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NOISE INDUCED HEARING LOSS AND ITS ASSOCIATION WITH HYPERTENSION IN IRON AND STEEL ROLLING MILL WORKERS IN NCR/GHAZIABAD

Occupational Health

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ABSTRACT

Noise pollution has always been prevalent in industrial environment. Present study was conducted in Iron and steel rolling mill in Ghaziabad (NCR region) to study the effect of noise on hearing loss and blood pressure. This study is a cohesive assertion on the actual effect of these noise exposures on hearing loss and blood pressure. 416 subjects were who were exposed to industrial noise participated in this study. The effect of noise on their hearing acuity and on the cardiovascular system was studied. The subjects were examined thoroughly, grouped, and investigated for their age, duration of service, place of work, numbers of hours of work with periods of rest per day, intensity of sound at workplace, enquiry about use of protection and detailed history of present, past and family were taken. Hearing assessment was done by Tuning fork tests and Audiometry. In Cardiovascular measurement, Blood pressure was measured. The workers who had Noise induced hearing loss and without any family history of hypertension or treatment of drugs for cardiovascular problems, were selected as subjects in this study. Chi square and t tests were used, P value <0.05 was accepted as significant. In present study it was observed that 40.4% of the subjects showed noise-induced hearing loss (NIHL). It was observed that hypertension and hearing loss was more prevalent in sections having noise level above 104dB. Prevalence of hypertension among Continuously exposed group (26.3%) was significantly higher than intermittently exposed group (8.3 %). Hypertension was more common in sections having high levels of sound. The subjects with hearing impairment had more cases of hypertension (33.3%) than those with normal hearing (14.5%). This association was statistically significant ($X^2 = 5.147$, p=0.022).

KEYWORDS

Hypertension, Noise induced hearing loss, Industrial noise.

INTRODUCTION

Exposure to excessive noise is the most common preventable cause of hearing loss. It is generally recognized that continued exposure to any sound measured at 85 dBA can be harmful to the human ear. According to the National Institute for Occupational Safety and Health (OSHA), the maximum exposure time at 85 dBA is eight hours. In general, the louder the noise, the less time is required to cause damage to one's hearing. Noise levels above 140 dBA can cause damage after just one exposure. It has been suggested that 12% or more of the global population is at risk for hearing loss from noise, which equates to well over 600 million people [1]. The World Health Organization estimated that one-third of all cases of hearing loss can be attributed to noise exposure [2]. Exposure to noise hinders communication between workers and may also result in different type of physical, physiological and psychological effects on the workers [3].

Manufacturing processes generate noise as an unwanted by-product of their output with more than 70% of noise exposure occurring in the manufacturing industries [4,5]. It is estimated that each year the cost of unaddressed hearing loss exceeds 750 billion international dollars globally [6].Effects of exposure to noise on workers in the industries have been divided into auditory or non-auditory. The auditory effects include hearing impairment and permanent hearing loss due to excessive noise exposure. The non-auditory effects include hypertension, ischaemic heart diseases, and stroke, communication difficulties, impaired attention, increased arousal, learned helplessness, frustration, noise annoyance, and consequences of sleep disturbance on performance [7,8].

Acute exposure to different kinds of noise is associated with arousals of the autonomic nervous system and endocrine system. [9]. Various studies over the years have proved that noise exposure increases systolic and diastolic blood pressure, changes heart rate, and causes the release of stress hormones (including catecholamines and glucocorticoids) [7]. Chronic exposure affects metabolism and the cardiovascular system, which causes increase in cardiovascular disease risk factors such as blood pressure, blood lipid concentrations, blood viscosity, and blood glucose concentrations. These changes increase the risk of hypertension, atherosclerosis, and are related to severe events, such as myocardial infarction and stroke[10].

Although several previous studies have reported effect of industrial noise on blood pressure and hearing, but none has been done in NCR especially Ghaziabad which is a hub of heavy industries with increasing level of noise pollution. Since there is continuous exposure to industrial noise, there are chances of developing hearing impairment & audio-stress effects on the cardiovascular system. This cross-sectional study has therefore been undertaken with an aim to study the effect of different types of noise on hearing and cardiovascular system and to determine the (i) Prevalence of hearing impairment and hypertension in iron and steel industry workers. (ii) Association between hearing impairment and hypertension. (iii) Association between hearing impairment and hypertension, with intensity of exposure, duration of exposure and age. (iv) Correlation between levels of sound and noise induced health problems viz. hearing impairment and hypertension. (v) Awareness of people about adverse effects of noise and its prevention and the use of personal hearing protection devices are the major strategies against adverse effects of noise.

This prevalence of hearing loss and hypertension among mill workers is due to unregulated exposure to noise and non-use of hearing protection. In the present study the sound level were within the range of 68-110 dB (A) similar to a study by Uday W. Nalwar in Nagpur, India which showed range between 38-110 dB (A) in rolling mills. Noise levels in the workstations of mill workers in both the studies exceeded the acceptable noise levels of 85 dB for eight hour per day [11].

MATERIAL AND METHODS

The present study was conducted in the different sections of iron and steel rolling mill in Ghaziabad. Written permission was obtained from competent authority of the factory. The subjects included 416 male workers employed in different sections of iron & steel rolling mill in Ghaziabad, exposed to industrial noise of different level & duration.

The control groups were 120 healthy subjects within the age group of 18-60 years, comprising of people from the general population who volunteered to participate in the study and were not exposed to high level of noise.

Selection of the subjects was done based on predetermined inclusion and exclusion criteria:

Inclusion criteria:
Either sex, in age group of 18-60 yrs. in good general physical condition Ears free from disease/ conductive hearing loss.

Exclusion criteria:
Operated cases for any ear disease. History of head injury with unconsciousness.

History of ototoxic drugs or operative procedure done for any ear disease. History of familial deafness. History of any systemic disease like Hypertension, Tuberculosis & Diabetes prior to joining this mill.

For analysis and comparison Wire rolling mills (WRM), TMT rolling mill (TRM), & Administrative department (AD) was taken as continuously exposed group (CEG), whereas Maintenance department (MD) was taken as intermittently exposed group (IEG)as workers working in this section visit manufacturing group intermittently. The workers in WRM, TRM, MD work 8 hrs shift while those in AD work 12 hrs shift. None of the workers were using protective devices. All the workers included were males as no female were employed in iron and steel factory. The hearing tests were carried out in a soundproof room. Selection of cases was randomly done. The subjects were grouped according to their age, place of employment, duration of work per day, duration of exposure, amount of hearing loss, changes in the blood pressure & heart rate.

The subjects were thoroughly interviewed, examined & investigated for detailed medical and occupational history. General physical & systemic examination, local examination of both ears, Tuning fork tests, Pure Tone Audiogram of both ear and Noise survey was done.

Measurement of heart rate
Subject was made to sit and relax so that any tachycardia due to anxiety or exertion subsides. The rate of the radial pulse was noted in beat per minute for full 1 minute.

Measurement of Blood Pressure
As per the standard protocol recording of the systolic blood pressure (SBP) and diastolic blood pressure (DBP) was carried out. The measurement was performed with the use of a digital sphygmomanometer with the subjects sitting following ≥ 15 min of rest. The definition of hypertension was a SBP ≥ 140 mmHg and/or a DBP ≥ 90 mmHg. Analysis of the data included by the medical examination report was performed. Subjects were categorized by different levels of hypertension as stated by WHO with respect to hypertension. The blood pressures were obtained three times while workers were at work: between 10 am to 12 pm. Three readings of the blood pressures were obtained, and the average values used as representing the blood pressures of the workers.

Tests for Hearing Loss
The workers were tested at the start of work shifts to minimize temporary threshold shift effects. The workers tested had not worn hearing protectors. The tests were conducted for workers who are exposed to continuous and intermittent noise in various departments and for control group volunteers from general population who were not exposed to high level of noise.

Rinne's Test, Weber's and Absolute bone conduction test were done by using a vibrating stainless steel tuning fork of 512 Hz. Pure tone audiometry was done to measure the hearing acuity. The pure tone audiometry was done in a sound treated room by the portable audiometer -ELKON EDA 3N3 portable Audiometer Multi with software with the help of certified audio technician. It was calibrated biologically and acoustically at regular intervals to International (ISO) standard level.

The audiometry was primarily done for Air Conduction and Bone Conduction mainly for frequency at octave steps - 125, 250, 500, 1000, 2000, 4000, 6000 and 8000 Hz (Figure-1). The intensity can be increased or decreased for each frequency form 10dBA to 120 dBA. Charted in the form of graph (audiogram). Proper masking was done for all the tests to avoid any false negative results.

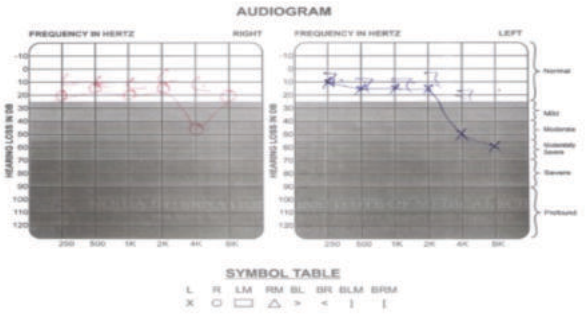


Figure – 1 Right Noise Induced Hearing Loss, Left Noise Induced Hearing Loss With High Frequency (4KHz dip)

Noise Level
The noise exposure was assessed for 12 working hours at different sections of rolling mills. It was measured with the help of portable sound level meter (Lutron SL -4030 digital sound level meter) which measures sound between 35-130 dB; with resolution of 0.1 dB. The noise level was recorded after the sound level meter was calibrated at A-weighted sound pressure level. It was used to determine the frequency of noise which was carried by each worker within their working hours. Three measurements at the mentioned times were obtained on an hourly basis in all the four sections covered by the study. The average of the noise levels was calculated and taken as the mean noise level for each of the section. The noise exposure level in the factory was then classified into 4 categories (WRM – 110 dB, TRM - 104 dB, MD - 96 dB, AD - 68 dB).

Criteria For Hearing Impairment (WHO's Grades of hearing impairment)

S No.	Grade of impairment	Corresponding audiometric ISO value a,b
1.	0: No impairment	25 dB or better
2.	Slight impairment	26–40 dB
3.	Moderate impairment	41–60 dB
4.	Severe impairment	61–80 dB
5.	Profound impairment including deafness	81 dB or greater

a. dB: decibel; Hz: Hertz; ISO: International Organization for Standardization; m: meter; WHO: World Health Organization.
b. Average of 500, 1000, 2000 and 4000 Hz

Source: Stevens et al. (2013),Olusanya et al.(2014),WHO[12,13,14].

Statistical Analysis
The whole data was analyzed on SPSS 16 version. X^2 test & coefficient of co-relation were used for statistical tests. Chi square test and t tests were used. P value <0.05 was accepted as significant. Frequency distribution tables & percentage were used to summarize study data in tabular formats.

RESULT
In the present study 416 subjects were taken from the Iron & steel rolling mill in Ghaziabad, who were exposed to industrial noise. 120 subjects taken as control were never exposed to industrial noise. The effect of noise on their hearing acuity and on the cardiovascular system was studied. Noise in Wire rolling mill (WRM), TMT rolling mill (TRM) section, and Administrative department (AD) were of continuous variety whereas in Maintenance department (MD) it was intermittent. WRM had highest level of noise i.e., 110 dB whereas Administrative department had lowest level of noise i.e. 68 dB. In TRM the noise level was 104 dB and in Maintenance department it was 96 dB. It was observed that the sound level was more than permissible limit in WRM, TRM and MD. In the case group 104 (25.0%) subjects were employed in WRM unit, 100 (24.0%) in TRM, 96 (23.1%) in MD unit & 116 (27.9%) in AD unit. The controls were the 120 subjects not exposed to loud noise.

In the present study 96 (23.0%) subjects were exposed for the duration

of less than 5 yrs, 144 (34.6%) subjects for the duration of 6-15 yrs, 108 (26.0%) subjects for the duration of 16-25 years and 68 (16.3%) subjects for the duration of 26-35 yrs. Maximum number of subjects were exposed for the duration 6-15 yrs. There were 80 (19.2%) subjects in the age group of 18-25 yrs, 120 (28.8%) subjects in the age group of 26-35 yrs, 120 (28.8%) subjects in the age group of 36-45 yrs, 96 (23.2%) subjects in the age group of 46-60 yrs. 236 (56.7%) subjects worked 7-8 hrs per day & 180 (43.3%) subjects worked 11-12 hrs per day. Subjects in WRM, TRM & MD units mainly worked 7-8 hrs shift and those in AD unit worked 11-12 hrs shift. All 416 subjects were exposed to industrial noise of various intensities. Among these 168 (40.4%) subjects had sensorineural hearing loss at high frequency. Majority subjects had mild to moderate hearing loss. The maximum hearing loss was observed in sections having high intensity of sound viz. WRM (61.5%), TRM (40.0%), MD (37.5%) as compared to AD (24.2%) where level of sound was low. Maximum subjects having moderate to severe hearing loss were seen in WRM & TRM sections where level of sound was very high. The association between intensity of sound and hearing loss was found to be significant. The significant hearing loss was observed in subjects exposed to longer duration i.e., more than 16 yrs. Maximum hearing loss was seen in subjects who were exposed to industrial noise for the duration of 26-35 years i.e., 76.5% (Table-1).

Table No.1 Indicate Frequency and Percentages For Duration Of Exposure To Noise And Hearing Loss (n =416)

Duration of Exposure (Yrs)	Hearing loss	No Hearing Loss	Hearing Loss in dB			
			26-40	41-55	56-70	71-90
≤ 5 (n=96)	12(12.5%)	84(87.5%)	8(8.3%)	4(4.2%)	0(0%)	0(0%)
6-15 (n=144)	32(22.2%)	112(77.8%)	28(11.1%)	4(2.8%)	0(0%)	0(0%)
16-25 (n=108)	72(66.7%)	36(33.3%)	44(40.7%)	16(14.8%)	8(7.4%)	4(2.9%)
26-35 (n=68)	52(76.5%)	16(23.5%)	12(17.6%)	16(23.5%)	16(23.5%)	8(7.4%)
Total (n=416)	168(40.4%)	248(59.6%)	52(22.1%)	36(8.7%)	12(5.8%)	16(3.8%)

Maximum subjects having moderate to severe hearing loss were seen in this group. The association between duration of exposure & hearing loss was found to be significant. In all the subjects who had hearing loss (168), 92.8% were those who were exposed for the duration of more than 10 yrs.

The prevalence of hearing loss was observed in subjects aged more than 36 yrs. Maximum hearing loss was seen in subjects who were in the age group of 46-60 years i.e., 70.8% (Table-2).

Table No. 2 Indicate Frequency and Percentages For Relationship Between Age & Hearing Loss (n =416)

Age in yrs	Hearing loss	No Hearing Loss	Hearing Loss in dB			
			26-40	41-55	56-70	71-90
18-25 (n=80)	12(15.0%)	68(85%)	8(10.0%)	4(5.0%)	0(0%)	0(0%)
26-35 (n=120)	16(13.3%)	104(86.7%)	16(13.3%)	0(0%)	0(0%)	0(0%)
36-45 (n=120)	72(60.0%)	48(40.0%)	48(40.0%)	12(10.0%)	8(6.7%)	4(3.3%)
46-60 (n=96)	68(70.8%)	28(29.2%)	16(16.7%)	24(25.0%)	20(20.8%)	8(8.3%)
Total (n=104)	168(40.4%)	248(59.6%)	88(22.1%)	40(8.7%)	28(5.8%)	12(3.8%)

Maximum subjects having moderate to severe hearing loss were seen in this group. There was a positive association between duration of exposure and hearing loss. The prevalence of hearing impairment was directly associated with duration of exposure. This association was found to be statistically significant in all the sections (X^2=13.09, df-3, p=.004) except administrative department (68dB).

It was observed that hypertension was more common in sections having high levels of sound viz. WRM (38.5%) & TRM (24%).

The prevalence was more in CEG (WRM, TRM, and AD) than IEG (MD). There was a positive association between intensity of sound and hypertension (Table-3).

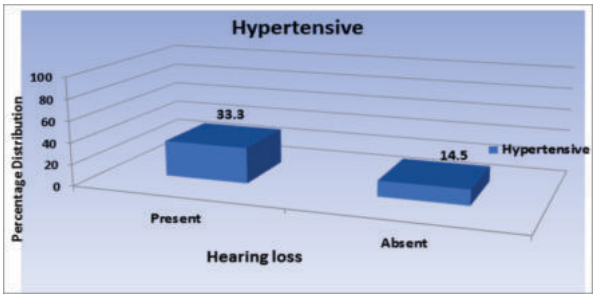
Table no.3 Indicate Frequency and Percentages For Relationship Between Intensity of Noise & Hypertension (n =416)

Place of Work	Hypertensive	Non Hypertensive
Control (n=120)	1(3.3%)	29(29.7%)
WRM (n=104)	10(38.5%)	16(61.5%)
TRM (n=100)	6(24.0%)	19(76.0%)
MD (n=96)	2(8.3%)	22(91.7%)
AD (n=116)	5(17.2%)	24(82.8%)

Table no. 4 - Indicate Frequency and Percentages For Relationship Between Duration of Exposure& Hypertension (n =416)

Duration of Exposure (Yrs)	Hypertensive	Non-Hypertensive
≤5 (n=96)	0(0%)	96 (100%)
6-15 (n=144)	12 (8.3%)	132 (91.7%)
16-25 (n=108)	32 (29.6%)	76 (70.4%)
26-35 (n=68)	48 (70.6%)	20 (29.4%)
Total (n=416)	92 (22.1%)	324 (77.9%)

A prevalence of hypertension was observed in subjects exposed to longer duration i.e., 26-35 yrs. Maximum cases of hypertension were seen in subjects who were exposed to industrial noise for 26-35 years (Table-4). There was a positive association between duration of exposure & hypertension. The prevalence of hypertension was positively associated with age of subject in almost all the sections of the industry except maintenance department (IEG). This association was found to be statistically significant (X^2=11.21, df=3, p=0.011). The workers with hearing impairment had significantly more hypertension (33.3%) than workers with normal hearing (14.5%).



Graph 1 - Showing Association between hearing & hypertension df=1, X^2=5.147, p=0.02

This association was found to be statistically significant (X^2=5.147 df=1, P=0.02). It was also seen that prevalence of hypertension was positively associated with duration of exposure in almost all the sections of the industry except maintenance department (IEG). This association was found to be statistically significant, X^2=14.38, df-3, p=0.02 (Graph-1). It was also observed that prevalence of hypertension was more among workers of CEG (26.3%) as compared to workers of IEG (8.3%).

DISCUSSION

There are considerable studies so far linking environmental noise exposure with hearing loss and hypertension as well as other cardiovascular disease. The data available is supportive rather than definitive. There is variability in assessment of duration of exposure, sound level uses and various other additional factors which lead to mixed results.

This study was carried out in iron and steel rolling mills in Ghaziabad to explore the problem of hearing loss and hypertension due to excessive noise exposure, In the present study the sound level were within the range of 68-110 dB (A) similar to a study by Birender Yadav et al (2006-2007) in lock factories in Aligarh, India which showed range between 82-104 dB (A) in rolling mills [15]. Noise levels in the workstations of mill workers in both the studies exceeded the acceptable noise levels of 85 dB for eight hour per day. In the present study based on pure tone audiometry it was found that 40.4% workers had some degree of hearing loss as compared to that of 6.7% in the control. This prevalence of hearing loss among mill workers in this trade is due to unregulated exposure to noise and non-use of hearing protection. In present study prevalence of NIHL in workers exposed to

noise level below 80 dB(A) was 24.2% whereas in those who were exposed above 80 dB(A) was 46.7%. It is now accepted that the risk of hearing damage is negligible at a noise level of less than 75 dB(A) for a daily exposure of 8 hrs and even at exposure levels up to 80 dB(A) there is detectable increase of hearing impairment (WHO) [16]. The difference was found between hearing loss in subjects exposed below 85dB(A) and in those exposed groups between 80-85 dB(A) and above 85 dB(A). In present study we found a strong correlation between hearing impairment and duration of exposure. Maximum hearing loss was observed in subjects who were exposed to industrial noise for the duration of 26-35 yrs. (76.5%) compared to those who had been exposed for less than 16 yrs (18.3%). U.G.Oleru et al. reported that hearing threshold among the exposed subjects increased with both duration of employment and age, and were significantly correlated (r = -.026, p <0.05).[17] Rosler G et al. reported compilation of eleven investigations by different authors regarding the progression of hearing deterioration during severe long-term exposure to noise [18]. In all these investigations it was found that duration of employment was the most decisive cause for pronounced increase in hearing loss. Noise induced hearing loss progressed rapidly during 8-10 yrs of exposure after which it slows down and stabilizes. Age is a confounding factor on hearing loss. Presbycusis is the loss of hearing that takes place with increasing age. The influence of age has purely additive effect on primary noise induced hearing loss. In present study 70.8% worker in the age group of 46-60 years showed NIHL among which 16.6% had mild and 54.1% had moderate to severe hearing loss. Its effect begins around the age of 40 yrs. Rangkooy HA et al. established Age and work experience had a significant relationship with hearing loss at some frequencies under the study (P0.05) [19]. There was also a significant difference between the mean of blood pressure in the case and control group (P0.05).

Many studies have shown correlation of high-level noise and cardiovascular effects especially hypertension. In present study it was observed that hypertension was more prevalent in sections having noise level above 104dB(A) viz. WRM (38.5%) and TRM (24%). The prevalence was more in CEG (26.3%) (continuously exposed group) as compared to that in IEG (8.3%) (Intermittently exposed group). Another study done by S.B.Parameswarappa (2015) indicates the prevalence of hearing impairment was significantly more in CEG (31.59%) as compared to IEG (16.36%) [20]. Talbot Helmakamo et al. (1985) noted that subjects with severe noise related hearing loss less than <65 dB HL averaged over 3, 4 and 6 KHz had a greater likelihood of hypertension and suggested that this could be the result of long-term noise exposure [21]. In a study carried out by Jing Liu on Chinese coal miners it was found that the occupational noise influenced the hypertension and hearing loss, and the occupational noise was an independent risk factor for hypertension and could increase the values of SBP and DBP [22].

In the present study a significant association between duration of exposure and hypertension was found. In the subjects exposed for the duration of 26-35 years the prevalence of hypertension was maximum (70.6%) whereas in those who were exposed for less than 16 yrs it was 5%. Narlwar UW et al. (2005) in a study done in iron and steel mill Nagpur reported similar results [11]. In present study in different sections a direct association was between duration of exposure and hearing impairment (X^2= 13.09, df =3, p = 0.004) and between duration of exposure and hypertension (X^2 =3, df = 3, p = 0.002). A similar section wise association was found between age and hearing loss (X^2-10.71, df-3, p.013) and between age and hypertension (X^2-11.21, df-3, p-011).

S.B.Parmeswarrappa in a similar study noted the co-relation between level of noise exposure and hearing impairment was found to be significant(r = 0.92; p < 0.001) [20]. Positive relation between level of sound and hypertension was found (r =0.78; p< 0.05). The results of present study indicate that hypertension & hearing impairment are common problem among workers exposed to high levels of occupational noise. Another study done in a sack manufacturing industry in 2013 by Salami Olasunkanmi Ismaila suggested that workers should not be exposed to more than 89 dB as this had the least systolic blood pressures, though the diastolic blood pressures had least values at about 91 dB [23]. Talbot E.O. (1990) noted a marginally significant relationship between severe noise related hearing impairment and the prevalence of hypertension in subjects above the age of 64 years in a study of 245 retired workers in heavy industry [24]. Talbot et al observed no significant relationship between level of noise and hypertension in group of 197 workers working in a noisy environment (>89 dB) and another group of 169 workers working in less noisy environment (<81 dB); however they reported a strong relationship between severe noise induced hearing loss (>65 dB loss at 3, 4 or 6 KHz) and a high blood pressure (>90 mmHg diastolic or treatment with blood pressure medication) in 56+ age group in both the above mentioned groups.

In the present study it was found that the subjects with hearing impairment had more cases of hypertension (33.3%) than those with normal hearing (14.5%). This association was statistically significant (X^2 5.147, df 1, p= 0.022). Also, it was found that hypertension was more common in workers with hearing impairment. Definite correlation was found between levels of sound in different sections and noise-induced health problems. This correlation was prominently seen in WRM, TRM and MD where the exposure was higher than permissible level of sound. This study demonstrated that noise is a serious occupational health hazard in the iron & steel rolling mills. The major risk factors for noise induced hearing loss & hypertension were intensity of noise, duration of exposure & age. NIOSH (National Institute of Occupational Safety Hazard) predicted that every one out of four workers exposed to noise level of 90 dB or more during lifetime will develop noise induced hearing impairment [25]. Kelsey et al. (1999) identified that release of stress hormones such as steroids and activation of the sympathetic nervous system with release of epinephrine when workers are exposed to noise were the cause of hypertension [26]. Chang et al. (2003) also listed two possible mechanisms that initiate hypertension resulting from noise exposure as through sympathetictonia induced endothelial lesion and stress induced hormone release [27]. Acute noise exposure may lead to the activation of sympathetic reflex immediately, accelerating the development of structural changes in the cardiovascular system, and finally induce a sustained elevation of blood pressure [28, 29]. This high prevalence can be due to not using protective devices non-existence of noise reduction measures.

CONCLUSION

Exposure to excessive noise is the major avoidable cause of permanent hearing impairment worldwide. NIHL is an important public health priority because as populations live longer and industrialization spreads, NIHL will add substantially to the global burden of disability**.** In the present study of 416 subjects in the steel rolling mills following conclusions were drawn There was an increased prevalence of hypertension in iron and steel industry workers with hearing impairment. Association between hearing impairment and hypertension was found to be statistically significant.

1. Prevalence of hearing impairment was directly associated with intensity of noise, duration of exposure and age.
2. Prevalence of hypertension was positively associated with intensity of noise, duration of exposure and age in almost all the sections of the industry except maintenance department (IEG).
3. The workers should be made aware about adverse effects of noise and its prevention and the use of personal hearing protection devices. Educate the subjects working in noisy environment to minimize effect of disability.
4. Hearing assessment and general physical examination should be carried out time to time so that measures can be taken to prevent and correct further hearing loss and hypertension.
5. Measures should be taken to reduce the workplace noise.

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Limitations And Lacunae of The Study

As this is a cross-sectional study design the correlation between hypertension and occupational noise exposure does not assure that the outcome is an effect of exposure, to approve cause-effect relationship.

Conflict Of Interest - None

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