

Lower Back Pain and Disability: An Occupational Public Health Dilemma of Chamalang, Balochistan Coal Miners

Muhammad Arif¹, Ayesha Babar Kawish², Midhet Nasim³, Amir Zeb⁴

Received: 26 May 2021 / Revised: 9 June 2021 / Accepted: 11 June 2021 / Published online: 02 July 2021

© 2021 Foundation University Journal of Dentistry

ABSTRACT

Objective: Lower back pain (LBP) is a common problem associated with the musculoskeletal system due to abnormal and persistent working posture among coal miners. This study aims to explore the occupational and personal factors associated with LBP and disability in coal miners of Baluchistan.

Materials and Methods: This cross-sectional study was conducted in Chamalang, Baluchistan, spanned over four months. Using the random sampling technique, a total of 376 underground conventional coal miners were approached. A pre-validated structured questionnaire i.e., Oswestry Lower Back Pain Questionnaire based on the Oswestry Disability Index (ODI) was used for data collection. Descriptive statistics, correlations analysis and chi-square tests were performed for data analysis using SPSS version 20.0. A value of $p < 0.05$ was considered statistically significant.

Results: Amongst the 376 respondents with the age distribution 20-50 years, the majority (50%) were from the 31-41 years age group and, nearly all suffered from LBP and had developed varying degrees of disability. Occupational factors contributing towards LBP included lifting heavy loads (81.1%), static posture underground (81.9%), working in confined spaces (77.9%), jolts from machinery (66%) and personal factors contributing towards lower back pain were age, smoking (71.8%), and existing respiratory condition (58.5%). No significant association was found between job satisfaction and the lifting of heavy loads.

Conclusion: Increasing age, diagnosed respiratory condition and nature of work were found to be significantly associated with LBP in coal miners. It is recommended to define and implement proper guidelines for the coal miners. This will improve their quality of life, as well as minimize disability-oriented risks associated with LBP.

Keywords: Coal miners, Disability, Lower back pain, Musculoskeletal disorders, Pakistan

¹Al-Shifa School of Public Health, Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan

²Associate Professor & Head, Al-Shifa School of Public Health, Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan

³Senior Lecturer and Research Supervisor, Pakistan Institute of Ophthalmology, Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan

⁴Public Health Research Officer, Eye Donors Organization, Wah Cantt, Pakistan

Corresponding author:

Midhet Nasim, Pakistan Institute of Ophthalmology, Al-Shifa Trust Eye Hospital, Jhelum Road, Rawalpindi, Pakistan.
Email: midhet.nasim1@gmail.com

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).

All copyrights © are reserved with Foundation University Journal of Dentistry (FUJD) under **(CC BY-NC-ND 4.0)**. FUJD is an open-access peer-reviewed journal; however, reproduction of and adaptations to the articles published in FUJD in any form is not permitted without the written permission of the Editor-in-Chief. FUJD does not allow commercial use of any article published in FUJD. All articles published represent the view of the authors and do not reflect the official policy of FUJD.

How to cite this Article:

Arif M, Kawish AB, Nasim M, Zeb A. Lower Back Pain and Disability: An Occupational Public Health Dilemma of Chamalang, Balochistan Coal Miners. Found Univ J Dent. 2021;1(1):18-24.

INTRODUCTION

Musculoskeletal disorders (MSDs) such as pain, inflammation, paresthesia or poorly functioning muscle, nerve, bone or joint are reported to be associated with many professions including miners, healthcare workers and drivers.¹ They have negative impacts on quality of life such as work-related disability as well as substantial financial implications related to medical expenses and workers compensation. Coalmining poses numerous high-risk health challenges of varying degrees including cardiovascular, gastrointestinal, skin, joints and many more with MSDs being a characteristic health feature of the miners.²

Lower back pain (LBP) is one of the most common causes of musculoskeletal disorders. It can be defined as a “Subjective perception of pain in the lower back, buttocks, or legs” while “Disability” associated with coal mining is a complex phenomenon ranging from activity limitations, participation restrictions to permanent impairment.³ An estimated 80% of the general population experiences a back problem at some point in their life.⁴ The 2010 global burden of disease study reported lower back pain as one of the top ten diseases and/or injuries causing the highest number of disability-adjusted life years (DALYs) worldwide.⁵

The Mining industry as reported in scientific literature has the highest reported incidences of Lower Back Pain, back injury ratio and other musculoskeletal disorders. Vertebral disc compression, spinal sprains due to lifting heavy loads, jolts of drill machine, working in confined spaces and others are examples of the occupational hazards that expose the miners to lower back pain and disability.⁶

In Pakistan, coal mining is very important and is a significant contributor to the economy. Pakistanis refer to coal as “Black Pearl” and to meet the country's interminable demands of energy it is being extracted from Chamalang coal fields in Baluchistan since 1973.⁷ Despite technological advancements, most of the coal mining at Chamalang is of underground conventional type and is pre-dominantly non-mechanized and hence miners are expected to lift heavy loads, work crouched or in bent positions and are often exposed to vibrations. Over the years, the mining industry has witnessed long term health issues and disabilities including accidents and even fatalities.

Despite the existence of international standards such as those formulated by the World Health Organization (WHO) and International Labor Organization (ILO) and national regulations such as the provision of Mines Act and/or provision of essential safety equipment in the 1923 Act, irregularities and violations have been reported. Safety equipment to protect against the emission of deadly gases are also either not available or not in the use of the coal miners. In the absence of implementation of standardized protocols, the coal miners are at serious risk of occupational hazards including health hazards.^{8,9}

From reviewing the literature, it was found that significant gaps existed in exploring predisposing risk factors to occupational hazards associated with conventional non-mechanized coal mining particularly in Baluchistan, Pakistan. Therefore, this study aims to develop an understanding of occupational risk factors contributing to lower back pain and disability in coal miners. The objective of this study is to determine the occupational and personal factors associated with lower back pain (LBP) and disability in coal miners of Chamalang, Baluchistan.

MATERIALS AND METHODS

This cross-sectional study was designed whereby a validated Oswestry Lower Back Questionnaire was used to record lower back pain and disability in coal miners from Chamalang, Baluchistan. A hypothetico-deductive approach was adopted to investigate the relationship between musculoskeletal and respiratory condition with the nature of work performed by coal miners in Chamalang. Al-Shifa Eye Trust IRB provided ethical approval for this study as part of the Masters in Public Health Degree Course (MSPH-IRB-02/02-04).

The data collection took four months. Adult underground coal miners aged 20 years and above were included in the study, primarily males owing to the protracted and laborious nature of the work and cultural and ethnic restrictions to women from working in the field.

The probability multistage sampling technique was used for the selection of an appropriately sized sample. Randomly, through a lottery, amongst all the coal mines in the Chamalang area, one was selected for this study. The owner of the coal mine provided the researchers with an attendance sheet of 1200 coal miners attending

the mine. They were stratified into 400 were surface coal miners and 800 underground coal miners. Surface coal miners were excluded from the study. Based on the nature of work they do, amongst the 800 underground coal miners, there were 600 loaders, 100 drillers and 100 blasters working in the coal mine. The statistical formula $n = (z)^2 p (1 - p) / d^2$ was used to calculate a sample size representative of the proportion of underground coal miners in each sub-group having lower back pain. A total sample size of 375 was calculated. To obtain this sample size, using a simple random sampling technique, every third loader, every third blaster and every third driller was selected for data collection. The final sample included 282 loaders, 46 blasters and 46 drillers. Figure 1 illustrates the sampling technique used for the study.

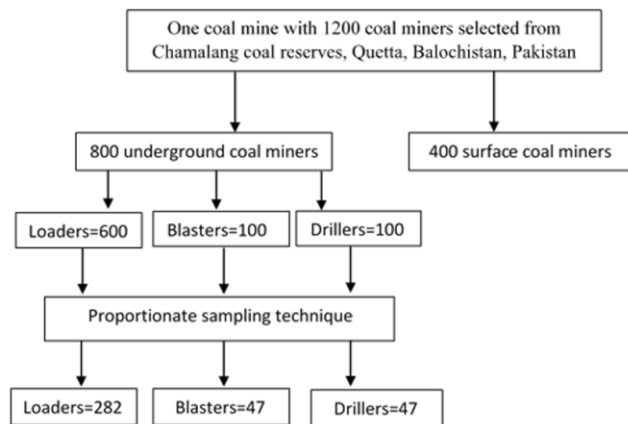


Figure 1: Flow chart showing sampling technique used for the study.

The study excluded surface coal miners, miners who were suffering from a systemic health condition and lower back pain before starting work at the mines and those miners unwilling to participate in the study.

The data collection tool was a validated, structured questionnaire that was initially pilot tested for reliability and validity and then revised to fulfil the requirement of this study. Since most coal miners were unfamiliar with the English language owing to the cultural backdrop and literacy levels of the study population, to compensate for the language barrier, a notarized translation of the tool into the Urdu language was done for the convenience of the miners. To assess the degree of disability in coal miners, the Oswestry Disability Index (ODI)¹⁰ derived from the Oswestry Lower Back Pain Questionnaire¹¹ was used. A validated Urdu translation

of the ODI done by the Notary Public in Quetta was used.

The data collected were analysed using statistical software Statistical Package for Social Sciences® version 20.0. Descriptive statistics and chi-square statistical tests were performed on the data, by the authors. The study population was not blinded.

This study was a part of a research project for the completion of a post-graduate program and was self-funded. The respondents were not blinded. However, all data collected was following informed consent while confidentiality and privacy of the responses were maintained, at all times.

RESULTS

Data of 376 underground coal miners from the Coal Mining Sector of Baluchistan (Pakistan) was collected. Respondents were between 20 years to 50 years with the majority between 31-41 years of age (50%). 207 respondents had a work experience of 5-10 years (55.1%) working in Chamalang coal mines. 270 respondents were smokers (71.8%). Seventy-five per cent of the total study population was of loaders.

Results on basic demographic and occupational variables, as shown in Figure 2, revealed 330 respondents claiming lower back pain, 244 were diagnosed with a respiratory condition, 293 had worked in confined spaces, and 290 had an experience of trunk twisting during work.

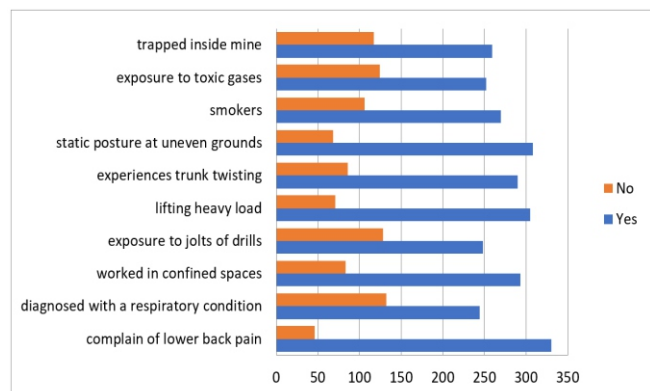


Figure 2: Assessment of lower back pain in underground conventional coal miners in Chamalang

Results of the study revealed an alarming 87.8% of the respondents having complaints of Lower back pain. Amongst the respondents, 134 aged 20-30 years, 168 aged 31-41 and 28 aged 42-50 complained of lower

back pain during the last 3 months. Results also showed that 220 respondents were diagnosed with a respiratory condition and had a complaint of lower back pain. No significant association was found between job

satisfaction and the lifting of heavy loads. Table 1 shows the association of, lifting heavy loads and job satisfaction of respondents with a complaint of lower back pain in the last three months.

Table 1: Association of Lower back pain with occupational variables

	Lifting of heavy loads		Job satisfaction		Age of respondents			Diagnosed respiratory condition	
	YES	NO	YES	NO	20-30 years	31-41 years	42-50 years	YES	NO
Any episode of pain in lower back/buttocks/legs during last 3 months									
YES	72.1%	15.7%		22.4%	35.6%	44.7%	7.4%	58.5%	29.35
NO	9.0%	3.2%	28.2%	8.5%	4.3%	5.3%	2.7%	6.4%	5.9%
χ^2	1.776		0.053		7.807			3.722	
Df	1		1		2			1	
p-value	0.183		0.818		0.02			0.042	

77.9% of this population owed LBP to confined space in coal mines, 66% attributed LBP to jolts of drilling machines, 81.1 % identified lifting heavy loads as a contributing factor to LBP, 77.1% experienced trunk twisting, 81.9% complained of static posture at the uneven ground as a predisposing condition to LBP and 59 % of the total respondents associated LBP with the repetitiveness of work.

Out of the total study population, 259 (68.9%) miners had been trapped inside a mine at least once in their mining careers. An alarming 67% reported exposures to toxic gases during mining.

A relatively significant proportion of respondents reported severe disability, i.e., 34.8% blasters, 33.9% loaders and 39.2% drillers. From 46 blasters there were 7 mildly disabled, 10 moderately, 16 severely, 8 crippled and 5 exaggerated their complaints. From 283 loaders, there were 25 mildly disabled, 78 moderately, 96 severely, 63 crippled and 20 were exaggerating. There were 8 persons from the drilling category with mild disability, 9 moderately disabled, 18 severely disabled and 10 were crippled. Figure 3 illustrate the degree of disability reported by miners in the blasting, loading and drilling groups.

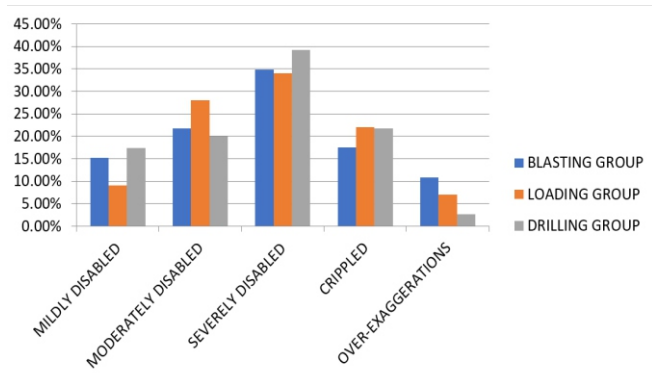


Figure 3: Degree of disability in underground conventional coal miners, in Chamalang

DISCUSSION

The scarcity of research on non-mechanized conventional coal mining particularly in Pakistan was a major contributing factor to the design and formulation of this study investigating the relationship between muscular-skeletal problems such as lower back pain and occupational experiences of coal miners. Research has shown that since underground mining is dangerous and involves serious risks to health and safety, devising protocols and national-level regulations to incorporate applied principles of ergonomics has become essential to ensure the former.¹²

Amongst the 376 respondents aged between 20-50 years, 259 responded with having been trapped in mines during their work experience to date of data collection. In this study, the majority of the participants complained of LBP. Similar studies have been reported which showed LBP being the major complaint among the coal miners.¹³⁻¹⁵ Besides LBP, 58.5% of the study participants also diagnosed with respiratory conditions as an occupational variable. Recently, a study was performed which assessed disability degree in coal miners using pulmonary function and hypoxemia with Pneumoconiosis and a result showed significant association.¹⁶ Coal mine dust causes a spectrum of lung diseases collectively termed coal mine dust lung disease (CMDLD). A study has shown that coal mine dust remains a relevant occupational hazard and miners remain at risk for CMDLD.¹⁷

A significant 77.9% associated their lower back pain with working in confined spaces in the mines. Another significant finding from the study was the contribution of working in static postures at uneven grounds to lower back pain of coal miners. These findings are coherent with MSD risk factors reported in scientific literature, associated with obstructive work environments including low ceiling heights, hot humid temperatures at/inside physically laborious work sites.¹⁸⁻²⁰

In this study, a strong association between bending, the repetitiveness of work, twisting, jolts of drilling machine occupational risk factors and reports of LBP with varying degrees of disability were observed which is coherent with the previous studies.²¹⁻²⁴ Identification of these occupational risk factors provides valuable information for planning, implementation and evaluation of injury prevention programs and devising guidelines for the management of occupation hazards for coal miners. Another significant finding was the exposure of the coal miners to toxic gases. A recent study has shown similar findings where coal mine dust lung disease contributes to significant morbidity and mortality among those exposed.²⁵ Through active participation from all stakeholders' procedures for hazard identification, risk assessment, evaluations for improvements, policing of implementation of these procedures and follow-ups conducted with due diligence can facilitate creating a support structure to minimize these occupational health hazards related to coal mining in Pakistan.

Inaccessibility and poor infrastructure approach to Chamalang coal mines was a major limiting factor while conducting this study. The area is remote, under-developed and sensitive owing to local disputes and the prevailing uncertain law and order situation were an additional challenge to reaching the coal mine for data collection. The researchers were able to build trust and rapport for data collection from the miners through strong advocacy and personal acquaintances with the locals. Limited resources such as accommodation and lodging for the researchers, funding and human resource for data collection also posed constraints in conducting this study.

This study was a first step towards identifying the prevalence of lower back pain and associated disability in underground non-mechanized coal miners and personal and occupational factors that contribute towards lower back pain and associated levels of disability. The researchers suggest further research and organized efforts in this field to identify and bring to light the issues relating to the health and quality of life of underground coal miners in Pakistan. Moreover, the health challenges associated with the general working milieu and safety of the coal miners in rural Balochistan discovered in the study need to be highlighted at public health forums. Periodic medical examinations and the provisions of universal health care need to be made accessible at affordable costs to coal miners to address the degree of disability associated with their occupation.

CONCLUSION

The compelling percentage of underground coal miners having lower back pain and varying degrees of disability associated with personal factors such as age, years of work experience and existing spinal injury and/or respiratory conditions and occupational variables such as nature of work, posture, bending of the trunk during work, lifting of heavy loads suggest a significant association of these occupational and personal factors with musculoskeletal issues in miners.

ACKNOWLEDGMENTS

We would like to extend our gratitude to the faculty of Al-Shifa School of Public Health, Al-Shifa Trust Eye and our families and friends for their support and encouragement.

DISCLAIMER

None.

CONFLICT OF INTEREST

None to declare.

ETHICAL STATEMENT

Al-Shifa Eye Trust IRB provided ethical approval (MSPH-IRB-02/02-04) for this study as part of the Masters in Public Health Degree Course.

AUTHORS CONTRIBUTION

Conception and design of the study: M. Arif, A.B. Kawish

Acquisition of data: M. Nasim

Analysis and interpretation of data: M. Nasim, A. Zeb

drafting of the manuscript: M. Nasim

Critical review of the manuscript: M. Nasim, A. Zeb

Approval of the final version of the manuscript to be published: M. Arif, A.B. Kawish, M. Nasim, A. Zeb

REFERENCES

- Ijaz M, Ahmad SR, Akram MM, Thygerson SM, Ali Nadeem F, Khan WU. Cross-Sectional Survey of Musculoskeletal Disorders in Workers Practicing Traditional Methods of Underground Coal Mining. *Int J Environ Res Public Health*. 2020;17(7):2566.
- Ijaz M, Akram M, Ahmad SR, Mirza K, Ali Nadeem F, Thygerson SM. Risk Factors Associated with the Prevalence of Upper and Lower Back Pain in Male Underground Coal Miners in Punjab, Pakistan. *Int J Environ Res Public Health*. 2020;17(11):4102. doi: 10.3390/ijerph17114102.
- Louw QA, Morris LD, Grimmer-Somers K. The prevalence of low back pain in Africa: a systematic review. *BMC Musculoskelet Disord*. 2007;8:105. doi: 10.1186/1471-2474-8-105.
- Bernstein IA, Malik Q, Carville S, Ward S. Low back pain and sciatica: summary of NICE guidance. *BMJ*. 2017;356:i6748.
- Hoy D, March L, Brooks P, Blyth F, Woolf A, Bain C, et al. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. *Ann Rheum Dis*. 2014;73(6):968–74.
- Kroemer KHE. Ergonomic design for material handling systems. CRC Press; 2017.
- Malkani MS, Shah MR. Chamalang coal resources and their depositional environments, Balochistan, Pakistan. *J Himal Earth Sci*. 2014;47(1).
- Ashraf H, Cawood F. Implementation plan for a new mineral policy development framework and mining cadastre system for Pakistan. *J Sci Technol Policy Manag*. 2019;(10)2:371-403.
- Ishtiaq M, Jehan N, Rehman Z, Hussain H, Wahid MI, Kibria Z, Iftikhar B, Khan GS, Bakhtiar M. Frequency of Musculoskeleton Health Problems and its Relation with Demographic Variables among Cherat Coal Miners District Nowshera Khyber Pukhtunkhwa Pakistan. *J Dow Uni Health Sci* 2014; 8(3): 117-120.
- Fairbank JCT, Pynsent PB. The Oswestry disability index. *Spine (Phila Pa 1976)*. 2000;25(22):2940–53.
- Intensity P. Oswestry Low Back Pain Disability Questionnaire. Berlin Heidelberg: Springer; 2013.
- Winn FJ, Biersner RJ, Morrissey S. Exposure probabilities to ergonomic hazards among miners. *Int J Ind Ergon* [Internet]. 1996;18(5):417–22. Available from: <https://www.sciencedirect.com/science/article/pii/0169814195001042>
- Xu G, Pang D, Liu F, Pei D, Wang S, Li L. Prevalence of low back pain and associated occupational factors among Chinese coal miners. *BMC Public Health*. 2012;12(1):1–6.
- Zejsa JE, Stasiów B. Cervical spine degenerative changes (narrowed intervertebral disc spaces and osteophytes) in coal miners. *Int J Occup Med Environ Health*. 2003;16(1):49–53.
- Jeripotula SK, Mangalpady A, Mandela GR. Ergonomic Assessment of Musculoskeletal Disorders Among Surface Mine Workers in India. *Mining, Metall Explor*. 2021;38:1041–1046.
- Duo C, Zhao Q, Li C, Wang J, Wu J. The Comparison of Assessing Disability Degree by Pulmonary Function and Hypoxemia on Coal Workers with Pneumoconiosis. *Int J Educ Econ*. 2020;3(3):50-53.



17. Laney AS, Weissman DN. Respiratory diseases caused by coal mine dust. *J Occup Environ Med*. 2014;56 Suppl 10(0 10):S18-22. doi: 10.1097/JOM.0000000000000260.
18. Brinckmann P, Frobin W, Biggemann M, Tillotson M, Burton K. Quantification of overload injuries to thoracolumbar vertebrae and discs in persons exposed to heavy physical exertions or vibration at the workplace Part II Occurrence and magnitude of overload injury in exposed cohorts. *Clin Biomech*. 1998;13 Suppl 2:S1–36.
19. Korhan O, Memon AA. Introductory chapter: work-related musculoskeletal disorders. *Work Musculoskelet Disord*. 2019;1–10.
20. Dinar A, Susilowati IH, Azwar A, Indriyani K, Wirawan M. Analysis of ergonomic risk factors in relation to musculoskeletal disorder symptoms in office workers. *KnE Life Sci*. 2018;16–29.
21. Wami SD, Abere G, Dessie A, Getachew D. Work-related risk factors and the prevalence of low back pain among low wage workers: results from a cross-sectional study. *BMC Public Health* [Internet]. 2019;19(1):1072. Available from: <https://doi.org/10.1186/s12889-019-7430-9>
22. Chisenge S. Occupation-related low back pain and functional activities of mineworkers from Solwezi District, Zambia. [thesis on the Internet]. Bellville, Republic of South Africa: University of Western Cape; 2017 [cited 2021 May 31]. Available from: <http://hdl.handle.net/11394/6141>
23. Parker TW, Worringham CJ, Greig K, Woods SD. Age-related changes in work ability and injury risk in underground and open-cut coal miners. 2006;
24. Jones R, Cattani M, Cross M, Boylan J, Holmes A, Boothroyd C, et al. Serious injuries in the mining industry: preparing the emergency response. *Australas J Paramed*. 2019;16. doi: <https://doi.org/10.33151/ajp.16.652>.
25. Gandhi S, Cohen RA, Blanc PD, Rasmussen DL, Go L. Coal Mine Jobs with High Silica Exposure Predict Abnormal Gas Exchange During Exercise. In: A105 SILICA, INORGANIC DUST, AND MINING. *Am J Respir Crit Care Med* 2020;201:A2633.