Pulmonary Rehabilitation in the Management of Chronic Obstructive Pulmonary Disease among Asian Indians- Current Status and Moving Forward

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REVIEW

Pulmonary Rehabilitation in the Management of Chronic Obstructive Pulmonary Disease among Asian Indians- Current Status and Moving Forward

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ABSTRACT

Chronic Obstructive Pulmonary Disease (COPD) is a significant public health concern in India with high prevalence and associated disability, morbidity, mortality. The progression of COPD is not confined to the lungs but includes extrapulmonary involvement that reduces the functional capacity and quality of life. Pulmonary Rehabilitation (PR) is an evidence-based intervention, targeting multiple domains of pulmonary and extrapulmonary manifestations, and therefore, is recommended as an integral part of COPD management. The practical implementation of PR in India is poor. In this review, we have summarized the latest pieces of evidence in support of PR and highlight the challenges and potential solutions for PR implementation in India.

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Exercise; skeletal muscle dysfunction; sarcopenia; functional capacity; tele-rehabilitation

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a complex, heterogeneous chronic respiratory disease with systemic manifestation characterized by airway obstruction, dyspnea, fatigue, and systemic inflammation secondary to smoking or inhalation of toxic particles. Nearly 10% of the global population above the age of 40 years is affected by COPD [1]. In 2016, the WHO Global Burden of Disease Study has reported 251 million cases of COPD globally and more than 90% of COPD-associated deaths in low- and middle-income countries [2]. COPD alone is responsible for a higher mortality burden in the South Asian region compared to HIV, Malaria and Tuberculosis combined [3]. India, the second most populated country in the world, constituting nearly one-fifth of the world population, is experiencing a marked increase in the burden of respiratory diseases. Demographic, economic, environmental, and lifestyle changes in past decades have remolded the nation's mortality and morbidity determinants; there is a drastic shift from infectious diseases to non-communicable diseases (NCDs) [4]. COPD has been shown to have a mortality rate of 8.7% in India as per the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2016 [5] and is the second leading cause of death in the country [5, 6]. It is estimated that India contributes to approximately 20% of worldwide COPD cases annually [4]. The crude estimate of COPD burden in this country is over 30 million [3]. COPD contributed to 75.6% of the nation's chronic respiratory disease disability-adjusted life

years (DALY) in 2016 [7]. In a recent report in economic times, Sundeep Salvi, Director of Chest Research Foundation, Pune, labeled India as the "COPD Capital of the World" [8].

Additionally, the cost of management of COPD is high. In 2011, the estimated economic loss due to COPD in India (₹350 Billion) was higher than the total budget of the Ministry of Health and Family Welfare of India for the year 2010–2011 (approx. ₹251 Billion) [3, 9]. This massive disease volume and associated mortality, morbidity, and economic losses in the country calls for revisiting the prevention and management strategies to identify gaps, pitfalls, and opportunities.

COPD management in India primarily concentrates on pharmacological treatment to manage symptoms that are frequently associated with poor compliance. Philip *et al*, in their recent study, found that about one-third of the patients were non-adherent to prescribed treatment [10]. Most importantly, COPD is a systemic illness that involves extrapulmonary manifestations including weight loss, skeletal muscle dysfunction, cachexia, and osteoporosis [11] often appearing to be clustered. Pharmacological therapies such as bronchodilators and corticosteroids certainly help in the management of the pulmonary pathology but might have a limited role in improving extrapulmonary involvement like the skeletal muscle manifestation and associated loss of physical capacity. Muscle wasting itself may be a potential side effect of corticosteroids used for the management of exacerbations [12]. Pulmonary rehabilitation (PR) is an evidence-based non-pharmacological approach that integrates

multiple interventions (exercise training, dietary advice and nutritional support, patient education, and psychosocial support) to address the extrapulmonary manifestations of COPD [13]. PR has consistently shown promising results in improving dyspnea, functional capacity, exacerbation frequency, recurrent hospitalization, and quality of life [13–15]. According to the American Thoracic Society, the PR program teaches the patients to be “in charge” of their breathing [14]. Despite well-established benefits, PR programs are extremely underprovided and/or underutilized in developing countries like India. This review focuses on the current state of pulmonary rehabilitation and the challenges in implementing PR programs in India as well as emphasizes the urgent need for the development of a comprehensive rehabilitation program for the well-being of the patients.

Pulmonary rehabilitation: The pressing priority in the management of COPD

Skeletal muscle dysfunction is an overreaching condition that is associated with the disease progression in COPD and affects the physical capacity and overall quality of life of the patients [11, 16]. It is caused by loss of muscle mass and oxidative capacity. Unintended weight loss in COPD is often the result of the loss of both skeletal muscle mass and fat mass which may progress and manifest as pulmonary cachexia. Muscle loss in COPD predicts morbidity and mortality independent of airflow obstruction [17] and is associated with higher utilization of health care resources [18]. Indians, in general, are known to possess lesser muscle mass and strength compared to western ethnic groups [19]. The disease-associated pathophysiological alteration of skeletal muscle may further accelerate muscle mass and related function loss. In addition to this, malnutrition which is widely prevalent in developing countries is another important issue that demands attention. 14% of the total population in India (189.2 million) has been observed to be undernourished as per the Food and Agricultural Organization's 2020 report on “The State of Food Security and Nutrition in the World” [20]. COPD also has a key role in the development of malnutrition among patients because of the decrease in appetite, increased caloric needs because of the work of breathing, chronic inflammatory state, etc. This may further deteriorate lung function, reduce immunity, increase infection risk [21], and catalyze skeletal muscle loss. In a nation where a substantial portion of the population is already undernourished and even the seemingly healthy adults possess a low muscle quality, a chronic disease like COPD can do substantial damage. Hence it is essential to screen all the COPD patients for muscle quality and nutritional status to identify the patient at risk and initiate early rehabilitation so that the grave outcomes can be minimized.

Exercise training serves as the cornerstone of PR that addresses the vicious cycle of dyspnea, physical inactivity, deconditioning, and isolation [22]. It may, therefore, result in improvement of oxidative capacity and skeletal muscle adaptation depending on the intensity and frequency of exercise. Early initiation of PR can potentially minimize the

effect of acute exacerbations on the skeletal muscle and prevent the deterioration of skeletal muscle to a significant extent [23], thus appearing to be an effective strategy to change the course of the disease [24]. Several other studies have demonstrated significant improvement in muscle function and quality of life [25–30], psychosocial wellbeing [31], reduction in mortality, and rate of hospitalization [32] following successful completion of PR. The benefits of PR can be further maximized by introducing supplemental nutrition [33, 34]. Recent meta-analyses and systematic reviews found that nutritional support in COPD improves the nutritional status among the patients that have been associated with significant improvement in functional capacity, respiratory muscle strength, and quality of life [33]. Nutritional support with PR has the potential to prevent a negative energy balance as well as to prevent or reverse weight loss and muscle wasting [34].

Pulmonary rehabilitation in India- current scenario

In India, the concept of PR was adopted into COPD care probably in the 1990s in the southern part of India. However, it came into practice at the beginning of the twenty first century [35]. Nevertheless, effective implementation of PR in clinical practice in India is still lacking. Several studies have demonstrated the good clinical outcomes of successfully implemented PR even in a poor resource setting [36–42]. Though limited in number, the results seem promising to recommend its use in India to improve clinical outcomes and facilitate independence in COPD patients (Table 1). For instance, Bhattacharyya *et al* demonstrated that even a single supervised session of curriculum-based PR which included patient education, bronchial hygiene, and exercise training when practiced by patients, resulted in significant health status improvement after 6 weeks and the benefits lasted for a year, provided, it was reinforced and supervised [36]. It is noteworthy, that indigenous practices such as yoga have also been proven to be beneficial in improving dyspnea and fatigue along with significant improvement in SpO₂% and 6 min walk distance [37]. Multiple studies have evaluated the effectiveness of home-based PR programs and found a favorable outcome to consider home-based PR as an economical but effective alternative [38–40].

PR has been in existence for seven decades and is a recommended mode of managing COPD in most guidelines, yet its implementation in India is in its infancy which is indeed surprising. Only a few isolated clinicians and researchers deliver the benefits of PR to their COPD patients which are primarily located in metropolitan cities. In a country, where a majority of the population resides in the rural areas [43], access to PR therapy by the rural population is extremely important so that all patients are benefited irrespective of their geographical location or social strata. There might be gaps at multiple levels; delay in diagnosis and referral at clinician level, resistance to participate in rehabilitation programs at the patient level, lack of accessibility to PR services, lack of structured policies to manage the disease at the national level. However, given the proven

Table 1. Pulmonary rehabilitation studies conducted in India.

Author & Year	Objective	Study design	Participants number and characteristics	Intervention	Outcomes
Bhattacharyya P <i>et al.</i> , 2018 [36]	Effects of a "self-managed, and supervised real-world practice of an intensive single-session education and training based on a simple curriculum for the COPD patients in rural India"	prospective cohort study	recruited 96 stable COPD patients, mean age 62 ± 9 years, 70 attended the intervention and 54 reassessed at long term follow up	A single session of intensive intervention in association with bronchial hygiene, patient education and exercise training. Participants continued to practice the exercises under encouragement and supervision from trained volunteers.	<ul style="list-style-type: none"> Significant improvement in the health status (CAT (COPD Assessment Test) score) in participants practicing the education and training for 6 weeks This improvement continued to last for 1 year, provided, it was reinforced and supervised
Ranjita R <i>et al.</i> , 2016 [37]	To evaluate the effect of "Integrated Approach of Yoga Therapy in management of coal miners with COPD"	Randomized, waitlist controlled, single-blind clinical trial	81 coal miners (36–60 years) with stable Stages II and III COPD	Asanas, breathing practices, pranayama, loosening exercises, cyclic meditation, yogic counseling vs standard care 41 participants in Yoga group and 40 in control	<ul style="list-style-type: none"> Statistically significant reductions in dyspnea, fatigue scores Significant improvements in SpO₂% and 6-minute walking distance test observed in the yoga group
Sindhvani G <i>et al.</i> , 2011 [39]	Use of domiciliary PR in the severe COPD.	non-randomized unblinded study	20 patients with severe COPD (GOLD classification)	Duration 12 weeks experimental group: domiciliary PR along with medical management, control group: medical management only, 10 participants in the experimental group and 10 controls. Duration of treatment: 6 months	<ul style="list-style-type: none"> Statistically significant improvement in clinical COPD questionnaire scores in both groups from the fourth month The results of the 6-minute walking test showed a similar improvement No difference was observed in the spirometry values
Ragaselvi S <i>et al.</i> , 2019 [41]	To find "different patient- and/or disease-related factors that may predict response to PR in stable COPD"	Prospective cohort study	102 stable COPD patients of various GOLD classification stages, mean age 60.9 ± 9.1	comprehensive outpatient PR program that included exercise, education, nutritional, and psychological counseling duration 8-week	<ul style="list-style-type: none"> 52.5% of the participants showed improvement in both 6-minute walking test and Quality of life (St George Respiratory Questionnaire) Multivariate logistic regression analysis found, forced expiratory volume in 1 s < 50% predicted and osteoporosis as independent factors predicting PR efficacy.
Orooj M <i>et al.</i> , 2020 [42]	To evaluate the "effectiveness of six weeks PR in patients with asthma-chronic obstructive pulmonary disease overlap syndrome (ACOS)."	Randomized control trial	28 patients	Intervention group: supervised endurance and resistance training, breathing exercises, self-management, and education. control group: usual routine care 14 participants in the PR group, 14 in the control group Duration: six weeks	<ul style="list-style-type: none"> Significant improvement in 6-minute walking test and Quality of life and Bode index in the PR group after six weeks compared to the control group. No significant difference between the groups in pulmonary function.

benefits of PR, it needs to be more widely available to reduce the functional burden of disease, associated disabilities, and economic loss caused by COPD.

Challenges of pulmonary rehabilitation programs in India and the way forward

Translation of PR into clinical practice is not only poor in developing countries like India but also in developed countries. Internationally, the utilization of PR is in only 1–2% of the total COPD population [44]. This is indeed striking, given the burden of this disease and the observed benefits of PR. Therefore, it is important to understand the reasons for its poor implementation.

The deficit is not only in the management but in the diagnosis and follow-up as well. A great degree of under-diagnosis is still present as spirometry is not performed routinely. A study on the use of spirometry for diagnosis of obstructive airway disease in India demonstrated that as of 2013, 72% of chest physicians, 26% general physicians, and 12% general practitioners used spirometry as a diagnostic tool [45]. This can be estimated to be more when comparing rural with the urban population. This is compounded by the lack of public awareness about the disease, its implications, and treatment options [46]. Thakrar *et al*, reported COPD awareness among Indians to be around 47.8% and PR awareness to be around 25.1% [47]. Therefore, diagnosis predominantly takes place at a more advanced stage that limits the potential benefits that could have been achieved through early intervention and treatment. Lack of awareness among healthcare professionals and the community about the beneficial role of PR plays a vital role in the nonavailability of adequate PR facilities in India [48]. According to Kunoor *et al*, only 54.7% of healthcare professionals approached by them were aware of PR components [49]. Lack of awareness among the patients also serves as a limitation to the success of PR. According to the respondents in the study conducted by Kunoor *et al*, the major reasons for referred patients not attending PR programs were inaccessibility of PR centers, demotivation, unavailability of transport, cost, lack of caretakers, and recurrent exacerbations [49].

In India, acquiring the required workforce and associated cost may be an issue. A strong PR program would involve a multidisciplinary team consisting of several trained healthcare personnel working in collaboration [48, 50]. This entails increased manpower and cost hence increased treatment cost which may not be acceptable or affordable for many patients. In India, the annual mean out-of-pocket expenditure of a patient with COPD has been reported to be between Indian Rupees (INR) 11835.85 to 50805.24, depending on government or private healthcare [51]. It is noteworthy that half of the total out-of-pocket expenditure in the given amount accounted for the hospital stay, followed by the cost associated with drug therapy. Other common treatments such as bronchodilators and oxygen therapy are easily available as well as adequately marketed [44]; the same cannot be said for PR. Interestingly, a study in the

UK has shown the cost-effectiveness (cost per quality-adjusted life year) of PR to be much better than that of bronchodilator therapy [44, 52].

To establish a rehabilitation program one of the first criteria is the availability of adequate space and resources such as trained staff and equipment [48]. Developing such a center in India may be a major challenge given the space constraint already existent in hospitals. Additionally, since PR is time-consuming and results take time to appear, hospital authorities prefer to invest existing space and resources in the development of services like intensive care facilities where the returns are faster, and outcomes are quick to appear. In addition, as early detection of COPD is low in India, and the disease is often diagnosed during an acute exacerbation, there appears a greater need for intensive care facilities than PR facilities [48]. Also, the emphasis on curative rather than preventive in most hospital settings is a deterrent. Telerehabilitation may, therefore, be an effective solution to help overcome the constraints in a conventional PR facility. Telerehabilitation is defined as the provision of rehabilitation services with the use of digital technology. It allows the providers to deliver services and monitor the patient remotely *via* desktop or smartphone and has been suggested as an effective therapy [53]. The main benefit of telerehabilitation is accessibility and feasibility with limited space even in the home environment, easy monitoring, reduction in cost from both the patient as well as the hospital side [54]. Telerehabilitation using exercise instruction videos, educational material, online counseling sessions can help the patients stay motivated throughout the PR program thereby ensuring better compliance and sustainability. Internationally, the validity and reliability of telerehabilitation against conventional rehabilitation programs have been found to be satisfactory [55]. Telerehabilitation appears to be an excellent opportunity for delivering PR services but requires expertise. Considering the insufficient knowledge and implementation of conventional PR already existent in the country, it may not be appropriate to use it as the standard mode of delivery immediately. At this stage, it is important that the health care personnel and caregivers are educated and trained on the concepts of PR to reinforce the development of PR services in the country.

PR is an effective but slow and gradual process that requires specialized infrastructure. If it is to be widely used one will have to educate both doctors and patients of its importance and utility. It also must be advocated to the community. Early diagnosis of COPD and concepts of PR should be included in both UG and PG training of doctors, nurses, and physiotherapists. This requires an elevated level of collaborative engagement among medical professionals, community workers, and the general population. Innovative methods and solutions may be looked at. Telerehabilitation is a promising approach that may be explored but it still requires experimental validation. A multipronged strategy of advocacy, education, and innovation is required if we want to use this effective treatment to manage COPD patients more effectively and reduce the burden of disease.

Conclusion

Management of COPD in India is reliant on bronchodilators, corticosteroids, and oxygen therapy. PR has been, time and again, proven to be beneficial in the holistic treatment of COPD and has been established as the standard of care in the management of COPD (in combination with pharmacological treatment). Implementing a protocolized rehabilitation program in a developing country with inadequate resources is indeed challenging. However, the nationwide burden of the disease and associated economic loss with conjoining constraints such as poor muscle quality and high prevalence of malnutrition in the population necessitates the utilization of PR in the country. Moving forward, educating the health care fraternity, and promoting mass awareness is of foremost importance for the success of PR. Telerehabilitation appears to be an attractive mode of delivery but it must be evaluated in developing world setting through appropriate clinical trials.

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