

HYPERTENSION AND HEARING IMPAIRMENT IN WORKERS OF IRON AND STEEL INDUSTRY

UDAY W. NARLAWAR*, BHOOSHAN G. SURJUSE
AND SUSHAMA S. THAKRE

*Department of Preventive and Social Medicine,
Indira Gandhi Govt. Medical College,
Nagpur – 440 015*

(Received on August 18, 2005)

Abstract : The objectives of the present study were to study the (i) prevalence of hypertension and hearing impairment in iron and steel industry workers, (ii) association between hypertension and hearing impairment, (iii) association between hypertension and hearing impairment, with duration of exposure, and (iv) correlation between levels of sound and noise induced health problems viz. hypertension and hearing impairment in a cross sectional study involving Workers working in iron and steel industry at Nagpur. Of a total of 804 workers, 770 workers participated in the study. There were five sections in the factory; Steel melting section (SMS), rolling mill section (RMS), quality control department (QCD), maintenance department (MD) and administration department (AD). Workers working in SMS, RMS, & QCD formed a continuously exposed group (CEG); workers of MD and AD formed intermittently exposed group (IEG). Workers were interviewed, examined and information was collected in a pre-tested pro-forma. Blood pressure was measured, and tuning fork tests were done to assess hearing ability. Prevalence of hypertension among CEG (25.51%) was significantly higher than IEG (14.05%). ($X^2=14.28$, $df=1$, $P<0.001$). There was positive association between duration of exposure and prevalence of hypertension. The prevalence of hearing impairment was significantly more in CEG (20.5%) as compared to IEG (8.91%). ($X^2=11.69$, $df=1$, $P<0.001$). Occurrence of hearing impairment was also directly proportional to the duration of exposure. The correlation between level of sound exposure and hearing impairment was found to be significant ($r=0.98$; $P<0.05$), the correlation between level of sound and hypertension was found to be statistically insignificant ($r=0.84$; $P>0.05$). The results of the present study indicate that hypertension and hearing impairment are commoner in workers continuously exposed to high levels of occupational noise.

Key words : hypertension hearing impairment occupational disease

INTRODUCTION

The steel and iron industry has been one

of the world's most important industries ever since it was first founded. Simon¹ stated that the iron and steel industry is a "heavy

*Corresponding Author

industry”, in addition to the safety, hazards are inherent because of giant plants, massive equipments and movement of large masses of materials. Workers are exposed to high level of noise, temperatures up to 1,800°C, toxic or corrosive substances, and respirable air-borne contaminants (1).

Steel manufacturing is one of the noisiest industries. The major source of noise includes fume extraction system, vacuum systems using steam ejectors, electrical transformers and the arc process in electrical arc furnaces, rolling mills and the large fans used for ventilation. The National Institute for Occupational safety and health (NIOSH) has stated that noise induced hearing loss is one of the most prevalent occupational health hazards facing workers today (2). Approximately 30 million people are exposed to hazardous level of noise at their work sites. 9 million are reported to have occupational health illnesses. 70% people suffer from hearing loss by the age of 60 years (2). Mortality morbidity weekly report (MMWR) stated that noise is a worldwide problem that has substantial impact on the prevalence of hearing loss among the working population (3). Recent estimates indicate that between 8 and 10 million people work at sites where the level of noise is 85 decibels (dB) or higher and they present with increase risk of noise induced hearing loss (3).

Noise induced hearing loss is most commonly observed condition in the workers of iron and steel industry (4). Industrial noise pollution produces loud noise which tends to last much longer, 52 to 60% of all industrial workers get exposed to noise level of 85 dB or more for 8 hours a day (4). It

may be associated with impaired hearing by directly involving internal ear circulation by rendering workers ear more susceptible to noise (4). Long-term exposure to occupational noise is itself a risk factor for occupational hypertension (5). The present study, which was carried out in the largest iron and steel industry of Nagpur was an attempt to find out the association between hypertension and hearing impairment in these workers, and also to study distribution of these problems in a continuously exposed group (CEG) and an intermittently exposed group (IEG).

METHODS

Study place :- Iron and Steel Industry, Nagpur.

Study design :- Cross sectional study.

Study period :- 1st April 2001 to 31st March 2002.

Study subjects :- All 804 workers of the factory were included in the study.

Of these 770 workers participated in the study. Thus the response rate was 95.7%. Written permission was obtained from the competent authority of the factory and the institutional Ethical committee of Indira Gandhi Govt. Medical College, Nagpur cleared the study protocol.

For analysis and internal comparison, Steel melting section (SMS), rolling mill section (RMS) AND quality control department (QCD) were taken together as continuously exposed group (CEG), as

workers working in these sections were exposed to working environment continuously during their working hours. While maintenance department (MD) and administration department (AD) were taken as intermittently exposed group (IEG) as workers working in this section visit the manufacturing unit intermittently. The factory works continuously round the clock in three shifts of eight hours each. Posting of worker in particular section was of permanent nature. The shifts of workers were changed in rotation at the interval of one month. The workers working in AD have working schedule from 9 AM to 6 PM. Protective devices like apron, shoes, helmets; goggles, hand gloves and masks were made available for workers in all sections.

All the workers who participated in this study were examined in the factory dispensary with a prior appointment. Each worker was interviewed and examined. Information was collected in a pretested proforma that was finalised after conducting a pilot study on a group of randomly selected 100 workers.

Blood pressure was measured in supine position by using mercury sphygmomanometer. Hearing ability was assessed by tuning fork tests viz. Rinne's test, Weber's test and absolute bone conduction test.

Statistical test :- X^2 test and coefficient of correlation were used as a statistical tests. P value <0.05 was accepted as significant. Chi square test and tests of correlation were used. P value <0.05 was accepted as significant.

RESULTS

Table I shows section wise distribution of sound level. It was observed that sound level was more than permissible level in QCD, RMS, and SMS. In this study morbidity associated with exposure to noise like hearing impairment and hypertension was found to be significantly more in SMS, RMS and QCD.

TABLE I: Section wise distribution of sound level.

<i>Section</i>	<i>Sound level in dB</i>
Steel Melting Section	110
Rolling Mill Section	106
Quality Control Department	98
Maintenance Department	66
Administrative Department	38

Table II shows section wise distribution of workers and association between hypertension and duration of exposure. It was observed that prevalence of hypertension was positively associated with duration of exposure in all the sections of the industry. This association was found to be statistically significant ($X^2=15.73$, $df=2$, $P<0.001$). It was also observed that prevalence of hypertension was more among workers of CEG (25.51%) as compared to workers of IEG (14.05%). This association was found to be statistically significant. ($X^2=14.28$, $df=1$, $P<0.001$).

Table III shows section wise distribution of workers and association between hearing impairment and duration of exposure. It was observed that prevalence of hearing

TABLE II: Section wise association between duration of exposure and hypertension.

<i>Duration of exposure in years</i>	<i>SMS (n=114)</i>	<i>RMS (n=157)</i>	<i>QCD (n=129)</i>	<i>MD (n=140)</i>	<i>AD (n=230)</i>	<i>Total (n=770)</i>
<10	6(5.26)*	6(3.82)	3(2.32)	3(2.14)	3(1.30)	21(2.72)
10-20	19(16.66)	16(10.19)	8(6.26)	6(4.28)	10(4.34)	59(7.66)
>20	18(15.78)	14(8.91)	12(9.30)	10(7.14)	20(8.69)	74(9.61)
Total	43(37.71)	36(22.92)	23(17.82)	19(13.57)	33(14.34)	154(20.00)

SMS-Steel Melting Section.
 RMS-Rolling Mill Section.
 QCD-Quality Control Department.
 MD-Maintenance Department.
 AD-Administrative Department.
 Data in cells represent number of subjects with hypertension.
 *Figures in parenthesis show percentage of 'n'.

TABLE III: Section wise association between duration of exposure and hearing impairment.

<i>Duration of exposure in years</i>	<i>SMS (n=114)</i>	<i>RMS (n=157)</i>	<i>QCD (n=129)</i>	<i>MD (n=140)</i>	<i>AD (n=230)</i>	<i>Total (n=770)</i>
<10	5(4.38)*	4(2.54)	3(2.32)	1(0.71)	2(0.86)	15(1.94)
10-20	13(11.40)	13(8.28)	10(7.75)	2(1.42)	5(2.17)	43(5.58)
>20	15(13.15)	8(5.09)	11(8.52)	4(2.85)	19(8.26)	57(7.40)
Total	33(28.94)	25(15.92)	24(18.60)	7(5.0)	26(11.30)	115(14.93)

SMS-Steel Melting Section.
 RMS-Rolling Mill Section.
 QCD-Quality Control Department.
 MD-Maintenance Department.
 AD-Administrative Department.
 Data in cells represent number of subjects with hearing impairment.
 *Figures in parenthesis show percentage of 'n'.

impairment was directly associated with duration of exposure. This association was found to be statistically significant ($X^2=20.27$, $df=2$, $P<0.001$). It was also observed that prevalence of hearing impairment was more among workers of CEG (20.5%) as compared to workers of IEG (8.91%). This association was found to be statistically significant. ($X^2=11.69$, $df=1$, $P<0.001$).

Table IV shows association between hearing impairment and hypertension. It

TABLE IV: Association between hearing impairment and hypertension.

<i>Hearing impairment</i>	<i>Hypertensive</i>	<i>Non hypertensive</i>	<i>Total</i>
Present	78(67.82%)	37(32.17%)	115(14.93%)
Absent	76(11.60%)	579(88.39%)	655(85.06%)
Total	154(20%)	616(80%)	770

*Figures in parenthesis show percentage.
 $X^2 = 193.26$, $df = 1$, $P<0.001$.

was observed that workers with hearing Impairment have significantly more

hypertension than workers with normal hearing. This association was found to be statistically significant. ($X^2=193.26$, $df=1$, $P<0.0001$).

Table V shows association between level of sound and noise induced health problems like hypertension and hearing loss. It was observed that hypertension and hearing loss were more common in sections having high levels of sound viz. SMS, RMS and QCD as compared to MD and AD where level of sound was low. When correlation between level of sound and noise induced health problems was studied in four sections viz. SMS, RMS, QCD and MD, the correlation between level of sound and hearing impairment was found to be significant ($r=0.98$; $P<0.05$), the correlation between level of sound and hypertension was found to be statistically insignificant ($r=0.84$; $P>0.05$).

TABLE V: Association between level of sound and noise induced hypertension and hearing impairment in each section.

Section	Sound level in dB	No. of workers with hypertension	No. of workers with hearing impairment
Steel Melting Section	110	43(37.71)	33(28.94)
Rolling Mill Section	106	36(22.92)	25(15.92)
Quality Control Department	98	23(17.82)	24(18.60)
Maintenance Department	66	19(13.57)	7(5.0)
*Administrative Department	38	33(14.34)	26(11.30)

•Figures in parenthesis denote percentage.

•Hearing Impairment; $r=0.98$; $t=6.28$.

•Hypertension; $r=0.84$; $t=2.14$.

*Not included in the analysis of coefficient of correlation.

DISCUSSION

NIOSH (6) predicted that one out of every four workers exposed to noise level of 90 dB or more during lifetime will develop noise induced hearing impairment. Kryter GKD (7) carried out study in Sweden and identified 44 male workers aged 41–66 years who had severe noise induced hearing loss (defined as a 65 dB or greater reduction in threshold at 3000, 4000 or 6000 Hz) and who experienced noise exposure during their past employment. Compared to this group of 44 workers with 74 men having normal hearing, <20 dB mean hearing threshold at any testing frequency from the same industrial population, the author observed that the prevalence of high blood pressure (defined as greater than 160/100 mm of Hg) in the hearing loss group was 22% to 1% in those with normal hearing (7).

It was found that occupational noise induced hearing loss was most frequent among all occupational diseases. The incidence of this condition is 16 per 100000 populations annually from 1971 to 1979 (2). It was also stated that noise induced hearing loss is one of the most prevalent occupational health hazards today (2).

Barr Thomas compared 100 boiler makers with 100 iron moulders and postmen. Three quarters of the boilermaker, had difficulty in hearing in Churches or in the public but only 12% of the iron moulders and 8% of the postmen had the same difficulty (8). Podoshin et al (9) in a study of 59 subjects with myocardial infarction compared with age-matched control found a significantly higher auditory threshold at 4 and 8 KHz in the study

group. They also noted a higher incidence of hypertension in the study group.

Talbot noted that subjects with a severe noise related hearing loss <65 dB HL averaged over 3.4 and 6 KHz had a greater likelihood of hypertension and suggested that this could be result of long term noise exposure (10). In a study carried out on foundry workers Koshela et al found that systolic and diastolic blood pressure were slightly higher in exposed workers than workers who were unexposed (11). Tarter and Robins studied prevalence of hypertension and mean blood pressure in 150 white men and 119 black men exposed to industrial noise of 85 dB or greater for a minimum of 5 years. It was observed that hearing loss at 4000 Hz and years worked in high noise departments were significantly associated with mean blood pressure and hypertension among the black workers (12). Talbot 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 (13). Noise induced hearing loss is the second most self reported occupational illness or injury among American workers (14). According to NIOSH (1999) construction employees and fire fighters were all exposed to unsafe noise at different times during their work shifts (14). It has been estimated that hearing related workers' compensation costs from 1984 to 1993 amounted to \$ 3.4 billion (14).

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 (15).

Although hearing loss was diagnosed on the basis of tuning fork tests, a audiometry would have been more sensitive and specific test for diagnosis of noise induced hearing loss. Also, in the present study, data related to body mass index, alcohol intake and other potential confounders were not collected. Nevertheless, results of the present study indicate that hypertension and hearing loss are significantly associated with duration of exposure. Both noise-induced health problems were significantly more common in CEG workers as compared to IEG workers. 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 CEG workers working in SMS, RMS and QCD and exposed to higher than permissible level of sound.

ACKNOWLEDGEMENTS

Authors are extremely thankful to the administration of Iron and steel industry at Nagpur for giving permission and full cooperation for conducting this study.

REFERENCES

1. Simon PV. Iron and steel health and safety problems and patterns. *International Labour Office* 1992; 3: 73.
2. NIOSH (National Institute for Occupational Safety and Health). Alice Hamilton Lab. Columbia (1986 to 1997). Health Hazards Evaluation (HHE).
3. MMWR (Mortality morbidity weekly report). Self-reported hearing loss among workers potentially exposed to industrial noise, United States 1998; 37: 158.
4. NIOSH (National Institute for Occupational Safety and Health). Occupational noise induced hearing loss meeting, Pooks Hill Marriott, Maryland, 1998; 30.
5. Lang T, Fouriaud C, Jacquient-Salord MC. Length of occupational noise exposure and blood pressure. *Int Arch Occup Environ Health* 1992; 63: 363–372.
6. NIOSH (National Institute for Occupational safety and health). Proposed National strategies for prevention of leading work related diseases and injuries- part 2. Association of schools of public health, Washington DC 1988.
7. Kryter GKD. Extra auditory effects of noise in hearing. Edited by D. Henderss, P Hamernik, Dosani DS and J Mills, New York Academic Press 1976; 535–540.
8. Barr T. Enquiry in to the effects of loud sound upon the hearing of boil makers and others who work amid noisy surrounding. *Proc Glasgow Philosophy Soc* 1986; 17: 222–239.
9. Podoshin L, Fradis M, Pillar T, Zisman D. Sensorineural hearing loss as an expression of atherosclerosis in young people. *Eye, Ear and Throat Monthly* 1975; 54: 18–23.
10. Talbot E Helmkamo J, Matthews K, Kuller L, Cottington E and Redmond G. Occupational noise exposure. Noise induced hearing loss and the epidemiology of high blood pressure. *Am J of Epidemiol* 1985; 21: 505–514.
11. Koskella, Ritta S, Mutanen, Pertti K, Matti S, Juha A. Predictive factors of IHD mortality among foundry workers. Finnish Institute of occupational health. *Topeliuksenkatu* 41 a, FIN-0025 Helsinki.
12. Tarter SK, Robins TG. Chronic noise exposure. High frequency hearing loss and hypertension among automotive assembly workers. *J Occup Med* 1990; 32: 685–689.
13. Talbot EO, Eindla RC, Duller LH, Lenkner LA, Matthews KA, Day RD. et al. Noise induced hearing loss: a possible marker for high blood pressure in older noise exposed population. *J Occup Med* 1990; 32: 696–699.
14. Penny PJ, Earl CE. Occupational noise and effects on blood pressure: Exploring the relationship of hypertension and noise exposure in workers. *AAOHNJ* 2004; 52: 476–480.
15. Talbot S, Helmkamp J, Mathews K, Kuller L, Kottington E Redmond G. Occupational noise exposure, noise induced hearing loss and the epidemiology of high blood pressure. *Am J Epidemiology* 1984; 121: 4; 501–513.