Upper Respiratory Allergic Symptoms And Effects Of Coal Dust On Pulmonary Function Tests Of Individuals Working In Coal Mines, Near Quetta, Baluchistan, Pakistan

Zafar Ahmad Khan[1], Muhammad Imran Aslam[2], Mohammad Hashir Ahmad[3], Mohammad Tayyab Ahmad[3], Hajira Ishaq[4], Zahoor Ahmed[4]

[1]Department of Medicine, Bolan Medical College Quetta, Baluchistan.
[2]Department of Medicine, Sharif City Hospital, Lahore, Punjab.
[3]Rehman Medical College & Rehman College of Dentistry, Peshawar, Khyber Pakhtunkhwa.
[4]Department of Biochemistry, Khyber Medical College, Peshawar, Khyber Pakhtunkhwa

ABSTRACT

Objective

This research was carried in order to know hazardous outcomes of coal mine dust on upper respiratory system and their pulmonary function tests.

Methodology

In this longitudinal cross sectional study, we evaluated upper respiratory allergic symptoms and pulmonary function tests deterioration cause by coal dust exposure in coal mines workers near Quetta, Baluchistan (from October 2018 to March 2019). A total of 336 individuals working in coal mines meeting the preset selection criteria were selected and 41 normal healthy individuals of same age and sex were selected from the general public of the same region who had never been exposed to coal dust/coal mines and served as control group.

Results

Their pulmonary functions were recorded by (SX MULTI SPIRO, USA) and for the analysis of data SPSS version 18 was employed. The result shown in frequency and percentages, Chi Square test was used and *p* value of ≤ 0.05 was considered as significant.

Conclusion

Unprotected exposure to coal dust for longer period of time has bad impact on pulmonary function test and biochemical parameters and is associated with increased frequency of upper respiratory tract allergic symptoms.

Key words

Quetta, Coal mine, Pulmonary Function Test, Microspheres

***For Correspondence**

Dr. Zahoor Ahmed

Professor, Department of Biochemistry Khyber Medical College Peshawar.

Email
zakhan70@yahoo.co.uk

INTRODUCTION

Occupational and environmental respiratory diseases have a long history.[1] Observation of the association between health and surrounding traced in which philosophy, reasoning and observation lead to the idea that ill health resulted from an imbalance between human beings and their environment.[2] Vulnerability to air contamination is linked with increased cardiovascular mortality and morbidity.[3-5] The proposed mechanisms include oxidative stress, systemic inflammation, autonomic nervous, system imbalance and abnormal epigenetic changes.[6] The diseases of the respiratory system induce by occupational dust are determined by type, size, concentration of dust, and duration of exposure and breathing in the zone[2]. Coal dust is one of the important causes of lung disease as it a major energy source worldwide. In the United States (US), > 50% of electricity is generated in coal-fired power plants. Recent debate in the US has focused on increasing coal use and its effects on environment.

In fact, energy costs from a new coal power plant are low, between $ 0.035 and $ 0.04/kW-Hr. However, coal mining causes environmental issues such as acid mine drainage, whereas the inhaled coal particles at the work place may lead to the development of coal workers' pneumoconiosis (CWP), CWP deaths accounted for half of the pneumoconiosis deaths during the 10–year period from 1990 to 1999. Hazardous effects of air pollution on human health have been widely studied. Several researches have been carried out in the recent past to find an association between air pollution and pulmonary function test abnormalities,[7-8] or to establish a correlation between air pollution and mortality from cardio–respiratory causes.[9-10] Coal mine workers are at risk for a range of chronic respiratory diseases including coal workers' pneumoconiosis, diffuse dust-related fibrosis, and chronic obstructive pulmonary disease.[11]

There is an increase in the risks of developing asthma and chronic obstructive pulmonary disease (COPD), such as chronic bronchitis and emphysema among the workers of coal mining according to

This article may be cited as: Khan, Z. Upper Respiratory Allergic Symptoms And Effects Of Coal Dust On Pulmonary Function Tests Of Individuals Working In Coal Mines, Near Quetta, Baluchistan, Pakistan. Adv Basic Med Sci. 2021; 5(1): 07-10

occupations listed by the US. Coal mining is the highest risk job according to the census industry code and is related with asthma and COPD death, Federal "black lung" program payments amounted to > $ 1.5 billion for nearly 19 million legatees in 1999. Occupational lung disease compensation, costs can bring the total cost from $ 0.035–0.04/kW–Hr to as high as $ 0.0556–0.083/kW–Hr. If we can forecast the injurious effects of coal before mining, we may be able to develop screening and prevention programs that carefully monitor early bad effects and, thus, reduce health care costs related.[12-13]

Unfortunately, very few studies have been carried out in this region of the world i.e. Baluchistan, Pakistan where a large number of people are working in coal mines and are expose to coal dust most of the hours of day without any protective clothing or masks etc. It is very important to establish the safety of such units from the care point of view. Since no facilities are available to measure the size of various particles in the ambient air, we studied only the pattern and frequency of various respiratory symptoms and tried to establish their correlation with pulmonary function abnormalities in these workers.

METHODOLOGY

The present cross sectional study was carried out at Department of Medicine, Bolan Medical College (BMC), Quetta, Baluchistan in collaboration with Department of Biochemistry & Clinical Chemistry, Khyber Medical College (KMC), Peshawar, Khyber Pakhtunkhwa, Pakistan on coal mine workers of coal mines situated near Quetta (from October 2018 to March 2019). Approval of study taken from the Ethical Committee of BMC Quetta. A total of 336 individuals working in coal mines meeting the preset selection criteria were included in the study and 50 apparently normal healthy individuals of same age and sex were randomly selected from the general public of the same region who were never exposed to coal dust/coal mines and served as controls. Out of total study subjects 336 who had exposure to coal mine and or coal dust were further divided into two subgroups on the basis of exposure time (i.e. < & > 62000 working hours). Those who were exposed for less than 62000 working hours was labeled as group–1 and the other which was exposed for more than 62000 working hours was labeled as group–2 respectively. After getting informed consent their initial data, age, weight, height etc. were measured and recorded. Performa regarding upper respiratory tract symptoms were filled and their pulmonary function tests were done and recorded on predesigned Performa.

For the analysis of data SPSS version 18 was employed and the difference between these groups and normal healthy subjects (controls) was compared. Chi square test was used and p value of < 0.05 was considered as significant.

RESULTS

Table–1 depicts general anthropometric information of the individuals that were examined during this research work. Significant differences (p < 0.05) were noted for systolic and diastolic blood pressure and use of tobacco as snuff (Naswar). Regarding pulmonary function test FEV1/FVC of 52 %, PEF of 68% and FEF_{25} of 68% were less than 80% of the predictive values in group–2. While FEV1/FVC of 33.30%, PEF of 47.10% and FEF_{25} of 41.40% were less than 80% of the predictive value in group–1. In control group FEV1/FVC of 35.30%, PEF of 23.50% and FEF_{25} of 17.60% were less than 80% of the predicted. The difference between these groups was noted to be significant (p < 0.05) as given in Tables–3, 4 & 5 respectively.

If we summarize, 25 (normal healthy individuals, were taken as controls) and 258 coal mine workers exposed group and was divided further into two groups on the basis of exposure time (i.e. < & > 62000 working hours). The frequency of upper respiratory tract allergic symptoms were more exposed group with cough in 68%, sneezing in 52%, shortness of breath in 84%, headache in 52%, eye burning in 72% and nasal irritation in 68% respectively. Regarding pulmonary function tests FEV1/FVC of 52%, PEF of 68% and FEF_{25} of 68% were less than 80% of the predictive value in more exposed group than the controls. The difference between these groups was significant (p < 0.05) when compared with controls.

Parameters	Coal Mine Workers	Controls	p – value
Age (Years)	51.50±6.75	49.50±8.25	0.16
Weight (Kg)	78.25±16.80	80.00±19.80	0.63
Height (Meters)	1.90±0.65	1.75.00±0.65	0.52
SBP (mm Hg)	129.00±6.75	118.00±18.45	0.04
DBP (mm Hg)	88.00±6.75	75.00±20.18	0.06
Snuff (Naswar)	45.00%	14%	0.03

Table-I. Basic Information of Study Population

URT Symptoms	Controls	Group–1	Group–2
Cough	6 (11.8%)	99 (37.9%)*	51 (68%)*
Sneezing	3 (05.9%)	108 (41.4%)*	13 (52%)*
Shortness of breath	6 (11.8%)	123 (47.1%)*	63 (84%)*
Headache	6 (11.8%)	120 (46.0%)*	39 (52%)*
Eye burning	9 (17.6%)	102 (39.1%)*	54 (72%)*
Nasal irritation	6 (11.8%)	117 (44.8%)*	51 (68%)*

**p value less than 0.05; Controls = Not exposed to coal dust. Group–1 = Exposed to coal dust up to 62000 working hours Group–2 = Exposed to coal dust from 62001-125000 working hours*

Table–2: Upper Respiratory Tract Symptoms among the Study Population.

Frequency	Controls	Group–1	Group–2
80% & above	42 (82.35%)	174 (66.70%)	36 (48.0%)*
65 to 79%	09 (17.65%)	54 (20.70%)	24 (32.0%)*
50 to 64%	00 (00%)	30 (11.50%)	12 (16.0%)*
35 to 49%	00 (00%)	03 (01.10%)	03 (04.0%)*
Less than 34%	00 (00%)	00 (00%)	00 (0%)*

**p < 0.05; Controls = Not exposed to coal dust, Group–1 = Exposed to coal dust up to 62000 working hours, Group–2 = Exposed to coal dust from 62001-125000 working hours*

Table - 3: Forced Expiratory Volume 1/Forced Vital Capacity (FEV1/FVC) of Study Population

Frequency	Controls	Group–1	Group–2
80% & above	39 (76.50%)*	138 (52.90%)*	24 (32.0%)*
65 to 79%	12 (23.50%)*	90 (34.50%)*	24 (32.0%)*
50 to 64%	00 (00%)	33 (12.60%)*	21 (28.0%)*
35 to 49%	00 (00%)	00 (00%)	06 (08.00%)*
Less than 34%	00 (00%)	00 (0%)	00 (00%)

**p < 0.05; Controls = Not exposed to coal dust, Group–1 = Exposed to coal dust up to 62000 working hours, Group–2 = Exposed to coal dust from 62001-125000 working hours*

Table – 4:Forced Expiratory Flow (FEF) of the Study Population.

Frequency	Controls	Group–1	Group–2
80% & above	33 (64.70%)*	153 (58.60%)*	24 (32.0%)*
65 to 79%	18 (35.30%)*	63 (24.11%)*	21 (28.0%)*
50 to 64%	00 (0%)	33 (12.60%)*	21 (28.0%)*
35 to 49%	00 (0%)	12 (04.60%)*	09 (12.0%)*
Less than 34%	00 (0%)	00 (00%)	00 (00%)

**p < 0.05; Controls = Not exposed to coal dust, Group–1 = Exposed to coal dust up to 62000 working hours, Group–2 = Exposed to coal dust from 62001-125000 working hours*

Table –5: Forced Expiratory Flow 25% (FEF_{25}) of the Study Population.

DISCUSSION

Mining (especially underground) needs tools and manpower to operate beneath the earth. Subsurface atmosphere may be adulterated with poisonous gases that replace the necessary oxygen to support life or flammable gases that may cause ignition and thus cause explosion. Therefore, it is necessary to develop technologies and find ways to exactly calculate concentration levels of poisonous and combustible gases levels in subsurface atmosphere for protection of underground coal mines.[14] Environmental air pollution due to industries, power stations and nearby motorway almost always results in an increase in acute and persistent respiratory symptoms among the affected individuals. Coal fire is responsible for almost half of the particulate air pollution, and increase in the concentrations of which similarly results in increase number of respiratory signs and symptoms.[15] However, some studies have failed to show such relationship our study confirm a significant higher prevalence of acute and chronic respiratory symptoms among exposed individual in both group–1 and 2 as compared to control population and thus is in agreement with the above mentioned study. This fact conforms the impact of pollution at work place on respiratory symptom that has been studied extensively in past few years' evidence suggest that allergic diseases are becoming more common particularly in industrial localities severe asthma also occur more commonly in individual living in polluted areas. Exercised induced asthma and use of asthma medicine was twice as high in areas near power stations where coal was used as source of energy to run these industrial plants. Wilkie *et al.*, (1995),[16] in his study reported in New Zealand that the frequency of upper respiratory symptoms increases in people who are bared to higher levels of carbon particles and coal dust, which in our study is also true as allergic symptoms were prevalent in all individuals exposed to coal dust and was more in severity and frequency in those who were exposed for longer period of time than those who were exposed for shorter period of time. In a study by Dockery and colleagues (1996),[17] a relationship was found between air pollution, respiratory symptoms, and lung function. Similar results were observed in our study. The study done by Khalid *et al.*, (1996),[18] failed to show any relation between exposure time and derange pulmonary functions in nonsmoker individuals. This may be due to less no of particles in the atmosphere due to proper exhaust system, the coal composition may contain less iron content which in turn is responsible for worsening of lung function, our study was associated with derange pulmonary function test and more respiratory symptoms which may be due to poor cross ventilation inside coal mines, less proper protective measures resulting in continues excessive exposure to coal dust and thus is contradictive to study conducted by Khalid and colleagues.

Impact of various type of occupational air pollution on respiratory symptoms and respiratory functions has also been studied in past few years in detail. It is interesting to note that the organic and inorganic dust both affects the ventilator function but there is definite association between organic dust (leather, cotton, jute, flour etc.).[19] Many studies confirm that correlation between air pollution and pulmonary function abnormalities or mortality

depend on relative concentration of the size of various particles in polluted air.[20-21] The results of our study also match those in which the respiratory symptoms and functions were affected by the exposure to dust at occupational place. The increase frequency of allergic symptoms and pulmonary functions deterioration seen in our study confirms that unprotected exposure to coal dust in coal mines have hazardous effects on human health. Further studies on larger scale need to be done to establish the relationship between the respiratory tract problems and exposure to coal dust in the workers working there.

CONCLUSION

Unprotected exposure to coal dust for longer period of time has bad impact on pulmonary function test and biochemical parameters and is associated with increased frequency of upper respiratory tract allergic symptoms. Those workers who are exposed for longer period of time without protective mask and clothing have greater frequency of upper respiratory tract allergic symptoms and impaired pulmonary function test as compared to control group.

REFRENCES

1. Corn J K. Historical Perspective. In: Occupational and Environmental Respiratory Disease Marc Ph, Shenker B, Balmes Jr (Ed). London, Mosby. 1996; Pp: 3-4.
2. Mengrsha Y A, Bekele A. Relative Chronic Effects of Different Occupational Dust on Respiratory Indices and Health of Workers in Three Ethiopian Factories. Am J indmed. 1998; 34:373–80.
3. Qian Z, Bloom, M S, Heinrich J, Dharmage S C, Rolling C A, Savannah S. Jordan, Komppula M, Leskinen A, Bowatte G, Shanshan Li, Chen G, Liu K K, Xiao-Wen Z, Li-Wen Hu, Guang-Hui D. Association of Long-term Exposure to Ambient Air Pollutants With Risk Factors for Cardiovascular Disease in China. JAMA Netw Open. 2019; 2(3):e190318.
4. Chen K, Wolf K, Breitner S, *et al*., UF & HEALTH Study Group. Two-way effect modifications of air pollution and air temperature on total natural and cardiovascular mortality in eight European urban areas. Environ Int. 2018; 116:186–96.
5. Cesaroni G, Forastiere F, Stafoggia M, *et al*., Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE Project. BMJ. 2014; 348:f7412.
6. Rajagopalan S, Al-Kindi SG, Brook RD. Air pollution and cardiovascular disease: JACC State-of-the-Art Review. J Am Coll Cardiol. 2018; 72(17):2054–70.
7. Pope C A III. Respiratory Diseases Associated With Community Air Pollution And A Steel Mill, Utah Valley. Am J Public Health.1989; 79:623–28.
8. Willes S R, Fitzgerald T K, Permutt T, Proud D, Haley N J, Bascom R. Acute Respiratory Response to Prolonged Moderate Level of side stream Tobacco Smoke. J Toxicol Envuron Health.1998; 53(3):193–209.
9. Evan J S, Tosteson T, Kinney P L, Cross sectional Mortality Studies and air Pollution Risk Assessment. Environ Int.1984; 10:55–83.
10. Devereux G, Ayatollahi T, Bromly C, Bourke S J, Stenton S C, Hendrick D J. Asthma, Air Ways Responsiveness and Air Pollution in two Contrasting Districts of Northern England. Thorax. 1996; 51(2):169–74.
11. Go LH, Kreth SD, Cohen RA & Rose CS. Lung disease and coal mining: what pulmonologists need to know? Curr Opin Pulm Med. 2016; 22(2):170–78.
12. Attfield M D, Kuempel E D. Pneumoconiosis, Coalmine Dust and the PFR. Ann Occup Hyg. 2003; 47:525–29.
13. Xi Huang, Weihong Li, Michael D. Attfield, Arthur Nádas, Krystyna Frenkel and Robert B Finkelman. Mapping and Prediction of Coal Worker's Pneumoconiosis with Bioavailable Iron Content in the Bituminous Coals. Environ Health Prospect. 2005; 113(8): 964–68
14. Kumar A, Kingson TMG, Verma RP, Kumar A., Mandal R, R, Dutta S, Chaulya K and Prasad G M. Application of Gas Monitoring Sensors in Underground Coal Mines and Hazardous Areas. IJCTEE. 2013; 3(3):9–23.
15. News WHO sets new guidelines for air pollution 2009.
16. Wilkie A T, Fordrb, Pattemore P, Schulter P J, Town I, Graham P. Prevalance of Childhood Asthma Symptoms in an Industrial Suburb of Christchurch. N Z Med J.1995; 108(1000):188–90.
17. Dockery D, Pope CA. Epidemiology of acute health effects: summary of time-series studies. In: Wilson R, Spengler J, eds. Particles in our air. Boston: Harvard University Press, 1996; 123–47.
18. Khalid G H, Ali M, Ahmed J, Abbas M N. Prevalence Of Respiratory Symptoms And Their Correlation To Pulmonary Function abnormalities In Individuals Exposed To Environmental Pollution. Pak J Med Res. 1999; 38(1):32–37.
19. Sunyer J, Kogevinas M, Kromhout H, Anto J Met Al. Pulmonary Ventilatory Defects and Occupational Exposure In A Population-Based Study in Spain. Spanish Group of the European Community Respiratory Health Survey. AMJ Respire Critcare Med. 1998; 157(2):512–17.
20. Miller F J, Gardner D E, Graham J A, Leere J R, Wilson W E, Bachman J D. Size Consideration of Inhalable Particles. J Air Poll Control Assoc. 1979; 29:610–15.
21. Chestnut L G, Schwartz J, Savitz D A, Burchfiel C M. Pulmonary Function and Ambient Particulate Matter: Epidemiological evidence from NHANES I. Arch Environ Health. 1991; 103:172–77.