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LUNG FUNCTION EVALUATION THROUGH SPIROMETRY IN STONE CRUSHING WORKERS OF QUETTA DISTRICT, PAKISTAN

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ABSTRACT

Purpose:

The study was planned to evaluate the influence of silicon dust on lung function between stone crushing workers and general population.

Methodology:

The one hundred and six male study respondents age of 20 years and above were considered, out of which 53 were from stone crushing workers and 53 were from general population randomly selected from Quetta district, Pakistan. Respondents were divided into two groups; group-I (stone crushing workers) and group-II (general population). Data was collected by self-designed performa and Spirometer. The forced vital capacity (FVC), forced expiratory volume in one second (FVE1), peak expiratory flow rate (PEFR), ratio of FEV1 and FVC (FEV1/ FCV %) and forced mid expiratory flow ($FEF_{25-75\%}$) were calculated and explored. The frequency, percentage and descriptive statistical measurements were observed for both groups by using SPSS 22.

Friedman's two-way analysis of variance by rank (1) test was applied and Sig level (P<0.05) was observed.

Result:

The mean value of FVC in stone crushing workers was (61.3%) and means value of FVC in control group was (69.2%). The FEV1 mean value for the stone crushing workers was (70.0%) and in control group the mean value was (77.4 %). The mean value for PEFR was (77.2%) in stone crushing workers but the mean value for PEFR in control group was (86.1%). The mean value for FEV1/FVC ratio was (114.5%) in stone crushing workers and in control group mean values was (112.2%). The mean value for $FEF_{25-75\%}$ was (104.6%) in stone crushing workers and the mean value for $FEF_{25-75\%}$ in control group was (108.5%).

Conclusion:

This study was concluded that no significant difference found between silicon dust exposed group and non-exposed group, both the groups showed slightly restrictive lung defects but the non-exposed group was bit better than the silicon exposed group.

Keywords: Stone Crushing, spirometry, control group, FVC, FEV1, PEFR, FEV1/FVC%, FEF_{25-75}.

INTRODUCTION

Silica is a most important and constituent, mineral ores, rock and is the another utmost corporate mineral in the earth's outside afterward to feldspar (Bahrami *et al*., 2008). Standard term states to the chemical compound SiO2 silicon dioxide which take place naturally in shapeless, crystal-like and glassy shapes (Bahrami *et al*., 2008). The inhaled particles of silica become placed in lung and these are very slowly removed from the lung (Rathod, Mane, Handergulle, & Kekan, 2014). These elements put forth their end product on lung straight afterward the contact is still (Rathod et al., 2014). Work-related contact to respirable crystal-like silica roots silicosis is connected with tuberculosis and lung cancer may be associated to the growth of autoimmune diseases such as rheumatoid arthritis and chronic renal disease (Gottesfeld, Nicas, Kephart, Balakrishnan, & Rinehart, 2008). The silicosis, utmost projecting of the silica correlated morbidities is an interstitial, lung infection produced principally via the mouthful of air of free crystal-like silica (Gottesfeld et al., 2008). Prolonged silicosis has a potential era of 10-30 exposure years to respirable crystal-like silica soil at comparatively little concentrations (Gottesfeld et al., 2008). The acute silicosis, though, typically matures

after very great respirable crystalline silica levels contacts causing in beginning of signs in as slight as a small number of weeks to 5 years post contact (Gottesfeld *et al*., 2008).

Studies have also shown a three time bigger danger for emerging tuberculosis in work forces by silicosis associated to personsminus silicosis (Gottesfeld et al., 2008).The outcomes of earlier studies display that contact to all these possibly hypersensitive or irritation mediators could effect in increased of asthma risk and deterioration in lung function bronchial hyper alertness. (Bohadana *et al*., 2000; Halpin, Graneek, Turner-Warwick, & Taylor, 1994; Malo, Cartier, Desjardins, Weyer, & Vandenplas, 1995; Schlünssen, 2001; Spiewak, Bozek, Maslowski, & Brewczynski, 1994). Exposure to Crystalline silica most important adverse effects include silicosis, certain connective tissue disorders , lung cancer and chronic bronchitis (Bahrami et al., 2008; Parks, Conrad, & Cooper, 1999). Spirometer is a valued device to help the specialist segregate standard from nonstandard lung function define obstructive from restrictive defects and show the disease or super vision (Kaslovsky & Sadof, 2014) and (Bugti et al., 2017).

The present study aims to conclude statistical evidences around the ecological injuries and the poor workers health status that are at work in stone crushing and associated doings and living with their families, living in the surrounding area where stone crushing machines are fixed. The valley of Quetta is enclosed by a large number of mountains and stone crushing machines are operating in these mountains day and night. The main objective of this study was to find the comparison of lung function between stone crushing worker and general population.

MATERIALS AND METHOD

This study was case-control study. The study was conducted in Quetta, district of Balochistan, Pakistan. The male stone crushing workers and general population were targeted in this study. The stone crushing workers and general population were randomly selected from Quetta district of Balochistan, Pakistan. One hundred and six stone crushing workers and general population were considered.

Data Collection Instruments:

The self-designed questionnaire and Spirometer were used in this study. The parameters of questionnaires were 1. Demographics part; age, gender, birth place, qualification and work exposure. 2. Physical examination; this part contains weight in kg, height in m2, BMI, pulse speed, blood pressure (Systolic/Diastolic) and related to

the diseases like anemia, respiration, cardio vascular system, urinary tract infection, central nervous systems and others. 3. Spirometer Parameters; FVC (Forced Vital Capacity), FEV1 (Forced Expiratory Volume in One Second), PEFR (Peak expiratory flow rate), FEV1/ FVC ratio and FEF_{25-75}% (Forced mid expiratory flow). 4. This part consists of consent form.

Study Procedure:

The pre consent was taken from the every study respondents of both groups and also informed about the objective of the study. The interview conducted on stone crushing workers and general population of the Quetta district of Balochistan, Pakistan and recorded the data in the questionnaire and spirometry test was performed for stone crasher workers and general population separately, FVC (forced vital capacity), FEV1 (forced expiratory volume in one second), PEFR (peak expiratory flow rate, FEV1/ FVC ratio and FEF_{25-75}% (forced mid expiratory flow) were calculated and analyzed.

Statistical Analysis:

The frequency, percentage and descriptive statistical measurements were observed for both groups by using SPSS 22. Friedman's two-way analysis of variance by rank (1) test was applied and Significance level ($P<0.05$) was observed.

Ethical Requirements:

Study was approved by the Research and Ethics Committee, Faculty of Pharmacy and Health Sciences, University of Baluchistan, Pakistan. Earlier consent was filled from all the study respondents of both groups' stone crushing workers and general population of Quetta district of Balochistan, Pakistan.

RESULT

Group-I: Stones crushing workers; total fifty three males exposed to silicon dust were selected out of which age group of 20-29 were 31 (58.4%), age group 30-39 were 14 (26.4%) , age group 40-49 were 05 (9.4%) and age group 50 & above were 04 (7.5%). The mean±sd of age was 29.83±9.80, smokers were 19 (35.8%) and non-smokers were 34 (64.2%). The mean±std of pulse rate was 84.70±12.95, systolic blood pressure was 133.40± 9.42, diastolic blood pressure was 82.75±12.10 and BMI was 24.90±5.07 as shown in table no 01. The prevalence of anemic disease in stone crushing workers were 2 (3.8%),respiratory disease were 13 (24.5%), cardio vascular disease were 3 (5.7%) as shown in table no.02.

Group-II: control group; total fifty three males un-exposed to silicon dust were selected out of which age group of 20-29 were 28(52.8%), age group 30-39 were 18(33.9%), age group 40-49 were 05 (9.4%)

and age group 50 & above were 02 (3.7%). The mean±sd of age was 30.45±7.95, smokers were 15 (28.30) and non-smokers were 38 (71.69). The mean±std of pulse rate was 81.58±15.49, systolic blood pressure was 122.91±11.70, diastolic blood pressure was 81.13±9.33and BMI was 24.91±3.96as shown in table no 01. The prevalence of anemic disease in control group of males were 4 (7.5%), cardio vascular patient and central nervous system patient was only 1 (1.9%) each as shown in table no.02.

Spirometry comparison between stone crushing workers and control group (general population) as shown in table no.03; the FVC mean value in stone crushing workers were 61.3% percent which concluded that moderate obstructive defects can be present whereas the control group shows FVC mean value about 69.2%,which indicates mild obstructive defects.

The FEV1 mean value for the stone crushing workers was 70.0% which indicates the mild obstructive defects but in control group the mean value was 77.4 %, shows also mild obstructive defects. The mean value for PEFR was 77.2% in stone crushing workers which shows mild obstructive defects but the mean value for PEFR was 86.1%, shows restrictive defect minimal obstructive defects. The mean value for FEV1/FVC ratio was 114.5% in stone crushing workers and in control group mean values was 112.2% which shows both groups were in normal range. The mean value for FEF25-75% was 104.6% in stone crushing workers and the mean value was 108.5% for FEF25-75% which show that the mean standards of together groups were falling in the standard range as shown in table no.03 significance level ($p<0.001$).

Table 1: Demographics Characteristics of Stone Cursing Workers and Control Group

Description (N=53)	Age (M ± SD)	Smokers N (%)	Non-Smokers N (%)	Pulse (M ± SD)	Sys B.P (M ± SD)	Diast B.P (M ± SD)	BMI (M ± SD)
Stone Crushing Workers	29.83±9.80	19 (35.8)	34 (64.2)	84.70±12.95	133.40±9.42	82.75±12.10	24.90±5.07
Control Group	30.45±7.95	15(28.30)	38(71.69)	81.58±15.49	122.91±11.70	81.13±9.33	24.91±3.96

1. BMI = Body mass index. 2. Sys B.P= Systolic blood pressure.3. Diast B.P= Diastolic blood pressure. 4. M = Mean. 5. SD = Standard deviation

Table 2: Prevalence of Different Diseases in Stone Cursing Workers and Control Group

Description (N=53)	Anemia N (%)	Respiration N (%)	CVS N (%)	UTI N (%)	CNS N (%)	Other N (%)
Stone Crushing Workers	2 (3.8)	13 (24.5)	3 (5.7)	Nil	Nil	Nil
Control Group	4(7.5)	Nil	1(1.9)	Nil	1(1.9)	Nil

CVS= Cardio vascular disease, UTI = Urinary tract infection, CNS = central nervous system

Table 3: Spirometry Comparison Between Stone Crushing Workers and Control Group

Description	FVC Percent			FEV1 Percent			PEFR Percent			FEV1/FVC Percent			FEF25-75 Percent			Friedman's Two-Way Analysis of Variance by Rank(1)
Stone Crushing Workers Age Group	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**P<0.001**
20-29	**31**	**61.7**	**13.1**	**31**	**70.0**	**13.3**	**31**	**78.3**	**17.7**	**31**	**114.3**	**3.5**	**31**	**101.5**	**21.7**	
30-39	**14**	**61.5**	**14.4**	**14**	**71.1**	**17.0**	**14**	**72.5**	**15.9**	**14**	**114.7**	**8.8**	**14**	**112.8**	**26.0**	
40-49	**05**	**55.6**	**10.1**	**05**	**61.8**	**3.2**	**05**	**76.8**	**9.7**	**05**	**115.2**	**6.1**	**05**	**103.6**	**15.1**	
50&>	**03**	**66.0**	**12.2**	**03**	**76.6**	**7.0**	**03**	**88.6**	**20.1**	**03**	**114.3**	**8.3**	**03**	**99.6**	**23.8**	
Total	**53**	**61.3**	**13.0**	**53**	**69.9**	**13.7**	**53**	**77.2**	**16.7**	**53**	**114.5**	**5.7**	**53**	**104.6**	**22.5**	
Control Group Age Group	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**N**	**M**	**SD**	**P<0.001**
20-29	**28**	**69.0**	**10.98**	**28**	**76.2**	**10.8**	**28**	**84.1**	**17.9**	**28**	**110.9**	**6.1**	**28**	**91.4**	**15.8**	
30-39	**18**	**68.0**	**10.69**	**18**	**76.6**	**10.9**	**18**	**83.3**	**15.9**	**18**	**113.1**	**4.8**	**18**	**90.8**	**27.5**	
40-49	**05**	**70.6**	**12.97**	**05**	**82.2**	**15.9**	**05**	**105.2**	**24.6**	**05**	**116.5**	**4.2**	**05**	**103.6**	**23.3**	
50&>	**02**	**79.5**	**79.50**	**02**	**88.5**	**6.3**	**02**	**93.0**	**24.0**	**02**	**111.3**	**8.9**	**02**	**98.5**	**36.0**	
Total	**53**	**69.2**	**10.85**	**53**	**77.4**	**11.2**	**53**	**86.1**	**18.6**	**53**	**112.2**	**5.7**	**53**	**108.5**	**21.4**	

1. FVC = Forced Vital Capacity.2.FEV1 = Forced expiratory volume one second.
3. PEFR = Peak expiratory flow rate.4.FEV1/FVC%=Ratio.5.$FEF_{25-75\%}$ = Forced mid expiratory flow

DISCUSSION

The study conducted in India concluded that highly substantial reduction in value of $FEF_{25-75\%}$ in stone crusher as compared to controls (Rathod et al., 2014) . The parallel results were detected in the studies performed by (Choudat, Frisch, Barrat, El Kholti, & Conso, 1990), (Chia, Ng, & Jeyaratnam, 1992), (N MOHAN Rao et al., 1992), (Ghotkar, Maldhure, & Zodpey, 1995), (Koo et al., 2000), and (Meijer, Kromhout, & Heederik, 2001). But present study concluded that no substantial difference were establish between the value of $FEF_{25-75\%}$ for stone crushing workers and control group, but the control group (general population) was a little improved than stone crushing workers which result was conflicting to the result of recent studies were performed as cited above.

The disorder (MDAD) Mineral Dust Airway Disease take place due to particulate substance resembling silica (Churg & Wright, 1998). The barriers of respiratory bronchioles and alveolar ducts mostly affected by silica (Churg & Wright, 1998). This responsive oxygen species generated by silica produces fibro genic growth factors in airway epithelium and inflammation of cells that recruit fibro genic reaction (Hnizdo &

Vallyathan, 2003). The pathological abrasion contains of pigmentation, inflammatory infiltrates and fibrous tissue (Rathod et al., 2014). Entirely this variation supsets respiratory bronchioles and these variations lead to obstruction in airflow and reduction of $FEF_{25-75\%}$ (Koo et al., 2000).

Extremely meaningfully decreased in the value of PEFR in all employees when matched by way of controls (Ghotkar et al., 1995; Johncy, Ajay, Dhanyakumar, PrabhuRaj, & Samuel, 2011; Nellore Mohan Rao, Takiar, & Sharma, 2006; Rathod et al., 2014; Singh, Chowdhary, & Purohit, 2006; Sivacoumar, Jayabalou, Swarnalatha, & Balakrishnan, 2006; Tiwari, Sharma, & Saiyed, 2004). Observed no important change in a study performed by (Merenu, Mojiminiyi, Njoku, & Ibrahim, 2007). The PEFR value in existing study was reduced in stone crushing workers but was normal in control group (general population), which shows PEFR value was better in control group than stone crushing group. Which was not accordance with studies performed through (Rathod et al., 2014) and (Merenu et al., 2007).

The PEFR (peak expiratory flow rate) is resolute by the forced expiration pressure exerted and from now on expiratory muscle power (Rathod et al., 2014). The PEFR is other struggle reliant on and expiratory airway resistance index (Rathod et al., 2014). The released protein from eosinophil in inflammatory response may give to the hyperactive reaction of airway (Rathod et al., 2014). of The upper respiratory tract mucosa irritation due to sustained silica contact in hypertrophy of mucosal inside layer (Meijer et al., 2001). Then increased mucus secretion and mucosal plugs formation which reasons obstruction to breathe out air (Tiwari et al., 2004). Obstructed airways failure more with no trouble than the typical airways which results in reduced movement of exterior air (Rathod et al., 2014). This decreases the peak expiratory flow rate (Rathod et al., 2014). The scarring bronchial and hypertrophy connected lymphoid tissue and intra-pulmonary lymph node might also compress larger airways and decease in peak expiratory flow rate (Chierakul, Boonyarattaphun, & Nana, 2007).

The predicted percentage value of FVC and $FEV_{\%}$ in the silica contact group were superior than non-contact group (Chattopadhyay, Gangopadhyay, Bandopadhyay, & Alam, 2006), but in present study the value of FVC is better in non-exposed group (control group), but the predicted value for $FEV_{\%}$ in both groups were felled in normal range but in exposed group (stone crushing

group) is bit better than non-exposed group (general population). The utmost extensively used Spiro metric parameter is FEV1 for airway obstruction calculation (Kumar, Mampilly, Rao, & Anand, 2014). The FVC (Forced vital capacity**)** and FEV1 both and $FEV1/FVC_{\%}$ were used for diagnostic purposes (Kumar et al., 2014). If the predicted value for $FEV1/FVC_{\%}$ is lesser than estimated it indicates the of obstructive lung defects and if the value of FEV1 and FVC are together reduced associated with and $FEV1/ FVC_{\%}$ is normal or in elevation than estimated indicates restrictive lung defects (Kumar et al., 2014). If the estimated value for $FEV1/ FVC_{\%}$ more than 80% shows restrictive lung diseases lightly obstruction lung defects, if in the range of estimated value between 65 - 80% shows, minor obstructive lung disease, if the range between 50 - 65%, shows modest obstructive lung disease if the estimated value less than 50% indicates severe obstructive lung disease (Bugti et al., 2017).

RECOMMENDATIONS

For exposed group (stone crushing workers) individual safety, suitable masks would be worn and they want to be washed or the filter would be reformed as and as soon as necessary. For stop accidents throughout stone crushing process, the appropriate usage of detachable fence with cable nets (foldable by joints) is required. Special kinds of shoes and dresses for this work is as well necessary and chemical examination for silicon dust must be performed.

For the non-exposed group (general population), a fitness awareness program is essential to increase their healthiness wakefulness. The key straight forward need is to sustain worthy health, fitness education, a sustained consciousness program, pre assignment, and episodic medical investigations and recording outcomes are compulsory.

CONCLUSION

This study was concluded that no significant difference were found between silicon dust exposed group and non-exposed group (general population), both the groups showed slightly restrictive lung defects but the non-exposed group was bit better than the silicon exposed group.

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