

Prevalence Of Occupational Health Hazards Among The Sand Mine Workers Of Odisha

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Abstract

Background of the study: Modern urbanisation has a constant increased demand for sand mining. The working nature and environmental stress involved in sand mining may expose the workers to multiple work-related disorders. The current study was undertaken to assess the occupational health hazards associated with sand mining.

Materials and Methods: The study includes 57 sand miners, those were randomly selected from the Kathajodi and Mahanadi riverbed in the Odisha district of Cuttack. On-site evaluation and self-reported health complaints were used to assess work-related health risks. A detailed questionnaire study on discomfort feeling was done by the modified Nordic questionnaire, which considering the information about work nature, job stress and discomfort feeling.

Results: The prevalence of musculoskeletal pain and discomfort was 93.34%, with the lower back, shoulder, and neck being the most involved. Sensory deficits at multiple sites and ear pain were found in 66.6% and 76.6% of people, respectively. Miners who carried loads for longer periods of time had a higher risk of MSDs than those who carried loads for shorter periods of time. There was a lack of health and safety measures such as personal protective devices and security schemes.

Conclusion: Sand mining, a physically demanding job in coastal Odisha, has a high prevalence of multiple work-related disorders and hazards. There was also a lack of health and safety measures.

Keywords: Musculoskeletal disorders, Occupational health, Heavy load carrying

Introduction:

The sand mining industry is a crucial component of the economy in various parts of the world, including the state of Odisha in India. [1] Sand mining, specifically, poses unique challenges due to the nature of the work and the environments in which it is conducted. In Odisha, a state in eastern India, sand mining is a common occupation, often associated with informal labor practices and inadequate health and safety regulations. However, the workers in this industry face a myriad of occupational health hazards that often go unrecognized and underreported. Odisha's sand mining sector is particularly concerning, as the state is known for its abundant mineral resources, yet it also grapples with economic backwardness. [2] The existing legislation, such as the Factories Act of 1948, has been unable to adequately address the occupational health concerns of the majority of Indian workers, who fall outside the purview of this act.[3] Furthermore, occupational health services in the informal sector, which includes the sand mining industry, are largely non-existent or dysfunctional, leaving these workers deprived of basic occupational health care. [3]The manufacturing industry, which shares some similarities with the sand mining sector, has also been shown to pose significant health and safety risks, with hazards such as musculoskeletal disorders, noise-induced occupational diseases, chemical exposures, and workplace violence being prevalent.[4]

Sand mine workers are frequently exposed to physical hazards, including excessive noise, vibration, and extreme weather conditions. Prolonged exposure to high noise levels can lead to hearing loss, while constant vibration from machinery can result in musculoskeletal disorders.[5] About 60% of sand mine workers in Odisha report symptoms of musculoskeletal pain, which can be attributed to the repetitive and strenuous nature of their work.[6]According to a report by the National Institute of Occupational Health (NIOH), the prevalence of silicosis among sand mine workers in Odisha is alarmingly high, with some studies indicating rates as high as 30% (NIOH, 2020). Additionally, exposure to other hazardous chemicals, such as heavy metals and pollutants, further exacerbates respiratory issues and other health problems.[7]

Ergonomic hazards in sand mining arise from manual handling of heavy loads, awkward postures, and prolonged periods of physical exertion. About 45% of sand mine workers suffer from chronic back pain and other musculoskeletal disorders. [8] These conditions are often aggravated by the lack of proper lifting techniques, repetitive movement and ergonomic tools, leading to long-term disability and reduced quality of life. [9] While essential for development, this industry exposes its workforce to a range of occupational health hazards. These hazards often go unaddressed and underreported, particularly in Odisha, a state grappling with economic challenges. Existing legislation, such as the Factories Act of 1948, struggles to protect these workers, many of whom fall outside its scope. [10] This is further compounded by inadequate occupational

health services in the informal sector, leaving sand mine workers vulnerable and deprived of essential healthcare. Given the potentially hazardous nature of the sand mining industry, the present study aimed at investigating the prevalence of occupational health hazards among the workers in Odisha.

Materials and Methods:

Selection of subjects: 57 sand miners were randomly selected for the study from the Kathajodi and Mahanadi riverbed in the Odisha district of Cuttack. They belong to the age group of 20-35 years. A verbal consent was taken before the onset of the study.

Questionnaire study:

A detailed questionnaire study focusing on the prevalence and types of discomfort experienced by sand mine workers was conducted. This study employed a modified Nordic questionnaire, to evaluate ergonomic risk factors and musculoskeletal discomfort in different parts of body. This modified questionnaire was specifically adapted to capture comprehensive information about the unique work nature of sand mining, including physical demands, posture, repetitive motions, and environmental stressors. Additionally, it delved into the workers' perceived levels of job stress and their correlation with experienced discomfort. It was structured to assess the prevalence of musculoskeletal discomfort among the sand mine workers. It was divided into sections focusing on subjective symptoms and work-related pain in various body regions, including the neck, shoulders, elbows, wrists, hands, upper and lower back, hips, knees, and ankles. Participants were also given the opportunity to report discomfort in any other areas. This comprehensive approach aimed to identify potential musculoskeletal disorders by evaluating the reported discomfort in relation to work activities. Data collection involved one-on-one interviews with each participant to ensure clarity and accuracy in their responses.

Posture Analysis:

OWAS (Owako Working Posture Analysis System) tool was applied for the assessment of discomfort in practiced posture among sand mine workers. The analysis involved observing and recording the workers' postures by the help of digital videography during various tasks, focusing on the positioning of their back, arms, and legs, as well as the loads they handled. Each observed posture was then classified according to the OWAS method, which assigns a risk level based on the potential for musculoskeletal strain and injury. This detailed assessment provided valuable insights into the ergonomic hazards present in the sand mining work environment.

Statistical Analysis: A paired t-test has been used to assess if there is a significant change in the heart rate and blood pressure of sand mining workers before and after work, using a significance level of $p < 0.05$.

Results:

The mean age of the sand mine workers was 27.17 years. The average height and weight for the study participant was 162.47 cm and 53.65 kg and shown in the Table 1.

Table1: Physical Characteristics Of Sand Mining Workers

Variables	Mean± SD
Age (years)	27.17±7.05
Height (cm)	162.47±4.95
Weight (kgs)	53.65±6.44

Table 2 showed the work duration and rest on a day basis of the sand mine workers. It was found that the average work duration of the workers was 10.5 hours and they took rest of 1.5 hours. The sand mine workers had to work for six days on a average in a week.

Table 2: Mean duration of work and rest per day with average number of working days in a week

Duration of work Per day (in hour)	Duration of rest Per day (in hour)	Number of working days in a week
10.5 (± 2.11)	1.5 (± 1.00)	6

The following table describes the nature of load handled by the sand mine workers along with the nature of the work. It was found that 80% of the study participant reported that they need to had the load alone. 66.7% of the workers were engaged in

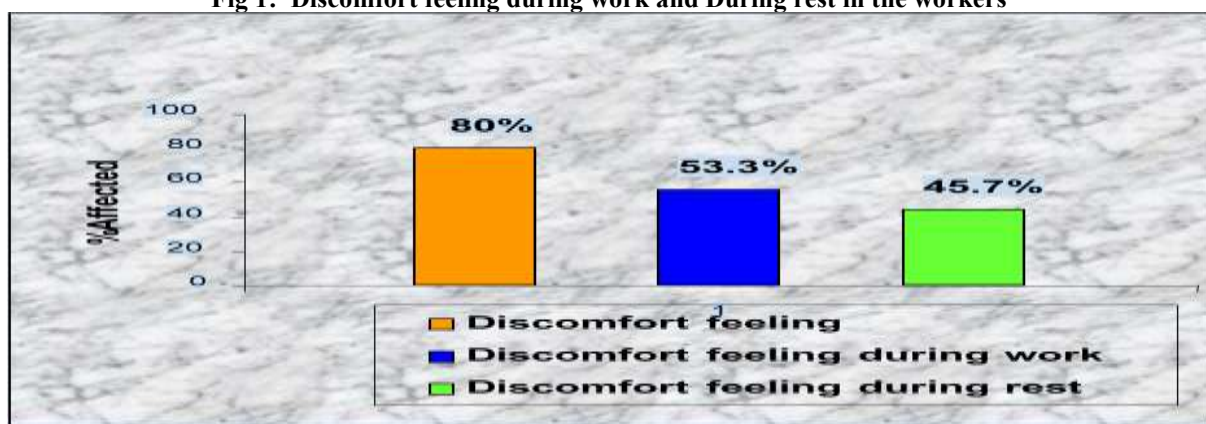
lifting of sand, 6.7% of the workers were involved in carrying of load and a majority of 76.6% were involved in throwing of sand respectively as shown in the following Table 3.

Table 3: Working Behavior of the Sand mining workers

Load Handled		Nature of Work		
Alone	With others	Lift	Carry	Throw
80%	20%	66.7%	6.7%	76.6%

80% of the sand mine workers complained to have discomfort feeling. Figure 1 showed that 53.3% of the study participant felt discomfort during work while 45.7% of the sand mine workers felt discomfort while they are taking rest.

Fig 1: Discomfort feeling during work and During rest in the workers



The sand mine workers complained to have discomfort feeling at different areas of body. Majority of workers about pain and discomfort in the upper extremities however 93.01% complained of having pain in low back pain due to prolong manual handling of sand and awkward posture. 66.7% of the workers complained to have discomfort in wrist region. 52.6% of the workers felt discomfort in the shoulder region and 36.8% had pain in the neck region. 43.7% of the study participant felt pain in leg due to prolong standing while working as shown in Figure 2.

Fig 2: Discomfort feeling at different body parts

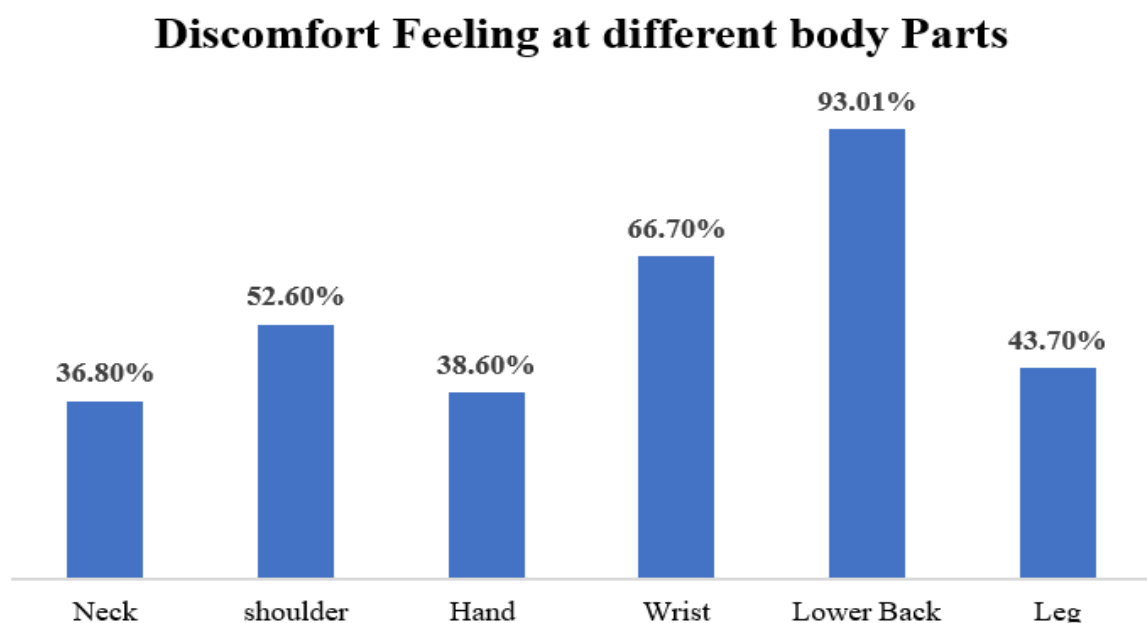
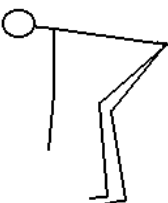


Table 4: Posture analysis of the Sand mine workers

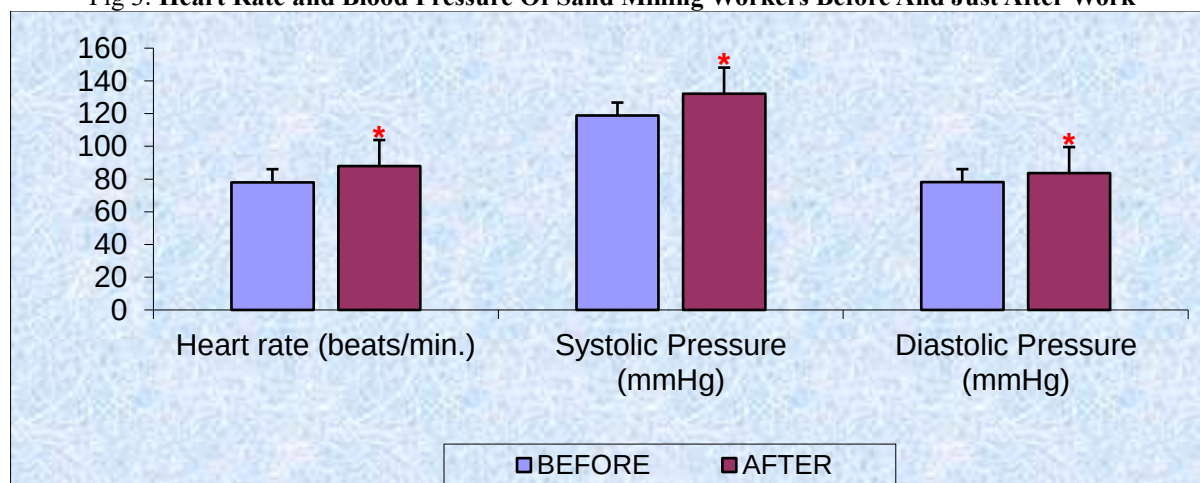
ACTIVITY	FIGURE	CODE	ACTION CATEGORY	REMARKS
CARRY THE SAND		3133	2	CORRECTIVE MEASURES IN NEAR FUTURE
FILLING THE SAND		2153	3	CORRECTIVE MEASURES AS SOON AS POSSIBLE
LIFTING SAND		2133	3	CORRECTIVE MEASURES AS SOON AS POSSIBLE
THROWING THE SAND		2333	3	CORRECTIVE MEASURES AS SOON AS POSSIBLE
FILLING SAND BY SHOVEL		2122	2	CORRECTIVE MEASURES IN NEAR FUTURE

The sand mine workers had discomfort feeling in different parts of the body and the discomfort experience of the workers had collaboration with different job task practiced by them. OWAS assessment of the different postures practiced by the workers was carried to look for the development of Musculoskeletal Disorders (MSD) risk among them. Majority of the posture including filling the sand, and throwing of sand had a OWAS score of 3 which provided the inference of high risk of MSD and implementation of correction is required in immediate basis. However, the posture practiced while carrying the

sand and filling sand by shovel also had a likelihood of developing MSD and corrective measures were required as shown in Table 4.

The mean hear rate before and after the work was found to be 79.2 beat/min and 90.25 beats/ min. A paired t test was carried out and it showed the increase in hear rate was statistically significant ($t=3.45$, $p<0.05$). Blood pressure of the workers was recorded before and after the end of the work. Paired t test analysis showed that the difference in both systolic blood pressure ($t=23.193$) and diastolic pressure ($t=7.245$) was statistically significant at $p<0.05$ as shown in following Figure 3.

Fig 3: Heart Rate and Blood Pressure Of Sand Mining Workers Before And Just After Work



Discussion:

The present study showed that 80% of the sand mine workers complained of having pain and discomfort. This may be due to working in a awkward position and predominantly doing manual handling of heavy load (sand) for a prolong period of time (10.5 hours each day) for six days in a week. 53.3% of the workers felt major discomfort during work while 45.7% felt pain while taking rest as shown in Figure 1. This may due to continuation of manual task of lifting , carrying and throwing sand in a awkward posture for a prolong period of time which increases the likelihood of development of MSDs. Similar results have been found by Patel & Ghosh (2023) that working in awkward posture for prolong hours lead to the development of MSD. They used a different methodology from current study as they used RULA assessment tool and Modified Nordic Questionnaire for the assessment of prevalence of musculoskeletal disorders among the fish processing workers.[11] Figure 3 showed the physiological parameters predominantly heart rate and systolic blood pressure and diastolic blood pressure. They were recorded before and after the end of the work. A paired t test showed significant increase in heart rate($p<0.05$) and blood pressure ($p>0.05$) after the work indicating stress. The heart rate can be considered as a indicator of physical work load. The type of work they performed can be determined by comparing their post-work heart rates with the standard set by Astrand (1986). Based on this comparison, it can be concluded that sand mine workers engage in 'hard work'. Additionally, these workers continue their job for 10 hours per day, which can also lead to stress.[12]

Heart rate has been used as a physiological indicator of the subjective state of underload and mental effort. Job stress has been linked to an increased prevalence of cardiovascular diseases among industrial workers. In this study, there was a significant increase in heart rate among carpenters from the beginning to the end of the workday. This progressive rise in heart rate over time indicates physiological fatigue.[13]

The sand mine workers experienced discomfort at various parts of the body -wrist region (66.7%), shoulder (52.6%) , neck (36.8%) and leg (43.7%). This may be due to manual handling of the sand (heavy lifting) for a prolong period of time in awkward position and repetitive manner which may result in the increase risk of developing MSD among the workers. Many studies have demonstrated that maintaining awkward and stationary positions for prolonged periods, along with repetitive hand and wrist movements, can lead to musculoskeletal disorders (MSDs). These disorders can result in pain in the neck and upper limbs.[14,15] The sand mine workers are involved in frequent manual handling task. 80% of them independently participate in heavy material handling of which a majority of 66.7% are engaged in heavy lifting of sand all alone which may be reason for developing the low back pain as a majority of 93.01% have reported. Occupational back pain is either caused or aggravated by work. It can result from a traumatic incident, such as a fall or blow, or from repetitive or continuous exposure to physically demanding tasks, whole-body vibration, bending, twisting, or static sedentary postures. Due to the heavy material handling typical of sand mining, a higher prevalence of work-related musculoskeletal disorders of the back is expected. In many jobs, heavy or frequent lifting, forceful movements, and carrying heavy loads are complicated by awkward

body postures. If the load is too heavy or the lifting frequency exceeds tolerance levels, acute or chronic injuries to the lumbar spine can occur. [16-18]

Conclusion:

This study highlighted the significant MSD discomfort and physical strain experienced by workers engaged in sand mining in coastal Odisha. The majority of the workers reported experiencing low back pain due to strenuous activities. The analysis using the OWAS (Ovako Working Posture Analysis System) action categories revealed that many of the workers' postures require immediate correction to prevent further musculoskeletal disorders (MSDs). The findings indicate that the adoption of awkward postures and the handling of heavy loads at work are primary contributors to these MSDs, leading to decreased productivity and adversely affecting the workers' health. Moreover, the study underscores the high prevalence of multiple work-related disorders and hazards in sand mining, emphasizing the physically demanding nature of the job. The lack of adequate health and safety measures exacerbates these issues, underscoring the urgent need for intervention. To improve the well-being and productivity of the workers, it is crucial to implement corrective measures for posture, enhance ergonomic practices, and establish comprehensive health and safety protocols. These steps are essential to mitigate the risks associated with sand mining and to promote a healthier, more sustainable working environment.

Limitation of the study:

The study's findings are based on data collected from a specific site and a sample of 57 workers, which presents a limitation regarding the generalizability of the results. Conducting research on a single site means that unique environmental factors, organizational culture, and specific job roles may influence the outcomes, limiting their applicability to other settings. Additionally, the relatively small sample size of 57 workers may not capture the full range of variability present in a larger workforce, making the results more susceptible to random variations and less representative of a broader population. Increasing the sample size and diversity will help ensure that the outcomes are diverse and may have broader context.

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