Original Article

Morbidity Profile of Workers in a Sponge Iron Industry in Goa: A Retrospective Record-based Study

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Abstract

Introduction: The Sponge iron industries are categorized as red industries (i.e. highly polluted industries) with the major pollutants including particulate matter and gaseous pollutants, the toxic effects of which are often rapid. Prolonged exposure to such pollutants leads to obstructive lung diseases such as asthma or chronic obstructive respiratory disease. The current study aims to assess the morbidities prevalent among the workers in the Sponge iron industry in Goa and help them minimize those with suitable measures.

Objective: To study the morbidity profile of workers in a Sponge iron industry in Goa.

Materials and Methods: A retrospective record-based study was conducted on 217 workers. Selected health parameters were studied: socio-demographic details, anthropometry, blood pressure, serum Creatinine, Total cholesterol, vision tests, ECG, Spirometry, urine microscopy, and audiometry readings.

Results: Among the 217 workers that were studied, 8% had Hypertension, 40% workers had a refractive error, 31% had Dyslipidemia, 14.7% had mild restriction, 0.9% had moderate restriction and 1.3% had a severe restriction in Spirometry testing, 10.1% had elevated Creatinine, 2.7% had mild to moderate hearing loss, 0.9% had changes in ECG and was referred to do echo.

Conclusion: The study revealed that the conditions of employment have caused numerous comorbidities among the sponge iron industry workers, several of which had spirometry restrictions suggesting pulmonary changes which may lead to eventual respiratory deterioration and the advent of diseases such as COPD. The study revealed issues about overall health parameters including but not limited to other intricate issues. Consequently, further tests will have to be conducted along with the use of protective equipment to reduce and limit the effects of such occupational outcomes.

Keywords: Goa, sponge-iron, industry, morbidity, occupational health.

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Introduction

Sponge iron is a transitional material used in the production of steel and is manufactured either from coal or natural gas.[1] India is the largest producer of sponge iron, producing 30% of all sponge iron around the world.[2] Globally Sponge Iron is being manufactured using natural gas which is a cleaner and more efficient resource, while in India sponge iron is produced using coal which is highly polluting. [3] The Sponge iron industries are categorized as red industries (i.e. highly polluted industries) with the major pollutants including particulate matter and gaseous pollutants, the toxic effects of which are often rapid.[1][4][4] Prolonged exposure to such pollutants leads to obstructive lung disease such as asthma or chronic obstructive respiratory disease.[4]

While the industry plays a vital role in generating employment, the occupational health and well-being of its workforce is of paramount importance. Understanding the health challenges faced by these workers is imperative for designing effective preventive and intervention strategies.

Objective

To assess selected morbidities among workers from a Sponge iron industry in Goa.

Materials and Methods

A retrospective record-based cross-sectional study was conducted over a period of two months i.e. November-December 2022. The records of 217 workers from a Sponge iron industry in Goa who were directly involved in handling machineries and manufacturing and who have been working for at least 2 years in the industry were included. A universal sampling method was used after all necessary permissions were obtained. Those patients whose records were incomplete were excluded.

The records were obtained from the Occupational Health and Safety (OHS) centers, which conduct periodic medical check-ups of the industry workers. The records maintained by the OHS centers serve as a reliable source of epidemiological data.

The data included socio-demographic details, periodic health check-up records including anthropometry (height, weight), blood pressure measurements, routine blood investigations (Total cholesterol, Triglyceride, Blood urea, Creatinine, Urine), Vision testing, ECG, Spirometry, and Audiometry readings. Blood samples were processed using standard assays in the laboratories attached to the OHS centers.

The ethical clearance for this study was obtained from the IEC of Goa Medical College under the reference code.

The confidentiality and privacy of the industry workers obtained from the records were strictly maintained.

Statistical Analysis

The data was entered and analyzed in SPSS version 24. The results are given as frequencies and percentages.

Study Variables

Hypertension: Workers with a systolic Bp ≥ 140 mm Hg or Diastolic Bp ≥ 90 mm Hg were considered as being hypertensive. [5]

Dyslipidemia: A finding of serum triglycerides > 150 mg/dl or total cholesterol> 200 mg/dl was taken as the diagnostic criteria for dyslipidemia.[6] Blood tests were done using standard assay techniques at the laboratories attached to the OHA's.

Audiometry: audiometry results were interpreted as follows, based on WHO grades of hearing impairment. Hearing levels of 26-40 dB as mild,41-60 dB as moderate, 61-80 dB as severe, and > 80 dB as profound hearing impairment.[7]

Near vision: Roman type chart was used to assess near vision. The following values were considered, Normal ≥ N6, Satisfactory N8-N12, Poor <N12

Far vision: Far vision was tested using Snellen's chart. Normal vision was considered as 6/6 in both eyes, satisfactory vision was taken as 6/9-6/12 in the worse eye, and vision was considered as poor if the vision was <6/12 in the worse eye.

Body Mass Index (BMI): The BMI was calculated using the formula weight in kilograms divided by the square of height in meters. [8]

The BMI of the workers was categorized as follows, underweight (<18.5), normal (18.5-22.9), overweight (23-24.9), and obese (≥25) [9]

Results

In our study, all 217 workers who were included were male. The age of the workers ranged between 22-58 years, with most of the workers belonging to the 30-39 age group i.e. 120 (55.25%).

The BMI of each of the workers was calculated and it was found that the majority of the workers had a normal BMI i.e. 138 (64%). The distribution of the workers according to BMI is given in Figure 1.

Table 1: Distribution of workers according to age

Age (in years)	Frequency	Percentage (%)
20-29	49	22.5%
30-39	120	55.29%
40-49	34	15.6%
50-59	14	6.4%

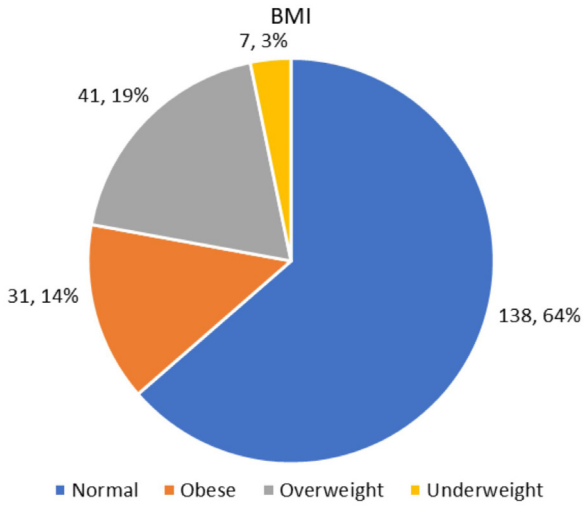

Figure 1: Distribution of workers based on BMI

Regular BP checks revealed that 18 (8%) of the workers were found to be hypertensive. A little over a quarter of the workers were found to have dyslipidemia i.e. 67 (31%), while 22 (10.1%) were found to have an elevated serum creatinine level.

The workers were assessed for both far and near vision defects, along with color vision and it was found that 87 (40%) of the workers had some form of refractive error. Out of these workers, only 3 (1.3%) had a corrected refractive error. None of the workers were detected with color blindness.

A 12 lead ECG was done for each of the workers and it was found that 2(0.9%) workers had changes in their ECG for which they were advised to get a 2D ECHO done.

Audiometry findings revealed that 6 (2.7%) of the workers had mild-moderate hearing loss in either one or both ears. There were no cases of severe hearing loss in any of the workers.

Table 2: Distribution of workers based on selected morbidities

Morbidity	Frequency (N=217)	Percentage (%)
Hypertension	18	8%
Elevated serum creatinine	22	10.1%
Dyslipidemia	67	31%
Refractive errors	87	40%
Mild-moderate hearing loss	6	2.7%
ECG changes	2	0.9%

Spirometry was done to assess the pulmonary functions of the workers. This test revealed that 32 (14.7%) of the workers had restriction, 2 (0.9%) had moderate restriction and 3 (1.3%) had severe restriction.

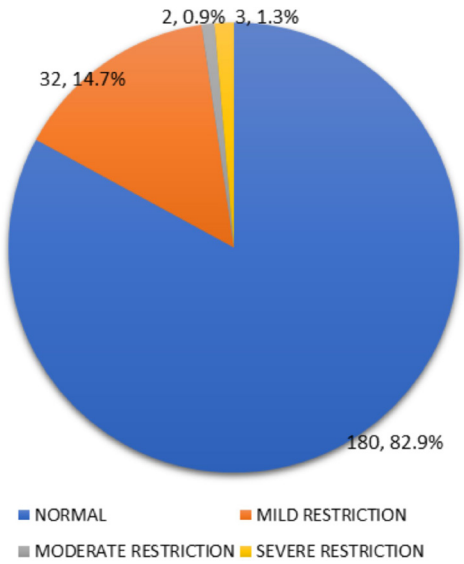

Figure 2: Distribution of workers based on spirometry readings

Discussion

Our research offers insights, into the health status of workers in the iron industry. Most workers have a body mass index (BMI) suggesting a normal distribution of weight among the group. However, a notable percentage of workers are Overweight (19%) or obese (14%) though these figures are lower than those reported in other studies.[10] This points to improvements in health habits or workplace interventions are needed.

The occurrence of high blood pressure among workers (8%) is lower than the rates observed in Goa indicating cardiovascular health outcomes within this group. Nevertheless, concerns arise from creatinine levels in 10% of workers hinting at kidney issues likely influenced by heat stress from machinery exposure – a trend consistent with earlier research findings.[11]

A significant portion of workers (40%) experience refractory errors which can be due to heat stress or age-related factors.[12] It is crucial to emphasize the use of gear like goggles to reduce these risks and maintain eye health. Moreover, slight hearing impairment (2.7%) might be linked to noise pollution from machinery underscoring the necessity for noise control measures at work.[13]

A worrying finding is that 18% of workers exhibit spirometry restriction, which could lead to problems. which shows pulmonary changes are likely taking place in their bodies already. The thought behind mentioning spirometry limits implies that these employees might have respiratory problems now that could worsen into Chronic Obstructive Pulmonary Disease (COPD) with time.[14] This issue frequently arises in the iron industry because of workers being exposed to dust and other contaminants from the industry.

The identification of health hazards has highlighted the desperate requirement for immediate action that targets the safety of iron industry employees. Recommendations are as follows:

Heat Stress Management: Heat stress management protocols should be put in place such as hydration, rest breaks, and engineering controls to lower ambient temperature.

Personal Protective Equipment (PPE): Adherence to the usage of personal protective equipment must be ensured especially goggles and ear protection to reduce the risk for ocular and auditory problems.

Noise Control Measures: Workers' noise-induced hearing loss can be reduced through implementation of measures like soundproofing and regular maintenance on equipments that generate high levels of noise.

Respiratory Protection: To prevent respiratory diseases caused by dust or impurities inhaled while working in the iron industry, it is important to improve respiratory protection methods including appropriate masks and ventilation systems.

Conclusion

To end, our examination underscores the multifaceted connection between work-related exposures and workers' health in businesses that deal with iron. The engagement of all concerned parties in targeting interventions designed to control these risks as well as enhancing safety within working environments can help prevent occupational sicknesses while safeguarding employee welfare thus leading to increased productivity gains coupled with reduced morbidity burden from such ailments. Additionally, there should be further studies carried out continuously for monitoring purposes which will aid in evaluating how effective these measures have been so far towards managing occupational health within this sector.

Limitation of the study

The study's concentration on a solitary sponge iron factory restricts the broader relevance of its conclusions to analogous contexts. Moreover, the exclusive inclusion of male participants, attributed to the predominantly male workforce in this particular industry, potentially obscures any gender-specific nuances in the findings. This limitation suggests caution in extrapolating the study's outcomes to settings with different industrial dynamics or gender compositions.

Declarations

Ethical clearance was obtained from Institutional ethical committee of Goa medical College dated

7/12/2022 with reference number GMCIEC/ 2022/ 291.

Data was collected from the occpational health officer after the permission from the industry

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Conflict of interest: Nil

References

1. Chattopadhyay K. Prevalence and Predictors of Respiratory Diseases Among Coal-Based Sponge Iron Plant Workers: A Cross-Sectional Study in Barjora, India. Ann Glob Health. 85(1):14.
2. AMIT C. Sponge Iron Production By Direct Reduction Of Iron Oxide. PHI Learning Pvt. Ltd.; 2010. 376 p.
3. Sponge iron industries are killing fields [Internet]. [cited 2024 Feb 25]. Available from: https://www.downtoearth.org.in/coverage/sponge-iron-industries-are-killing-fields-8328
4. Biswas M, Chattopadhyay K. Relationship between health-related quality of life and respiratory health status among coal-based sponge iron plant workers in Barjora, India. Z Gesundheitswissenschaften. 2018;26(3):355–9.
5. Satheesh G, Dhurjati R, Huffman MD, Rosende A, Rodgers A, Prabhakaran D, Ordunez P, Jha V, Salam A. Standardized treatment protocols for hypertension: global availability, characteristics, and alignment with the hypertension guideline recommendations. Journal of Hypertension. 2024 May 1;42(5):902-8.
6. Halawani AF, Alahmari ZS, Asiri DA, Albraheem AA, Alsubaie AM, Alqurashi AG, Alturkistani FM, Albalawi MK, Alzaid FN, Alsaluli MM, Alghamdi MS. Diagnosis and Management of Dyslipidemia. Archives of Pharmacy Practice. 2019 Oct 1;10(4).
7. Olusanya BO, Davis AC, Hoffman HJ. Hearing loss grades and the International classification of functioning, disability and health. Bull World Health Organ. 2019 Oct 1;97(10):725–8.
8. Misra A, Dhurandhar NV. Current formula for calculating body mass index is applicable to Asian populations. Nutrition & diabetes. 2019 Jan 28;9(1):3.
9. Peterson CM, Thomas DM, Blackburn GL, Heymsfield SB. Universal equation for estimating ideal body weight and body weight at any BMI. The American journal of clinical nutrition. 2016 May 1;103(5):1197-203.
10. Shannawaz M, Arokiasamy P. Overweight/Obesity: An Emerging Epidemic in India. Journal of Clinical & Diagnostic Research. 2018 Nov 1;12(11).
11. Nerbass FB, Pecoits-Filho R, Clark WF, Sontrop JM, McIntyre CW, Moist L. Occupational Heat Stress and Kidney Health: From Farms to Factories. Kidney Int Rep. 2017 Nov 1;2(6):998–1008.
12. Bormusov E, Amir-Sharon N, Eliaz-Volkovich A, Dovrat A. Heat in Workplaces Such as a Neighborhood Bakery or a Glass Factory Can Promote Aging of the Eye Lens. Open Longev Sci Former Open Aging J. 2008 Oct 23;2.
13. Singh LP, Bhardwaj A, Deepak KK. Occupational noise-induced hearing loss in Indian steel industry workers: An exploratory study. Human factors. 2013 Apr;55(2):411-24.
14. Bala S, Tabaku A. Chronic obstructive pulmonary disease in iron-steel and ferrochrome industry workers. Central European journal of public health. 2010 Jun 1;18(2):93.