
Shri Datta-Laxmi, Karnataka	Parola, Dist-Jalgaon	4	99.3	102.1	101.5	101.6	99.3	102.1	101.5	110.9
Yellama Devi, Karnataka	Dharur, Dist.-Beed	5	99.1	103.4	99.6	101.6	99.1	103.4	99.6	109.0
Mery's Kerela	Ambad, Dist.-Jalana	6	102.1	103.2	100.4	102.7	102.1	103.2	100.4	109.4
Drill king, Andhra Pradesh	Deulgaon Raja, Dist.- Buldhana	7	103.4	102.3	99.8	103.8	103.4	102.3	99.8	109.1
Shree Raj Karnataka	Partur, Dist- Parbhani	8	100.1	102.0	104.1	101.8	100.1	102.0	104.1	113.5
Laxmi, Maharashtra	Basmat, Dist-Hingoli	4	100.6	100.2	100.0	100.0	100.6	100.2	100.0	109.2
Shiva, Karnataka	Mudkhed, Dist.-Nanded	3	97.1	96.8	103.5	101.3	97.1	96.8	103.5	112.5
New Balaji, Tamil Nadu	Akot, Dist.- Akola	5	99.9	103.5	103.2	101.8	99.9	103.5	103.2	112.7

Table 2: Audiometric test results of bore well workers

Experience (years)	Audiometric test result 4KHz.			
	Total no. tested	No. with HTL <25dBA	No. with HTL >25dBA	%NIHL
1-5	12	7	5	25.0
6-10	23	13	10	43.5
11-15	23	11	12	52.2
16-20	8	3	5	62.5
20-25	9	2	7	77.8
25<	13	0	13	100.0

Discussion

Researchers collected data from 17 bore well machines around Maharashtra State. It was shown that, noise levels of 85dB and above has an adverse impact on the human auditory system. Bore well workers of different age groups were subjected to average noise levels of 101.8dB with a **Leq** of 111dB. The prevalence of NIHL among bore well workers was 57%. From the above statistics it is well understood that these workers have a high risk of hearing problems. Magnitude and duration of noise exposure are the most important variables in determining NIHL outcome[10]. It is interesting to find that, those workers employed for more than 10 years had chronic NIHL, as shown in **Table 2**. Those laborers working in noisy environments for a long time had more severe forms of NIHL. In order to make a diagnosis of NIHL, a subject's hearing loss history and subsequent physical examination should be taken. Respondents involved in present study were asked for hereditary or family deafness and ear illness, but no one reported any such history.

The average noise level among bore well machinery was found to be substantially higher than other heavy machine operations[12]. Cleark and Boline reported that, hearing loss might occur in the higher frequency in regions of the cochlea partition even when the peak spectral energy of the noise exposure is limited to low frequency stimuli[13]. This is because of metabolic events and cochlea micromechanics significantly influence the magnitude of ear damage, resulting in NIHL.

Researchers at the National Institute on Deafness and other Communication Disorders (NIDCD) showed that among NIHL cases, damaged hair cells do not re-grow in humans and other mammals[4]. Many studies on the treatments for both acute and chronic NIHL have reported that medicines are not effective for curing the NIHL[17]. However, NIHL can be prevented through use of personal hearing protective devices such as ear plugs and ear muffs. These are more efficient in attenuating sound at 1 kHz, and reduce the amount of noise reaching the inner ear[15]. Ear muffs with a light seal are capable of attenuating sound by up to 45dB, while ear plugs may reduce the noise level by 30 dB[14,15].

Case I

Mr. Yallapa B., a 36 year-old bore well worker who complained of hearing loss for the last 7 to 8 years. I met him at Dharur, Dist.-Beed. He had been working with bore well machines for 15 years, fixing pipes without wearing any ear protective devices. The audiometric results showed that even at 400 Hz his HTL was >25dB, and he was unable to detect weak signals. He told me about the hazards of this profession, *'This work is so tough and risky. High noise creates many health complaints like fatigue, anxiety and phobia. But for bread and butter I don't have any option.'* During discussion with Mr. Yallapa B., I observed the problem of speech interference. There is a strong correlation between high noise levels and inability to distinguish words[16].

Case II

Mr.Veerbhadra Katti, a 59 year-old bore well worker whose chief complaint was gradual-onset hearing loss over many years. This worker lost his ability to understand soft talking and ladies' voices. He had been working for the last 30 to 32 years with different bore well machines and presently worked as a machine operator. He regretted not wearing any ear

protective devices when working. The audiometric test results showed that he could not hear 25dB sounds at several different frequencies. He said, *'From the beginning I saw this profession has more hazards than others but it gives good economic rewards to me. Initially I felt uncomfortable in this profession but with passing of time I became more at ease in bore well operations. My chief complaint is hearing loss. I don't hear quiet voices though I request other fellows to speak loudly. Even my voice is louder than common people's. Bore well operations don't have a specific shift time. It continues between 8 to 15 hours. After that I don't have full relief of hearing because of heavy stress.'*

Case III

Mr. Prakash Bhadhure, a 28 year-old man whose chief complaint was hearing loss over many years which created difficulty understanding television and radio programs. The worker had 9 years' experience in different fields. He had previously worked in road construction and in the sugar industry. Over the last five years he worked on bore wells as a porter. Audiometric tests revealed that he could not detect even 45dB signals. Mr. Prakash discussed his experience of bore well operations and noise pollution. *'From last five years I have been working on this bore well machine. In work I felt disturbed with the noisy environment. Sometimes sleepless nights create acidity problems and I cannot concentrate on work. Because of good money I don't vacate form this work.'* Jayprakash Kakada (2012) reported that, noise makes workers mentally ill and reduces their efficiency. Irregular bursts of noise are more disruptive than steady state noise, and sound levels of 90dB or more may interfere with the performance of a task.

Case IV

Mr. Joney Aalex, a 42 year old bore well worker with 20 years' experience. He was working in Avadhut bore well machine as

an assistant and driver. Mr. Joney spoke about his experience, *'I drive around India for work. In one year we dug 200-250 bore wells. Loss of hearing is a common complaint in bore well workers. They are continuously working in noisy environments for 10 to 20 hours per day. This retards their hearing capacity. My hearing capacity is reduced and my doctor suggested I use hearing protective devices but I didn't take it seriously. I know because of this profession one day my ears will not work normally.'*

Conclusion

The present study ascertains some inserting findings which show that bore well workers are victims of NIHL. This problem depends on the duration and magnitude of exposure to loud noise. During digging of bore wells, average noise levels were 101.8dB, and 57% of workers were affected with NIHL. Those working for more than 10 years were severely affected with NIHL. Noise levels beyond 85dB are known to present a risk to hearing, while in the present study recorded noise levels were much higher than this limit. Even those bore well workers with only 1-5 years' experience had NIHL. Ear plugs and ear muffs are the protective tools which reduce noise intensity by 30dBA and 45dBA respectively. These devices prove helpful in preventing NIHL for those working in noisy environments. However, these instruments are not provided to workers operating bore well machines. Laws are currently being prepared to ensure bore well personnel do not work for more than two years continuously. This will reduce the contact period to high noise levels and enable recovery of normal hearing capacity.

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