

The Effect of Chronic Exposure to Loud Noise on Hearing in the Employees of Alasaad Steel Factory in Khartoum, Sudan

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ABSTRACT

Introduction: Noise induced hearing loss (NIHL) is a common occupational hazard affecting workers at different noisy working places as well as recurrent ear infections.

Objectives: Is to determine the prevalence of NIHL among Alasaad steel factory employees and to correlate its incidence with intensity, frequency and duration of exposure to loud noise. Design and settings: This was observational analytical case control study included 80 employees selected randomly from Al-asaad steel factory compared to a matched control of 80 employees selected randomly from International University of Africa (IUA). Personal interview was conducted. Sound level was measured using sound level meter. Hearing acuity was determined using audiometer. Data was analyzed using SPSS computer program. P value ≤ 0.05 was considered significant.

Results: The sound level at Alasaad steel factory was 92.31 ± 7.85 dB while it was 67.00 ± 0.00 dB at IUA. There was high prevalence of NIHL among Alasaad Factory employees than IUA (85% and 20% respectively, P value=0.001). The prevalence of bilateral NIHL was greater than unilateral NIHL (62.5% bilateral, 10% right ear and 12.5% for the left). There was positive correlation between the prevalence of NIHL and the sound level (P value =0.001). Almost all employees at Al-asaad steel factory did not use hearing protection device. NIHL was associated with recurrent ear infection, tinnitus and noisy head.

Conclusion: Exposure to loud sound at Alasaad steel factory leads to high prevalence of NIHL among employees. Prevalence of NIHL was positively correlated to intensity, frequency and duration of noise exposure.

Key words: Noise induced hearing loss (NIHL), Chronic Exposure, Loud Noise, Alasaad Steel Factory, Khartoum, Sudan

BACKGROUND

High levels of sound can cause mechanical damage to the cilia on the basilar membrane, which are responsible for the transmission of impulses to the auditory nerve¹. Noise is a major health threat in occupations where the level exceeds the permissible limit (85 decibel). The degree of negative effects of noise depends on its intensity, frequency, duration of exposure and individual sensibility². World Health

Organization reported that 16% of the disabling hearing loss in adults is attributable to occupational noise exposure. Noise induced hearing loss is completely preventable, especially when safety measures are taken, however it becomes irreversible once acquired³. The hearing loss incurred would depend on the sound qualities, duration of exposure and individual susceptibility and protection⁴

METHODOLOGY

Design and settings:

A descriptive analytical case-control study conducted at Alasaad steel factory in Khartoum, Sudan.

Study population:

An exposed group of 80 adult males working at Alasaad steel factory excluding those recently received drugs that affect hearing, those with congenital hearing problems and those who were exposed to excessive noise or having middle or inner ear problems before being employed in the factory. A control group of 80 adult males selected randomly from International University of Africa, Khartoum.

Questionnaire:

A questionnaire, as well as an interview was conducted, including personal data, noise exposure history and questions about current work environment.

The audiometry: Audiometric test was conducted by using calibrated Kamplex Diagnostic audiometer (KLD 23 mha, BSEN 60645) in Alasaad steel factory to determine hearing thresholds of the employees.

Procedure: The subject was made to sit in a sound treated room for testing, then the audiometer was connected to the power supply and switch it on. Earphones were

placed on the client's head. It was usual to place them in such a manner that the blue phone covers the left ear and the red phone the right ear. Ensure that the opening of the earphone is positioned directly over the external ear canal, after that the subject was required to give a response on hearing a tone, like lifting hand or finger or pressing a button. The procedure was carried out manually. The least loudness level heard by the subject in each frequency was recorded and was called Threshold. Thresholds were determined for tones with frequencies starting at about 125 Hz and increasing in frequency by octaves or half-octaves to about 8000 Hz. Hearing tests of the right and left ear were done independently. Air conduction testing and bone conduction testing were carried out to determine the type of hearing loss. Bone conduction testing was done with the help of the oscillator

Sound level meter: A Wensen WS 1361 type 2 digital sound level meter was used to determine noise levels at different factory sections and at International University of Africa.

Statistical analysis:

SPSS computer program was used for data analysis. The t-test was used for significance ($P \leq 0.05$).

RESULTS

Table (1): Correlation between sound level and induced hearing loss.

	Sound level (dB)	Noise induced hearing loss (NIHL)			
		Normal	Right	Left	Both
Inclinor	106	0.0%	5.9%	11.8%	82.4%
Line production	95	15.4%	7.7%	15.4%	61.5%
Production	84	7.7%	0.0%	15.4%	76.9%
Control and cylinder	88	24.3%	16.2%	10.8%	48.6%
Control	67	80.0%	5.0%	5.0%	10.0%

There is significant difference in sound level between Alasaad factory employees and the control ($p=0.001$) with variation in sound level between different sections in the factory. There was significant incidence of NIHL in the exposed group (employees of Alasaad steel factory) compared to the control with positive correlation between the level of exposure at the different sections of the factory and rate of NIHL. NIHL in the exposed group mostly affects both ears. The inclinor section showed the highest rate of incidence of NIHL (Table 1).

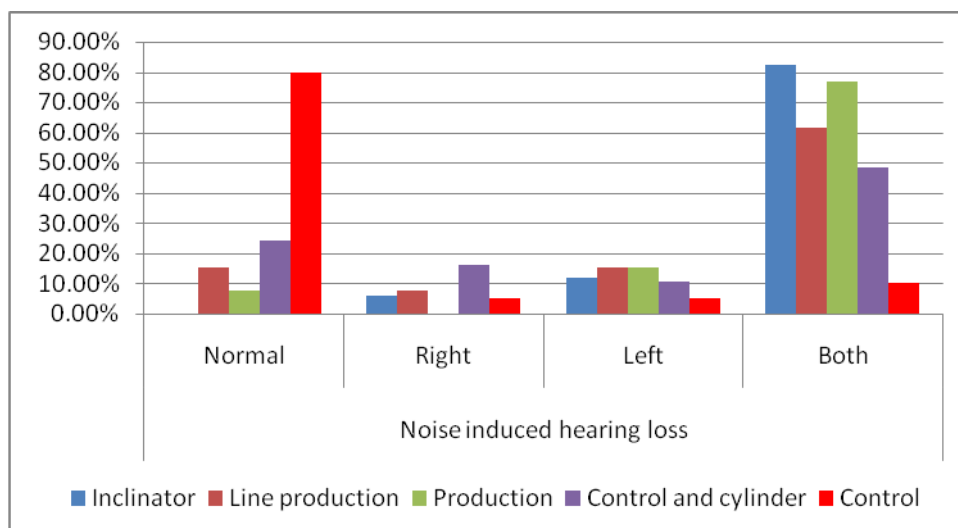


Figure (1): NIHL among different sections of Alasaad steel factory.

The rate of incidence of ear infection among the employees is 15% compared to 6.2% in the control group

Table (2): Incidence of ear infections and head tinnitus (n=160).

	Ear infection. No (%)	Head tinnitus. No (%)
Case	12 (15%)	40 (50%)
Control	5 (6.2%)	33 (41.3%)

Ear infection in the exposed employees showed more permanent effect on hearing than in the control with more percent of employees developing.

10% of the employees (case) have reported that noise interfere with their hearing compared to 2.5% of the control.

DISCUSSION

Our results were in agreement with that of Musiba (2015)⁵ who found a high prevalence (47%) of NIHL among Tanzanian miners. In a similar study among 50 workers exposed to high level of sound, there was 80% of workers had degree of hearing loss and 20% were normal⁶. Strong relationship between hearing loss and noise level has been proved⁷.

Another cross-sectional study done at the Khartoum International Airport, Sudan, investigated noise-induced hearing loss among employees of Khartoum international airport. The results showed high incidence of NIHL among employees (55%)⁸.

Our study showed that prevalence of bilateral NIHL was higher than unilateral NIHL. This in agreement with Ranga et al (2014)⁹ who found that chronic exposure to noise in textile industrial workers causes bilateral cochlear damage and high prevalence of noise induced hearing loss (39%). Nandi and Dhattrak had found that there was significant association between the hearing loss and duration of exposure in both ears among workers exposed to low level of noise and only in the left ear among workers exposed to high level of noise. Thomas et al found that left ear alone was affected equally as both ears together but right ear alone was less affected less¹⁰. Bilateral hearing loss was higher among workers in two Plants factories in Eastern Saudi Arabia⁷. Other study showed that in Traffic Police Personnel of Kathmandu Metropolitan City (40.9%) bilateral hearing loss more than unilateral hearing loss, (24%) left ear and (4%) right¹¹.

Our study showed significant correlation between the duration of exposure and the prevalence of NIHL. This in consistent with the study revealed an overall Association between the hearing loss and duration of exposure was significant in both the ears among workers exposed to low level of noise (<80dB) and only in the left ear among workers exposed to high level of noise¹² There was a significant increase in prevalence of hearing loss with duration of

exposure with 50.8% of employees in Indian air force personnel.

In a previous study, tinnitus was reported in 50% of the cases¹³.

In conclusion, our study revealed that sound level at Alasaad steel factory was greater than the recommended level. The high prevalence of NIHL among employees was attributed to high sound level and absence of hearing protection devices.

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How to cite this article: Abdelaziz OM, Bashir AA, Abdalla IM. The effect of chronic exposure to loud noise on hearing in the employees of Alasaad steel factory in Khartoum, Sudan. Int J Health Sci Res. 2020; 10(10):157-160.
