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A Study on Validity and Usability of Low Cost Outdoor and Home Based Pulmonary Rehabilitation Programme in Developing Countries

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ABSTRACT
Chronic Obstructive Pulmonary Disease (COPD) is a major cause of chronic morbidity and mortality throughout the world. COPD represent a public health challenge in both industrialized and developing countries because of their frequency and economic impact. In developing countries, where poverty and non-communicable respiratory disease have long been linked, most patients have poor access to health care; this is even true of the poorest minorities in industrialized countries. To study the usability and validity of low cost outdoor and home based pulmonary rehabilitation programme in uncomplicated COPD patient in developing countries. It is Prospective observational analytical study. This study was conducted at R.G. Kar Medical College and Hospital, Kolkata, West Bengal from June, 2020- November, 2021 (18 months). In our study BODE 1 Total, the mean CON+REHAB (Mean±S.D.) of patients was 4.0455±1.1329. In BODE 3 Total, the mean CON+REHAB (Mean±S.D.) of patients was 1.0909±1.1916. In BODE 1 Total, the mean Conservative B (Mean±S.D.) of patients was 3.9091±0.9211. In BODE 3 Total, the mean Conservative (Mean±S.D.) of patients was 4.7727±1.1519. So this result showed improvement in physical and functional status of body in rehab group with routine management than only routine management. At 3 months, 6 months follow up statistically significant improvement was also seen as per the BODE index score as a measure of physical and functional status.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is the leading cause of chronic morbidity and death across the world. COPD constitute a public health challenge in both developed and developing nations because of its prevalence[1]. and economic impact. In developing countries, where poverty and non-communicable respiratory disease have long been linked, most patients have poor access to health care; this is even true of the poorest minorities in industrialized countries[2,3].

In underdeveloped nations, however, health planners have extra challenges due to inadequate resources. This paper discusses the burden and trend of chronic respiratory diseases, as well as their economic impact and proposes practical strategies for improving patient management in developing countries. In middle-income countries such as Algeria, COPD and asthma are emerging as public health problems. However, the prevalence of COPD is likely underestimated since it is rarely recognized until it is clinically evident and substantially progressed. COPD affects males more commonly than women, generally begins after the age of 45 and becomes more common as people age. Tobacco smoking is the single most important cause in the development of COPD, accounting for more than 75% of cases globally; however, additional environmental risk factors are also identified. Several studies have demonstrated that COPD is connected with job pollution and indoor air pollution from biomass fuel appears to contribute to COPD in women in developing countries In addition, COPD is associated with acute respiratory infections in children and low socioeconomic status[4,5]. The rate of tobacco consumption is increasing throughout the developing world. Between 1985 and 1990, for example, the rates rose by 3.4% and were predicted to rise by 2.7% between 1995 and 2000[6].

Many people suffer from this disease for years, dying prematurely from it or its complications. COPD is currently the third leading cause of death in worldwide and 80% of these deaths occurred countries like India, Bangladesh etc[7]. Almost every month, a new drug hits the market, with promises of 'relief' but falling short in really relieving the patient from the misery of the disease. It has been realized that drugs alone won't suffice if relief is desired.

Pulmonary rehabilitation is a comprehensive intervention based on thorough assessment followed by patient-tailored therapies, such as exercise training, education and behavior change. It is designed to promote the long-term adherence of health-enhancing behaviors. Essential elements include patient assessment and correct prescription, physical exercise, education and program evaluation[8]. PR has been shown to improve patients' QOL and physical outcomes.

Numerous studies have confirmed the benefits of pulmonary rehabilitation at various levels[9,10]. Majority of the studies used elaborate rehabilitation programs most of which had an indoor rehabilitation component. This caused a massive escalation of expenses, which added to the cost of medication beyond the reach of the majority of COPD population in the developing countries. Dyspnoea and fatigue after mild exertion (decreased exercise tolerance) are the two most common and palpable symptoms experienced by patients with COPD[11,12].

Our present study tries addressing this problem. A home based trial on the outdoor patients was conducted to determine the impact of a low-cost pulmonary rehabilitation program in a group of COPD patients, compared with another group of COPD patients receiving only "routine" outpatient advice. Both groups continue receiving an optimal drug management.

AIMS AND OBJECTIVE

Aim: To study the usability and validity of low cost outdoor and home based pulmonary rehabilitation programme in uncomplicated COPD patient in developing countries.

Objectives:

- To assess and compare the improvement in exercise tolerance
- To assess and compare the improvement on dyspnoea index
- To assess and compare the improvement in physical and functional status

MATERIALS AND METHODS

This study was initiated after receiving from the institutional ethical committee of RG KAR Medical Collage and Hospital, Kolkata.

History, clinical examinations with relevant information and measurements were be noted in pretested, pre- designed study proforma (enclosed).

All the patients and their care- givers were explained about physical status available management, outcomes and complications in a language that would be understandable to them. Informed consent were taken from each of them before inclusion in the study.

Type of study: Prospective observational analytical study.

Study area: This study was conducted in department of Physical Medicine and Rehabilitation in R.G. Kar Medical College and Hospital, Kolkata, West Bengal.

Study period: June, 2020 to November, 2021 (18 months).

Study population: All patients diagnosed clinically were counted in the study population, after considering inclusion and exclusion criterias.

Inclusion criteria:

- The diagnosis of patient suffering from mild to severe COPD in accordance to the GOLD guidelines
- Patients were in a stable condition at the time of recruitment and were under care of a primary care physician or a specialist receiving an acceptable medical regimen for their condition over six month
- Willingness to participate in all aspects of the study
- Age 40-65 years

Exclusion criteria:

- Hospitalized patient
- Presence of any other significant disabling lung disease
- Presence of neuromuscular disease
- Orthopedic or neurologic disease that affected gait. e. Cardiac problem like AMI, Heart failure etc.
- Stroke

Statistical analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests, which compare the means of independent or unpaired samples, were used to assess differences between groups. Paired t-tests, which account for the correlation between paired observations, offer greater power than unpaired tests. Chi-square tests (χ^2 tests) were employed to evaluate hypotheses where the sampling distribution of the test statistic follows a chi-squared distribution under the null hypothesis; Pearson's chi-squared test is often referred to simply as the chi-squared test. For comparisons of unpaired proportions, either the chi-square test or Fisher's exact test was used, depending on the context. To perform t-tests, the relevant formulae for test statistics, which either exactly follow or closely approximate a t-distribution under the null hypothesis, were applied, with specific degrees of freedom indicated for each test. p-values were determined from Student's t-distribution tables. A $p \leq 0.05$ was considered statistically significant, leading to the rejection of the null hypothesis in favour of the alternative hypothesis.

RESULTS AND ANALYSIS

In BMI (1), the mean CON+REHAB (Mean±S.D.) of patients was 22.8716±1.3844. In BMI (3), the mean CON+REHAB (Mean±S.D.) of patients was 22.6045± 1.3138. Distribution of mean CON+REHAB with BMI(1) and BMI(3) was not statistically significant (p = 0.5151). In BMI (1), the mean Conservative (Mean±S.D.) of patients was 22.5227±2.0307. In BMI (3), the mean Conservative (Mean±S.D.) of patients was 23.1864±1.8879. Distribution of mean Conservative with BMI (1) and BMI (3) was not statistically significant (p = 0.2679). In ATS-1, the mean Conservative (Mean±S.D.) of patients was 2.3182±0.4767. In ATS-3, the mean Conservative (Mean±S.D.) of patients was 2.7273±0.4558. Distribution of mean Conservative with ATS-1 and ATS-3 was statistically significant (p = 0.0058) (Table 1).

In BODE 1 Total, the mean Conservative B (Mean±S.D.) of patients was 3.9091±0.9211. In BODE 3 Total, the mean Conservative (Mean±S.D.) of patients was 4.7727±1.1519. Distribution of mean Conservative with BODE 1 Total and BODE 3 Total was statistically significant (p = 0.0088). In AQ20 (1), the mean CON+REHAB (Mean±S.D.) of patients was 14.8182±1.8679. In AQ20 (3), the mean CON+REHAB (Mean±S.D.) of patients was 8.6818±2.4375. Distribution of mean CON+REHAB with AQ20 (1) and AQ20 (3) was statistically significant (p<0.0001). In AQ20 (1), the mean Conservative (Mean±S.D.) of patients was 13.4545±1.5032. In AQ20 (3), the mean Conservative (Mean±S.D.) of patients was 16.0909±1.6593. Distribution of mean Conservative with AQ20 (1) and AQ20 (3) was statistically significant (p<0.0001). In CON+REHAB Group, the meanAQ20 Difference (Mean±S.D.) of patients was 6.1364±2.2103. In Conservative Group, the mean AQ20 Difference (Mean±S.D.) of patients was -2.6364±1.7056. Distribution of mean AQ20 Difference with Group was statistically significant (p<0.0001).

DISCUSSION

Demographical characteristics: It was a prospective observational analytical study between two equal and matched groups of patients who were selected after careful deliberation of inclusion and exclusion criteria, One group received pulmonary rehabilitation with optimum drug therapy (Group 1) and the other group received only optimum drug therapy (Group 2) for COPD management. Patients were selected from the Out-Patient Department using history, clinical examination and other investigations like chest x ray, PFT to rule out other causes) (Table 1).

Of the 56 patients who were enrolled for the study, only 44 patients completed the study. Eight patients were excluded and four patients dropped out. Baseline and incomplete follow up data collected from the drop-out participants were not included in statistical analysis.

Table 1: Association between age in group: Group

	Groups		
Age in group	CON+REHAB	Conservative	Total
45-50	16	8	24
Row (%)	66.7	33.3	100.0
Col (%)	72.7	36.4	54.5
51-55	5	9	14
Row (%)	35.7	64.3	100.0
Col (%)	22.7	40.9	31.8
56-60	1	5	6
Row (%)	16.7	83.3	100.0
Col (%)	4.5	22.7	13.6
Total	22	22	44
Row (%)	50.0	50.0	100.0
Col (%)	100.0	100.0	100.0

Table 2: Distribution of mean BMI(1), BMI(3): Group

	Numb er	Mean	SD	Minimum	Maximum	Median	p-value
BMI(1)							
CON+REHAB	22.00	22.87	1.38	20.20	25.40	22.90	0.51
Conservative	22.00	22.52	2.03	19.00	26.70	22.95	
BMI(3)							
CON+REHAB	22.00	22.60	1.31	19.80	24.80	22.55	0.24
Conservative	22.00	23.19	1.89	19.60	27.10	23.55	

Table 3: Distribution of mean CON+REHAB, conservative: Group

	Numb er	Mean	SD	Minimum	Maximum	Median	p-value
CON+REHAB							
BMI(1)	22	22.8716	1.3844	20.2	25.4	22.9	0.5151
BMI(3)	22	22.6045	1.3138	19.8	24.8	22.55	
Conservative							
BMI(1)	22	22.5227	2.0307	19	26.7	22.95	0.267
BMI(3)	22	23.1864	1.8879	19.6	27.1	23.55	

Table 4: Distribution of mean CON+REHAB, conservactive: Group

	Number	Mean	SD	Minimum	Maximum	Median	p-value
CON+REHAB							
AQ20(1)	22.00	14.82	1.87	11.00	18.00	14.00	<0.0001
AQ20(3)	22.00	8.68	2.44	5.00	15.00	8.00	
Conservative							
AQ20(1)	22.00	13.45	1.50	12.00	16.00	13.00	<0.0001
AQ20(3)	22.00	16.09	1.66	11.00	18.00	16.00	

In CON+REHAB, 16 (72.7%) patients were 45-50 years old, 5 (22.7%) patients were 51-55 years old and 1 (4.5%) patient was 56-60 years old. In conservative, 8 (36.4%) patients were 45-50 years old, 9 (40.9%) patients were 51-55 years old and 5 (22.7%) patients were 56- 60 years old. Age is an independent, non-modifiable risk factor of COPD. It is known that COPD is more prevalent in elderly people. However, in our study we excluded the patients below 40 year and above 65 years (Table 2).

In CON+REHAB, 7 (31.8%) patients were Female and 15 (68.2%) patients were Male. In conservative, 11 (50.0%) patients were Female and 11 (50.0%) patients were Male. Association of Sex with Group was not statistically significant (p = 0.2200) (Table 3).

In CON+REHAB Group, the mean Difference of BMI (Mean±S.D.) of patients was 0.2671±0.4635. In Conservative Group, the mean Difference of BMI (Mean±S.D.) of patients was -0.6636±0.3200. Distribution of mean Difference of BMI with Group was statistically significant (p<0.0001) (Table 4).

The earliest description of COPD was by Laënnec, the inventor of the stethoscope in 1821[13]. He was performing dissections of patients whom he had been following and described the combination of overinflated lungs and bronchi filled with mucous fluid. Regarding the per capita monthly income (in rupees), the patients were classified according to the modified BG Prasad socioeconomic classification scale, January 2014. There were 5 categories viz. 5357 and above (Upper class), 2652-5356 (Upper middle class), 1570-2651 (Middle class), 812-1569 (lower middle class) and <811 (lower class). In CON+REHAB, 5 (22.7%) patients were Income (per capita) 1, 14 (63.6%) patients were Income (per capita) 2 and 3 (13.6%) patients were Income (per capita) 3. In conservative, 8 (36.4%) patients were Income (per capita) 1, 10 (45.5%) patients were Income (per capita) 2 and 4 (18.2%) patients were Income (per capita). Out of these maximum was in the category of lower middle class (Table 5).

Discussion regarding outcomes of the study: This prospective observational analytical study was planned to assess the effects of pulmonary rehabilitation along with conservative management of COPD by comparing its outcome with that of the conservative management only. The comparison was done in terms of improvement in dyspnoea index (measuring ATS scale), Exercise tolerance (measuring 6MWT) Physical

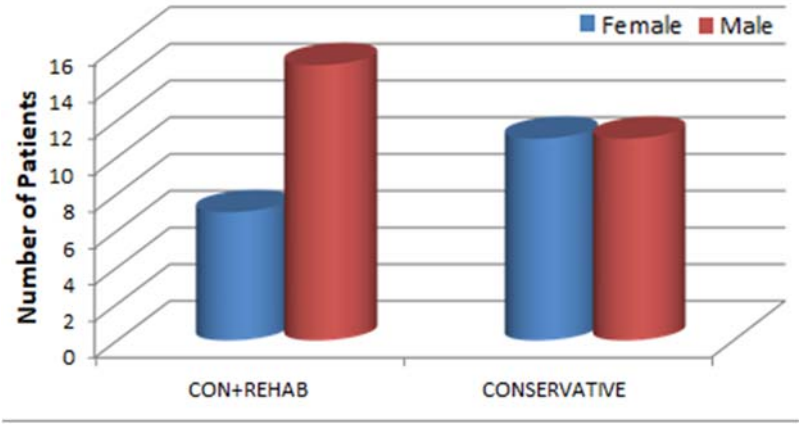

Fig. 1: CON+REHAB vs conservative

Table 5: Distribution of mean AQ20 difference: Group

	Numb er	Mean	SD	Minimum	Maximum	Median	p-value
AQ20							
CON+REHAB	22	6.1364	2.2103	-1	10	6	<0.0001
Difference							
Conservative	22	-2.6364	1.7056	-5	3	-3	

Table 6: Distribution of mean all parameters

	Number	Mean	SD	Minimum	Maximum	Median	p-value
CON+REHAB							
ATS-1	22	2.4545	0.5096	2.0000	3.0000	2.0000	<0.0001
ATS-3	22	1.1364	0.6396	0.0000	2.0000	1.0000	
Conservative							
ATS-1	22	2.3182	0.4767	2.0000	3.0000	2.0000	0.0058
ATS-3	22	2.7273	0.4558	2.0000	3.0000	3.0000	
CON+REHAB							
6MWT-1	22	330.7727	7.6278	310.0000	340.0000	331.0000	<0.0001
6MWT-3	22	405.9091	22.9718	315.0000	430.0000	410.0000	
BODE 1 total							
CON+REHAB	22	4.0455	1.1329	3.0000	6.0000	4.0000	0.6636
Conservative	22	3.9091	0.9211	3.0000	6.0000	4.0000	
CON+REHAB							
BODE 1 total	22	4.0455	1.1329	3.0000	6.0000	4.0000	<0.0001
BODE 3 total	22	1.0909	1.1916	0.0000	4.0000	1.0000	

and functional status (measuring BODE index), Respiratory health related quality of life (AQ 20 Questionnaires). The patients were followed up twice (3 months and 6 months) (Table 6).

We found that the patients in the Rehab group showed significant improvements in dyspnoea indices (measuring ATS scale). In CON+REHAB Group, the mean ATS Difference (Mean±S.D.) of patients was 1.3182±0.6463. In Conservative Group, the mean ATS Difference (Mean±S.D.) of patients was -0.4091±0.5032. Distribution of mean ATS Difference with Group was statistically significant (p<0.0001). At the end of the study these patients felt less 'breathless' and were able to tolerate higher levels of exertion. The improvements noted in the dyspnoea levels and exercise tolerance concurred with most previous findings (Fig. 1).

Goldstein3 showed significant benefits in dyspnoea levels of 45 patients who participated in an 8-week inpatient pulmonary rehabilitation program followed by 16weeks of supervised outpatient care.

In one of the largest studies on pulmonary rehabilitation Ries concluded that patient's receiving comprehensive pulmonary rehabilitation showed significantly improved exercise endurance and reported less dyspnoea and greater comfort when walking as compared to patients who received education alone

Exercise tolerance was measured using the 6 min walking distance (6MWD). In 6MWT-1, the mean CON+REHAB (Mean±S.D.) of patients was 330.7727±7.6278. In 6MWT-3, the mean CON+REHAB (Mean±S.D.) of patients was 405.9091±22.9718. In 6MWT-1, the mean Conservative (Mean±S.D.) of patients was 314.6364±11.1720. In 6MWT-3, the mean Conservative (Mean±S.D.) of patients was 302.6364±13.5032. In our study we noted an increase of 75.13 m in the 6MWD after six months. We anticipated some improvements in the 6MWD as the patients were on an exercise regimen targeted to counter the de-conditioning effects of COPD. It is also

worth noting that the non-rehab group actually showed a decrease of 12m at the end of the six-month study. The value, though non-significant, is suggestive of a reduction in exercise tolerance.

In our study BODE 1 Total, the mean CON+REHAB (Mean±S.D.) of patients was 4.0455±1.1329. In BODE 3 Total, the mean CON+REHAB (Mean±S.D.) of patients was 1.0909±1.1916. In BODE 1 Total, the mean Conservative B (Mean±S.D.) of patients was 3.9091±.9211. In BODE 3 Total, the mean Conservative (Mean±S.D.) of patients was 4.7727±1.1519. So this result showed improvement in physical and functional status of body in rehab group with routine management than only routine management.

In AQ20(1), the mean CON+REHAB (Mean±S.D.) of patients was 14.8182±1.8679. In AQ20(3), the mean CON+REHAB (Mean±S.D.) of patients was 8.6818±2.4375. In AQ20(1), the mean Conservative (Mean±S.D.) of patients was 13.4545±1.5032. In AQ20(3), the mean Conservative (Mean±S.D.) of patients was 16.0909±1.6593. Less score in AQ(20) means improvement in respiratory related health quality of life. In our study result shows improvement in respiratory related health quality of life in rehabilitation with routine management group.

In essence, our findings concurred with most of the international findings, showing improvements of dyspnoea levels and exercise tolerance with pulmonary rehabilitation. But the most striking thing was that the rehabilitation programme used was a compact, outpatient and home- based program using less time in the hospital, minimal resources but producing significant benefits comparable to similar studies. These findings support the prescription of similar rehabilitation program to all patients with COPD.

CONCLUSION

At the end of the study, ATS score values for dyspnoea in COPD showed statistically significant improvement on follow up at 3 months, 6 months in pulmonary rehabilitation group. At 3 months and 6 months follow up there was significant increase in 6MWD for exercise tolerance pulmonary rehabilitation group. At 3 months, 6 months follow up statistically significant improvement was also seen as per the BODE index score as a measure of physical and functional status. At the end of the study there was improvement in respiratory quality of life as measured by AQ20 questionnaires. Since no controls were used, no inference can be obtained from these. The study shows that low-cost outdoor and home-based pulmonary rehabilitation programs are effective and feasible in underdeveloped nations. Despite limited resources, these programs effectively enhance patients' respiratory function, exercise ability and quality of life. Participants saw substantial improvements in pulmonary metrics, decreased symptom load and improved overall well-being. The flexibility and accessibility of these rehabilitation options make them viable alternatives to typical hospital-based programs, particularly in resource-constrained situations. Implementing such cost-effective approaches can bridge healthcare gaps, enhance patient outcomes and serve as a paradigm for sustainable chronic illness management in comparable locations.

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