

Original Research Article

A study on selected morbidities among mining workers in Goa

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Received: 14 January 2021

Accepted: 10 February 2021

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ABSTRACT

Background: Given the complexity of the underground work system, the accidents at mining site and associated occupational diseases are dysfunctions that reduce the efficiency, productivity and profitability of workers. The present study provides a profile of selected morbidities among mining workers in Goa.

Methods: Data was obtained from the records of a Occupational Health Service (OHS) centre in Ponda, Goa that conducted periodic health check ups of mining workers employed in 4 open cast iron ore mines from 4 Talukas, 2 each from North and South districts of Goa. Patient records of 199 workers representing different categories of work were obtained and analyzed. Data primarily focussed on visual acuity, audiometry findings, spirometry reports, ECG and basic laboratory blood investigations.

Results: Upon analysis of data, it was observed that a high proportion of workers (43.21%) had defective vision. Assessment of audiometry reports revealed that 22.61% of workers had some form of hearing loss. As much as 19 (9.5%) workers were hypertensive, 26 (13.06%) were diabetic and 26 (13.06%) were dyslipidaemic. As high as 40 (20.1%) workers had ECG changes while 5 (2.51%) had pulmonary function impairment.

Conclusions: Mining workers suffer from various health problems, notably, hearing loss, visual impairment, pulmonary function abnormalities and non-communicable diseases. This study emphasizes the importance of pre-employment and periodic medical check-ups in the mining industry for timely detection and appropriate treatment of these health conditions among the mining workers.

Keywords: Goa, Hearing loss, Iron ore, Mining, Morbidity, Visual impairment

INTRODUCTION

Mining is a multi-disciplinary industry, drawing on several professions and trades. It is an ancient occupation long recognized as involving the most arduous working environment. India was estimated as the fourth largest producer of iron ore and the third largest exporter of iron ore in 2017. India has rich mineral resources, contributing to around 1.53% of India's Gross National Product in 2018.¹

Lately, a ban on iron ore mining has stirred a varied discussion due to the different interests between various stakeholders of Goa. On 5th October 2012, iron ore mining was banned by the Supreme Court of India in Goa. Goa, being the Smallest state of India, exported

around 50% of the total iron ore exported from the whole country. Although mining and quarrying contribution to Goa's GDP is around 5%, accounting all direct and indirect activities connected to mining activity, it is deemed second most important business next to tourism.² Mining practice in Goa has been the open- cast method which requires deforestation, removal of the topsoil below in which there are mineral deposits and finally digging out the ore body from the earth bed.³

Although the contribution of mining industry to the Indian economy is undeniable, the mining sector is plagued by several environmental and health and safety related problems. The most common health hazards due to mining involve traumatic injury, exposure to dust, noise, mechanical vibration, etc. out of which coal

worker's pneumoconiosis, silicosis and noise induced hearing loss (NIHL) are Notifiable diseases under Mines Act (1952).⁴ Hence, it is necessary to study the health profile of mine workers periodically to determine the impact of mining environment and activities on these workers.

As there has been only one published study in Goa regarding health hazards among mine workers, the present study was undertaken to provide additional evidence on morbidities among such workers that would help in formulating policies and institute preventive measures to minimize the risk of occupational hazards and ensure occupational health, safety and environment for such workers.

METHODS

This cross-sectional study was a retrospective, record-based study conducted over a period of 2 months (November - December 2018). Data was gathered from the records of an Occupational Health Service (OHS) centre in Ponda, Goa that conducts periodic health check-ups of mining workers employed in 4 open cast iron ore mines from 4 Talukas; 2 each from North and South districts of Goa. Data of workers in the respective iron ore mines whose health records were obtained were included in the study. Mining workers represented different categories of work in the respective mines such as machine operators, drivers, security officers, helpers, field assistants, supervisors and managers. The health records of 199 workers who had voluntarily consented for medical check-up were obtained. Workers whose health records could not be traced or were lost or incomplete were not included in the study. The data included records of their sociodemographic details of the workers (age, sex), vitals [(pulse, blood pressure (BP)], vision (near, far, colour), basic blood laboratory investigation reports (fasting and 2 hour post prandial blood sugar, lipid profile), audiometry readings, spirometry findings and ECG reports.

Visual acuity was measured with Snellen's chart at a distance of 6 metres. Near vision was assessed using Roman text type. Ishihara's chart was used for the evaluation of colour blindness. Audiometry was performed in a small closed room having minimal background noise. Spirometry was conducted by a trained technician following standard procedure using a calibrated spirometer. Three readings were obtained for each individual and the best reading was taken for reporting and analysis. The results were interpreted as normal, restrictive, obstructive or mixed impairment. Blood samples were collected in the fasting state and 2 hours after a meal. These were then sent to the laboratory attached to the OHS centre and were processed using standard assays for estimation of blood glucose and cholesterol levels. For ECG reports, the worker was placed in supine position and 12 lead ECG reading was taken to look for abnormal heart rhythm.

The study variables were classified as follows:

Hypertension: History of high blood pressure or a finding of Systolic BP >140 mm Hg or Diastolic BP >90 mm Hg.⁵

Diabetes: History of high blood sugar levels or a finding of Fasting plasma glucose ≥ 126 mg/dl or 2-h plasma glucose ≥ 200 mg/dl.⁶

Dyslipidaemia: A finding of Hypertriglyceridemia (Serum triglycerides >150 mg/dl) or Hypercholesterolemia (Serum total cholesterol >200 mg/dl).⁷

Audiometry readings were interpreted using WHO grades of hearing impairment as follows: 16-25 dB as minimal, 26-40 dB as mild, 41-60 dB as moderate, 61-80 dB as severe and >80 dB as profound hearing impairment.⁸

A working definition was developed for visual status:

Near vision: Normal $\geq N6$; Satisfactory N8-N12; Poor <N12 (Roman text type)

Far vision: Normal 6/6; Satisfactory 6/9-6/12; Poor <6/12 (Snellen chart)

Colour vision was assessed using Ishihara's chart and was interpreted as defective if the worker could not correctly identify at least 12 out of the 14 red/green plates.

Confidentiality was assured to the Occupational Health Physician in charge with respect to the identity of the workers. Ethical approval was taken from the Institutional Ethics Committee (IEC) of Goa Medical College before commencement of the study.

The data was entered into Microsoft Excel version 2010, statistically analysed using IBM SPSS version 22. Descriptive statistics was used to describe the data and presented using tables and figures.

RESULTS

In the current study, among 199 mine workers, 192 (96.4%) were males and 7(3.5%) were females. Age of the workers ranged between 20-69 years; with majority of workers belonging to the young age group of 20-29 years i.e., 67(33.67%). Fifty-nine (29.65%) workers belonged to the age group of 30-39 years (Figure 1).

Figure 2 shows the distribution of mine workers according to their visual status. More than half of the workers i.e., 113(57%) had normal vision. However, a significant proportion of workers i.e., 80(40%) had poor visual acuity, 2(1%) had abnormal near vision while 4 (2%) of workers were detected with colour blindness.

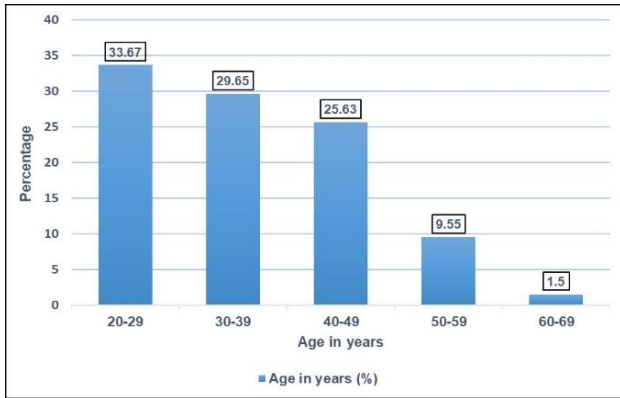


Figure 1: Age-wise distribution of mine workers.

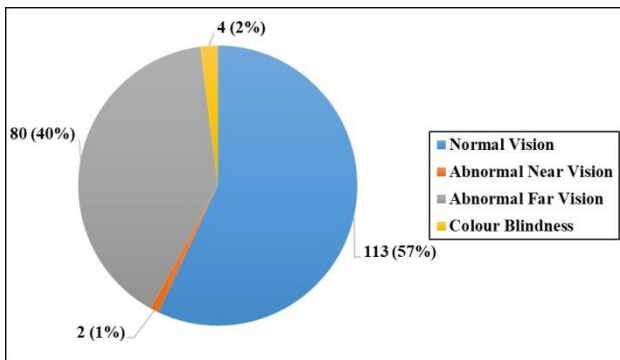


Figure 2: Distribution of mine workers according to visual acuity status.

As far as audiometry findings are concerned, nearly two-thirds of the workers i.e., 154(77%) did not have hearing impairment. Among the 45 workers detected with some form of hearing impairment, 11(5%) had minimal amount of hearing loss, 23(12%) had mild hearing loss and 11 (6%) had moderate hearing loss. No case of severe hearing impairment was detected among the workers (Figure 3).

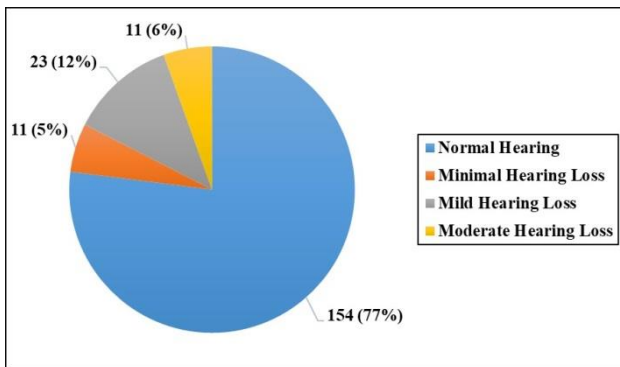


Figure 3: Distribution of mine workers according to audiogram findings.

As per the records of the laboratory investigation reports of the workers, assessment of blood pressure revealed that 19 (9.5%) workers were hypertensive. The prevalence of

diabetes and dyslipidaemia was found to be 13.06% each respectively (Table 1).

Table 1: Distribution of mine workers based on selected morbidities.

Morbidity	No. (%)
Hypertension	
Present	19(9.5)
Absent	180(90.4)
Diabetes mellitus	
Yes	26(13.06)
No	173(86.9)
Dyslipidaemia	
Yes	26(13.06)
No	173(86.9)
ECG Changes	
Present	40(20.1)
Absent	159(79.8)
Spirometry abnormalities	
Normal	194(97.4)
Restrictive	4(2.01)
Obstructive	1(0.5)

It was also noted that 40(20.1%) employees had an abnormal ECG finding. Pulmonary function test reports of the workers showed that 4(2.01%) workers had restrictive lung disease while 1 worker (0.1%) showed signs of obstructive lung disease (Table 1).

DISCUSSION

While mining is beneficial to the State economy in the form of employment opportunity and infrastructural development, it also results in environmental degradation leading to disruption of ecosystem, besides being associated with adverse health effects among mine workers and people living around these mines. Hence, it is necessary that extraction of State’s mineral resources should go hand-in-hand with environmental and health protection and perseveration strategies. Research studies conducted among workers employed in the iron ore mines of Goa have highlighted that mining operations vastly and disproportionately increase the hardships borne by these workers in their role as caretaker of food, water and health of the family as well as their livelihood. Due to increased urbanization and industrialization, socio-economic development and changing lifestyles, non-communicable diseases have been increasingly prevalent among mine workers.

Our study revealed that a high proportion of mining workers had vision problems (43.21%). Nandi SS et al (2015) in their study on morbidity pattern among barytes mine workers in South India noted that impaired visual acuity was present in 32.2% of the study participants.⁹ In another study done by Oliveira S et al among 314 mine workers employed in an open-cast iron ore mine of South Goa, 27.7% of mine workers had defective vision.¹⁰

Ovenseri-Ogbomo et al also observed visual impairment among 28.1% of the study population comprising industrial mine workers at a gold mine in Tarkwa, Ghana in the form of refractive error, presbyopia, pterygium/pinguecula, conjunctivitis, glaucoma and cataract.¹¹

In our study, we observed that 22.61% of the mining workers had some form of hearing loss. Comparable findings were reported in a study conducted by Nandi SS et al among lignite mining workers in western India, where 12.15% of the workers had NIHL.¹² Another study done by Dhatrak et al to assess the health status of mine workers in West Singhbhum district of Jharkhand showed that 45% mine workers were having some form of hearing impairment of which 23.8% was attributed to NIHL while remaining 21% was due to other factors.¹³ Since the audiometry readings procured from the data records could not be compared with preplacement audiometry findings in our study, we could not conclude with certainty that the hearing loss noted in these mine workers was occupation-related NIHL.

The overall prevalence of hypertension in our study was 9.5% which was lower compared to studies done across India in the past. Rajashekar et al in their study on morbidity among mine workers in Chitradurga city of Karnataka reported a high prevalence of hypertension of varying severity (43.8%).¹⁴ Biswas et al also observed that hypertension was prevalent among 23% of workers engaged in an iron and steel industry in Central India.¹⁵ Chatterjee also observed a prevalence of 19% of hypertension in workers employed in a private iron ore mine of Jharkhand.¹⁶ The higher prevalence of hypertension in the above studies was attributed to the greater distribution of study population in the older age group of above 40 years and occupational stress associated with the workload, whereas in our study, majority were youth.

The proportion of mine workers detected with diabetes in our study was 13.06% which was comparable to studies done by Chatterjee A in Jharkhand (14%).¹⁶ Neelakanti et al also noted a comparable prevalence of diabetes of 16.37% among coal mine workers in South India.¹⁷ As far as dyslipidaemia is concerned, the present study findings (13.06%) were in contrast to a study done by Fan et al which showed an astonishingly high prevalence of dyslipidaemia, particularly raised triglyceride levels among Chinese coal miners (68.28%) which could be the result of westernized lifestyle and improved socioeconomic status.¹⁸

As per recent National statistics, the current study shows a much higher prevalence of hypertension and diabetes than the average national prevalence of hypertension and diabetes in the general population (6.19% and 4.75% respectively) which could probably be due to type of work, duration of exposure, smoking and alcohol consumption, tobacco chewing, pre-existing comorbidities such as obesity, thereby increasing the risk of cardiovascular diseases in such workers.

Our study revealed that 5 (2.51%) workers showed signs of abnormal pulmonary function on performing spirometry test of which, 4 (2.01%) workers had restrictive lung disease while 1 worker (0.1%) showed signs of obstructive lung disease. This finding was comparable to a study done by Oliveira et al in Goa in which 3.2% of the workers had pulmonary function abnormalities.¹⁰ However, in another study done by Dhatrak et al in a limestone mine in Rajasthan, it was seen that 15.21% of the workers had abnormal spirometry findings.¹⁹ Borges et al also noted a high prevalence of pulmonary function impairment (17.69%) among pyrochlore mine workers in Brazil.²⁰ The lower prevalence of pulmonary function impairment in the present study could be due to younger age of the mine workers and less period of working, possible improvements in working conditions, the use of PPE, and to the adoption of dust reduction measures at the work site. Radiological data on chest X-rays was unavailable, hence the presence of pneumoconiosis could not be ascertained. In addition, the current study findings were compared with those studies involving mine workers exposed to other mineral dusts with potentially different effects.

Our study revealed a significantly high proportion of mine workers with abnormal ECG findings (20.1%). This finding was in contrast to findings noted by Oliveira A et al in Goa wherein ECG changes were present in a mere proportion of 2.5% of mine workers in the form of sinus bradycardia (2.2%) and left ventricular hypertrophy (0.3%).¹⁰ Nandi et al found that 2.5% of the workers had ECG changes suggestive of ischaemic heart disease under similar study settings.⁹ It has been suggested by epidemiological studies in the past that exposure to dust particles for a prolonged period of time contributes to increased risk of cardiovascular disease among mine workers in the form of aberrant heart rate, heart rate variability and possibly triggered myocardial infarctions, especially in individuals with pre-existing diabetes and hypertension.²¹

Limitations

Since this study is record-based, we cannot conclude with certainty that the observed morbidities among the study population are solely occupation-related, especially morbidities with prolonged exposure to dust and noise such as pulmonary function impairment and hearing loss respectively. Data concerning the socio-demographic details of the workers couldn't be obtained. Preplacement medical records of the workers weren't available since the mining companies sent their employees to different Occupational Health Centres/Medical Facilities for periodic medical check-ups.

CONCLUSION

Our study highlights a significant prevalence of auditory and visual impairment, pulmonary function abnormalities and non-communicable diseases among iron ore mine

workers in Goa. Hence, there is a need to adopt necessary measures for promotion of health among these workers to improve quality of life, functionality, and productivity, on an occupational or personal level. A thorough pre-placement medical examination should be conducted for all workers and categories of work should be allotted as per principles of ergonomics. Maintenance of records and mandatory periodic health check-ups should also be ensured by the mining companies. Regular shuffling and substitution of workers may be implemented within departments with varying exposure to dust. These companies can also seek to offer worker-targeted health care programs for continuous monitoring of workplace, encouragement of good health practices, and regular follow-ups with specialists to stimulate participation of workers in health promotion activities. The workers should be imparted health education concerning diet, physical exercise, meditation and yoga for reducing prevalence of non-communicable diseases. Workers must be aware of hazards present in workplace to avoid injuries. The workers should be taught about usage of personal protective equipment and their importance in prevention of occupational diseases. Strict laws should be laid down for usage of protective devices among mine workers as occupational health, safety and environment is of utmost importance. Our study can be viewed as a pilot project for assessment of health hazards iron ore mine workers. It is recommended to conduct a large-scale epidemiological study for determination of health status and morbidity profile in areas affected by iron ore mining in Goa.

ACKNOWLEDGEMENTS

We would sincerely like to thank Dr. Vallabh B. Dhaimodker for providing us access to the medical records at his Occupational Health Centre for conducting the study.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kalyani S, Vernekar PP, Cacodcar JA. A study on selected morbidities among mining workers in Goa. *Int J Community Med Public Health* 2021;8:1460-5.