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Original Research Article

Respiratory Abnormalities among the Workers of Iron and Steel Industry

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Abstract: World labor was estimated to encounter various occupational injuries and health effects shown in iron and steel industries as 37% back pain, 16% hearing loss, 13 % chronic obstructive pulmonary disease (COPD), 11% asthma, 9 % trachea, bronchus or lung cancer, 8% injuries, 2% leukemia. %. Significant decreases in FEV_1 and FVC have been associated with increases in occupational exposures to gases and fumes. The objective of this study is to study the effect of occupational exposure on lung function of the workers of iron and steel industry. The present cross- sectional descriptive study was carried out between Jul 2013 and Dec 2014 to assess the effect of occupation on respiratory system among 200 workers in Iron and Steel Industry in Nanded City (Maharashtra). For analysis and internal comparison steel melting section, Rolling mill section and quality control section were taken together as continuously exposed group and maintenance and administrative section as intermittently exposed group. It was observed that out of 200 workers most of the workers 102 (51.00%) had peak expiratory rate above 400. 98 (49.00%) workers had peak expiratory flow rate below 400. pulmonary function tests among the workers of various section. It had been observed that among all the workers who were referred 78(39%) had mild obstruction while 19(9.5) and 9 (4.5%) were having moderate and severe obstruction respectively. It can be concluded from the present study that most of the findings were more among the workers of continuously exposed i.e. steel melting section, rolling mill section, and Quality control department group than intermittently exposed group.

Keywords: chronic obstructive pulmonary disease (COPD), Quality control

INTRODUCTION:

Although the dominant cause of chronic obstructive pulmonary disease (COPD) is cigarette smoking, there is little doubt that chronic occupational exposures to various agents contribute to the incidence and the severity of chronic airways disease, including COPD[1-4]. The quantitative contribution of occupational factors to the burden of COPD morbidity or mortality has been recently estimated at about 15%[5]. In iron and steel industry, workers are exposed to chemical hazards including vapours and fumes, physical hazards like noise, vibration, temperature, etc.[6]. World labor was estimated to encounter various occupational injuries and health effects shown in iron and steel industries as 37% back pain, 16% hearing loss, 13 % chronic obstructive pulmonary disease (COPD), 11% asthma, 9 % trachea, bronchus or lung cancer, 8% injuries,2% leukemia[7]. Occupational exposures to dust, fumes, and gases are associated with increased prevalence of respiratory symptoms and impairment of lung function. %. Significant decreases in FEV_1 and FVC have been associated with increases in occupational exposures to gases and fumes. Combined occupational exposures to dusts and gases and fumes have been reported to reduce peak expiratory flow rate[8].

OBJECTIVE:

To study the effect of occupational exposure on lung function of the workers of iron and steel industry

MATERIAL AND METHODS:

The present cross-sectional descriptive study was carried out in an Iron and steel Industry in MIDC area of Nanded city of Maharashtra (India) between July 2013 and Dec 2014. Present study included all 200 workers, both administrative and working staff of this iron and steel industry since all these staff members were working in the same campus.

To begin with the study, necessary permission was taken from general manager of the industry and cooperation was assured by him. The purpose of the study was explained to the workers. Repeated visit were given to industry and rapport was developed.

Industry has 5 sections where the different procedures were carried out.

- Rolling mill section (RMS): In this section solid material from SMS section is passed through hot rolling mill.
- Steel melting section (SMS): In this section continuous casting of molten metal with complete stream shrouding is done
- Quality control Department (QCD): Here product is inspected, metallurgically tested and then put in the peeling bed of sulfuric acid to remove rust and clear the small holes.
- Maintenance department (MAINT): All materials including mechanical and electrical machinaries are kept here and handled by store boy and electrician.
- Administrative department (ADMNS): All administrative function of a factory is done here.

For analysis and internal comparison Steel melting section, Rolling mill section and Quality control section were taken together as continuously exposed group and Maintenance and Administrative section as intermittently exposed group.

Ethical clearance was obtained from Institutional ethical committee. Informed verbal consent was obtained from each participant after the researcher provided a clear explanation of the study purpose. Confidentiality of the data was maintained throughout the study period. A pretested and structured questionnaire was used to collect socio demographic, behavioural characteristics and Symptoms or presenting complaints among the workers. Clinical examination was done to identify Respiratory system. Peak expiratory flow rate was assessed by using peal expiratory flow meter. Minimum three reading were taken to given the final reading. Lowest reading was considered final. Medical records were also reviewed. They were also referred to the government hospital for further respiratory investigations. Information was also gathered about their occupation, its type, section of work, etc. They were also asked about the various protective equipment (PPE) available in the industry, whether they were using them or not, if not then what were the reasons and about their replenishment.

STATISTICAL ANALYSIS

Data was entered into excel sheet and analyzed by using Open Epi 3.03 version. Chi square test was applied to find out the significance. Percentage, mean and standard deviation were also calculated.

RESULTS:

Among the 200 permanent industrial workers 8% belonged to administrative section, 13 % to quality control section, 16% to steel melting section, 22% to rolling mill section and 41% to maintenance section. They were distributed as continuously exposed group which includes workers from quality control section, rolling mill section and steel melting section i.e 51%. While intermittently exposed group which includes maintenance and administrative department comprised of 49% of the workers. This group had been made according to the degree of exposure to the industrial environment. When the data obtained was analysed following results had been drawn:

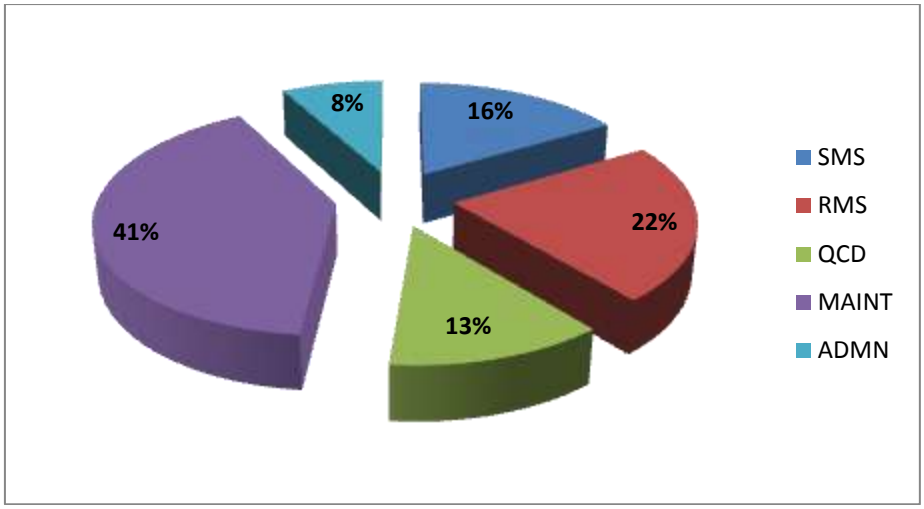

Fig-1: Section wise distribution of workers

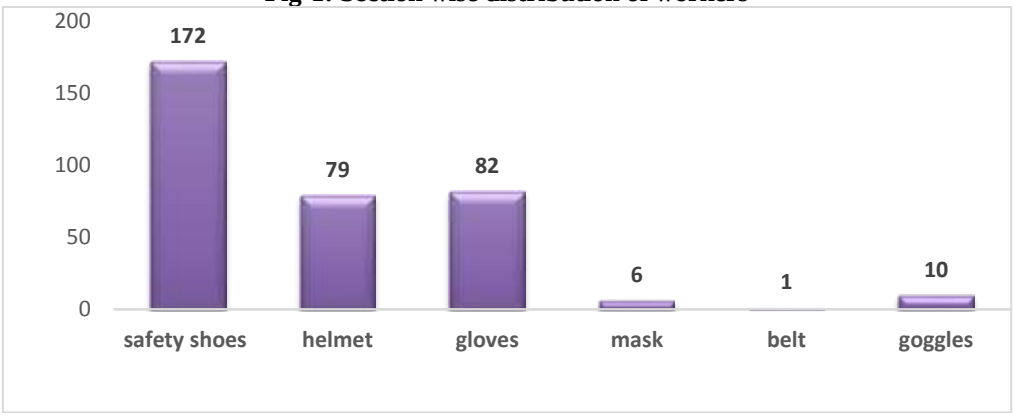

Fig 2: Shows the type of protective devices used by the workers in various sections.

Out of 200 most of the workers i.e. 172 (86.00%) were using safety shoes. However 1 (0.50%) was using safety belt. Helmet was used by 79 (39.50%) workers. 82 (41.00%) workers were using gloves. Mask and goggles were used by 06 (03.00%) and 10 (05.00%) workers respectively.

Table 1: Reasons for not using protective devices by workers of various sections:

Reasons	SMS (n-33)	RMS (n-45)	QCD (n-25)	MAINT (n-81)	ADMNS (n-16)	Total (n-200)
Not available	5(15.15)	5(11.11)	3(12.0)	11(13.58)	0(0)	24(12.0)
Not consider necessary	4(12.12)	7(15.56)	5(20.0)	8(9.88)	1(6.25)	23(11.5)
Not comfortable	4(12.12)	1(2.22)	4(16.0)	7(8.64)	0(0)	16(8.0)
Not required	0(0)	2(4.44)	1(4.0)	11(13.58)	8(50.0)	22(11.0)
Careless	0(0)	0(0)	0(0)	0(0)	1(6.25)	01(0.5)

(Figures in parenthesis show percentage)

In Table 1 various reasons for not using the protective devices had been mentioned. Out of 200 most 24 (12.00%) of them said that devices were not available for them. 23 (11.50%) of them said that they did not consider necessary to use the protective device during their work. Among them 22 (11.00%) of them said that they did not require protective device in their work. 16 (08.00%) were not comfortable with using the device. 01 (0.50%) of them said that he was careless thus not use the protective device. No availability was most common reason given by them but they were also uncomfortable on using the PPE which were though available to them. These reasons may be given by them because of lack of proper training and lack of knowledge for the importance of use of personal protective equipments.

Table 2: Section wise distribution of workers according to their present respiratory complaints

Complaints	SMS (n-33)	RMS (n-45)	QCD (n-25)	MAINT (n-81)	ADMNS (n-16)	TOTAL (n-200)	P Value
Breathlessness	11(33.33)	8(17.78)	3(12)	7(8.64)	0(0)	29(14.5)	0.0045
Cough and cold	9(27.27)	12(26.67)	2(8)	5(6.17)	0(0)	28(14.0)	0.0005
Wheezing	9(27.27)	14(31.11)	3(12)	3(3.70)	0(0)	29(14.5)	<.0001
Dizziness	5(15.15)	8(17.78)	1(4.0)	1(1.23)	0(0)	15(07.5)	.0007
Headache	9(27.27)	8(17.78)	8(32.0)	10(12.35)	2(12.5)	37(18.5)	.0303
Sleeplessness	1(3.03)	1(2.22)	0(0)	0(0)	0(0)	2(01.0)	.5113
Others	8(24.24)	6(4.44)	4(16.0)	10(12.35)	2(12.5)	30(15.0)	.3123

(Figures in parenthesis shows percentage)

Table 2 shows the section wise distribution of workers according to their present respiratory complaints. Most of them 37(18.5%) were having headache followed by breathlessness and wheezing in 29(14.5%), cough and cold in 28 (14.0%), and dizziness in 15(7.5%) while 30 (15.0%) of them were having other symptoms. Breathlessness, cough cold, wheezing dizziness and headache was significantly higher among the workers of continuously exposed group.

Table 3: Peak Expiratory Flow Rate of the workers of various sections

PEFR	SMS	RMS	QCD	MAINT	ADMNS	Total	p-value
<400	25(75.75)*	25(55.56)	14(56.0)	29(35.80)	05(31.25)	98(49.00)	<.0001
>400	8(24.24)	20(44.44)	11(44.0)	52(64.20)	11(68.75)	102(51.00)	

(Figures in parenthesis shows percentage)

(χ^2=14.66, df=1, p<0.0001)

Table 2 shows peak expiratory flow rate among the workers of various section. It was observed that out of 200 workers most of the workers 102 (51.00%) had peak expiratory rate above 400. 98 (49.00%) workers had peak expiratory flow rate below 400.

In section wise distribution it had been observed that mostly 25 (75.75%) out of 33 workers of SMS had low PEFR, followed by QCD 14 (56.00%) out 25, RMS 25 (55.56) out of 45, Maintenance 25 (35.80%) out of 81 and administrative section 05 (31.25%) out of 16.

When the PEFR had been compared between the continuously exposed groups i.e. Steel Melting Section, Rolling Mill Section and Quality Control Department and intermittently exposed group i.e. Maintenance section and Administrative Department it was found that to be significantly lower among continuously exposed group.

Table 4: Relation between the duration of work and PEFR

Duration (in years)	Low	Normal	Total	p-value
<10	26(28.57)	65(71.43)	91(47.00)	<.0001
10-20	58(65.16)	31(34.84)	89(49.00)	
>20	14(70.00)	6(30.00)	20(9.00)	
total	98(49.00)	102(51.00)	200	

(*Figures in parenthesis shows percentage) (χ^2=28.04, df=1, p <.0001)

Table 4 shows the comparison between the duration of job and peak expiratory flow rate. It had been observed that with increase in the duration of exposure PEFR is getting reduced.

It was found that among the workers who had duration of job for more than 20 years i.e. out of 20, 14 (70.00%) had low PEFR. It was also observed that those who had duration of job since 10-20 years 58 (65.16%) out of 89 had low PEFR. While only 26 (28.57%) out of 91 of the workers who had duration of

job for less than 10 years had low PEFR. This association of low PEFR with increase in duration of job had found to be statistically significant.

Table 5: Pulmonary function tests results among the workers of various sections.

PFT results	SMS (n-33)	RMS (n-45)	QCD (n-25)	MAINT (n-81)	ADMNS (n-16)	TOTAL (n-200)	p-value
Normal	5(15.15)	12(26.67)	5(20.0)	58(71.6)	14(87.5)	94(47)	<.0001
Mild obstruction	20(60.6)	24(53.33)	13(52)	20(24.69)	1(6.25)	78(39)	
Moderate Obstruction	5(15.15)	6(13.33)	5(20)	2(2.47)	1(6.25)	19(9.5)	
Severe Obstruction	3(9.09)	3(6.67)	2(8)	1(1.23)	0(0)	9(4.5)	

(Figures in parenthesis shows percentage) (χ^2=57.42, df=1, p<0.0001)

Table 5 shows the results of pulmonary function tests among the workers of various section. It had been observed that among all the workers who were referred 78(39%) had mild obstruction while 19(9.5) and 9 (4.5%) were having moderate and severe obstruction respectively.

When the obstruction had been compared among continuously exposed group and intermittently exposed group it had been observed that moderate and severe obstruction is significantly higher among the continuously exposed group.

Table 6: Section wise distribution of workers as per diagnosis of chronic illness

Morbidities	SMS (n-33)	RMS (n-45)	QCD (n-25)	MAINT (n-81)	ADMNS (n-16)	TOTAL (n-200)
TB	1(03.03)	2(04.44)	0(0)	1(1.23)	(0)	4(2)
Diabetes	0(0)	0(0)	1(4)	2(2.47)	3(18.75)	6(3)
Asthma	6(18.18)	1(2.22)	2(8)	1(1.23)	1(6.25)	11(5.5)
Allergy	6(18.18)	9(20)	10(40)	11(13.58)	6(37.5)	42(21)
Bronchitis	7(21.21)	8(17.78)	6(24)	4(4.94)	1(6.25)	26(13)
Others	1(3.03)	8(17.78)	1(4)	4(4.94)	0(0)	14(7)

(Figures in parenthesis show percentage)

Table 6 shows the section wise distribution of workers with their chronic illnesses which they already know. Most common illness among them was allergy 42(21%) followed by bronchitis in 26(13%), asthma 11(5.5%), diabetes in 6(4%) and TB in 4(2%) of the workers. While 14 (7%) of the workers were suffering from some chronic illnesses.

DISCUSSION

In our study among the workers of iron and steel industry it had been observed that most of them 86 % were using safety shoes among personal protective devices. Out of 200 most of the workers i.e. 172 (86.00%) were using safety shoes. However 1 (0.50%) was using safety belt. Helmet was used by 79 (39.50%) workers. 82 (41.00%) workers were using gloves. Mask and goggles were used by 06 (03.00%) and 10 (05.00%) workers respectively. Gomes J *et al.* [9] carried out a study among the foundry workers found that shoes (95%) were most commonly used. On the contrary gloves (90%) and safety glasses (86%) were used by most of the workers. Whereas helmets (65%) and face masks (64%) were used less frequently. Ademola-Popoola DS *et al.* [10] carried out study among the staff of a government owned steel rolling company in Nigeria observed that Thirty-eight (53%) of the 71 employees of the production and technology units reported possessing EPD. Out of them 31.6% never use them, 44.7% sometimes use them while 23.7% use them regularly.

Various reasons for not using the protective devices had been given by the workers. Out of 200 most 24 (12.00%) of them said that devices were not available for them. 23 (11.50%) of them said that they did not consider necessary to use the protective device during their work. Among them 22 (11.00%) of them said that they did not require protective device in their work. 16 (08.00%) were not comfortable with using the device. 01 (0.50%) of them said that he was careless thus not use the protective device. No availability was most common reason given by them but they were also uncomfortable on using the PPE which were though available to them. Bezroy J *et al.* [11] had observed that reason was discomfort (for instance, sweating due to the goggles) for not using them. Overconfidence in the job due to familiarity with the mechanical process resulted in 18.7% of the injuries. Similarly Jani V *et al.* [12] had

observed that reasons were inconvenient in 48.24%, not required in 32.94%, Ignorance in 8.24% and not available in 10.58%. Ademola-popoola DS [10] had observed reasons that were low-level risk believed (3; 12%), discomfort of the device (5; 20%), inadequacy of protection (11; 44%), lack of practice (4; 16%), and considering it unnecessary (2; 8%).

Khan MMA *et al.* [13] carried out the study among the workers of chemical industry in which they had observed that the various reasons given for not using the PPE by highly skilled workers were insufficient supply by 34% , 33% said that PPE available are poorly maintained while 22% do not use them because of overconfidence. Parameswarrappa SB *et al.* [14] observed that no nearly 50% of the workers complaint of discomfort with respect to usage of helmet, face mask, shoes and thick cotton uniform.

Peak expiratory flow rate among the workers of various sections has been observed. It was found that out of 200 workers most of the workers 102 (51.00%) had peak expiratory rate above 400. 98 (49.00%) workers had peak expiratory flow rate below 400. Tiwari RR *et al.* [15] in a study conducted among silica exposed workers had observed that PEF were lower for the categories aged ≥ 35 years of age, females, those who were working for >2 years in the present occupation and those having respiratory morbidity like silicosis, silico-tuberculosis and tuberculosis. Chattopadhyay BP *et al.* [16] had studied the respiratory impairments among the male beedi workers and found that PEFR was significantly higher among unexposed group. Jannet JV *et al.* [17] conducted a study among the women laborers of ginning factory in tirupur and had observed that there was significant reduction in PEF (Z=3.36, significant at 1% level) in those women when compared to the control women which suggests chronic lung obstruction.

Cummings KJ *et al.* [18] had conducted the study about the respiratory symptoms and lung function abnormalities related to work at s flavouring manufacturing facility where they had found that Participants who spent ≥1 h daily in production areas had significantly higher prevalence of most symptoms, any spirometric abnormality and low diffusing capacity, as well as significantly lower mean spirometric parameters. Ghasemkhani M *et al.* [19] in the study among the various industries in south tehran had observed that the Peak expiratory flow rate had been significantly reduced among the workers.

Various respiratory complaints among them were breathlessness 14.5% cough 14. % wheezing 14.5%, headache 18.5% and dizziness 7.5%. 53 % of the workers had impaired lung function. Parameswarappa S and Narayan J [14] in their study among the workers of iron and steel industry had observed that 23.2 % had cough, 15.6% had wheezing, 13.2% had breathlessness. Kayhan S *et al.* [20] in their study among the workers of foundry industry observed that out of total 347 workers 20.46% of the patients had phlegm and 14.98% had cough. Other symptoms were breathlessness im 80.06%, chest tightness in 4.03% and wheezing in 2.01% persons. In a study conducted by Bala S and tabaku A [21] among the workers of iron and steel and ferrochrome industry it was observed that prevalence of chronic cough among workers was 40.1%, while wheezing, breathlessness and dyspnea were in 12%, 13.9% and 22.5 % workers respectively.

In present study 78(39%) had mild obstruction while 19(9.5) and 9 (4.5%) were having moderate and severe obstruction respectively. Gomes J *et al.* [9] conducted a study on workers of small iron foundry regarding the dust exposure and impairment of lung function in a rapidly developing country in which it was observed that %). The lung function values for FEF_{25-75}, FEV_1, FEV_1/FVC, FEV_1/VC, and PEF were significantly lower for the exposed group than the unexposed group. Ould-kadi F *et al.* [22] in their study among the industrial workers had found that In comparison with the control group, FVC and FEV_1 were significantly lower in welders and workers exposed to solvents. Sharifian SA *et al.* [23] conducted a study among the automobile assembly welders for the adverse effects of welding fumes and had found that average FEV1 and FEV1/FVC was lower in high exposure welders than low exposure welders significantly (P=0.04 and 0.01 respectively). Hamzah NA *et al.* [24] in their study among the workers of iron and steel industry had observed the reduction of lung function among them. Cumming KJ *et al.* [18] in their study had observed that 8 % of flavoring manufacturing workers had obstruction [18]. This may due to exposure to various dust in the industry. In a study conducted by Bala S and tabaku A [21] among the workers of iron and steel and ferrochrome industry it was observed that among 459 workers the prevalence of COPD was 42.4% and 35.4% in smelters and furnace workers respectively.

CONCLUSION

It can be concluded from the present study that most of the findings were more among the workers of continuously exposed i.e. steel melting section, rolling mill section, Quality control department group than intermittently exposed group i.e maintenance section and administrative department. It had also been concluded that the effects of the environmental conditions over the health of the workers increases with the increase in duration of job.

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