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RESEARCH ARTICLE

EFFECT OF PULMONARY REHABILITATION ON FUNCTIONAL CAPACITY OF LUNG AND DYSPNEA IN PATIENT SUFFERING FROM SILICOSIS

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ABSTRACT

Purpose of study: Pulmonary rehabilitation often incorporates self-management strategies to promote treatment adherence and this approach has been advocated for bronchiectasis. There is limited evidence for the effects of pulmonary rehabilitation in silicosis so there is the need for physiotherapist to know the effect of pulmonary rehabilitation in silicosis. There are many option for clinical therapist to treat silicosis, as this condition associated with many impairments. Wide varieties of approach are available to treat such a condition. Pulmonary Rehabilitation is comprehensive intervention based on a thorough patient assessment followed by patient tailored therapies. So there is need for the therapist to know better treatment option for patient with silicosis. As a research, purpose, there are many article which shows significant improvement in COPD patients by PR. but, only few studies are supporting the same effect in non-COPD condition . So, there is the need of the study to check whether the same benefit can be obtained by PR in silicosis patients.

Methods: Out of 60 patients, only 48 patients were selected based on inclusion and exclusion criteria and divided equally into two groups.

Outcome Measures: PFT (FVC, FEV1/ FVC), MODIFIED MEDICAL REASERCH DYSPNEA SCALE.

Procedure: Pulmonary rehabilitation for 45 min/ a day for 4 days/ a week for 4 week.was designed according to American Thoracic Society/European Respiratory Society Statement JUNE 2013. The data were analysed useing t-test.

Conclusion: This study concludes that a supervised pulmonary rehabilitation program of 4 weeks duration have improved functional capacity of lungs and dyspnea. in patients with silicosis.

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INTRODUCTION

Silicosis is a lung disease caused by breathing dust that contains extremely fine particles of crystalline silica. Crystalline silica is a common mineral found in materials such as sand, quartz, concrete, masonry, and rock. As the body tries to eliminate these irritating particles that lodge in the lungs, inflammation causes scarring of lung tissue. The result is a less efficient transfer of oxygen and decreased lung capacity. (American Lung Assosiation. Silicosis 2014) Historically, silicosis used to be called 'knife grinders' lung. Silicosis is caused by prolonged inhalation of silicon dioxide, commonly called silica. Silica constitutes about one-fourth of earth's crust. Therefore, a number of occupations engaged in silceous rocks or sand and products manufactured from them are at increased risk. These include miners (e.g. of granite, sandstone, slate, coal, gold, tin and copper), quarry workers, tunnellers, sandblasters, grinders, ceramic jewelry foundry workers and those involved in the manufacture of abrasives containing silica. Peculiar to India are the occupational exposure to pencil, slate and agate-grinding industry carrying high risk of silicosis (agate = very hard stone containing silica). (Mohan, 2011) Silicosis is defined as an occupational lung disease attributable to the inhalation of silicon dioxide, commonly known as silica, in crystalline forms, usually as quartz, but also as other important crystalline forms of silica, for example, cristobalite and tridymite. These forms are also called "free silica" to distinguish them from the silicates. The silica content in different rock formations, such as sandstone, granite and slate, varies from 20 to nearly 100% According to Parker, John, Wagner, Gregory R. International Labor Organization, Geneva, 2011. (Parker *et al*., 2011) silicosis lung disorder caused by continued, long-term exposure to the dust of an inorganic compound, silicon dioxide, which is found in sands, quartzes, and many other stones; chronic silicosis is marked by widespread fibrotic nodular lesions in both lungs (Rebert and Kacmarek 10th edition) Silicosis is a potentially irreversible, fibrotic pulmonary disease that may develop subsequent to the inhalation of large amounts of silica dust over time. In most circumstances, silicosis only develops subsequent to substantial

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occupational exposures. The disease has a long latency period and may clinically present as an acute, accelerated, or chronic disease (Michal and Greenberg, 2007) Silicosis is an occupational lung disease attributable to the inhalation of silicon dioxide, commonly known as silica, in crystalline forms, usually as quartz, but also as other important crystalline forms of silica, for example, cristobalite and tridymite. These forms are also called "free silica" to distinguish them from the silicates. The silica content in different rock formations, such as andstone, granite and slate, varies from 20 to nearly 100%. (Parker and Wagner, 2011) Silica refers to the chemical compound SiO2 (silicon dioxide) that occurs in two speci c and distinct forms: amorphous and crystalline. The word "crystalline" implies that the silicon and oxygen atoms are oriented and related to each other in a xed pattern as opposed to the random fashion that predominates in the amorphous form of silica. Workers engaged in speci c occupations, such as abrasive blasting, may have the potential for medically important exposures to crystalline silica. The American College of Occupational and Environmental Medicine (ACOEM) considers that silica exposure today is still widespread and the estimated death rate due to silicosis in the United States may be in the range of 200 to 300 individuals per year (American College of Occupational and Environmental Medicine). It has been noted that some workers may have the potential for silica exposure even despite efforts to limit and control occupationally based exposures (Occupational Safety and Health Administration (OSHA) 2004). Occupational exposure to respirable crystalline silica (aerodynamic diameter <10μm) occurs in many industries and occupations, whenever substances or materials containing free crystalline silica (eg, rocks and stones) are mechanically broken down to form dust or when those containing ne particles of silica (eg, silica our and sand) are handled or disturbed. (Silicosis, 2012)

The U.S. mining industry continues to deny hazards associated with silica exposure while keeping itaway from the public eye. This, along with faulty lawsuits from the early 2000's, leads to questions about thevalidity of silicosis. Despite political and in dustrial debate, the worker's exposed to silica continue to suffe r. Sincechronic silicosis is the most common form of silicosis, generally occurring after 10 or more years of exposure, thiscan give workers a false security, or "it will never happen to me" m entality. While this is the train of thought industry appears to follow, this is the type of thinking that needs to be altered. (A Brief Review of Silicosis in the United States, 2010). China has the most patients with silicosis, with more than 500 000 cases recorded between 1991 and 1995, and 6000 new cases and more than 24 000 deaths reported annually. (WHO, 2011) The problem is particularly acute for workers in small-scale mines, who often have an accelerated form of disease (Tse *et al*., 2007). In the Brazilian gold-mining area in Minas Gerais alone, more than 4500 workers were reported to have had silicosis between 1978 and 1998 (Carneiro *et al*., 2006). Of gold miners in South Africa dying from external causes (eg, injuries, burns, poisoning, and drowning), proportions with silicosis identi ed at autopsy increased from 3% to 32% for black miners and from 18% to 22% for white miners between 1975 and 2007 (Nelson *et al*., 2010). Silicosis is also an occupational health concern in developed countries. About 600 000 workers in the UK and more than 3 million workers in Europe were exposed to crystalline silica from 1990 to 1993. (Kauppinen *et al*., 2000) Mostly, less than 100 cases were reported every year in the UK between 1996 and 2009, and deaths from silicosis declined from 28 in 1993, to ten in 2008(http://www.hse.gov.uk/statistics/causdis/pneumoconiosis/index.htm). In the USA, more than 121 000 workers were exposed to concentrations of respirable crystalline silica of 0·05 mg/m³ or more in 1993 (Linch *et al*., 1998). and 3600–7300 silicosis cases occurred annually from 1987 to 1996 (Rosenman *et al*., 2008). Overall age-adjusted mortality rates in the USA declined from 8·9 per million in 1968, to 0·7 in 2004 (Bang *et al*., 2008). However, silicosis deaths in young adults (aged 15–44 years), which are probably a result of intense and recent exposures, have not fallen since 1995 (Mazurek and Att eld, 2008). Protective measures (eg, dust control and respirators) have caused a steady decline in death rates due to silicosis in the past few decades in developed countries, but new outbreaks still occur occasionally. (Bang *et al*., 2008; Madl *et al*., 2008; Seaton *et al*., 1991) According to an Indian Council of Medical Research report, it is estimated that about 3 million workers in India are at high potential risk of silica exposure employed in a variety of occupations including construction workers. An infrequent acute form of silicosis called accelerated silicosis produces irregular fibrosis adjoining the alveoli which is filled with lipoproteinaceous exudates and resembles alveolar proteinosis (Mohan, 2011). Following sporadic reports of silicosis and deaths among the agate grinders, NIOH carried out detailed About 19% of the male agate grinders and 22% of female agate grinders developed silicosis within five years. The overall prevalence of tuberculosis amongst male and female agate grinders was 37.4% and 40.3% respectively. Pulmonary function abnormalities were found in about 51% grinders. The mean "total" and "respirable" dust concentrations during agate grinding were 25.4 (14.5‑35.1) and 2.74 (1.73‑4.04) mg/M3 respectively, which are much higher than the prescribed limits. The free silica contents of the dust were 60%. Clinical radiological survey of agate workers which showed that the problem of silicosis was most severe among the agate grinders. The prevalence of silicosis in male and female agate grinders was 39.8% and 34.2% respectively. (National Insti tute of Occupational Heal th (NIOH)) Agate is a hard, semiprecious stone, a variety of chalcedony, with striped or clouded coloring and containing high amount of free silica (>60%). It is used to make cheap jewelry and various articles of decoration. Dust is generated mainly during the grinding process. Grinding of the stones is carried out indoors or under open shade, on electric emery. Dust generated during grinding pervades the work environment as well as the community (Saiyed, 2004) Agate grinding and polishing is a traditional vocation in the Khambhat Taluka of Gujarat and Jaipur (Rajasthan) (National Insti tute of Occupational Heal th (NIOH)). In India, an estimated 3 million workers are exposed to silica in mines and in industries, such as stone cutting, silica milling, agate, slate pencil, etc. it was stated by national institute of occupational health. (Nayanjeet Chaudhury *et al*., 2010) Among these, the highest prevalence of silicosis is in the slate pencil industry (54.5%) followed by workers in agate industries (38%). There are very few epidemiological studies on silicosis in India where the prevalence of silicosis varies from 3.5% in ordnance factory to 54.6% in slate pencil industry (Kulkarni, 2007). This

situation is true of the Shakarpur area of Khambhat, a coastal city of Gujarat, India, where several small agate stone polishing units operate from individual houses for many decades (Census of India, 1960). However, there is no systematic documentation of patients' records to date. Workers manufacture ornaments, decorative and showcase items from agate and other stones in their households (Nayanjeet Chaudhury *et al*., 2010).

Even though silicosis is a notifiable disease as per factories act 1948. The provisions of the Act are applicable only to the registered units in an organized sector. There is no system in place for medical professionals to document and inform government public health systems about the morbidity and mortality associated with silicosis (Nayanjeet Chaudhury *et al*., 2010). Total agate grinders in Shakarpura village in Khambat are around 200 (Deepak *et al*., 2011). Although silicosis is an ancient disease, new cases are still reported in both the of morbidity and mortality. Contemporary workers are still exposed to silica dust in a variety of occupations—and when new technology lacks adequate dust control, exposures may be to more hazardous dust levels and particles than in non-mechanized work settings. (Parker *et al*., 2011)

Role of Physiotherapy

Exercise has been reported to have beneficial effects in the management of a multitude of conditions. Its benefits range from enhancing all steps in the oxygen transport pathway to other peripheral and central effects related to virtually every other organ system. The preventive effects of exercise are central to patient care across all conditions and physical therapy specialties. Exercise is advocated preventively to avoid the deleterious effects of immobility and to provide optimal systemic health protection secondary to cardiopulmonary conditioning. Mobilization and exercise are the physical therapist's (PT's) "dug" with definable indications, contraindications, and side effects for each patient. The primary clinical manifestations of an acute exacerbation of interstitial pulmonary fibrosis reflect an acute or chronic problem usually resulting from an inflammatory episode, pulmonary infection, or both. The mechanisms responsible include reduced alveolar ventilation, an inflammatory process and its manifestations, potential airway obstruction, and increased work of breathing and of the heart in severe cases. These patients are prone to desaturation during exercise and thus need to be monitored closely.(62)

In mild cases, mobilization increases the homogeneity of ventilation, and ventilation and perfusion matching (Jernudd-Wilhelmsson *et al*., 1986). Between treatments and in the management of the severely affected patient, body positioning is used to reduce the work of breathing and arousal, maximize alveolar ventilation, maximize ventilation and perfusion matching, and optimize coughing. Patients with moderate-to-severe interstitial lung disease may desaturate during sleep (Perez-Padilla, West, and Lertzman, 1985) and readily desaturate on physical exertion (Arita, Nishida, and Hiramoto, 1981), thus warranting close monitoring during and between treatments. Increased pulmonary vascular resistance secondary to hypoxic vasoconstriction contributes to increased work of the right heart and potential cardiac insufficiency. General debility and deconditioning warrant a modified exercise program that can optimize the function of all of the steps in the oxygen transport pathway (Arita *et al*., 1981; Chung and Dean, 1989). Dyspnea (shortness of breath) is supposed to be the most troublesome symptom in respiratory systemic diseases (63)in patient with silicosis. Pursed-lips breathing (PLB) is a technique whereby exhalation is performed through a resistance created by constriction of the lips. Although the breathing maneuver is often spontaneously adopted by patients, it is also routinely taught as a breathing-retraining exercise in pulmonary rehabilitation programs because it is thought to alleviate dyspnea. It appears, however, that not all patients obtain symptom benefits from PLB.(64) Pulmonary rehabilitation is an established component in the therapy of patients with chronic obstructive pulmonary disease (COPD).(65) Since the American Thoracic Society (ATS)/European Respiratory Society (ERS) Statement on Pulmonary Rehabilitation was published in 2006(66). this intervention has advanced in several ways.(67)

In 2006, pulmonary rehabilitation was de ned as "an evidence-based, multidisciplinary, and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic and often have decreased daily life activities. Integrated into the individualized treatment of the patient, pulmonary rehabilitation is designed to reduce symptoms, optimize functional status, increase participation, and reduce healthcare costs through stabilizing or reversing systemic manifestations of the disease."(67) On the basis of current insights, the ATS and the ERS have adopted the following new de nition of pulmonary rehabilitation: "Pulmonary rehabilitation is a comprehensive intervention based on a thorough patient assessment followed by patient-tailored therapies, which include, but are not limited to, exercise training, education, and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence of health-enhancing behaviors." (67) There is increased evidence for use and ef cacy of a variety of forms of exercise training as part of pulmonary rehabilitation; these include interval training, strength training, upper limb training, and transcutaneous neuromuscular electrical stimulation. Pulmonary rehabilitation provided to individuals with chronic respiratory diseases other than COPD (i.e., interstitial lungdisease, bronchiectasis, cystic brosis, asthma, pulmonary hypertension, lung cancer, lung volume reduction surgery, and lung transplantation) has demonstrated improvements in symptoms, exercise tolerance, and quality of life. Frequent reasons for referral to pulmonary rehabilitation include persistent respiratory symptoms (dyspnea, fatigue) and/or functional status limitations despite otherwise optimal therapy. A list of conditions considered appropriate for this intervention is shown in Table.

Pulmonary rehabilitation can be provided in inpatient and out-patient settings, and exercise training can also be provided in the individual's home. Outpatient settings include hospital outpatient departments, community facilities, and physiotherapy clinics (67). There is no consensus on the

optimal duration of pulmonary rehabilitation. Duration of rehabilitation for the individual patient is ideally set by continued progress toward goals and optimization of bene t; in reality it is also in uenced by the resources of the program and reimbursement issues. The number of sessions per week offered by pulmonary rehabilitation programs also varies; whereas outpatient programs commonly meet 2 or 3 days/week, inpatient programs are usually planned for 5 days/week.

Table 1. Conditions appropriate for referral to pulmonary rehabilitation

Conditions appropriate for referral to pulmonary rehabilitation		
Obstructive diseases	Restrictive diseases	Other conditions
COPD	Interstitial lung diseases Interstitial brosis	Lung cancer
Persistent asthma	Occupational/ environmental lung disease	Pulmonary hypertension
Diffuse bronchiectasis	Sarcoidosis Connective tissue diseases	Before and after thoracic and abdominal surgery
Cystic brosis	Hypersensitivity pneumonitis	Before and after lung transplantation
	Lymphangiomyomatosis	Before and after lung volume reduction surgery
Bronchiolitis obliterans	ARDS survivors	Ventilator dependency
	Chest wall diseases	
	Kyphoscoliosis	Obesity-related respiratory disease
	Ankylosing spondylitis Posttuberculosis syndrome	

The session length per day is generally1–4 hours, which is usually within the attention span and physical capability of a patient with chronic respiratory disease(68). There remains no evidence-based guidance for optimal staff-to-patient ratios in pulmonary rehabilitation. In general, staffing for pulmonary rehabilitation is as variable as the structural design. The predominant clinical discipline of the program co-coordinator and supporting professional staff varies globally, with physical therapists in the majority in Australia, South America, and Europe, whereas respiratory therapists most commonly direct programs in the United States. Despite this variability, there is no one best staffing structure. The American Assosiation of Cardiovascular and Pulmonary Rehabilitation (AACVPR) uses ratios of 1:4 for exercise training, 1:8 for educational sessions, and 1:1 for complex patients ; the British Thoracic Society uses ratios of 1:8 for exercise training (with a minimum of 2) and 1:16 for educational sessions. These ratios are based on experience and opinion. Patient-centered outcomes have historically been used for patient assessment and measurement of change or impact of pulmonary rehabilitation in chronic respiratory disease. Individuals with chronic respiratory disease often have symptoms such as dyspnea, fatigue, cough, weakness, sleeplessness, and psychological distress (67) Breathlessness is the most commonly reported symptom for individuals with COPD, and may be present at rest and on exertion (69) Dyspnea assessment instruments can be divided into the following: short-term intensity tools situational measures, and impact measures. Fatigue assessment instruments are divided into short-term intensity tools and impact measures. (70-78).

Pulmonary function testing and MRC are valuable tools in epid emiologic studies of occupational lung disease. Pulmonary function tests (PFT) help in the evaluation of the mechanical function of the lungs. They are based on researched norms taking into account sex, height, and age When the patient performs the test actual results (observed) will be compared with the predicted value expected of a person of gender, height, and age to see if he falls within the "normal" range, or has a restrictive or obstructive component based on the tests. The flow volume curve is helpful in diagnosing lung disease, since it is independent of effort. In restrictive lung disease, the maximum flow rate is reduced, as is the total volume exhaled. In obstructive lung disease, the flow rate is low in relation to lung volume, and a scooped-out appearance is often seen (79) The MRC breathlessness scale does not quantify breathlessness itself. Other tools such as the Borg scale or visual analogue scales are used for that Rather, it quanti es the disability associated with breathlessness by identifying that breathlessness occurs when it should not (Grades 1 and 2) or by quantifying the associated exercise limitation (Grades 3–5). There is up to 98% agreement between observers recording MRC breathlessness scores The score correlates well with the results of other breathlessness scales,lung function measurements and with direct measures of disability such as walking distance. The MRC (r = 0.59 to 0.66)[80] breathlessness scale comprises ve statements that describe almost the entire range of respiratory disability from none (Grade 1) to almost complete incapacity (Grade 5). It can be self-administered by asking subjects to choose a phrase that best describes their condition, e.g. 'I only get breathless with strenuous exertion' (Grade 1) or 'I am too breathless to leave the house' (Grade 5). Alternatively, it can be administered by an interviewer with the statements framed as questions, e.g. 'Are you short of breath when hurrying on the level or walking up a slight incline' (Grade 2). The score is the number that best ts to the patient's level of activity. All the questions relate to everyday activities and are generally easily understood by patients. A score can usually be obtained in a few seconds(81)
So, in this study an effort is made to know the effect of pulmonary rehabilitation on patient with silicosis in anand district.

Aims and objectives of the study

- The aim of this study is, to know the effect of pulmonary rehabilitation on dyspnea and functional capacity of lung in patient with silicosis.
- To know the effect of educational program on dyspnea and functional capacity of lung in patient with silicosis.
- To compare effect of pulmonary rehabilitation and education program on dyspnea and functional capacity of lung in patient with silicosis.

Purpose of study

Pulmonary rehabilitation often incorporates self-management strategies to promote treatment adherence and this approach

has been advocated for bronchiectasis. There is limited evidence for the effects of pulmonary rehabilitation in silicosis so there is the need for physiotherapist to know the effect of pulmonary rehabilitation in silicosis.

- There are many option for clinical therapist to treat silicosis, as this condition associated with many impairments. Wide varieties of approach are available to treat such a condition. Pulmonary Rehabilitation is comprehensive intervention based on a thorough patient assessment followed by patient tailored therapies. So there is need for the therapist to know better treatment option for patient with silicosis.
- As a research, purpose, there are many article which shows significant improvement in COPD patients by PR. but, only few studies are supporting the same effect in non-COPD condition . So, there is the need of the study to check whether the same benefit can be obtained by PR in silicosis patients.

Proposed hypothesis

Null hypothesis (H0): There is no significant difference between the effect of pulmonary rehabilitation and education program on functional capacity of lung and dyspnea in silicosis patient

Alternate hypothesis (H1): There is significant difference between the effect of pulmonary rehabilitation and education program on functional capacity of lung and dyspnea in silicosis patient

Review of literature for pulmonary rehabilitation

1.Pierachille santus, linda bassi, *et al*. (2013) have investigated "Effectiveness of Pulmonary Rehabilitation in COPD: A Reappraisal". Cohort of 815 severe or very severe COPD patients undergoing a pulmonary rehabilitation program based on increasing exercise tolerance, transfers, and stair climbing, found that the 6min walking distance was increased by an average 90metres and that these changes were positively associated with the increase of survival rate. This literature supports the notion that pulmonary rehabilitation provides clinically relevant improvements in quality of life, breathlessness, exercise performance, and psychological status. Also the usefulness of the association of conventional pharmacological treatment and pulmonary rehabilitation has been repeatedly proven. However, uncertainties remain regarding some elements of pulmonary rehabilitation programs, such as duration and yearly frequency of the cycles, training intensity, and degree of supervision, for which further investigations are required(82).

2.Uta Occhman Nicola Kotschy (2012) –Lang conducted a longitudinal study to investigate Long-Term Efficacy of Pulmonary Rehabilitation in Patients with Occupational Respiratory Diseases. The patient with silicosis and other occupational respiratory diseas were taken and giver 4-week pulmonery rehabilitaion. The outcomes evaluated were lung function, 6-min walking distance (6MWD), maximum exercise capacity (Wmax), skeletal muscle strength, respiratory symptoms, exacerbations and associated medical consultations, quality of life (SF-36, SGRQ), anxiety/depression (HADS) and Medical Research Council and Baseline and Transition Dyspnea Index scores. Compared to baseline, there were significant improvements in 6MWD, Wmax and muscle strength immediately after rehabilitation, and these were maintained over 12 months. Overall, a significant reduction in the rate of exacerbations by 35%, antibiotic therapy by 27% and use of health care services by 17% occurred within 12 months after rehabilitation. No changes were seen in the questionnaire outcomes. They concluded that pulmonary rehabilitation is effective even in the complex settings of occupational respiratory diseases, providing sustained improvement of functional capacity and reducing health care utilization. (83)

3.Markovitz and Cooper (2010) investigated effect of Rehabilitation in non-COPD: mechanisms of exercise limitation and pulmonary rehabilitation for patients with pulmonary fibrosis/restrictive lung disease. The assessment of exercise performance, dyspnea, and quality of life as well as special protocols, safety considerations, and special techniques in PR as applied to patients with pulmonary fibrosis or restrictive lung disease. PR has been shown to improve functional exercise capacity and health-related quality of life in non-COPD patients, primarily those with interstitial lung diseases(84)

4.Salhi B, Troosters T, *et al*. (2010) investigated Effects of pulmonary rehabilitation in patients with restrictive lung disease. In a prospective, nonrandomized, noncontrolled study, patients with an established diagnosis of restrictive lung disease (RLD) participated in a 24-week outpatient multidisciplinary rehabilitation program. Pulmonary function, exercise capacity, muscle force, and dyspnea were measured at inclusion, after 12 and 24 weeks of rehabilitation. Primary outcome was the change in 6-min walk distance (6MWD) after 12 weeks of rehabilitation. At the end of study they concluded Patients with RLD respond well after 12 weeks of pulmonary rehabilitation, and even better results were seen after 24 weeks. Clinically significant improvements were obtained in the majority of the patients after 24 weeks.(85)

5.Einar Haave, Michael E Hyland, *et al*. (2007) investigated Improvements in exercise capacity during a 4-weeks pulmonary rehabilitation program for COPD patients do not correspond with improvements in self-reported health status or quality of life. 92 patients with moderate or severe chronic obstructive pulmonary disease (COPD) were assessed for walking tolerance, lung function, perceived health status (HS), perceived quality of life (QoL) and anxiety before and after a four weeks inpatient pulmonary rehabilitation (PR) program. There were signi cant improvements on all outcomes except anxiety, although the effect sizes were small or moderate. The largest improvement was observed on the walking test, but patients also improved on perceived health status (HS) and perceived quality of life (QoL)(86)

6.D. Jastrz˚Bski1, A. Gumola1, *et al.* (2006) investigated dyspnea and quality of life in patients with pulmonary fibrosis after six weeks of respiratory rehabilitation. Each patient underwent an intensive (30 min/Day) inpatient pulmonary

rehabilitation program of an average length of 4 wk, continued later at home for up to 12 wk Dyspnea and the quality of life were assessed at the time of admission and discharge. Rehabilitation caused dyspnea sensation to diminish significantly. Some domains of the quality of life in SF-36 questionnaire and St. George's Respiratory Questionnaire also were improved compared with the pre-rehabilitation results. They concluded that 12 weeks of combined inpatient and home-based rehabilitation programme improves the quality of live and sensation of dyspnea in patients with interstitial lung disease, despite changes in pulmonary function tests.(87)

7.Bm O'neill, D Johnston, *et al.* (1997) investigated Effect of once weekly pulmonary rehabilitation on exercise tolerance in patients with chronic lung disease. 74 patients who completed a six-week PR program were reviewed. Exercise tolerance was assessed by the shuttle walk test (SWT), and breathlessness by the BORG scale. Paired t-tests were used for within group analysis. This paper highlights the effect of PR on exercise tolerance and breathlessness in patients with chronic lung disease. [(88)]

8.Marques (2014) investigated Marques A (2014) investigated Effects of a Pulmonary Rehabilitation Program With Balance Training on Patients With COPD. Outpatients with COPD (N = 22, age = 68.0 ± 11.8 years; forced expiratory volume in 1 second = 72.2 ± 22.3% predicted) participated in a 12week PR program including exercise training and psychosocial support and education. Exercise training sessions comprised endurance, strength, and a specific component of balance training. The Timed Up and Go (TUG) test was used to assess functional balance before and after the PR. Health-related quality of life (St Georg's Respiratory Questionnaire), quadriceps muscle strength (10 repetition maximum), and exercise tolerance (6minute walk test) were also assessed. At the end of study they concluded that Pulmonary rehabilitation with a specific component of balance training had a large effect on functional balance in patients with COPD. Findings highlight the value of including balance training in PR programs. (89)

9.Jane Reardona, Richard Casaburi (2005) investigated effect of pulmonary rehabilitation program on quality of life and exercises capacity. Both programmes were conducted during two 30-min sessions, twice-weekly for 8 weeks. After completing the 8 weeks of training, patients undergoing either programme showed signi cant and equivalent improvement in questionnaire-rated dyspnoe(90)

10.Zupanic *et al.* (2014) investigated The Effect of 4-week Rehabilitation on Heart Rate Variability and QTc Interval in Patients with Chronic Obstructive Pulmonary Disease. The Effect was evaluated by comparing pre- and post-rehabilitation ECGs with age- and sex-matched control COPD patients not participating in the program. It is concluded that patients with COPD demonstrate reduced parameters of heart rate variability and that these can be improved in a rehabilitation program, thus improving health related quality of life.(91)

11.M.S. Al Moamary (2010) investigated Impact of a pulmonary rehabilitation programme on respiratory parameters and health care utilization in patients with chronic lung diseases other than COPD. A group of 51 patients diagnosed with interstitial lung diseases, bronchiectasis, asthma and scoliosis were studied. There was a signifcant improvement in functional exercise capacity as manifested on the 6-minute walking distance and distance on treadmill, bicycle and arm ergometer and signifcantly better utilization of health care resources (fewer emergency department and outpatient department visits) over the 12 months after completion of the programme.(92)

12.L Sewell, S J Singh, J E A Williams, *et al.* (2006) Morgan investigated How long should outpatient pulmonary rehabilitation be? A randomised controlled trial of 4 weeks versus 7 weeks. One hundred patients (56 men) with stable COPD of mean (SD) age 70 (8) years and forced expiratory volume in 1 second (FEV1) 1.13 (0.50) litres were randomised to either a 7 week (n = 50) or 4 week (n = 50) supervised PR programme. Patients were assessed at baseline, at completion of the supervised PR programme, and 6 months later. Patients randomised to the 4 week group were also assessed at the 7 week time point. Outcome measures were the Incremental Shuttle Walk Test, Endurance Shuttle Walk Test (ESWT), Chronic Respiratory Questionnaire-Self Reported, and the Breathing Problems Questionnaire. At the end of study they concluded that A shortened 4 week supervised PR programme is equivalent to a 7 week supervised PR programme at the comparable time points of 7 weeks and 6 months.(93)

Analysis of Review of litreture for pulmonary rehabilitation

From above mentioned reviews it was found that pulmonary rehabilitation shows improvement in different outcomes in patient with chronic respiratory diseases. In R.O.L 2-4 various authors have investigated effect of pulmonary rehabilitation in occupational lung disease / restrictive lung disease / non-COPD disease. The outcomes they have evaluated were lung function, 6-min walking distance (6MWD), maximum exercise capacity (Wmax), skeletal muscle strength, respiratory symptoms, dyspnea, and exacerbations and associated medical consultations, quality of life (SF-36, SGRQ), anxiety/ depression (HADS) and Medical Research Council(MRC)and Baseline and Transition Dyspnea Index scores. In Compared to baseline, there were significant improvements in 6MWD, Wmax and muscle strength functional exercise capacity and health-related quality of life after rehabilitation, and these were maintained over long term follow up. In R.O.L 1, 5-11 various authors have studied effect of pulmonary rehabilitation in COPD and other chronic lung disease for 4/6/8/12 week program. The They outcomes measures had taken were 6MWT, lung function, perceived health status (HS), perceived quality of life (SGRQ/HRQOL/SF-36) and anxiety, Dyspnea, SWT, quadriceps muscle strength (10RM), Timed Up and Go. After a rehabilitation of 4 week program significant improvement were noted in dyspnea, 6MWD, lung function, 10 RM. Whereas in QOL perceived health status (HS) there were no significant improvement upto 4 months but after 8 week improvement were noted in this parameters.

In contrast in R.O.L 12 author have studied effect of 4 versus 7 week PR on Incremental Shuttle Walk Test, Endurance Shuttle

Walk Test (ESWT), Chronic Respiratory Questionnaire-Self Reported, and the Breathing Problems Questionnaire patient with stable COPD. This study has shown that a shortened 4 week supervised PR program is capable of achieving similar results to a 7 week supervised PR program at the comparable time point of 7 weeks and at the end of supervised rehabilitation. A shorter supervised program may facilitate a more effective use of resources and result in PR being offered to a greater number of patients. From above mentioned reviews it was concluded that pulmonary rehabilitation is an useful tool to improve many of the impairments in chronic lung disease. The main impairments patients with chronic lung disease faces are dyspnea and altered lung functions. So they were chosen to be evaluated in Pulmonary rehabilitation as an intervention in experimental group.

Review of literature for education program

13. R Gosselink (2004) investigated usefulness of Breathing techniques in patients with chronic obstructive pulmonary disease (COPD) In patients with COPD, breathing techniques aim to relieve symptoms and ameliorate adverse physiological effects by: 1) increasing strength and endurance of the respiratory muscles; 2) optimizing the pattern of thoraco abdominal motion; and 3) reducing dynamic hyperinflation of the rib cage and improving gas exchange. They concluded that PLB is usefull technique to reduce dyspnea in COPD patient(94).

14.Jadranka Spahija (2005), investigated Effects of Imposed Pursed-Lip Breathing on Respiratory Mechanic and Dyspnea at Rest and During Exercise in COPD. 8 COPD patients (6 male and 2 female) with a mean (SD) age of 58 +- 11 years and a mean FEV of 1.34 0.44 L (50 21% predicted). And concluded that Conclusion: PLB can have a variable effect on dyspnea when performed volitionally during exercise by patients with COPD. The effect of PLB on dyspnea is related to the combined change that it promotes in the tidal volume and EELV and their impact on the available capacity of the respiratory muscles to meet the demands placed on them in terms of pressure generation.(95)

15.Ki-song Kim et al. (2012) investigated Effects of breathing maneuver and sitting posture on muscle activity in inspiratory accessory muscles in patients with chronic obstructive pulmonary disease. 12 men with COPD participated in the study. The results suggest that in COPD, PLB induced a favorable breathing pattern (increased TV and reduced RR) compared to Quiet Breathing(QB). Additionally, With Arm Support(WAS) and With Arm and Head Support positions(WAHS) increased muscle activity of the inspiratory accessory muscles during inspiration versus Neutral Position. Differential involvement of accessory respiratory muscles can be readily studied in COPD patients, allowing monitoring of respiratory load during pulmonary rehabilitation.(96)

Analysis of Review of literature for education program

In R.O.L 13-15 it is seen that pursed lip breathing technique in different positions are helpful to relieve dyspnea in patient with COPD and other respiratory conditions. Additionally, With Arm Support (WAS) and With Arm and Head Support positions(WAHS) increased muscle activity of the inspiratory accessory muscles during inspiration versus Neutral Position. So in this study PLB with different positions have been chosen as a dyspnea reliving techniques in control group.

Review of literature for outcome measures

16. Brian A. Boehlecke; James A. Merchant (1981) investigated The Use of Pulmonary Function Testing and Questionnaires as Epidemiologic Tools in the Study of Occupational Lung Disease. They concluded that Pulmonary function testing and questionnaires are valuable tools in epidemiologic studies of occupational lung disease.Accurate equipment and standardized methodology are vital to obtain reproducible responses. For spirometry, the FVC and FEV show the least intrasubject variability and on questionnaires, occupational and smoking history are more reproducible than symptomssymptoms.(97)

17.Carlos A. Vaz Fragoso (2010) investigated The Ratio of FEV1 to FVC as a Basis for Establishing Chronic Obstructive Pulmonary Disease sample of 3,502 white Americans aged 40–80 years and concluded that persons aged 40–80 years, an FEV1/FVC identi es persons with an increased risk of death and prevalence of respiratory symptoms.(98)

18.J. Behr and D. E. Furst (2008) investigated Spirometry is a simple test to measure static lung volumes at rest—slow (inspiratory or expiratory) vital capacity (sVC), forced vital capacity (FVC)—and dynamic volumes—forced expiratory volume in 1 s (FEV1), flow-volume loops. And concluded that Pulmonary function testing, is a major tool of investigation of lung involvement in Systemic sclerosis-associated interstitial lung disease (SSc-ILD).(99)

19. J C Bestall, E A Paul, R Garrod (1999) inestigated Usefulness of the Medical Research Council(MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. 100 patients with COPD were recruited from an outpatient pulmonary rehabilitation programme. Assessments included the MRC dyspnoea scale, spirometric tests, blood gas tensions, a shuttle walking test, and Borg scores for perceived breathlessness before and after exercise. Health status was assessed using the St George's Respiratory Questionnaire (SGRQ) and Chronic Respiratory Questionnaire (CRQ). The Nottingham Extended Activities of Daily Living (EADL) score and Hospital Anxiety and Depression (HAD) score were also measured. At the end of study they Concluded that The MRC dyspnoea scale is a simple and valid method of categorizing patients with COPD in terms of their disability that could be used to complement FEV1 in the classi cation of COPD severity.(100)

20. Spyros A. Papiris et al. (2005) investigated The Medical Research Council dyspnea scale in the estimation of disease severity in idiopathic pulmonary brosis, The population studied consisted of 26 untreated patients (15 males, aged 41–80 yr), with clinical and radiological features of IPF. They were recruited sequentially from the respiratory outpatient clinic over a period of 3 years. In conclusion, the close correlation observed in the present study between the MRC

dyspnea score and some of the most representative functional and radiological indices of disease severity and extent, indicates that the estimation of dyspnea with a simple and self-administered questionnaire is a useful adjunct in the assessment of the clinical status of patients with IPF.(101)

Analysis of Review of litreture for outcome measures

In R.O.L 17-20 authors have investigated whether the pulmonary function test (PFT) medical research dyspnea scale (MRC) are valid method of measuring functional capacity of lungs and dyspnea in chronic lung disease patient. It was concluded that The MRC dyspnoea scale is a simple and valid method of categorizing dyspnea and PFT (FEV1 and FEV1/FVC) is a valid tool to measure functional capacity of lungs. So PFT (FEV1 and FEV1/FVC were chosen as outcome measures in this study.

MATERIALS AND METHODS

Study design

Pre test – Post test Experimental study.

Sample design

Simple random sampling technique.

Population

60 patients suffering from silicosis who referred by chest physician were recruited for the study from Shakarpura area of Khambhat. Out of 60 patient 12 were excluded because of not matching the inclusion criteria. So 48 patients were included in this study.

Sample size

The 48 patients were selected and divided equally into two groups

- Experimental group: Group A (n=24)
- Control group: Group B (n=24)

Materials used

1. Spirometer- P.C.BASED RMS spirometer with Computer interface Machine for PFT measurement.
2. Weight cuffs and dumbbells for resistance training.
3. Treatment table, pen, paper, stop watch.
4. Medical research council dyspnea scale.
5. Patient education pamphlet

Methods of collection of data

48 subject were selected based on inclusion and exclusion criteria from Shakarpura area of Khambhat.

An informed and written consent was obtained from each of the patient in which the patients were agree to participate in the study.

Inclusion criteria

(a) Recognized stable occupational respiratory disease diagnosed as silicosis (>6 month of diagnosis)
(b) Age < 70 years,
(c) No malignant diseases.

Exclusion criteria

- Medical conditions which could place the individual at risk during exercise testing or training (e.g. unstable cardiovascular disease) or conditions that may restrict the participant's ability to exercise (e.g. severe orthopedic or neurologic impairments;
- Participation in a PR program within the last 12 months
- Other concurrent respiratory disease

Duration of the study

1 Month (4 weeks), 4 days/ week.
From 1st October to 1st of November, 2014.

Outcome measures

1.PFT (FVC, FEV1/ FVC)
2.MODIFIED MEDICAL REASERCH DYSPNEA SCALE

Procedure

60 patients were participated in the study. Out of 60 patient 12 patient were excluded from the study due to not matching inclusion criteria. 48 patients' Baseline measurements were taken All patients were randomly divided into two equal groups.

Group A (Experimental group, n = 24)
Group B (Control group n = 24).
Group A pulmonary rehabilitation for 45 min/ a day for 4 days/ a week for 4 week.was designed according to An Of cial American Thoracic Society/ European Respiratory Society Statement: Key Concepts and Advances in Pulmonary Rehabilitation, JUNE 2013(67).

The timing and intensity of the exercise program was prepared individually for each patient. The program consisted

1.Endurance Training

Frequncy : 4 days/week
Intensity : PRE of 12 to 14 Borg scale.
Time : 20-30 min/session
Type : Ground based walking

2.Resisted exercises of limbs were done at 60% of 1RM (i.e., the maximal load that can be moved only once over the full range of motion without compensatory movements.) Or one that evokes fatigue after 8 to 12 repetitions are appropriate,

1 to 3 sets of 8 to 12 repetition.

3.Flexibility training and Thorax mobility exercises

Including stretching of major muscle groups such as the Pect. Major, Trepezious SCM, Calves, Hamstrings, Biceps, and, Quadriceps as well as range of motion exercises for the neck, shoulders, and trunk.

Figure 1. Resisted exercises of upper limb

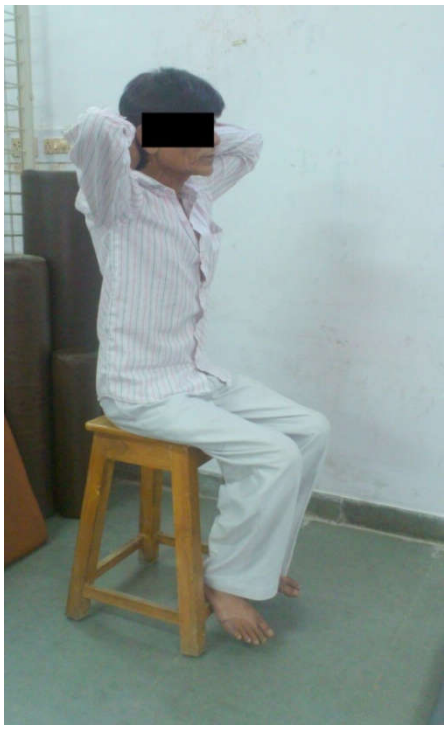
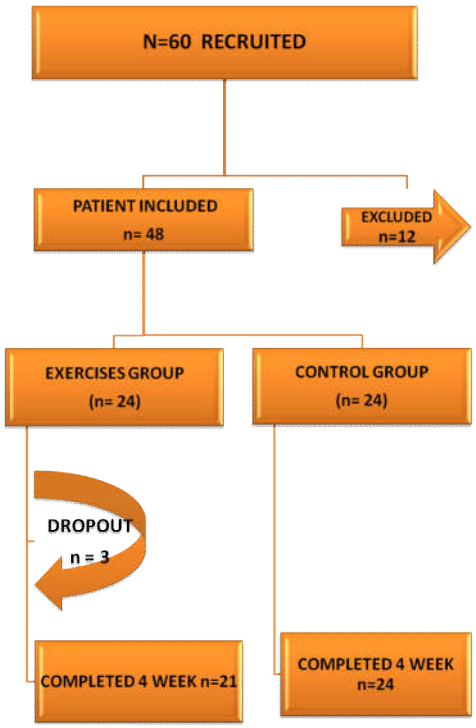


Figure 2. Chest mobility exercises, In exercises group

4.Respiratory muscle exercise, 3 -5 sets consisting of 5-breath cycles interspersed with 1-min rest periods in each. (altogether 15 -25 breaths)

Group B received disease specific educational program including normal anatomy and physiology of respiratory system, disease process of silicosis, dyspnea reliving postures, emergency procedures and preventive measures. Detailed patient education program is attached in ANNEURE- V.



Data analysis

Statistical analysis test

Out of 60 patient total 48 patients based on inclusion criteria participated in the study. All 48 patient were divided in to two equal groups. (n = 24). From 48 patients 45 patient, n = 21 in experimental and n = 24 patients in control groups completed the study. In both groups n < 30 So the data were analyzed using t test. The pre and post data within the groups were analyzed using paired t-test. The post data between both the groups were analyzed using unpaired t-test. Data were analyzed with the help of Graph pad Prism 5.03 statistical tool.

RESULTS

The effect of pulmonary rehabilitation was evaluated for dyspnea and lung function in 48 patient silicosis with MRC scale, FVC and FEV1/FVC. The baseline characteristics of the patient were as following.

Table 2. Baseline characteristics

Baseline characteristics		
Charactristics	Experimental group	Control group
Total no of subjects	24	24
AGE(Yr)	51.85	52.29
MALE	21	19
FEMALE	3	7
MRC	2.47	3.41
FVC (l/min)	2.36	1.64
FEV1/FVC	65.74	55.05

Comparison within the group

As shown in Table 3 the baseline mean MRC score for exercises group was 2.47 out of 4 and the SD was 0.60.

After 4 weeks the mean MRC score for post test value was measured again.

The post test mean MRC score was reduced from 2.47 to 1.09 out of 4. And SD was 0.88. The P value of paired t-test was <0.0001 with the df of 19.

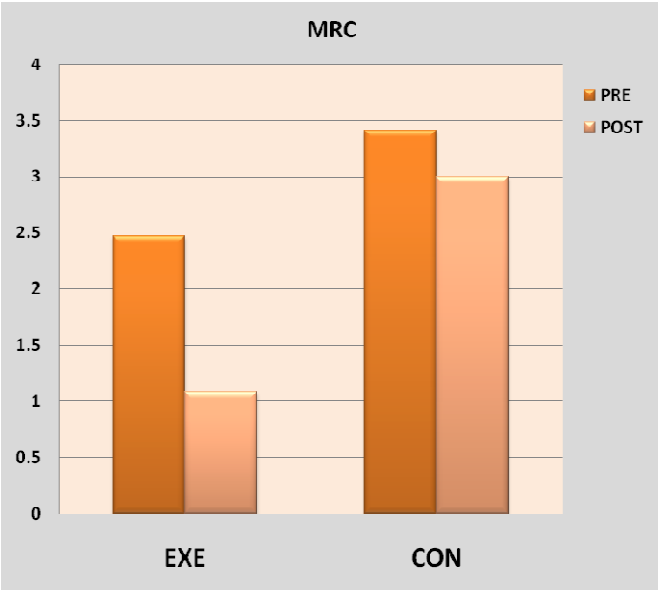
Whereas the baseline mean MRC of control group was 3.41 out of 4. And the SD was 0.50. After 4 weeks the MRC score was measured again.

The post test mean MRC score was reduced from 3.41 to 3 out of 4 and the SD was 0.78. The p value of paired t-test was 0.047 with the degree of freedom of 23.

So the significant change was noted within the experimental group in MRC scale but no significant change was there in control group.

Table 3. Mean MRC value

No	Group	MRC					
		Pre		Post		P Value	Df
		MEAN	SD	MEAN	SD		
1.	EXP	2.47	0.60	1.09	0.88	0.0001	19
2.	CON	3.41	0.50	3.0	0.78	0.047	23



As shown in Table 4 the baseline mean FVC of experimental group was 2.36 lit/min and the SD was 0.91.

Aftert 4 week the FVC was measured again.

The post means FVC of experimental group was increased from 2.36 to 2.41 lit/min and the SD was 0.92. The P value of paired t-test was <0.0001 with the df of 20.

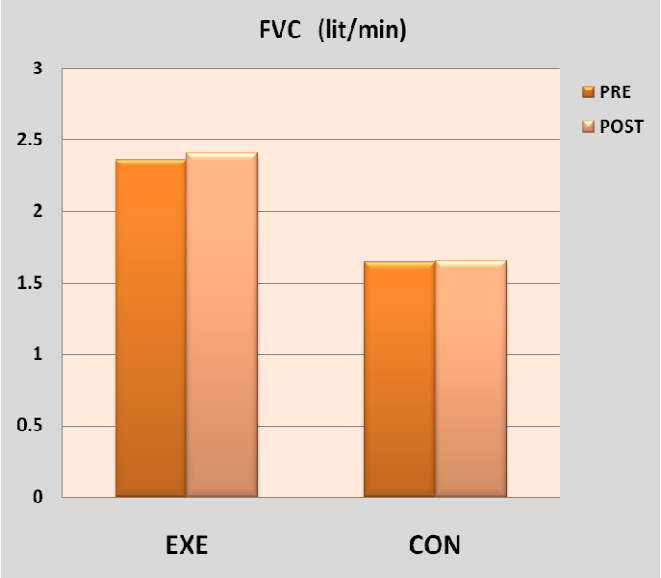
Where as the baseline mean FVC for control group was 1.64 lit/min and the SD was 0.40 and after 4 week the FVC was measured again.

There was mild increase in the FVC value from 1.64 to 1.65 lit/min. the p value of paired t-test was 0.74 and df was 23.

So there was a significant difference within the experimental group but there was no significant difference within the control group in FVC outcome.

Table 4. Mean FVC value

No	Group	FVC					
		Pre		Post		P value	Df
		Mean	SD	Mean	SD		
1.	EXP	2.36	0.91	2.41	0.92	0.0001	20
2.	CON	1.64	0.40	1.64	0.41	0.74	23



As shown in Table 5 the baseline mean FEV1/FVC ratio of experimental group was 65.74 and the SD was 10.38 after 4 week the FEV1/FVC ratio was measured again.

The post means FEV1/FVC ratio of experimental group was increased from 65.74 to 67.15 and the SD was 10.69. The P value of unpaired t-test was <0.0001 with the df of 20.

Whereas the baseline mean FEV1/FVC ratio for control group was 55.05 and the SD was 6.85 and at the end of 1 month the FEV1/FVC ratio was assessed again.

There was mild increase in the FEV1/FVC ratio from 55.05 to 55.09 . The p value of unpaired t-test was 0.70. and df was 23.

So there was a significant difference within the experimental group but there was no significant difference within the control group in FEV1/FVC ratio.

Table 5. Mean FEV1/FVC value

Nono	Group	Fev1/fvc					
		Pre		Post		P value	Df
		Mean	Sd	Mean	Sd		
1.	Exp	65.74	10.38	67.15	10.69	0.0001	20
2.	Con	55.05	6.85	55.09	6.88	0.70	23

Comparison between the group

When all outcomes were assessed the P value of unpaired t test for post MRC scale between experimental and control

group. Was <0.0001 with the df of 20. So there was statistically significant change was noted in MRC scale.

The P value of paired t test for post FVC score between experimental and control group was 0.0058 with the df of 20. So there was statistically significant change was noted in FVC.

The P value of unpaired t test for FEV1/FVC ratio score between experimental and control group was 0.0007 with the df of 20. So there was statistically significant change was noted in FEV1/FVC ratio

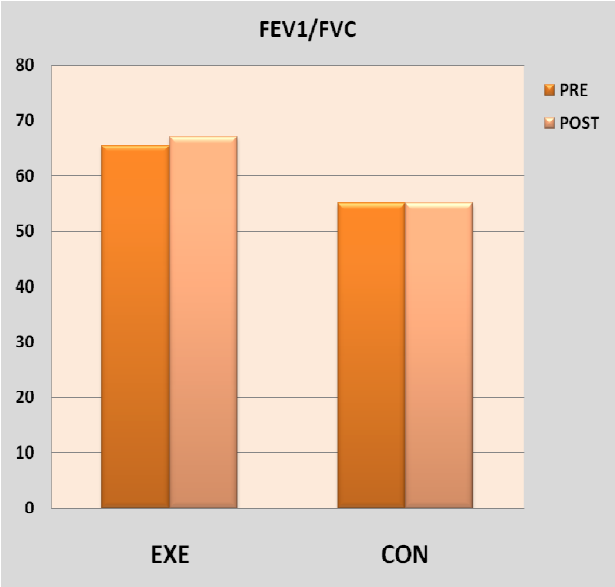
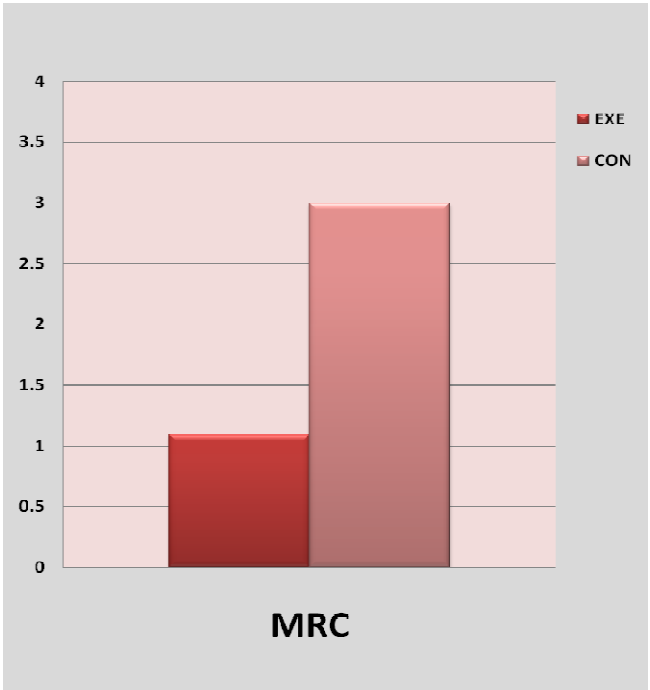
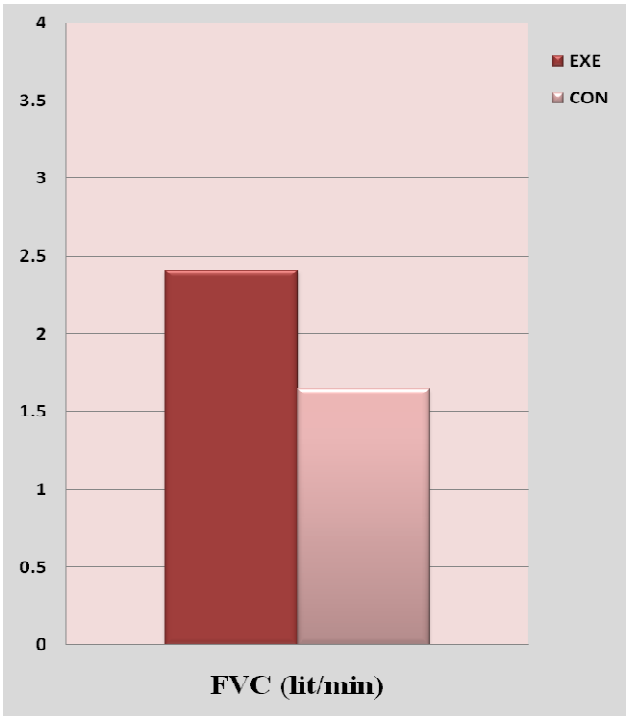
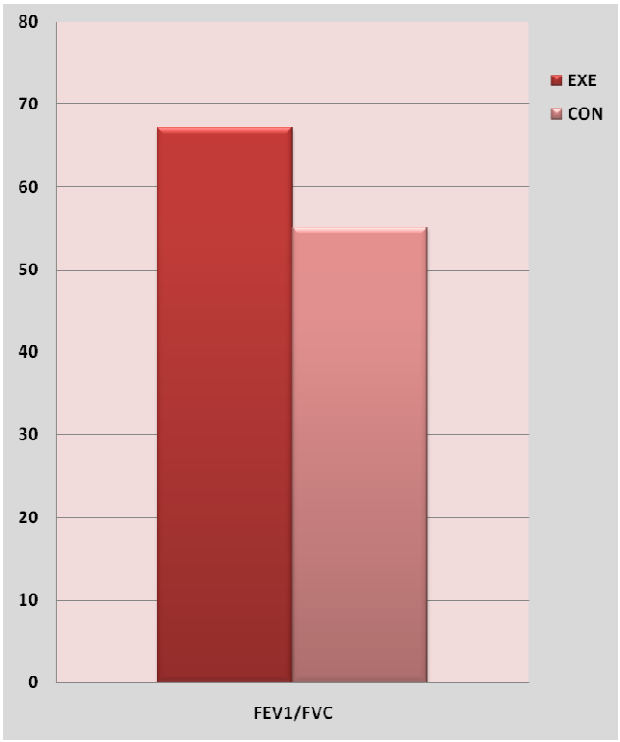


Table 6. Comparision between both groups

Outcomes		Exp		Control		P value	Df
		Mean	SD	Mean	SD		
MRC	Post	1.09	0.88	3.0	0.78	0.0001	20
FVC	Post	2.41	0.92	1.64	0.41	0.0058	20
FEV1/FVC	Post	67.15	10.69	55.09	6.88	0.0007	20







DISCUSSION

Silicosis is caused by exposure to respirable crystalline silica dust. Crystalline silica is a basic component of soil, sand, granite, and most other types of rock, and it is used as an abrasive blasting agent. Silicosis is a progressive, disabling, and often fatal lung disease. Dyspnea and altered lung functions are two of the main impairments facing by the silicosis patient. (102) Pulmonary rehabilitation is a well-recognized treatment option in chronic obstructive lung disease improving exercise performance, respiratory symptoms

and quality of life. In occupational respiratory diseases, which can be rather cost-intensive due to the compensation needs, very little information is available.(83) This study was done to evaluate the usefulness of pulmonary rehabilitation in patients with silicosis, in dyspnea and alterations of lung function with MRC scale, FVC and FEV1/FVC ratio. An experimental approach was chosen for conductions the study with pre and post design which is experimental in nature. Random sampling technique was used for selecting the sample of n= 23 subject in control group and n= 21 subject in experiment group giving a total sample size of 44. From the results it was noted that there was reduction in MRC score when compared with baseline data. After the stastical analysis significant difference (p< o.o5) was noted within the group in comparision of pre and post MRC score in experimental group which is suggestive of marked reduction in dyspnea after the rehabilitation of 1 month. Whereas in control group also there was reduction in MRC score when compared with baseline data. After the stastical analysis significant difference (p< o.o5) was noted in MRC scale which is suggestive of reduction in dyspnea with dyspnea releving postures but less significant compare to exercises group. When the FVC values of experiment group were examined there was increase in FVC value. After the statistical analysis of pre and post FVC value significant difference (p< o.o5) was noted which is suggestive of marked improvement in FVC. When the FVC values of control group were examined there was mild increase in FVC value. After the statistical analysis of pre and post FVC value no significant difference (p> o.o5) was noted which suggest that there is no improvement in FVC in control group.

When the FEV1/FVC ratio of experiment group was examined there was increase in FEV1/FVC ratio. After the statistical analysis of pre and post FEV1/FVC ratio significant difference (p< o.o5) was noted which is suggestive of marked improvement in FEV1/FVC ratio. When the FEV1/FVC ratio of control group were examined there was mild increase in FEV1/FVC ratio. After the statistical analysis of pre and post FEV1/FVC ratio no significant difference (p> o.o5) was noted which suggest that there is no improvement in FEV1/FVC ratio. The possible explanation for improvement in lung function and reduction in dyspnea can be given as follow. Some evidence exists that pulmonary rehabilitation improves dyspnea by increasing the condition of the muscles, thus decreasing metabolic demands and improving overall muscle performance (103) Furthermore, desensitizing patients to symptoms of dyspnea through controlled exposure to exertional dyspnea potentially helps alter the perception of dyspnea Reinforcing the need for bronchodilators either routinely or before exercise helps reduce the resistive loads and potentially improves ventilatory mechanics. Probably, pulmonary rehabilitation improves symptoms of dyspnea through a combination of mechanisms, many of which are still unclear.(104)

The possible reason for the improvement in FVC is improvement in breathing retraining which includes physiotherapy, which facilitates increases in the flexibility of the chest wall and improvements in the respiratory muscle s trength. Because FVC is dependent on muscular effort whereas FEV is not, such changes could explain this findings. (102, 103, 105) The present study shows the effects of exercise training in patients with silicosis. It has shown that the improvements in functional capacity of lungs and reduction in dyspnea are similar to those obtained after pulmonary rehabilitation in patients with COPD. These finding are in line with the following study conducted by various researcher. Uta Ochmann *et al*. investigated Efficacy of Pulmonary Rehabilitation in Patients with Occupational Respiratory Diseases Their prospective study demonstrated substantial effects of a 4-week pulmonary rehabilitation program in a large group of patients with different occupational respiratory diseases(asthma, silicosis, asbestosis, chronic obstructive pulmonary disease) they have given individually tailored program. (83). D. JASTRZÊBSKI *et al* investigated dyspnea and quality of life in patients with with interstitial lung diseases of respiratory rehabilitation. Each patient underwent an intensive (30 min/Day) inpatient pulmonary rehabilitation program of an average length of 4 wk, continued later at home for up to 12 wk Dyspnea and the quality of life were assessed at the time of admission and discharge. Rehabilitation caused dyspnea sensation to diminish significantly. They concluded that 12 weeks of combined inpatient and home-based rehabilitation programme improves the quality of live and sensation of dyspnea in patients with interstitial lung disease, despite changes in pulmonary function tests (89). This study have demonstrated significant improvement in functional capacity of lungs and dyspnea. In patients with silicosis.

Conclusion

This study concludes that a supervised pulmonary rehabilitation program of 4 weeks duration have improved functional capacity of lungs and dyspnea. in patients with silicosis. So the null hypothesis is rejected and alternate hypothesis is accepted in this study.

Summary

Introduction: Silicosis is defined as an occupational lung disease attributable to the inhalation of silicon dioxide, commonly known as silica or “free silica” in crystalline forms. according to International labor organization, Geneva. Pulmonary rehabilitation has established itself as a key management strategy in people with chronic respiratory disease. So, in this study an effort is made to know the effect of pulmonary rehabilitation on functional capacity of lungs and dyspnea in patient with silicosis.

Aims: To know the effect of pulmonary rehabilitation on dyspnea and functional capacity of lung in patient with silicosis.

Methods: Out of 60 patients 48 subject were be selected based on inclusion and exclusion criteria and divided equally into two groups.

Outcome: PFT (FVC, FEV1/ FVC), MODIFIED MEDICAL REASERCH DYSPNEA SCALE.

Procedure: Pulmonary rehabilitation for 45 min/ a day for 4 days/ a week for 4 week.was designed according to American Thoracic Society/European Respiratory Society Statement JUNE 2013. The data were analysed useing t-test.

Results: When pre and post data whitin the group were analyzed the significant change ($p<0.05$) was noted in the experimental group in MRC scale FVC and FEV1/FVC but no significant change was there in control group. When pre and post data between the group were analysed There was statistically significant change ($p<0.05$) was noted in MRC scale FVC and FEV1/FVC ratio.

Conclusion: This study concludes that a supervised pulmonary rehabilitation program of 4 weeks duration have improved functional capacity of lungs and dyspnea. in patients with silicosis.

Limitation of the study

- This study has been performed on small samples.
- The study was conducted only for silicosis patients.
- The study has not been done for long term effect of pulmonary rehabilitation on silicosis.
- The population included in the study was taken from only anand district.

Future recommendation

- The study can be done with large sample size.
- The study can be done with other occupational lung disease also.
- The long term effect of the pulmonary rehabilitation can be evaluated.
- The multicentre approach is required for better results.

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