



## Original Article

# A study on the prevalence of musculoskeletal disorders among the coalminers of Eastern Coalfields of India

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## Abstract:

Mining is an ancient occupation, long recognized as being arduous and liable to injury and disease. The lifecycle of mining consists of exploration, mine development, mine operation, decommissioning and land rehabilitation.

To explore the prevalence characteristics and influence factors related to the development of work related musculoskeletal disorders of underground coalminers in Eastern Coalfield mines.

In a cross-sectional study of 55 coalminers from Saatgram Project, Raniganj, Eastern Coalfields, modified Nordic Questionnaire was performed to assess the musculoskeletal disorders. Logistic regression analysis was performed to analyze the correlation between the occupational factors and their work related musculoskeletal disorders.

In this study 36 out of 55 miners (65.45%) complained about the development of musculoskeletal disorders at different body parts. The maximum pain was identified at lower back. The presence of lower back pain was observed among 58.18% of miners. The prevalence of pain in different body sites of the miners increased significantly with their ages. According to the present study, the repetitive operations and awkward postures were the risk factors for the development of work related musculoskeletal disorders in neck, shoulder and upper limbs; moreover, the repetitive operation of moving heavy substances and stooping postures continuously were related significantly with the development of lower back pain at lower limbs due to the long standing awkward posture.

It may be concluded from the above study that Eastern Coalfield miners are suffering from work related musculoskeletal disorders. This condition may be rectified by changing working postures or by implementation of ergonomically designed tools and machineries.

**Key Words:** Coalminers, Musculoskeletal disorders, Lower back pain.

## Introduction

Most coal seams are too deep underground for opencast mining and require underground mining, a method which currently accounts for about 60 % of the world coal

production. There is compelling evidence that work-related musculoskeletal disorders (WMSDs) affect mineworkers to a greater degree than workers in other industries. For example, studies have shown that miners experience more disability from knee and back pain, more absenteeism, more osteoarthritis, and more disk degeneration compared to other industrial populations [1,2]. According to the National Institute for Occupational Safety and Health (NIOSH), musculoskeletal disorders (MSDs) include

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a group of conditions that involve the nerves, tendons, muscles, and supporting structures such as intervertebral disks. They represent a wide range of disorders that can differ in severity from mild, periodic symptoms to severe, chronic, and debilitating conditions. Work-related musculoskeletal disorders (WMSDs) arise from such risk factors as frequent or heavy lifting; pushing or pulling heavy objects; prolonged awkward postures; vibrations; and repetitive, forceful, or prolonged exertion of the hands [3]. Examples of MSDs include low back pain, tendonitis, and carpal tunnel syndrome etc. Studies have shown that the mining industry had the second highest incidence ratio for low back disorders (1.5 claims/100 workers), trailing only to construction industry (1.6 claims/100 workers). Low back disorders are consistently the single leading cause of lost-time injuries in US coal mines, costing the industry tens of millions of dollars each year [1,4]. A musculoskeletal disorder is an injury or disease of the musculoskeletal system that arises in whole or in part from undertaking manual tasks in the workplace, whether occurring suddenly or over a prolonged period of time. Work-related musculoskeletal disorders (WMSDs) of muscle, tendons and nerves are a major cause of lost work in many labour-intensive industries [5]. Occupational risk factors include continual repetition of movements, fixed body positions, forces concentrated on a small part of the body, and lack of sufficient rest between tasks. WMSDs are recognised as leading causes of significant human suffering, loss of productivity and economic burdens on society [6]. Work activities which are frequent and repetitive or activities with awkward postures cause these disorders which may be painful during work or rest [10]. Better job design is promoted as the best method of reducing cases of LBP and can also reduce the disability (i.e., lost time from work) associated with LBP when it happens. The disorder occur when the body part is called on to work harder, stretch farther, impact more directly or otherwise functions at a greater level than it is prepared for. The immediate impact may be minute, but when it occurs repeatedly the constant trauma cause damage. The present investigation was carried out to explore the prevalence characteristics and influence factors related to the development of work related musculoskeletal disorders of workers in Eastern Coalfield Mines.

## Methods

### Subjects

The present research work was a cross-sectional pilot study carried out on 55 underground coalminers (male) of 'Saatgram

Project' Raniganj of Eastern Coalfields, having on average more than 15 years of working experience. Random sampling of population was undertaken to remove any bias. Participants responded to the survey and the interview on a one to one basis. Information on age and ethnicity was collected using a questionnaire. The subjects were requested to make an appointment prior to the commencement of the study.

### Measurement of Physical parameters

Anthropometric measurements were made following the standard techniques. Height was measured to the nearest 0.1 cm using Martin's anthropometer. Body weight of lightly clothed subjects was recorded to the nearest 0.5 kg on a weighing scale (Doctor Beliram and Sons, New Delhi, India). For height and weight, individuals were requested to remove their shoes prior to taking measurements. The body surface area (BSA) [7] and the body mass index (BMI) [8,9] were calculated using the standard equation:

$$BSA (m^2) = 0.007184 \times \text{Height (cm)}^{0.725} \times \text{Weight (kg)}^{0.425}$$

$$BMI (kg/m^2) = \text{Weight (kg)} / \text{Height (m}^2)$$

### Measurement of Physiological parameters

Blood pressure measurements were made after completion of the anthropometric measurements. Left arm blood pressure was taken with a sphygmomanometer and stethoscope after the participant had been seated in a relaxed position for five minutes. Two forenoon measurements were recorded and averaged for analyses. A five minutes relaxation period between the two measurements was maintained for all subjects. Systolic (SBP) and diastolic (DBP) blood pressure were recorded to the nearest mmHg as the appearance (phase I) and disappearance (phase V) of Korotkoff sounds, respectively.

### Questionnaire Study

A questionnaire comprising a question battery was prepared to assess the miners' marital status, income, number of family etc. Musculoskeletal disorder was assessed by using modified Nordic Musculoskeletal Questionnaire [10]. The group of questions requested the detailed information on MSD problems relating to different body areas of the miners engaged in different types of jobs in the underground coal mines.

### Statistical Analysis

The mean and standard deviation of the various physical and physiological parameters were calculated [11].

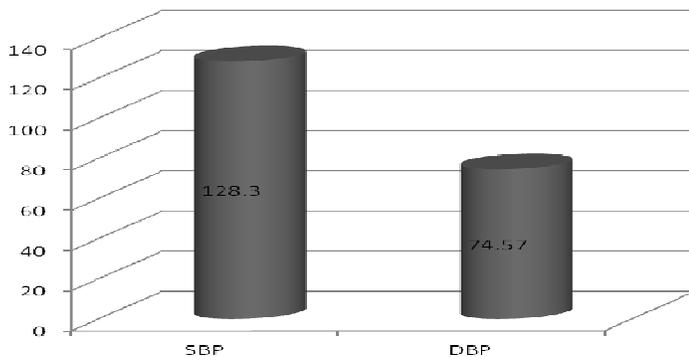
## Results

Table 1 displays the mean ( $\pm$ SD) age and the selected physical transients of height, weight, body surface area and body mass index of the underground coalminers participating in this study. In this study 65.45% of the underground coalminers complained about the development of pain at different parts of the body (Fig: 2). The maximum pain was identified at the lower back. The presence of lumbago was observed among 58.18% of the underground miners (Figure 3). The prevalence of pain in different body sites of the miners increased significantly with their ages. Figure: 1 depicts the resting systolic and diastolic blood pressure of the underground coalminers.

**Table I Physical Characteristics of Underground Coalminers (n=55)**

Parameters	Mean $\pm$ SD
Age (years)	43.83 $\pm$ 9.33
Height (cm)	161.56 $\pm$ 6.75
Weight (kg)	64.31 $\pm$ 10.36
BSA (m <sup>2</sup> )	1.77 $\pm$ 0.16
BMI (kg/m <sup>2</sup> )	24.58 $\pm$ 3.39

**Figure 1. Resting systolic blood pressure (SBP) and diastolic blood pressure (DBP) in (mm Hg) of underground coalminers.**



**Figure 2. Different body parts pain in coalminers.**



**65.45% OF THE UNDERGROUND COAL MINERS ARE SUFFERING FROM WMSDs.**

Table 2 depicts the respective percentage of coalminers suffering from pain in the different parts of the body. The miners suffering from neck trouble was 18.18%, whereas those suffering from leg trouble were reported to be of 29.29%. The coal miners suffering from shoulder trouble and wrist trouble were 14.54% and 12.72% respectively (Figure 3).

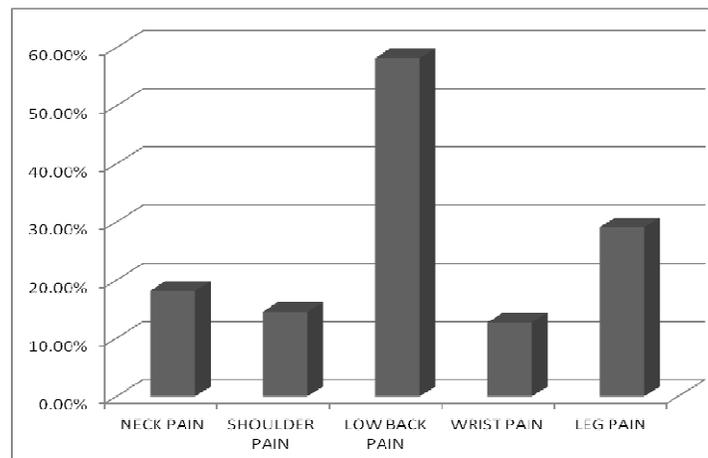
**Table II Feeling of discomfort in different body parts among underground coalminers (n=55)**

Body Parts	Percentage
Neck trouble	18.18 %
Shoulder trouble	14.54 %
Low back trouble	58.18 %
Wrist trouble	12.72 %
Leg trouble	29.09 %

## Discussions

Studies have shown that the mining industry had the second highest incidence ratio for low back disorders. Low back disorders are consistently the single leading cause of lost-time injuries in US coalmines, costing the industry millions of dollars each year [2]. MSDs (Shin splints) in Lower limbs were associated with the long standing and awkward posture. According to Gangopadhyay awkward and prolonged working posture is mainly associated with the development of musculoskeletal disorders (MSD) [12]. Repetitive operation and

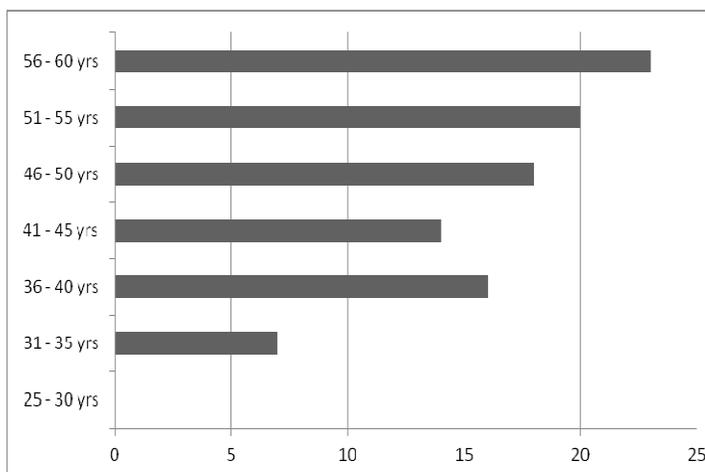
**Figure 3. Prevalence of MSDs in different body parts of underground coalminers**



awkward posture are the risk factors for MSDs in the neck & shoulder (Impingement syndrome). The underground coalminers engaged in drilling operations mostly complained about wrist (Wrist tendonitis) and shoulder trouble [13]. HDL Operators mostly complained about the wrist, shoulder and

ankle problem. Snapping Hip Syndrome and Hip Bursitis were found to occur in some Cable Carriers in the underground mines. Moving heavy substance (Trammers) and stooping posture were related significantly to lumbago [14]. The restricted workspace present in low seam coal mines forces worker to adopt awkward working postures (kneeling and stooping) which place high physical demands on the knee and lower back. According to the present study, the repetitive operations and awkward postures were the risk factors for the development of work related musculoskeletal disorders in neck, shoulder and upper limbs (Figure 3). Moreover, the repetitive operation of moving heavy substances and stooping postures continuously were related significantly with the development of Lower Back Pain at lower limbs due to the long standing awkward posture. It may be

**Figure 4. Incidence of pain in different body parts in different age group of coalminers.**



concluded from above experiment that Eastern Coalfield miners are suffering from the development of work related musculoskeletal disorders. This condition may be rectified by changing working postures or by implementation of ergonomically designed tools and machineries.

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