CHAPTER II

REVIEW OF LITERATURE

The Chronic obstructive pulmonary disease (COPD) is the most common chronic lung disease and the major impetus for the development of pulmonary rehabilitation (PR) programme over the past half century. Rehabilitation for patients with chronic lung disease is well established and widely accepted as a means of enhancing standard therapy in order to alleviate symptoms and optimise function (ATS Statement, 1999; BTS Statement, 2001; O’Donnell et al., 2003; BTS Consortium, 2004; Glaab et al., 2006).

The primary goal of rehabilitation is to restore the patient to the highest possible level of independent function. This goal is accomplished by helping patients to increase their activity through breathing and physical exercise training. Exercise training helps the patients to reduce dyspnoea, gain control of their symptoms, learn more about their disease, treatment options and coping strategies. Patients are encouraged to become actively involved in providing their own health care, more independent in daily activities and less dependent on health professionals and expensive medical resources. Rather than focusing solely on reversing the disease process, rehabilitation attempts to improve disability from disease (Casaburi and Petty, 1993; Fishman, 1994; Piquette, 2001).

This chapter presents information and studies related to rehabilitation of patients with COPD in seven sections as listed below.

1. COPD as a disease
2. Pulmonary rehabilitation
3. Breathing and physical exercise training.
4. Education
5. Psychosocial support
6. Six minute walking distance

2.1 COPD AS A DISEASE

Chronic Obstructive Pulmonary Disease is defined as a condition in which there is chronic obstruction due to chronic bronchitis and/or emphysema. Although the degree of obstruction may be less when the patient is free from respiratory infection and may improve somewhat with bronchodilator drugs, significant obstruction is always present.

In chronic bronchitis, the infection or bronchial irritants cause increased secretions, edema, bronchospasm and impaired mucociliary clearance (Ingram, 1994; Ignatavicius, 1991). The accumulated secretions in the bronchioles interfere with effective breathing. The symptom of chronic bronchitis is the presence of productive cough that lasts for three months a year for two consecutive years (Smeltzer & Bare, 2004). Pulmonary emphysema is defined as an abnormal distention of the air spaces beyond the terminal bronchioles with destruction of the walls of the alveoli. The alveolar destruction is caused by abnormalities of lung enzymes called protease’s (Dewit, 1998).

Distinguishing between asthma, chronic bronchitis and emphysema may be difficult because these can have similar historical, physical and laboratory finding. The principal causative agent cigarette smoking can cause more than one condition such as emphysema and chronic bronchitis (James, 1996).
Bronchial asthma is defined as the intermittent airway narrowing caused by three processes such as constriction of bronchial smooth muscle, excess production of mucus and edema of mucus membrane. Asthma like bronchitis affects the airways not the air sacs, and is reversible. Therefore, asthma does not typically lead to emphysema; however, asthma may coexist with emphysema and bronchitis (Ignatavicius, 1991).

According to the collaborative project titled Global Initiative for Chronic Obstructive Lung Disease (GOLD) and supported by US National Heart Lung and Blood Institute (NHLBI) and the World Health Organization (WHO) the diagnosis of COPD is ensured when a patient’s FEV₁ / FVC ratio is less than 70% of the predicted value in combination with an FEV₁< 80% which is not fully reversible (Pauwels et al., 2001).

2.2 PULMONARY REHABILITATION
2.2.1 Components of Pulmonary Rehabilitation

Pulmonary rehabilitation is a multidimensional continuum of services with the team of chest physician, nurse, respiratory therapist, physical therapist, occupational therapist, nutritionist, social worker, vocational & psychological counselor, to provide a quality service to persons with pulmonary disease and their families with the goal of achieving and maintaining the individuals maximum level of independence and functioning in the community. Among the team the nurse plays an important role as coordinator.
Among the rehabilitation team the nurse as a principal care provider to perform and maintain the following activities

1. Administers and trains the patient in the use of prescribed medication, exercise, personal hygiene, skin care, pulmonary toilet and adaptive equipment for activities of daily living (ADL).

2. Minimises immobility and dependence of patients and integrates the multidisciplinary team’s interventions into daily activities.

3. Educates the patient and the family regarding the patient impairments and the team’s strategies for decreasing disability.

4. Maintains the patient’s environment conducive to achieve the rehabilitation goal.

PR programmes generally have four major components, exercise training, education, psychosocial/behavioural intervention and outcome assessment. Exercise is the most important and basic foundation of PR. The three major goals in successful management of COPD are reduction of airflow obstruction, prevention of complication and improvement in HRQOL (Linus et al., 2004; Saroea, 1993).

2.2.2 Settings and Duration of Pulmonary Rehabilitation

PR improves dyspnoea and quality of life. Rehabilitation in patients with COPD has been shown to be an effective treatment and can be carried out in different settings ie. Inpatient, Outpatient or Home based (Salman et al., 2003).
The structure, components and duration of the program rather than the setting itself, determine the effectiveness of pulmonary rehabilitation (Ries, 2005; Reardon et al., 2005). The choice of setting often depends on the physical, functional and psychological status of the patients, the variability and distance to the program, affordability and patient preference. The patients who are severely disabled due to dyspnoea are probably better candidates for an inpatient PR programme.

In the following sections the outcomes of pulmonary rehabilitation conducted at various settings and for different durations are given.

2.2.3 Studies Related to Inpatient Pulmonary Rehabilitation

Inoue et al. (1996) evaluated the effects of pulmonary rehabilitation on pulmonary function. 15 patients of chronic pulmonary emphysema underwent PR for 6 weeks as inpatients. The interventions are relaxation techniques, breathing retraining, thoracic massage, physical exercise and walking. The findings of the study suggested that PR can increase vital capacity in some patients with chronic pulmonary emphysema and that such increase was not directly connected to increases in exercise capacity.

Buchi et al. (1996, 1997) assessed the success of inpatient PR among 54 patients with COPD. During hospital stay, FEV\textsubscript{1} % predicted improved from 42.5% to 51.9% on discharge (p < 0.001). Quality of life (p < 0.05) and health satisfaction (p < 0.001) improved significantly. One year after hospital stay 32 patients showed a still improved FEV\textsubscript{1} % (46.4%, p < 0.05) and health satisfaction (p < 0.05). In conclusion, the effects of PR on lung function and health satisfaction were improved positively and enduring.
Onodera and Yazak (1998) evaluated the effects of a short-term PR programme on dyspnoea, exercise capacity and lung function. 15 patients with chronic respiratory failure due to pulmonary emphysema were enrolled in 3 weeks inpatients PR program. The PR consisted of pursed lip breathing, diaphragmatic breathing, respiratory muscle stretch gymnastics, and walking with synchronised breathing. Dyspnoea as measured with a visual analog scale at the end of a 6 minutes walk before and after the program (50 ± 4.0 % to 24 ± 4 %) decreased significantly (p < 0.01). As a measure of functional exercise capacity, the 6MWD (227 ± 32m to 292 ± 36m) increased significantly (p < 0.01). The findings suggested that the PR program relieves dyspnoea, increases functional exercise capacity.

Haggerty et al. (1999) examined 164 patients with COPD who participated in PR programs in Connecticut. They were assessed in pre and post rehabilitation with the following outcome measures of 6MWD, Pulmonary Functional Status Scale (PFSS). HRQOL was measured using the CRQ. Rehabilitation resulted in significant increases in the 6MWD, the total PFSS scores (13%), and the total CRQ (18%) all at the level of p < 0.001. The pre rehabilitation function sub score and total PFSS score correlated strongly with the 6MWD (r = 0.76, 0.73; p < 0.001).

Miyahara et al. (2000) observed the physiologic and quality-of-life improvements in 18 patients with COPD after an inpatient PR program. The physical exercise training consisted of respiratory muscle stretch gymnastics and cycle ergometer exercise training for 3 weeks 5 days per week. Pulmonary function tests, an incremental ergometer exercise test, a 6MWT, and a HRQOL assessment by the CRQ were administered before and after the program. The peak VO_2_, an indicator of maximal exercise capacity, did not increase, although the 6MWD as an indicator of functional exercise capacity increased significantly after rehabilitation. There was a significant
improvement in the HRQOL in terms of dyspnoea, fatigue, and emotional state. Those findings suggested that even a 3 weeks program also be beneficial for COPD patients. Increases in functional exercise capacity, even without an increase in maximal exercise capacity, are helpful for reducing dyspnoea and improving HRQOL parameters in patients with COPD.

Stewart et al. (2001) evaluated the effects of a comprehensive 21 days inpatient PR program in COPD. 157 patients with moderate to severe COPD admitted to an inpatient PR program over a 3 years period. The outcome measures used were QOL questionnaire scores, COPD knowledge questionnaire scores, 6MWT and supplemental oxygen use. The three categories of ambulation such as bed bound, household ambulators, community ambulators were enrolled as study samples. Re-hospitalization 1 year after completion of the program was also assessed and compared with hospital days for the year before the program. An inpatient PR program results in improved endurance and functional ambulation, decreased supplemental oxygen use and fewer hospitalizations 1 year after discharge of patients with COPD.

Boueri (2001) evaluated the effects of 3 weeks comprehensive PR program on quality of life as measured by the Short Form-36 (SF-36) in 37 patients with COPD. PR program incorporates 12 exercise sessions, each of which included bicycle ergometer exercise training, upper extremity training, strength training, stretching, along with psychosocial counseling and education. The health status index (SF-36) and 6MWT were completed before and after rehabilitation. There was an improvement in 5 of the 9 quality of life subscales of the SF-36 and in functional capacity as measured by the 6MWD. There was no correlation between improvement in quality of life and improvement in functional capacity. There was no correlation between FEV_{1} and improvement in walk distance, but there was a correlation
between FEV$_1$ and improvement in SF-36, physical function and energy/fatigue subscales.

### 2.2.4 Studies Related to Outpatient Pulmonary Rehabilitation

Disabled patients with severe dyspnoea, who are probably better candidates for an inpatient or outpatient multidisciplinary approach. Outpatient PR can be hospital based or community based, requires a certain level of functional ability and has the potential to benefit most of the respiratory disorder specifically for patients with COPD (Garvey, 1999).

Outpatient PR programmes have been conducted for varying durations ranging between 4 weeks to 3 months and some times with a sustained follow up for a period of even more than 2 years (Strijbos et al., 1996; Romagnoli et al., 2006). For the purpose of comparison, the outpatient programmes are classified into

1. Short term programmes (upto 8 weeks),
2. Long term programmes (8 weeks – 6 months).
3. Prospective / longitudinal studies (After a structured PR a periodical follow up for a period more than 6 months)

### 2.2.4.1 Short Term Outpatient Pulmonary Rehabilitation Programmes

Lin et al. (1997) conducted a multidisciplinary PR program for 13 outpatients with moderately severe COPD. Exercise capability, including 6MWD, maximal workload endurance time, and maximal heart rate improved significantly (p < 0.05) as did subjective symptom and HRQOL. Maximum heart rate and FEV$_1$, are predictors of exercise capability improvement. Changes in pulmonary function and blood gas data were not significant.
Morgan (1999) evaluated the effect of education alone and exercise with education of COPD patients. 126 patients of COPD were stratified for dyspnoea using the Medical Research Council (MRC) dyspnoea score into MRC 3 - 4 (moderate, n = 66) and MRC 5 (severe, n = 60) dyspnoeic groups. The patients were randomly assigned to an 8 weeks programme of either exercise plus education (exercise group) or education (control group). Education and exercise programmes for the moderately dyspnoeic patients were carried out in a hospital outpatient setting. Severely dyspnoeic patients were all treated in an individualized training programme. There was a significant improvement in shuttle walking distance in the moderately dyspnoeic group, who received exercise training [baseline 191 ± 22m; post rehabilitation 279 ± 22m (p < 0.001)]. There was no improvement in exercise performance in the severely dyspnoeic patients who received exercise. Neither group of control patients improved. Health status was assessed by CRQ and found to be increased in moderately dyspnoeic patient who received exercise from 80 ± 18 to 95 ± 17 (p < 0.0001) after rehabilitation. Much smaller changes were seen in the other three groups. Improvement in exercise performance and health status in patients with COPD after an exercise programme depends on the initial degree of dyspnoea.

Young (1999) conducted an outpatient respiratory rehabilitation programme consisting of education on disease management, coping skills as well as progressive aerobic exercise for specific muscle training related to functional activities. The rehabilitation comprised of 7 two hours session over one month for groups of 6 to 8 patients. 51 patients with COPD completed the programme. The principal outcome parameters were exercise capacity (6MWD), degree of perceived breathlessness and HRQOL assessed by CRQ. There was a significant improvement in exercise capacity. 6 MWD improved from 375 ± 126 m at baseline to 440 ± 109 m at three months (p < 0.005).
There was significant improvement in HRQOL total score as well as in the domains of dyspnoea, fatigue and mastery. There was a reduction in the level of perceived dyspnoea (modified borg scale).

Griffiths et al. (2001) undertook a cost / utility analysis in conjunction with a randomized controlled clinical trial of PR versus standard care among 200 patients of COPD. The patients were randomly assigned to 18 visits, 6 weeks rehabilitation program and standard medical management. The rehabilitation group received educational activities and exercise period and session addressing the psychosocial aspect for three half days per week for 6 weeks. The outpatient PR program produces cost per quality adjusted life years (QALY) ratio within bounds, cost effective and it was likely to results in financial benefits to the health service.

Clini et al. (2001) compared the functional benefits and relative costs of administering an intense short term inpatient versus a long term outpatient pulmonary rehabilitation program (PRP) of patients with chronic airway obstruction (CAO). Retrospective case control study was conducted among 43 patients of either COPD or Asthma in pulmonary ward and outpatient clinic. The inpatients performed 10 to 12 daily session (five sessions a week). The control subjects performed 20 to 24 sessions (three sessions a week) of outpatient PRP. At baseline and after PRP, an incremental exercise test was performed including evaluation of dyspnoea and leg fatigue by Borg scale. A short term inpatient PRP results in improvement in exercise tolerance of inpatients with CAO similar to a longer outpatient PRP but with lower cost.

Sudo et al. (2001) studied the effect of pulmonary rehabilitation in seven patients with COPD for a period of 6 weeks PR. The program consisted of relaxation, pursed lip breathing, diaphragmatic, panic control, muscle
stretch gymnastics and exercise training. The 6MWD increased significantly from 246 ± 38m to 304 ± 28m (p < 0.05). The minimum SpO2 during 6MWT increased from 86 ± 2.8 % to 90 ± 1.3 %, dyspnoea as measured with Borg scale decreased but they were not significantly different.

Green et al. (2001) compared a 7 weeks versus 4 weeks PR programme for patients with COPD. A randomised controlled trial among 44 patients with COPD who were allocated to either 7 weeks or 4 weeks course of an outpatient based programme. They were assessed at baseline and at completion by the Chronic Respiratory Questionnaire (CRQ), the Breathing Problems Questionnaire (BPQ), the incremental shuttle walk test (ISWT), and the treadmill endurance test (TET). 21 patients completed a conventional 7 weeks course and 23 (67% men) completed a shortened 4weeks course. Patients who completed the 7 weeks rehabilitation programme had greater improvements in all outcome measures than those undertook the 4weeks course. These differences reached clinical and statistical significance for the total CRQ score, which was the primary outcome variable (p < 0.05). The CRQ domains of dyspnoea and mastery improves at (p < 0.05), the emotional status (p < 0.005). A 7 weeks course of PR provides greater benefits to patients than a 4weeks course in terms of improvements in health status.

Sewell et al. (2006) conducted a randomised controlled trial of patients with COPD to assess whether a 4 weeks PR was equivalent to the conventional 7weeks PR at equivalent time points of 7weeks and 6 months. 100 patients with stable COPD were randomised to either a 7 weeks (n = 50) or 4 weeks (n = 50) supervised PR. Patients were assessed at baseline, completion of the supervised PR and 6months later. Outcome measures were, Incremental Shuttle Walking Test, Endurance Shuttle Walk Test (ESWT), CRQ - Self Reported and the Breathing Problems Questionnaire. 41 patients in each group completed the PR. Patients in the 4weeks group attained higher
ESWT times (124 seconds, p=0.024) at the 7 weeks time point. There were no other statistically significant between group differences for any other measure at the 7 weeks or six months time points. Patients in both groups made statistically significant improvements in all outcome measures at 7 weeks. A shortened 4 weeks supervised PR is equivalent to a 7 weeks supervised PR at the comparable time points of 7 weeks and 6 months.

Eaton (2006) aimed to determine the responsiveness of the ESWT in COPD patients attending a hospital based PR program. 20 stable COPD patients were recruited to a standard 8 weeks pulmonary rehabilitation. Outcome parameters studied at baseline and completion of 8 weeks PR are lung volume, resting oxygen saturation, breathlessness score (Borg), 6 MWD, ESWT, health related quality of life (CRQ) and Hospital Anxiety and Depression (HAD) scale. Following rehabilitation, there were significant improvements in 6 MWD, ESWT, total CRQ and anxiety domain (HAD). The 6 MWD increased by 17% (47m 95% CI 3, 90), while the ESWT increased by 92% (302m 95% CI 104, 501). The author concluded that ESWT is a simple, acceptable and highly responsive outcome measure for COPD patients undergoing PR, it may be more responsive than the 6MWD.

2.2.4.2 Long Term Outpatient Pulmonary Rehabilitation Programmes

Ndundu et al. (2001) evaluated the effects of 12 weeks PR comprising 3 sessions per week on respiratory function, physical activity and changes in the quality of life of patients with COPD and Asthmatic patients. 38 patients (20 women) who had bronchial asthma (n = 14) or COPD (n = 24) were included in the study. The patients were treated with Kines therapy and inhaled bronchodilator drugs (salbutamol, and/or ipratropium bromide with a boreal nebulizer) as well as bronchial hygiene and breathing exercises on a bodyguard ergometer 990 with walking, running and climbing steps until
exhaustion. After the rehabilitation program FEV$_1$ increased from 1.37 ± 0.62 (50% expected) to 1.54 ± 0.69 (56% expected) (p < 0.01). The same trend was observed for walking distance (from 644 ± 459 m to 1213 ± 569 m, p < 0.001) and for maximal power developed on bicycle ergometric exercises (from 45 ± 20 W to 73 ± 37 W, p < 0.001). In contrast, the maximal work performed during climbing steps (from 106 ± 44 W to 115 ± 23 W) did not improve significantly. COPD patients improved their FEV$_1$ significantly compared with asthma patients. The PR program changes the quality of life of COPD patients who are able to move about better for longer periods of time, have a longer walking distance, and improved physical activity level.

Bingisser et al. (2001) developed a modular outpatient based 3 months rehabilitation program to determine the effects and feasibility of the program. 13 patients with COPD and 7 patients with Asthma were enrolled with the initial assessment of cardiopulmonary exercise testing, 6 MWD, lung function test, dyspnoea, depression and quality of life. The training consisted of 36 sessions of high intensity training of 2 hours duration including 30 minutes of stationary cycling to improve exercise tolerance. Another complete assessment was done on completion of the study at 3 months. The results revealed that 6 MWD improved significantly from 401 to 551m (p < 0.0001). The maximal exercise capacity increased significantly from 85 W to 99 W (p < 0.001). There was a reduction in dyspnoea and improvement in quality of life. The study results showed that the outpatient rehabilitation was helpful in improving exercise tolerance and HRQOL.

Ong et al. (2001) conducted a pulmonary rehabilitation programme (PRP) among 34 patients with chronic lung disease. The 6 weeks outpatient PRP includes education, physical and respiratory care instruction and supervised exercise training. Outcome measures such as pulmonary function, incremental exercise and 6-minute walk tests (6MWTs) disease specific
quality of life (CRQ) were assessed at baseline, on completion of PRP and 3 months after PRP. The improvements gained in maximal exercise capacity immediately following PRP were maintained in 17 patients who returned for repeat assessment 3 months after PRP. Patients who completed a comprehensive PRP showed significant increase in functional capacity, reduction of exertional dyspnoea and improvement in health status.

Trooster, Gosselink and Decramer (2001) investigated the significant benefits of exercise training. 49 stable outpatients with moderate to severe COPD were evaluated before and after 12 weeks of exercise training (3 times per week). Responders in exercise capacity were defined as having 15% increase in maximal workload and/or 25% increase in walking distance, while responders in quality of life showed an improvement of at least 10 points on the CRQ. 32 patients were responders in terms of improved exercise capacity. Ventilatory reserve (VE/MVV), inspiratory muscle strength (P1 max), and peripheral muscle strength (handgrip force and quadriceps force) were significant predictors of the training response (p < 0.05). Patients with reduced exercise capacity, ventilatory limitation, reduced respiratory and peripheral muscle strength are more likely to improve with exercise training. Improvements in quality of life after exercise training were significant but remained unpredictable with variables included in the trial.

Finnerty et al. (2001) undertook a randomized, prospective, parallel-group controlled study of an outpatient rehabilitation program for 65 patients with COPD. The active group (n = 36) took part in a 6 weeks program of education (2 hour per week) and exercise (1 hour per week). The control group (n = 29) were reviewed routinely as medical outpatients. The SGRQ was administered under supervision by a blinded observer at study entry, 12 weeks, and 24 weeks. There was a difference of 10.4 points (confidence interval [CI], 3.6 to 17.3) between the two groups at 12 weeks
(p < 0.001) and of 8.1 points (CI, 1.4 to 14.9) at 24 weeks (p = 0.02) in favor of the active group. A 6 weeks outpatient based program significantly improved quality of life in patients with moderate-to-severe COPD. Benefit was evident even after 24 weeks.

Ward (2002) conducted an uncontrolled interventional study in primary care-run community hospital. 34 patients with COPD with FEV\textsubscript{1} of 30 to 50% (mean = 40%) predicted, were enrolled. Patients were assessed at the start, on completion of the programme, and 6 months after completion using spirometry, shuttle walking distance, SF-36 and CRQ scores. It was reported that all but one patient completed the programme. There were significant improvements in the walking distance (by a mean of 100 m), SF-36, and in all domains of the CRQ. There was no significant change in the FEV\textsubscript{1} or FVC. It was concluded that PR programme conducted in community hospital was as effective as those run in secondary care and patients found easier to access.

2.2.4.3 Prospective Outpatient Pulmonary Rehabilitation Programmes

Vale et al. (1993) studied the long term benefits of Outpatient Pulmonary Rehabilitation (OPR) programme on exercise endurance and QOL. 51 patients who had completed 6 weeks OPR programme were subjected to 12 MWD and QOL measurements. The 12 MWD increased from 2,300 ± 611 ft at baseline to 2,789 ± 622 ft , while the QOL increased from 81.2 ± 21.4\% to 104.7 ± 22.2\% (p < 0.0001). 19 patients participated in a structured post OPR exercise maintenance programme. After 1 year of PR programme, it was found that 12 MWD decreased by 10.6 ± 15.8 \% (from 2,789 ± 622 ft to 2539 ± 803 ft) and QOL scores decreased by 7.6 ± 13.6\% (from 104.7 ± 22.2 to 96.4 ± 23.3) in comparison with the post OPR values.
Thus only a portion of the initial improvement in exercise endurance and QOL is lost at follow up months later.

Ries et al. (1995) compared the effects of comprehensive PR with those of education alone on physiologic and psychosocial outcomes in patients with COPD. 119 outpatients with chronic obstructive pulmonary diseased patients were randomly assigned to either an 8 weeks comprehensive PR program or to an 8 weeks education program. PR consisted of twelve 4 hours sessions that included education, physical and respiratory care instruction, psychosocial support, and supervised exercise training. Monthly reinforcement sessions were held for 1 year. The education group attended four 2 hours sessions that included videotapes, lectures, and discussions but not individual instruction or exercise training. Patients were followed for 6 years. In comparison with education alone, comprehensive PR produced a significantly greater increase in maximal exercise tolerance, exercise endurance and perceived breathlessness (p < 0.001), muscle fatigue (p < 0.01), maximal oxygen uptake (p = 0.06), and self-efficacy for walking (p < 0.05). There were slight but non significant differences in survival and duration of hospital stay. Measures of lung function, depression, and general quality of life did not differ between groups. Comprehensive PR significantly improved exercise performance for patients with moderate to severe COPD. Benefits were partially maintained for at least 1 year and tended to diminish after that time.

Rosa Güell (2000) investigated the short and long term effects of an outpatient PR for COPD patients on dyspnoea, exercise capacity, HRQOL, and hospitalization rate. Randomized controlled trial with blinding of outcome assessment and follow up at 3, 6, 9, 12, 18, and 24 months was carried out. 60 patients with moderate to severe COPD were recruited by randomisation (30 experimental and 30 control). 30 rehabilitation patients received 3 months of
outpatient breathing retraining and chest physiotherapy, 3 months of daily supervised exercise, and 6 months of weekly supervised breathing exercises. 30 patients in the control group received standard care. The authors found significant differences between groups in perception of dyspnoea, 6 MWD (p < 0.0001), day-to-day dyspnoea, fatigue, and emotional function as measured by the CRQ (p < 0.01). The improvements were evident at the third month and continued with somewhat diminished magnitude in the second year of follow-up. The PR group experienced a significant (p < 0.0001) reduction in exacerbations, but not the number of hospitalisations. Outpatient rehabilitation programs can achieve a worth while benefits that could persist for a period of 2 years.

Connor et al. (2001) evaluated the results after 8 and 52 weeks of a comprehensive PR programme for patients with COPD in Ireland. 170 patients with clinical and physiological evidence of COPD (mean FEV₁ = 43.1 ± 17.0 % pred.) were recruited into an 8 weeks of PR programme. At the time of final evaluation 15 patients had died, 25 patients had not been compliant with required attendances and 1 patient had transferred to another programme. The remaining 106 patients out of 129 patients were assessed after 8 weeks and of 78 patients after 1 year. Significant improvements in exercise tolerance, shuttle, treadmill, QOL, (BPQ, CRQ, SGRQ, p < 0.001) and dyspnoea (p < 0.001) were demonstrated after 8 weeks. These improvements were maintained for 1 year. The results suggested that PR increases exercise tolerance and improve QOL in patients with COPD.

Hui and Hewitt (2003) conducted a prospective longitudinal study to investigate the effect of simple outpatient based PR programme on health outcomes and hospital utilization of patients with COPD. The 3 weeks simple PR program consists of incremental exercise endurance training (walking, progressing to bicycle ergometer) incorporating upper and lower
limb weight training and endurance activities. 36 patients with COPD completed the PRP. Improved exercise endurance, increased 6 MWD (from $333 \pm 76$ to $423 \pm 107$ m, $p < 0.001$), reduced dyspnoea and improved HRQOL measurements were found. There was no improvement in lung function, FEV$_1$. In the 12 months following completion of program, hospitalisation and length of stay were reduced compared to prior to starting the program (preprogram, 7.4 days; post program, 3.3 days; $p < 0.005$). A simple, low-cost, outpatient PRP was able to improve health outcome for patients with COPD. Hospital utilisation and health cost were reduced as well.

Lorenzi et al. (2004) evaluated the effectiveness of occupational therapy (OT) with PR. A prospective clinical trial was conducted among severely disabled COPD patients ($n = 71$). They were assigned to either OT + PR ($n = 47$) or PR ($n = 24$). PR consisted of eighteen 3 hours daily sessions, whilst OT (domestic activities) was added 3 times a week up to nine 1 hour sessions. The study results revealed that 6MWD, dyspnoea, leg fatigue and BADL categories were significantly changed ($p = 0.004$) in OT + PR but not in the PR group. The addition of OT to comprehensive PR was able to specifically improve the outcome of severely disabled COPD inpatients.

Heppner et al. (2006) examined whether patient adherence to regular walking enhanced the long term maintenance of functional benefits gained from 8 weeks PR program. 133 patients with moderate to severe chronic lung disease completed 8 weeks PRP and participated in a 12 month maintenance intervention trail. Measures of weekly walking, lung function, self efficacy for walking, dyspnoea during activities of daily living, exercise capacity (6MWD) perceived breathlessness after 6MWD and HRQOL were obtained at post rehabilitation and at 6, 12 and 24 months after completing PR. Regular walkers were defined as those active on most days or every single day of the week on the average throughout 24 months period. Overall,
participants decreased in 6MWD (p < 0.001), reported increases in perceived breathlessness after 6MWD (p < 0.05) and decreased in overall HRQOL (p < 0.001) from post rehabilitation to 24 months. Regular walkers reported significantly better HRQOL (p < 0.5) as compared to irregular walkers. Irregular walkers decline significantly more than regular walkers on measures of shortness of breath during activities of daily living (p < 0.01) and walking self efficacy (p < 0.001) from post rehabilitation to 24 months. Findings suggested that participant in regular exercise such as walking after PR was associated with lower declines in overall HRQOL, walking self efficacy as well as less progression of dyspnoea during ADL.

2.2.5 Studies Related to Home Based Pulmonary Rehabilitation

Most studies on the efficacy of exercise training relied on hospital programs. A recent European trial confirms that exercise training can be successfully implemented in the home setting. Home based PR is an attractive approach for most of patients with COPD (Cigna et al., 2005). Although outcomes have not been studied well, home based PR is convenient for patients and family members and may provide sustained motivation for continued exercise training (Sharma, 2001).

Wijkstra et al. (1996, 2000) investigated the effect of 12 weeks rehabilitation at home in patients with COPD. The programme consisted of relaxation exercises, breathing retraining, upper limb training, target flow inspiratory muscle training and exercise training. Breathing retraining consisted of education on COPD, pursed lip breathing, expiratory abdominal augmentation, and synchronization of thoracic and abdominal movement. 43 COPD patients were included in the study, the mean baseline values of FEV₁, FEV₁ /FVC, 6MWD and maximal work load were 1.3 ± 0.4 L, 37 ± 8%, 438m and 70W respectively. After 12 weeks of rehabilitation the
experimental group showed a significantly larger increase of 9m in 6MWD and increase of 8W in maximal workload, however no significant increase in FEV\textsubscript{1} and FVC.

Cambach et al. (1997) evaluated the effects of a community based PR programme on exercise tolerance and QOL. The study evaluated the differences in efficacy between a 3 months rehabilitation programme including drug treatment, and a 3 months control period of drug treatment only for asthma and COPD patients. The programme consisted of exercise training, patient education, breathing retraining, evacuation of mucus, relaxation techniques and recreational activities. After 3 months the patients underwent the rehabilitation showed significant improvements in endurance time (421 s) and cardiac frequency (6 beats per min) during cycling, walking distance (39 m) and total CRQ score (17 points) compared to the control group.

Behnke et al. (2000) examined the feasibility of home based walking training to maintain the benefits of a short term exercise training in patients with severe COPD. After initial recovery from an exacerbation, a total of 46 patients were randomized into exercise training and control group, and 30 patients completed the programme. The training group performed a 10 days walking training programme in the hospital, followed by a 6 months programme of supervised walking training at home, integrated into daily activities but not the control group. The outcome of lung function, exercise performance and symptom scores were assessed prior and after. The improvement in 6MWD, HRQOL scores (measured using CRQ) changed significantly over 6 months (p<0.001). The control group showed no significant changes in exercise performance or QOL scores throughout the whole study period. Therefore, (i) significant improvements in exercise performance and CRQ scores were achieved after recovery from an
exacerbation and (ii) those improvements were maintained after discharge, when supported by a home based walking training.

Sudo (2002) reported that a 75 years old woman with COPD was suffering from cough, sputum, high-grade fever and dyspnoea on effort. After her laboratory data and general condition improved, they allowed her to perform pulmonary rehabilitation consists of pursed lip breathing, diaphragmatic breathing, muscle stretch gymnastics, and walking for about 6 weeks. The 6MWD increased from 170 m to 280 m. The minimum SpO₂ during the 6MWT increased from 88% to 91%. (O₂ 3 L/m) After discharge, she continued to receive home care from a visiting nurse specialized in respiratory medicine and 24 hours monitoring of O₂ compliance at home. She has not experienced acute exacerbation or re-hospitalization for 1 year. They concluded that home care service was effective to maintain stable conditions such as state of breathing, SpO₂, vital signs, and activities of daily living for elderly COPD outpatients.

Singh et al. (2003) evaluated the effect of domiciliary PR programme in patients of COPD. 40 stable COPD patients with severe airflow obstruction were divided into control and experimental groups randomly. Rehabilitation included walking, breathing exercises, postural drainage, controlled coughing and changes in life style activities. Exercises of 30 minutes duration were performed at home twice daily for 4 weeks supervision. 6MWD, FEV₁ and various indices of CRQ were measured in both experimental and control groups before and after completion of the study. In the experimental group, after 4 weeks, the mean ± SD difference in 6MWD, dyspnoea, mastery, fatigue and emotion scores were 54.2 ± 26.7 meters, 0.96 ± 0.26, 0.89 ± 0.44, 0.90 ± 0.40) and 0.91± 0.32 respectively. Changes in all these parameters were statistically significant (p < 0.001) as compared to the control group. There was no significant change in FEV₁. It
was concluded that domiciliary PR for 4 weeks results in significant improvement in the HRQOL and exercise tolerance, even without improvement in FEV$_1$.

### 2.3 EXERCISE TRAINING IN PULMONARY REHABILITATION

Exercise is widely recognized as a potential means of improving physical endurance. Exercise training is based on general principles of exercise physiology, intensity, specificity and reversibility. The training intensity may be set using heart rate, treadmill speed, shuttle walking speed or cycle ergometer load at a given percentage of peak work rate during the preliminary exercise test. Heart rate on exercise does not seem to be a strong predictor of work intensity in COPD (Zacarias et al., 2000). However, dyspnoea ratings (e.g. Borg scale) can be used to predict work intensity using a target level of dyspnoea (Mejia et al., 1999; Horowitz et al., 1996). Punzal et al., (1991) stated that the two effective strategies for progressing the exercise prescription are

i) Setting the duration of continuous exercise and then gradually increasing the work rate towards the target level

ii) Setting the intensity of exercise and then increasing the duration of exercise period towards the target duration

Most PR programmes emphasize endurance training, utilizing periods of sustained exercise for about 20 to 30 minutes, 2 to 5 times a week. The patient with severe air way obstruction who can not withstand the sustained period of 20 to 30 minutes at the level of 60 % percent of maximum work load can be placed under interval training consisting of two to three minutes of high intensity (60 to 80 % of maximal capacity) training alternating with equal periods of rest (Cooper, 2001; Debusk et al., 1990).
Lake et al. (1990) stated that training specificity refers to the observation that benefits gained only in those activities involving the muscle group that are specifically trained. (e.g.) increase in 6 MWD occurs in lower extremity training but not with upper extremity training.

Carter et al. (1992) explained about the increased physical ability and activities of daily living after exercise training in patients with COPD. Exercise training generally results in reduced dyspnoea and extended work tolerance with little or no change in pulmonary function (Covey & Larson, 2004; Cockram, 2006). This improvement is attributed to psychological encouragement, improvement in mechanical efficiency, improved cardiovascular conditioning, improved muscle function, biochemical adaptations responsible for reducing glucose utilization, desensitization to dyspnoea and better contribution to self care (Carolyn, 2003; Chavannes, 2002).

2.3.1 Breathing Exercises

Breathing exercises have been used since 1980s to improve respiratory function. They are commonly taught to patients with chronic lung disease (Mackenzie et al., 1989). The recommended breathing exercises are as follows

- Pursed lip breathing
- Diaphragmatic breathing
- Forced expiration technique
2.3.2 Purposes of Breathing Exercises

Breathing pattern retaining in the form of pursed lip breathing has to be used as one method in pulmonary rehabilitation to help alleviate the symptoms of dyspnoea endured by people who suffer from airflow obstruction secondary to COPD. The author emphasised the importance of pursed lip breathing pattern have been much useful to improve the capacity of persons with COPD to perform activities of daily living, a primary rehabilitative outcome (Collins, 2001).

The most disabling and frightening symptom experienced by patients with COPD is dyspnoea. Even with the use of bronchodilators, the symptom may not be completely relieved. Patients often develop their own strategies for managing shortness of breath, including the use of a breathing technique called pursed-lip breathing. Even though nurses are familiar with pursed-lip breathing technique, they often have difficulty in assisting patients to use it during acute episodes of shortness of breath. If the nurses are better trained, they can assist patients in pursed-lip breathing effectively during episodes of acute dyspnoea, (Truesdell, 2000). Breathing exercises represent a broad category of activities designed to achieve a variety of purposes including the following (Barrascout, 1984; Kesten, 1997).

1. To promote greater use of the diaphragm and decreased use of the upper rib cage and other accessory muscles of inspiration
2. To increase awareness of the muscles of respiration and to suppress the tendency for hurried and gasping respiration.
3. To provide patients with the tools necessary to better handle the distressful symptom of dyspnoea.
4. To identify and provide a means by which inefficient and inappropriate muscle use can be diminished or eliminated.
5. To improve the efficiency of alveolar ventilation by increasing tidal volume, slowing the rate of breathing, prolonging the expiratory time and promoting better distribution of ventilation to perfusion.

6. To improve the strength and endurance of the respiratory muscles

7. To improve the effectiveness of the cough

8. To improve the delivery of therapeutic aerosols.

9. To teach patients to co-ordinate their breathing with body motions and the activities of daily living

10. To relieve exertional dyspnoea so that patients can improve their overall cardiopulmonary fitness and general exercise tolerance.

The findings of the studies on the effects of breathing exercises are listed below in chronological sequence.

Tiwary et al. (1989) evaluated the effect of incentive breathing on lung functions in COPD. Blue bloater COPD patients were selected for the study. The breathing device used was working on the principles of bio-feedback for imparting breathing exercise. Respiratory exercise was given for half an hour daily for six weeks. There was significant increase in the vital capacity (VC) and reduction in air trapping in exercise group. There was remarkable improvement in subjective feeling of well being and free from breathlessness.

Yan and Sun (1996) investigated the effect of breathing exercise on patients with COPD. 324 patients with COPD were randomly assigned to the breathing exercise group (Group –1) and control group (Group –2). After 1 to 20 months of breathing exercise in Group –1, the maximum inspiratory
pressure, maximum expiratory pressure and diaphragmatic pressure were found to increase by 30.42%, 32.10% and 30.94% respectively.

Gigliotti (2003) emphasized that the commonest techniques to reduce dyspnoea that are being applied to patients with COPD subjected to PR. Pursed lip and diaphragmatic breathing are breathing retraining strategies employed by COPD patients in order to relieve and control dyspnoea. Exercise training is a mandatory component of PR and it improves exercise performances and peripheral muscle strength. Recent studies have focused on the effect of exercise training on breathlessness. The effect of exercise training on breathlessness has to be reinforced by inhaling oxygen. However, two studies have recently shown that breathing supplemental oxygen during training has either a marginal effect or no advantage over training. In a comprehensive PR programme, strength training and arm endurance training could have a role in decreasing peripheral muscle weakness, metabolic and ventilatory requirements for arm endurance training.

2.3.3 Upper Extremity Exercise Training

Endurance training of the upper extremities to improve the arm functions was supported arm exercises with ergometry and unsupported arm exercises by lifting free weights, dowels and stretching elastic bands. Both methods can effectively improve arm endurance (Martinez et al., 1993). Arm training has the potential to improve arm exercise performance by decreasing ventilatory demand during arm work and by improving endurance. When the arms are braced, arm training improves the ventilatory contribution of those muscles by increasing shoulder girdle muscle strength. Strength and endurance training of the upper extremities improves arm function as well it improves respiratory muscle function. Upper extremity exercise also helps in minimizing the metabolic and ventilatory demands in patients with COPD.
Arm exercises are safe, and should be included in rehabilitation program for patients with COPD (Ries, 1997).

Many exercise programs focus on lower extremity training. However, many ADL, such as bathing, dressing and grooming, require use of the upper extremities. For a given work load, upper extremity work demands more energy than lower extremity work and higher ventilatory demands is needed. For elderly patients, the increased energy and ventilatory demands of simple self care activities result in marked functional limitation. Because exercise training must be specific to the muscle involved in the task, it is important that upper extremity exercises tailored to the patient’s needs to be included in the program. A critical review of the literature suggested that exercise conditioning is essential in comprehensive leg and arm training to improve exercise performance and capacity (Puhan et al., 2005). Moreover, COPD patients with dyspnoea on exertion showed greater improvement in dyspnoea and HRQOL resulting from the inclusion of arm exercises in their training than from general exercise programs (Garvey, 1999).

**The findings of the studies on the effects of upper extremity exercises are listed below in chronological sequence.**

Ries et al. (1988) performed a randomized study to compare the effects of two different forms of upper arm training. Testing was done by means of cycle ergometry and unsupported arm exercises in addition, three tests of activities of daily living were used namely, dishwashing, dusting black board and placing grocery item in shelves. Training was performed for at least 6 weeks and showed that although the patients who underwent the upper extremity training improved their performance in the arm cycle ergometry, they did not improve their performance in arm activities of daily living.
Lebzelter et al. (2001) studied the relationship of resting pulmonary function and unsupported arm exercise (UAE) performance in 21 patients with COPD. UAE consisted of bilateral anterior arm elevation to shoulder level at a rate of 40 arm strokes minute\(^{-1}\). Therapeutic strategies that aim to increase inspiratory capacity, decrease functional residual capacity, increase inspiratory muscle strength and upper arm/torso muscle endurance are likely to alleviate symptoms and improve UAE performance in patients with COPD.

Dourado et al. (2006) investigated the influence of thoracic and upper-limb muscle function on 6MWD in patients with COPD. A prospective, cross-sectional study was conducted among 38 patients with mild to very severe COPD were evaluated. Pulmonary function and baseline dyspnoea index (BDI), handgrip strength, maximal inspiratory pressure (Pimax), and 6MWD were measured. HRQOL was assessed using the SGRQ. The study findings revealed that there were significant correlations between 6MWD and body weight, FEV\(_1\), and impact domain of SGRQ (p < 0.05). The correlation between 6MWD and BDI, Pimax, activity domain of SGRQ all found significance at (p < 0.01). A statistically significant negative correlation was observed between 6MWD and dyspnoea at the end of the 6MWT (r = - 0.29; p < 0.05). The results of the study showed the importance of the skeletal musculature of the thorax and upper limbs in sub maximal exercise tolerance and could open new perspectives for training programs.

Zhan et al. (2006) evaluated the test-retest reliability and validity of a 6-minute pegboard and ring test (PBRT) in 27 outpatients with COPD and 30 age-matched controls. 6 minutes PBRT and the Pulmonary Functional Status Dyspnoea Questionnaire-Modified version in 27 patients with COPD were measured as outcomes. Highly significant correlation coefficient (r = 0.91, p < 0.001) was found between test and retest of PBRT scores. Statistically significant correlation coefficients were found between PBRT
scores and pulmonary function tests such as FEV\textsubscript{1} % pred and FVC % pred, and activity sub domain of Pulmonary Functional Status Dyspnoea Questionnaire-Modified (p < 0.045). In addition, PBRT scores of healthy subjects were significantly higher than those of COPD subjects (p < 0.001). The FEV\textsubscript{1} % predicted and gender together accounted for 50% of the variance in the PBRT scores of patients with COPD. PBRT is a reliable and valid method to assess unsupported arm exercise endurance in patients with COPD.

2.3.4 Lower Extremity Exercise Training

Marked functional limitation often occurs in patients with respiratory disease. Dyspnoea begins a vicious cycle in which there is a progressive decrease in physical activity, reduction in muscle mass and deconditioning which in turn results in more dyspnoea. The main goal of exercise training is to break this debilitating pattern. Improvements in exercise tolerance may be achieved through both physiological and psychological inventions. Exercise training programs employing cycling and/or treadmill, walking, stair-climbing etc. have been widely and discriminately used for the rehabilitative management of individuals with different respiratory diseases, inclusive of COPD patients.

Motivation, the degree of functional impairment, age, and the results of a pre enrollment incremental exercise test are also critical factors in the selection of patients for exercise training. It seems safe to state that any patient capable of undergoing training will benefit from program that includes leg exercise. The optimal exercise intensity, duration and maintenance program remain to be determined.

Most PR programmes emphasize training of lower extremities using singly or in combination with stationary cycle exercise and treadmill walking
Higher intensity exercise (60–80 % maximal work rate) increases endurance time more than does lower intensity exercise (30 % of maximal work rate). The cycle ergometer training (Vallet et al., 1997), treadmill walking (Poole et al., 1985) or combined walking and cycling (O’Donnel et al., 1995) have also shown improvement in maximal work rate and endurance time.

The findings of the studies on the effects of lower extremity exercises are listed below in chronological sequence.

Iwanaga et al. (1998) investigated the long term effects of supervised exercise program using bicycle ergometers on exercise endurance and dyspnoea in patients with chronic pulmonary emphysema. 19 patients with moderate to severe airflow limitation (average FEV₁/FVC, 39.8%) were enrolled in an outpatient rehabilitation program. After their lactate thresholds were measured by an incremental symptom limited maximum test, patients engaged in exercise training 15 to 30 minutes per day in an arbitrary frequency and at a work rate at or below their lactate threshold (average: 20.1 W). No significant improvements were observed in resting pulmonary function, blood gas, nutrition, or systemic muscle volume. After long term exercise training of 33 months, 7 times per month the patients improved significantly in exercise endurance and relief of their dyspnoea during exercise. The study findings provide a physiologic rationale for long term exercise training by patients with chronic pulmonary emphysema.

Berry et al. (1999) determined the extent to which patients with stage I COPD experience improvements in physical performance and HRQOL are as a result of exercise training and to compare the improvements with those seen in stage I and II patients, 151 patients with COPD underwent a 12 weeks exercise program. Outcomes were measured at
baseline and follow up. Physical performance was evaluated by means of 6MWD, treadmill time, overhead task and stair climbing. General HRQOL was assessed with CRQ. The study findings revealed that irrespective of their stages and severity all patients with COPD obtained benefit from exercise rehabilitation.

Troosters (2000) investigated the short and long term effects of a 6 months outpatient rehabilitation program in patients with severe COPD. 100 patients were randomly assigned to receive either an exercise training program that included cycling, walking, and strength training (n = 50) or usual medical care (n = 50). 34 patients in the training group were evaluated after 6 months (end of training), and 26 were evaluated after 18 months of follow up. In the control group, 28 patients were evaluated at 6 months and 23 after 18 months. At 6 months, the training group showed improvement in 6MWD (mean difference of 52 m between training and control), maximal work load (12 W) maximal oxygen uptake (0.26 liters/min), quadriceps force (18 Nm) inspiratory muscle force (11 cm H₂O), and quality of life (14 points; p < 0.05). At 18 months all those differences persisted (p < 0.05), except for inspiratory muscle strength. For 6MWD and HRQOL, the differences between the training group and controls at 18 months exceeded the minimal clinically important difference. Among patients who completed the 6 months program, outpatient training resulted in significant and clinically relevant changes in 6MWD, maximal exercise performance, peripheral and respiratory muscle strength, and HRQOL. Most of the effects persisted 18 months after starting the program.

Stulbarg et al. (2002) performed a study to determine whether exercise training adds benefit of a dyspnoea self management (DM) program and the “dose” response to supervised exercise training (0, 4, or 24 sessions) in dyspnoea, exercise performance, and HRQOL. Subjects with COPD
(n = 103, 46 men, 57 women) were randomized to DM, DM-exposure or DM-training. Dyspnoea self management included individualized education about dyspnoea management strategies, a home walking prescription, and daily logs. Outcomes were measured at baseline and 2 months as part of a 1 year longitudinal randomized clinical trial. The DM-training group had significantly greater improvements than the DM-exposure and the DM groups in dyspnoea at isotime during ITT (p = 0.006), exercise performance during ITT (p = 0.005), ETT (p = 0.003), and 6MW (p = 0.01), SF-36 Vitality (p = 0.031), and CRQ mastery (p = 0.007). There was a dose dependent improvement in CRQ dyspnoea scores (p = 0.05) with significant improvements only in the DM training. Exercise training substantially improved the impact of a dyspnoea self management program with a home walking prescription. This impact tended to be dependent on the “dose” of exercise.

Puente-Maestu et al. (2003) evaluated the 13 months maintenance program (MP) for 39 severe COPD patients. Two different 8 weeks leg exercise training (LET) programs were given. One supervised at the hospital (group S; n = 20) and the other self monitored (SM; n = 19), had achieved different levels of exercise tolerance. After LET, patients in the group SM had a higher maximal oxygen uptake and endurance time than patients in the MP group. During the MP patients were advised to walk vigorously at least 4 km/day, 4 times/wk. CRQ scores, which had improved significantly after LET in both groups, remained high. Long term effects of MP were independent of the training strategy or whether physiological improvements had been obtained with the initial LET. SM exercise programs do not seem capable of maintaining physiological improvements and the exercise tolerance, though HRQOL can be maintained.
ZuWallack et al. (2006) observed the trajectory of changes in upper and lower extremity exercise performance, exertional dyspnoea and health status over the course of 12 weeks (24 sessions) of PR in individuals with COPD. 13 patients with COPD (5 males, 8 females) were studied. Improvement was noted in all outcome areas very early in the course of PR. Treadmill endurance time and arm lifts increased significantly over baseline by the fourth and eighth session, respectively. Exertional dyspnoea and CRQ also improved very early, with each showing a significant change from baseline by the fourth session. They suggested that 20 or more sessions are needed for optimal acute changes in exercise performance, but improvement in dyspnoea and HRQOL may occur earlier.

2.3.5 Combined Upper and Lower Extremities Exercise Training

In the management of respiratory impairment several decades of investigation have proved that both the upper and lower extremity exercises improve the respiratory and physical functions of the patients with COPD (ATS Statement, 1999; BTS Statement, 2001).

The findings of the studies on the effects of upper and lower extremity exercises are listed below in chronological sequence.

Lake et al. (1990) emphasized the specificity of limbs training (upper limb alone, both upper and lower limb). The first group was a control group who received no training, the second group received upper limb training only and the third group performed combined upper and lower limb training. Upper limb training incorporates cycle ergometry with varying resistances, throwing a ball against a wall with the arms above the horizontal, passing a bean- bag over the head and arm exercise with ropes and pulleys. Lower limb exercise was tested by cycle ergometry and 6MWD. Training was
continued for one hour, 3 times a week, for 8 weeks. The results showed that limb training was limb specific. Thus in the second group patients who received upper extremity exercises alone increases the endurance of upper extremity, while walk distance improved in the lower limb trained group. The combination of trained group showed improved in both upper and lower limb endurance. A modified quality of life questionnaire was used as an outcome measure. Significant improvement in HRQOL was noticed in the third group that received combined upper and lower limb training in comparison with other two groups.

Simpson et al. (1992) conducted a randomized controlled trial of weight lifting exercise among 34 patients with chronic airflow limitation (FEV$_1$ < 38% pred.; FEV$_1$ / FVC < 40%) and arterial oxygen desaturation during exercise. In the experimental group training was prescribed for upper limb (10 repetitions of single arm curl) and lower limb (single leg extension and single leg press) exercises were repeated 3 times a week for 8 weeks. The results revealed that the muscle strength and endurance time during cycling at 80% of maximum power output increased in the trained subjects than the control group. No significant changes in maximum cycle ergometer exercise capacity or distance walked in six minutes were found in either group. Responses to CRQ showed significant improvements in dyspnoea and mastery of daily activities in the trained group. The authors concluded that the weight lifting training used in patients with chronic airflow limitation improves the muscle strength, exercise endurance and subjective responses to some of the demands of daily living.

Bernard et al. (1999) evaluated whether strength training was a useful addition to aerobic training in patients with COPD. 55 patients with moderate to severe COPD were randomized to 12 weeks of aerobic training alone (Aero) or combined with strength training (Aero + ST). In conclusion,
the addition of strength training to aerobic training in patients with COPD is associated with significantly greater increases in muscle strength and mass, but does not provide additional improvement in exercise capacity or quality of life.

Machida (1999) confirmed the efficacy of lower extremity and upper extremity training and ventilatory muscle training in some selected patients. In their follow up study on 100 patients with chronic pulmonary emphysema who participated in PR program, groups that continued exercise more than 30 minutes a day at home, had lesser progression of dyspnoea after 19 months.

Physical activity is a key dimension of functional status in people with COPD. A cross sectional, descriptive study was conducted among 63 outpatients of COPD, (Belza et al., 2001). Daily physical activity, as measured by an accelerometer was strongly associated with maximal distance walked during 6MWT ($r = 0.60$, $p < 0.001$). Physical activity was not correlated with self report of functional status. The only predictor of physical activity was 6 MWD.

Storer (2001) stated that resistance exercise training has received relatively little attention. Only a few studies have examined the characteristics of skeletal muscle function or its responsiveness to strength training in patients with chronic respiratory diseases. However the studies clearly stated that peripheral muscles, particularly muscles of ambulation, are weak in COPD patients. Author concluded that well structured program of resistance exercise training is essential in a PR programme to develop strength, power and endurance of both peripheral and skeletal muscles of patients with COPD.
Troosters et al. (2001) investigated the benefits of exercise training between responders and non responders. 49 stable outpatients with moderate to severe COPD were evaluated before and after 12 weeks of exercise training (3 times per week). Responders in exercise capacity were defined as having 15% increase in maximal workload and/or 25% increase in walking distance, while responders in quality of life showed an improvement of at least 10 points on the CRQ. 32 patients were responders in terms of improved exercise capacity, ventilatory reserve ($V_e/MVV$), inspiratory muscle strength (PImax) and peripheral muscle strength (handgrip force and quadriceps force). Patients with reduced exercise capacity who experience less ventilatory limitation to exercise, reduced respiratory and peripheral muscle strength are more likely to improve with exercise training. Improvements in HRQOL after exercise training were significant but remained unpredictable.

Torres et al. (2002) investigated the capacity of several of most frequently used outcome measurements to detect changes after PR in a population of patients with severe COPD. The investigators evaluated 37 patients with severe COPD ($FEV_1 < 40\%$) before and after 6 to 8 weeks of outpatient PR. The following frequently used tools were evaluated. 6MWD, MRC, BD1/TD1, resting and 6MWD, visual analog scale (VAS), quality of life with a generic tool (SF-36) and two disease specific tools (CRQ and SGRQ). Clinically significant changes in the values for those outcome tools were detected in >50% of patients for the BDI/TDI, 29% of patients for the MRC scale, in 37% of patients for the 6MWD, in 48% of patients for the VAS at peak exercise, in 50% of patients for the CRQ and in 40% of patients for the SGRQ. The authors have concluded that the VAS peak exercise, BDI/TDI, and CRQ adequately reflect the beneficial effects of PR. The 6MWD evaluates a unique domain not related to quality of life. Due to their simplicity and sensitivity VAS at peak exercise, 6MWD and CRQ may be the best practical tool to evaluate responsiveness to PR.
Probst et al. (2006) measured the cardiopulmonary stress of a 12 weeks exercise training program in 11 COPD patients (FEV$_1$ = 42 ± 12% predicted). Pulmonary gas exchange and heart rate of 3 training sessions were measured with a portable metabolic system at the beginning, midterm and end of the programme symptoms were assessed with Borg scores. Training effects were significant (delta W max 14 ± 11 watts, 6 MWD 44 ± 36 meters; $p <0.05$ for all). In addition, the applied training program resulted in relatively homogeneous VO$_2$ responses, while HR response is much more variable. The study result revealed that the heart rate could not be used as a guide for setting intensity of exercise in COPD. The cardiopulmonary stress during resistance training was lower than whole body exercise.

2.4 EDUCATION

Patient education is a central feature of pulmonary rehabilitation (Wouters, 2006). Education encourages active participation in health care leads to a better understanding of the physical and psychological changes that occur with chronic illness and helps patient and their family explore ways to cope with those changes (Gilmartin, 1986; Neish, 1989)

The standard topics addressed in the education session are as follows

1. Anatomy, physiology, pathology and pharmacology
2. Dyspnoea / symptom management and chest clearance techniques
3. Energy conservation / Pacing
4. Nutrition
5. Managing travel / leisure
6. Smoking cessation
7. Anxiety, depression and stress management
8. Benefits of exercises and safety guidelines
9. Loving relationships / sexuality
10. Oxygen therapy
11. Environmental irritant avoidance

2.4.1 Need for Education in Rehabilitation

Gerald (2000) observed presence of advance directives among persons entering cardiac and PR, and identify characteristics of persons most likely to have advance directives. The sample consisted of 336 cardiac patients and 181 pulmonary patients who enrolled. As part of the initial program assessment, patients were asked two questions: (1) Do you have a living will? (2) Do you have any advance directives? Results indicate that 25% of both subgroups (cardiac and pulmonary patients) report having written advance directives. Logistic regression analysis indicates that among cardiac patients whites and older persons were more likely to have advance directives. Among pulmonary patients, females and whites were more likely to have advance directives. The author concluded that only a minority of cardiopulmonary rehabilitation patients have advance directives upon entry into the program, and that the prevalence differs among gender, racial, and age groups. Cardiac and pulmonary rehabilitation programs may be valuable sites for educating patients about advance directives and efforts by rehabilitation personnel may increase the prevalence of advance directives among patients.

Gibbons (2001) investigated a PR programme set out to improve HRQOL of patients with COPD by providing education and improving exercise tolerance. Progress was measured and outcomes monitored, the results indicating that such programmes could have a big impact, particularly on patients who are identified in the early stages of the disease.
Blanchard (2002) and Burge (2006) stated that exacerbations of COPD are a major source of morbidity and mortality, resulting in tremendous increases in healthcare costs. Spirometric testing of at risk persons can help identify patients early in the disease course who may benefit from early intervention to slow the disease process. Avoidance of irritants, smoking cessation, and use of pharmacologic agents aimed at decreasing airflow obstruction are strategies for reducing the frequency and severity of exacerbations.

Worth (2002) reviewed the recommended international and national guidelines regarding patient education as an integral part of an effective management for both, asthma and COPD. The evaluation of numerous structured education programs for adult asthmatics revealed an increase of quality of life of the educated patients, reduced morbidity with less asthmatic attacks, a decrease of emergency visits, sick leave days and hospitalizations due to asthma. On the basis of cost/benefit analysis cost effectiveness could be demonstrated for education programs for asthmatics. On the basis of education programs in COPD including self management, in a randomised controlled study the results revealed that an improvement of the patient's ability to overcome acute exacerbations and reduction of morbidity. Further controlled studies of the effects of patient education on morbidity, mortality and cost effectiveness are necessary to establish the role of structured education programs in the treatment of COPD with sufficient validity.

Jones et al. (2004) examined the patients' perceptions of factors that influence their compliance with inhaled therapy for COPD, and their compliance with health related behaviours related to smoking cessation, exercise and diet. 5 focus groups of 29 diagnosed COPD patients who had not attended pulmonary rehabilitation were recruited from secondary and primary care. The severity of their illness ranged from mild to severe. For each group,
the moderator asked patients what they had been told and what they actually did with regard to medication, smoking, exercise and diet. The study findings revealed all patients except one reported good compliance with medication but some patients expressed concerns about use of inhaler technique. Patients expressed that they had not been offered constructive help to quit smoking, inadequate information on diet, exercise and the reason for breathlessness during exercise. The author concluded that patients with COPD have low levels of intentional non-compliance with medication in COPD, probably because, unlike asthmatics, these patients are chronically symptomatic. Fear of dyspnoea and feelings of vulnerability also appear to contribute to good compliance. Information given by health professionals about lifestyle modification was poor. COPD patients require better education to manage their disease effectively.

Fritsch et al. (2005) conducted a prospective observational study, data from a questionnaire and from records of 45 patients previously admitted to the hospital with an acute exacerbation of COPD were collected, Diagnostic steps as well as therapeutic and prophylactic interventions were reviewed. The findings of the study revealed that the conformation of the diagnosis of COPD by spirometry is lacking in a significant number of patient. Efforts for disease prevention and education as well as awareness of the potential benefits of PR programs are still insufficient. Efforts to improve the adherence of guidelines for the management of COPD should be intensified.

Moninkhof et al. (2006) assessed the efficacy of COPD self management / education programmes on health outcomes and the use of health services. The reviewers included 12 articles describing eight randomized controlled trials and one controlled clinical trail self management education was compared with usual care in eight studies. The studies showed
no effect of self-management education on hospital admission emergency room visits, days lost from work and lung function. Authors conclusion revealed the need for future research on the effect of self-management should be focused on behavioral change, randomized controlled trial with long follow up time can be carried out.

Worth (2006) described the exacerbation in COPD patients are characterized by an acute aggravation of the condition with an increase in symptoms (labored breathing, cough, expectoration, tightness of the chest and rarely fever). Respiratory insufficiency with hypercapnea and acidosis necessitates the use of non-invasive positive pressure ventilation. For the prevention of acute exacerbations, elimination of cigarette smoking and the inclusion of optimized structured patient education is essential.

2.4.2 Effect of Patient Education in Rehabilitation

Bruinings et al. (1996) conducted an outpatient pulmonary rehabilitation programme for patients with Asthma and COPD. 64 patients participated in pulmonary rehabilitation. They were divided into 3 groups according to the result of spirometry: Group –1: FEV$_1$ > 60% of predicted value; Group –2 FEV$_1$ 40-60%; and Group –3: FEV$_1$ < 40%. Data were collected by spirometry, bicycle ergometry, walking distance and the questionnaire for patients with asthma and COPD, which measures quality of life, compliance with therapy, ability to cope and social support. Patients visited the outpatient clinic 3 times a week, during three months for training and guidance in a multidisciplinary setting, and attended a health education programme. Group –1 and 2 improved on exercise performance, walking distance and HRQOL scores, whereas Group –3 showed significant reduction in dyspnoea, anger and fatigue.
Gallefoos et al. (1999) investigated the effect of patient education in a RCT among 62 COPD patients. Patients were assigned either to a control (n=31) or interventional group (n=31). The intervention consists of 2 hours group sessions and one to two individual sessions each by a nurse and a physiotherapist. The study findings revealed that in COPD patients neither the HRQOL as measured by SGRQ nor FEV₁ improved.

Patients should be educated about modifiable risk factors, such as cigarette smoking, environmental exposures, improper inhaler technique, influenza and pneumonia vaccination, pulmonary rehabilitation, and use of supplemental oxygen (Smeele et al., 1999; Spohn et al., 2001). Early, aggressive interventions are necessary to improve quality of life, decrease hospital admissions, improve morbidity, mortality, and reduce overall health care cost. Health promotion incorporates patient and family education on early recognition of symptoms, smoking cessation strategies and participation in pulmonary rehabilitation that can reduce long term morbidity from this chronic disease (Gronkiewicz, 2004).

Carone et al. (2002) conducted an Edu-Care 6-months, multicentre, randomised, controlled, parallel-group study. Italian Association of Hospital Pulmonologists (AIPO) aimed to verify changes and improvements induced by an educational programme validated by AIPO in patients with COPD. In addition to treatment within the usual therapeutic schemes for COPD, patients were randomised either to the 'Educational' group, which receives the formal and structured educational programme, or to the 'General Advice' group. The outcome evaluations were pulmonary function test, walking distance, quality of life, register of number of exacerbations and hospital admissions. Out of the 1,230 patients enrolled, interim data are available from 1,003 patients. Males represent 85% of the study population. Smoking (21%). In the year prior to enrolment of patients 34% had one exacerbation, 49% had
2-3 exacerbations, and 17% more than 3 exacerbations. 72 percent of patients were not hospitalised over the year prior to enrollment, while 22% were hospitalised once and 6% had more than two hospitalisations. Edu-Care was the first large study aimed to evaluate the efficacy of an educational programme for patients with COPD.

White et al. (2002) compared the effectiveness of a short term PR program with brief advice given to patients with severe COPD. 103 patients with severe COPD, were randomly assigned to rehabilitation or to brief advice. 54 patients attended a rehabilitation program twice a week for 6 weeks. 49 patients attended a single session during which they were given printed educational materials and verbal advice and guidance about exercise. Subjects were reassessed at 3 months. The shuttle walking distance increased significantly in the rehabilitation group by 43 meters and 23 meters in the brief advice group. The patients with severe COPD, a short outpatient rehabilitation program of low intensity achieved small but significant improvement in shuttle walking distance, compared with brief advice. The improvements in HRQOL were modest and did not reach statistical significance. Although in some instances the confidence limits include differences that approach clinical significance. The relatively small effect may be due to the low intensity of the program or to the severity of the subjects ventilatory impairment.

Monninkhof et al. (2003) stated that in asthma, self management programmes have been proven to be effective. In COPD, their value is not clear. The objective was to assess the efficacy of COPD self management/education programmes on health outcomes and use of health services. They searched the Cochrane Airways Group trial registers, MEDLINE (January 1985 to October 2001), reference lists, abstracts of medical conferences and ongoing trials and unpublished material. Controlled trials of both randomised
and non randomised self management education in patients with COPD focus mainly on physical PR were excluded. Two reviewers independently assessed trial quality and extracted data. Investigators were contacted for additional information. The reviewers included 12 articles describing eight randomised controlled trials and one controlled clinical trial. Self management education was compared with usual care in 8 studies. The disease specific SGRQ showed better quality of life of patients in the intervention group patients. Self management education reduced the need for rescue medication, and led to an increased use of courses of oral steroids and antibiotics for respiratory symptoms. Further research on the effectiveness of self management programmes should be focused on behavioural changes and needs to use standardised outcomes designed for COPD patients, and a long time follow up in order to draw definite conclusions.

Bourbeau et al. (2003) evaluated the effect of a continuum of self management, specific to COPD, on the use of hospital services and health status among patients with moderate to severe disease. A multicentre, randomized clinical trial was carried out in 7 hospitals from 1998 to 1999. All patients had advanced COPD with at least one hospitalization for exacerbation in the previous year. Patients were assigned to a self management program or to usual care. The intervention consisted of a comprehensive patient education program administered through weekly visits by trained health professionals over two months period with monthly telephone follow up. Over 12 months, data were collected regarding the primary outcome and number of hospitalizations; secondary outcomes included emergency visits and patient health status. Hospital admissions for exacerbation of COPD were reduced by 39.8% in the intervention group compared with the usual care group (p = 0.01), and admissions for other health problems were reduced by 57.1% (p = 0.01). Emergency department visits were reduced by 41.0% (p = 0.02) and unscheduled physician visits by
58.9% (p = 0.003). Greater improvements in the impact subscale and total quality of life scores were observed in the intervention group at four months, although some of the benefits were maintained only for the impact score at 12 months. A continuum of self management for COPD patients provided by a trained health professional can significantly reduce the utilization of health care services and improve health status. So the self management approach of care can be implemented within the general practice.

Cai et al. (2006) evaluated the effect of health education on symptoms, lung function and HRQOL of patients with stable COPD. 82 patients were assigned in 2 groups randomly. The intervention group (n = 43) received education and not the control group (n = 39). Before and after 6 months they observed the number of smokers, Borg score, inhale treatment times of acute episode, SGRQ score and lung function in both the groups. The study revealed that there was no significant difference in lung function before and after 6 months between 2 groups. The symptom, activity and impact score as well the total score of SGRQ in the education group after 6 months were much lower than prior score, and those in control group had no significant difference.

Petty et al. (2006) compared the impact of the customized videotape on pulmonary rehabilitation versus an older videotape and usual care on HRQOL and ability to perform activities of daily living in persons with COPD. 214 patients diagnosed with COPD were recruited and randomized to receive customized videotapes, standard videotapes, or usual care. Outcome measures included the Fatigue Impact Scale, Seattle Obstructive Lung Disease Questionnaire, and the SF-36(R) Health Survey. Videotape users demonstrated better conversion to and retention of exercise habits, with over 80% of customized videotape subjects who reported exercise habits at baseline continuing the habits as compared with 40% in the usual
care group. Overall study findings demonstrate increased HRQOL, lower fatigue, and better compliance with a prescribed exercise regimen among subjects using the customized videotapes. There was a significant improvement in emotional functioning and coping skills among customized videotape subjects.

2.5 PSYCHOSOCIAL AND BEHAVIOURAL INTERVENTION

COPD leads to disabling and distressing symptoms. Patients often become socially isolated and have to give up activities that they enjoy. These factors may lead to the development of anxiety and or depression (Norwood, 2006). The symptoms and signs of these may be similar to those of COPD itself and may be overlooked. Depression is also relatively common and the two conditions may simply coexist; however, the presence of depression or anxiety may significantly worsen patients’ quality of life. A concurrent depressive disorder may bring the patient into a vicious circle, the depressed mood reduces the patient’s ability to cope with the physical symptoms which become less tolerable. Therefore the caregivers should help them to manage anxiety and deal with issues such as loss of role in the family (Dudley et al., 1980).

2.5.1 Management of Depression and Anxiety

Psychological and behavioural problems such as anxiety, depression, difficulties of coping and reduction in self efficacy contribute to the handicap of advanced respiratory diseases. However the coexistence of reduced self efficacy and the affective component of dyspnoea is likely to have an effect on performance. Improvements in self efficacy for walking and emotional components of health status have been demonstrated after rehabilitation (Marcus & Owen, 1992; Ries et al., 1995), as well as anxiety
and depression can also be reduced (Toshima et al., 1992; Withers et al., 1995).

Van Ede et al. (1999) reviewed three case control studies out of ten studies. They found that there was a significant increase in prevalence of depression among patients with COPD. Manen, (2002) also conducted a case control study to investigate whether depression occurs more often in patients with COPD. The demography and clinical variables associated with depression were also determined. The risk for depression was 2.5 times greater in severe COPD, living alone. The study findings underscore the importance of reducing symptoms and improving physical functioning in patients with COPD rather than focusing on lung function alone.

Kim et al. (2000) examined the relationship between the functional status and co morbid anxiety and depression and the relationship between utilization of health care resources and psycho-pathology in elderly patients with COPD. Elderly male (n = 43) with COPD completed anxiety, depression, and functional status measures. The authors constructed regression models to explore the contribution of COPD severity, medical burden, depression, and anxiety to the dependent variables of functional impairment and health care utilization. Anxiety and depression contributed significantly to the overall variance in functional status of COPD patients, over and above medical burden and COPD severity, as measured by the 8 scales of the Medical Outcomes Study 36-item Short Form Health Survey (MOS SF-36). The medical burden and COPD severity did not contribute significantly to overall variance in functional status. Few patients were receiving treatment for anxiety or depression.

Alexopoulos et al. (2006) tested the hypothesis that brief inpatient PR was followed by the improvement in depressive symptoms and the
physical activities of 63 patients with COPD with major depression. The study findings revealed that the acute inpatient rehabilitation was followed by improvement of depressive symptoms and disability in older COPD patients with major depression. They concluded that the improvement of depression might be of behavioral intervention rather than the use of antidepressant drugs.

Chen and Narsavage (2006) examined the relationship between physiological, psychological and social factors with hospital readmission among 145 patients with COPD. Depression as main factor for readmission of COPD followed by hospital discharge at 14 days and 90 days in a rural population at Taiwan was identified. The study findings revealed that the Mainlanders perceived less family support had higher depressive symptom and lower daily function than the other places like Fukiens and Hakkas or the Aborigines. Daily functioning, co-morbidity, severity of illness, self efficacy, depressive symptoms and perceived informal support were regressed on hospital admission. The study reinforced the need for identification of cultural differences and low functioning as risk factors for early readmission so that must be addressed in discharge planning.

Guell (2006) assessed the effect of PR on psychosocial morbidity, functional exercise capacity, and HRQL in patients with severe COPD. A prospective, randomized, controlled trial with blinding of outcome assessment and data analysis was conducted among 40 patients with severe chronic flow limitation were randomized either to a control group or to a PR group (PRG). 16 weeks of PR that included breathing retraining and exercise. They evaluated psychosocial morbidity using two questionnaires (Millon Behavior Health Inventory; MBHI) and the Revised Symptom Checklist (SCL-90-R) and measured 6WMD and HRQL using the CRQ at baseline and 16 weeks. Results of the depression, hostility, global severity, positive symptom distress
index (all \( p < 0.01 \)), somatization, anxiety, psychoticism, and positive symptom (all \( p < 0.05 \)) domains of the SCL-90-R favored the PRG. They found statistically and clinically significant differences between groups in 6MWD (85 m; \( p < 0.01 \)) and in two domains of the CRQ: dyspnoea (1.0; \( p < 0.01 \)) and mastery (0.6; \( p < 0.05 \)). PR decreases psychosocial morbidity in COPD patients even when no specific psychological intervention is performed. Findings of the study also confirm the positive impact of PR on functional exercise capacity and HRQL.

Garrod (2006) identified the prognostic features of COPD associated with success or failure in pulmonary rehabilitation. Patients were stratified according to the MRC dyspnoea score. A total of 74 stable COPD patients, 21 of them with MRC dyspnoea score grade 1 - 2, 29 with grade 3 - 4 and 24 with grade 5, and in total with a mean forced expiratory volume in one second of 1.1 ± 0.6 L, attended for rehabilitation. Assessments consisted of the following: quadriceps torque, 6MWD, Brief Assessment Depression Cards and SGRQ. Predictors of drops out and of response (a change in SGRQ of 4 points or 6MWD of 54 m) were tested using binary logistic regression. In total, 51 patients completed the study. 39 (77%) showed a clinically significant benefit in either 6MWD or SGRQ. Significant differences were seen between MRC dyspnoea score, change in 6MWD and SGRQ score. Only grade 1-2 and 3-4 patients improved. Depression was a risk factor for subject drops out compared with non depressed patients.

Cao et al. (2006) conducted a cross-sectional survey among 186 patients with moderate to severe COPD with one or more admissions for acute exacerbations to two large general hospitals. Frequency of previous readmissions for AECOPD in the past year, and clinical characteristics, including depression and spirometry were ascertained in the stable state both before discharge and at 1-month post discharge. Among them, 67% had one
or more previous readmission, 46% had two or more, 9% had 10-20 readmissions in the 1-year period prior to current admission. There was a high prevalence of current or ex-heavy smokers, underweight patients, depression and consumption of psychotropic drugs, and low prevalence of caregiver support, pulmonary rehabilitation and influenza and pneumococcal vaccination. Both the univariate and multivariate analysis revealed that the disease duration > 5 years, FEV₁ < 50% predicted, use of psychotropic drugs and vaccination status were independently associated with frequent readmissions for AECOPD. Overall conclusion revealed frequent past readmission for AECOPD was associated with disease severity and psychosocial distress and increased use of vaccinations.

2.5.2 Effect of Psychosocial Support in Pulmonary Rehabilitation

Psychosocial and behavioural intervention in comprehensive PR programme can be in the form of regular patient educational session or support groups focusing on specific problems such as stress management. Instructions in progressive muscle relaxation, stress reduction and panic control may help in reducing dyspnoea and anxiety (Renfroe, 1988). Because of the effects of chronic respiratory disease on the family, participation of family members and friends in PR support groups is encouraged. Informal discussion of common symptoms, concern and problems during rehabilitation session may lead emotional support to patients. Group therapy that is occasionally offered in PR programmes, integrates many of the principles of coping and role transition (Emery et al., 1991).
The findings of the studies on the effects of psychosocial support and other related areas are listed below in chronological sequence

Guyatt et al. (1984) studied the effects of encouragement on walking test performance in a randomized controlled study among 43 patients with chronic airflow limitation. The experimental group received encouragement but not the control group as they performed serial two and 6MWT every fortnight for 10 weeks. The study result revealed that simple encouragement improved performance (p < 0.02) for the 6MWTs and also the need for careful standardization of the performance of walking test.

Graydon and Ross (1995) investigated the influence of symptoms, lung function, mood and social support on level of functioning of patients with COPD. A total of 143 patients with COPD were assessed for their symptoms (symptoms checklist), mood (profile of mood states) social support (personal resource questionnaire) and functioning (sickness impact profile). Results indicated that symptoms and mood directly and social support indirectly influenced the functioning of the patients.

Devine and Pearcy (1996) examined the effectiveness of psychoeducational care in adult with COPD from the meta-analysis of the sources from CINAHL, MEDLINE and Dissertation Abstracts. The two main interventions administered were 1. Comprehensive PR (Breathing exercises, education and psychosocial support) on coping with stress breathing techniques and use of medications. 2. Interventions included are guided imagery, cognitive counseling and frontalis muscle feedback. 65 studies (n = 3642) were analysed and the authors found that the education alone had a significant benefit on the accuracy of performing inhaler skill but small or medium sized effect for health care utilization and on adherence to treatment regimen. Relaxation alone was helpful in significant reduction in dyspnoea
and improvement in the psychological well-being. But the overall comprehensive PR showed the statistically significant effects on the psychological well-being, endurance, functional status, oxygen uptake, reduction in dyspnoea and the adherence of treatment regimen.

Brooks et al. (2002) examined the effects of two post rehabilitation programmes on functional exercise tolerance and HRQOL in patients with COPD. 109 subjects were randomised to receive either enhanced follow up (EF) or conventional follow up (CF). Subjects in the EF group attended a monthly support group and received a telephone call from a staff member at the midpoint (two weeks) between their visits. Both groups had scheduled appointments with a physical therapist and physician at 3 months intervals after discharge. Longitudinal data were recorded in 85 subjects (37 EF and 48 CF). Over the course of the study, there was no difference in 6MWD between two groups. There was no difference in total CRQ score between groups at baseline or at any time interval despite a significant difference with time. There was a clear deterioration in functional exercise capacity and HRQOL after completion of respiratory rehabilitation but no difference between the groups.

O'Neill (2002) conducted a descriptive qualitative study to explore the feelings of women with regard to symptoms of COPD and disabilities. 21 women were enrolled in pulmonary rehabilitation programs. The patients suffered due to dyspnoea, fatigue, depression, loss of social support and intimacy, and stigma. Breathing techniques, medication, rest, and avoidance measures were the most frequently used coping strategies. Because dyspnoea is the central symptom, nurses must continue to teach methods to control it, as well as to search for new interventions to relieve the symptoms. Optimal levels of rest and the effect on outcomes deserve close attention. Devising
ways to deal with social and psychological isolation would also enhance coping with COPD.

Xiaolian (2002) reported that a descriptive correlation study was conducted at the outpatient pulmonary clinic of a large medical center to describe family support and self care behavior and to ascertain the relationship of these two variables among Chinese COPD patients. A total of 98 COPD patients completed the questionnaires providing demographic data and information about perceived family support and self care behavior. Results showed that most subjects perceived that they had received a high level of family support, and the majority of the subjects perceived that they had initiated an adequate amount of self care behavior. A slightly statistically significant positive relationship between family support and self care behavior was ascertained.

Rosenberg (2003) observed that COPD is characterized by worsening airflow obstruction. In its late stages, patients experience decreased physical function and increased incidents of pneumonia, pulmonary hypertension, cor pulmonale, and chronic respiratory failure. Patients who regularly participate in moderate exercise experience greater control of symptoms and increased functional capacity compared with those being treated by pharmacological measures alone. Encouraging exercise in older adults with COPD will help the individuals reach and maintain their highest level of function and quality of life.

Ries (2003) organised a long term maintenance PR for much benefit for patients with chronic lung disease. A telephone-based maintenance program after pulmonary rehabilitation in 172 patients with chronic lung disease was evaluated. Subjects were randomly assigned to a 12 months maintenance intervention with weekly telephone contacts and monthly
supervision with reinforcement sessions (n = 87) or standard care (n = 85) and followed for 24 months. During the 12 months intervention, exercise tolerance (maximum treadmill workload and 6MWD) and overall health status ratings were better maintained in the experimental group together with a reduction in hospital days. There were no group differences for other measures of pulmonary function, dyspnoea, self efficacy, generic and disease specific quality of life, and health care use. By 24 months, there were no significant group differences. They concluded that a maintenance program of weekly telephone calls and monthly supervised sessions produced only modest improvements in the maintenance of benefits after pulmonary rehabilitation.

Wong et al. (2004) conducted a randomized controlled study to evaluate the effects of nurse initiated telephone follow up study in 60 COPD patients (30 telephone follow up and 30 control). The self efficacy score of Chinese self-efficacy scale (U = 272.5, p < 0.009) of patients who were followed up by telephone improved significantly with the control group patients. The authors concluded that the nurse initiated telephone follow up group was able to manage dyspnoea effectively and resulted an improvement in self efficacy score than the control group patients.

Trappen Burg et al.(2005) conducted a cross sectional, explorative study to determine the contribution on a large number of psychological and socio-demographic variables on the response to 3 months outpatient PR. 81 consecutive patients with COPD were included in the study. The outcome measures of pulmonary function, 6 MWD, CRQ, Modified Pulmonary Functional Status and Dyspnoea Questionnaire (PFSDQ-M), Hospital Anxiety and Depression (HADS) were assessed before and after 3 months. In addition, psychosocial adjustment, social support, marital status, mode of transportation, education, employment and smoking status were assessed at
the start of rehabilitation. Final conclusion exhibited that the effects of PR were not affected by baseline psychosocial factors. Patient with less favorable psychologic or sociodemographic conditions can also benefit from PR indicate that multidisciplinary approach of the rehabilitation program might have contributed to that improvement.

Arnold et al. (2006) explored the experiences of COPD patients invited to join a pulmonary rehabilitation (PR) programme. PR has been shown to be an effective non pharmacological intervention; however uptake and completion of programmes is frequently low. Semi structured interviews were conducted for twenty COPD patients who have been referred to PR over a 2 years period. Once started, ongoing adherence to the programme was positively influenced by a sense of group support, and increased self confidence. Lack of social support at home and overcoming the effort of living with COPD in order to attend were cited as negative influences on continued adherence. The study has shown that the healthcare professional plays a key role in the uptake of PR programmes. Positive approach of healthcare professional could increase the level of adherence to PR. Recognition and support in the area of social support for those living alone is much essential to increase adherence.

Kavahan et al. (2006) evaluated the effects of an outpatient pulmonary rehabilitation on psychological morbidity (anxiety and depression) among patient with COPD (26 experimental and 19 control). The two months outpatient PR was carried out and the outcome measure was assessed with Hamilton Anxiety rating (HAM-A) and Hamilton Depression rating (HAM-D) prior and after PR. The study showed that the outpatient PR program become beneficial in minimizing anxiety and depressive symptoms, especially significant improvement in anxiety symptoms. In addition there was improvement in health status, exercise tolerance and considerable
reduction of dyspnoea significantly for the patients who underwent PR program.

de Blok et al. (2006) identified the effects of counseling on lifestyle physical activity with the feedback of a pedometer during PR. 21 COPD patients were randomized to an experimental group that followed a regular rehabilitation program plus the counseling intervention or to a control group that only followed rehabilitation. The primary outcome was daily physical activity assessed by pedometers. Secondary outcomes were physical fitness, HRQOL, activities of daily living, depression and self efficacy. The experimental group showed an increase of 1,430 steps/day (+69% from baseline), whereas the control group showed an increase of 455 steps/day (+19%). The study showed that the use of the pedometer, in combination with exercise counseling and the stimulation of lifestyle physical activity, is a feasible addition to PR and helps to improve outcome and maintenance of rehabilitation results.

2.6 SIX MINUTES WALKING DISTANCE

Objective measurements are usually better than self reports as outcome measures. There are several modalities available for the objective evaluation of functional exercise capacity in PR programme. The 12 minutes walking distance was adopted in earlier days to assess the disability in patients with COPD (Mc Gavin et al., 1976). In an attempt to accommodate patients with COPD for whom 12 minutes walking was too exhausting, a six minutes was found to be a simple and easily practicable. A recent review of functional walking test concluded that the 6MWT is easy to administer, better tolerated and more reflective of activities of daily living than other walk tests (Solway et al., 2001).
Revill et al. (1999) conducted an endurance shuttle walk test (ESWT), a new field test for the assessment of endurance capacity of 21 patients and after 7 weeks of PR. Following PR the ESWT duration increased by 160 (24%) and the ISWT distance increased by 32 (11%). The ESWT was simple to perform, acceptable to all patients and exhibited good repeatability after one practice walk. The test showed major improvement following PR of COPD patients. It was more sensitivity to change than the field test of maximal capacity.

Bowen (2000) conducted a study to evaluate the functional status and survival following pulmonary rehabilitation. The patients with advanced chronic lung disease were evaluated for survival, 6 MWD and with the use of pulmonary functional status scale, which has sub scores of functional activities, psychological status and dyspnoea. Variables strongly associated with increased survival, higher post rehabilitation. Functional activities score and a longer 6MWD. Author concluded that the indicators of functional status were the strong predictors of survival in patients with advanced chronic lung disease.

Damien Stevens et al. (1999) considered the 6 minutes walk test (6MWT) performed in the hallway (HW) as a clinical indicator of functional capacity in patients with lung disease. A 6MWT utilizing a treadmill (TM) is easier to perform and allows easier patient monitoring. Therefore, the authors formulated a standardized TM 6MWT protocol and compared the results with those of a HW 6MWT. Each subject performed three HW 6MWTs and three TM 6MWTs assigned randomly on subsequent days. There was a 30 minutes rest between each walk and at least a 48 hours rest between each test day. All patients completed both HW and TM 6MWT within 7 days. Supplemental oxygen was administered or increased if the saturation fell below 88%. The best of the 3 tests was used for data analysis. 21 subjects completed the
protocol. The mean FEV₁ was 1.07 ± 0.53 L. The mean HW 6MWT distance was 1,228 ± 255 ft (range, 612 to 1,679 ft) and the mean TM 6MWT distance was 1,060 ± 389 ft, which were statistically different (p = 0.01). The intra-test variability of the three HW 6MWTs was similar to the three TM 6MWTs and no significant difference in the coefficient of variation was found. A standardized TM 6MWT was feasible and allows easier patient monitoring, but there was a statistically significant difference between the HW and TM 6MWT distance and therefore they are not interchangeable. However, the intra-test reproducibility of the TM and HW 6MWTs were similar when three walks were performed in a single test session. The role of the TM 6MWT in PR requires further exploration.

Elpern et al. (2000) conducted a survey and analysed the information obtained from 71 of 99 programs with regard to timed walk tests. 57 respondents (80%), based on their results on a single walk. Walk tests were completed in a hall way (73%), on a walking track (9%) and on a treadmill programs (38%) the oxygen was carried by the patient. Informal non-standardized instructions were provided to patients prior to walking in 41 programs (58%). In 53 programs (76%) the walk supervisor could direct a patient to speed up, to slow down, or to rest. Evaluation of breathlessness and perceived exertion were measured during the walk by 73% and 16% programs respectively. Author has concluded that practices regarding performance of timed walk tests were poorly standardized so further research is needed to evaluate the impact of certain variations in testing practices on test results.

van Stel (2001) performed an exploratory factor analysis on physiological measurements and dyspnoea ratings recorded during testing. 83 patients with mild to severe COPD performed repeated 6MWTs before inpatient pulmonary rehabilitation. Factor analysis on 15 variables yielded a stable four-factor structure explaining 78.4% of the total variance. Recorded
heart rate variables contributed to factor one (heart rate pattern), walking distance, heart rate increase, and decrease contributed to factor two (endurance capacity), oxygen desaturation variables contributed to factor three (impairment of oxygen transport), and dyspnoea and effort variables contributed to factor four (perceived symptoms). Walking distance decreased in half of the 53 patients measured post treatment, but self perceived change in exercise tolerance improved in 84% and was explained by change in walking distance, by less desaturation, and by less dyspnoea (p = 0.005). Qualitative analysis showed that 29 of 53 patients improved in three or four factors. Performance in the 6MWT can be described with four statistically independent and clinically interpretable factors. Because clinically relevant changes consist of more than only walking distance, assessment of functional exercise tolerance in patients with COPD improves by reporting multiple variables

Chuang (2001) hypothesized the superiority of D x W (The product of walking distance and body weight) to walking distance (D) alone in any correlation with lung function, anaerobic threshold (AT) and maximal oxygen uptake (VO2max). The D x W product for a 6 mins. walk test (6 MWT) would correlate with the AT and VO2max because all three are markers of exercise ability. 33 male COPD patients with mean FEV1 of 1.2+/-.4 l were enrolled. Lung function and self-assessed every day activities using a oxygen-cost diagram were evaluated before entry of the study. A maximal effort ramp pattern cardiopulmonary exercise test (CPET) and a 6 MWT were conducted in random order. Borg score, heart rate, and O2 saturation with pulse oximetry (SpO2) were measured during both exercise tests. VO2 AT and minute ventilation were also measured during the CPET. Correlations were sought between the distance covered in the 6 MWT, and the D x W product with AT, VO2max and other variables. D x W was better correlated with diffusing capacity for carbon monoxide and vital capacity than D alone. They
concluded that D x W mimics the work of walking better than D and is suggested as a parameter for evaluation of patients’ fitness if gas exchange measurements are not available.

Solway et al. (2001) performed a systematic overview of the measurement properties of functional walk tests used in the cardio-respiratory domain. The data sources used were MEDLINE (1966-2000) CINAHL (1982-1999) and Bibliographies of the retrieved articles. Clinical trials and observational studies were included. Among 52 studies examined there were 5 studies on the 2MWT, 29 studies on the 6MWT, 13 studies on the 12MWT, 6 studies on the Self Paced Walk Test (SPWT), with the reported data on the validity, reliability, interpretability and responsiveness were reviewed systematically. Measurement properties were most strongly demonstrated for the 6MWT. Correlation of 6MWT distance and maximal oxygen consumption ranged from 0.51 to 0.90. A change in distance walked of at least 54m was found to be clinically significant for the 6MWT. Authors concluded that measurement properties of the 6MWT have been the most extensively researched and established. In addition, the 6MWT is easy to administer, better tolerated and more reflective of activities of daily living than other walk tests. Therefore, the 6MWT is currently the test of choice when using a functional walk test for clinical or research purposes.

Gerald et al. (2001) examined the relationship between six-minute walk change and COPD stage according to ATS guideline. 76 COPD patients were enrolled from January 1996 to June 2000. Data was collected on 6MWD upon entry into the program and upon program completion. There were significant differences among the three stages with regard to initial and ending of 6MWD. The study suggested that PR is equally effective in increasing physical performance for all patients regardless of COPD stage. It supported the recommendation of PR for patients early in the disease process.
Solway et al. (2002) examined the short-term effects of using a rollator on functional exercise capacity among 40 individuals with COPD. Repeated-measures randomized crossover design using the 6MWT as the primary outcome measure, two 6MWTs were performed on each study day. One 6MWT was performed unaided, and the other was performed with a rollator. The order was randomized on the first day and reversed on the second day. Use of a rollator was effective in improving functional exercise capacity by reducing dyspnoea (p < 0.001), rest during an unaided 6MWT was a significant predictor of improved functional exercise capacity with the use of the rollator (p < 0.005) among stable individuals with severe COPD. Individuals who walked < 300 m and individuals who required a rest during an unaided 6MWT benefited the most from using a rollator in terms of reduced dyspnoea, reduced rest time, and improved distance walked.

Carter et al. (2003) identified the superiority of six minutes walking distance x body weight product (6MWORK) as an improved outcome measure with a solid physiologic foundation than the 6MWD alone. 124 men and women with moderate to severe COPD volunteered and completed the testing sequence, which included pulmonary function, a peak effort ramp cardiopulmonary exercise study with gas exchange, and the 6MWD. The 6MWD averaged 416.8 ± 79.0 m for men and 367.8 ± 78.6 m for women, and the differences were significant (p < 0.002). When 6MWD was compared as the percent predicted of normal values, each gender presented with a similar reduction (p > 0.05), respectively. 6MWORK averaged 35,370 ± 9,482 kg/m and 25,643 ± 9,080 kg/m (p < 0.0001) for men and women, respectively. 6MWORK yielded higher correlation coefficients than did 6MWD when correlated with DLCO, lung diffusion for alveolar ventilation, FEV₁, FEV₁/FVC ratio, watts, peak oxygen uptake, peak minute ventilation, and peak tidal volume. They concluded that work calculated as the product of distance x body weight is an improved outcome measure for the 6MWD.
6MWORK can be used whenever the 6MWD is required to estimate a patient’s functional capacity and also to convert into indexes of caloric expenditure for direct cross-modality comparisons.

Sciurba et al. (2003) conducted 6MWTs on 761 patients with severe emphysema (FEV₁ % predicted = 26.3 ± 7.2) who were participants in the National Emphysema Treatment Trial. 470 participants had repeated walks on a separate day. The second test was improved by an average of 7.0 ± 15.2% (66.1 ± 146 feet, p < 0.0001, by paired t test). Participants were tested on continuous (circular or oval) courses had a 92.2-foot longer walking distance than those tested on straight (out and back) courses. Course length had no significant effect on walking distance. The training effect found in those patients with severe emphysema was less than in previous reports of patients with COPD. Furthermore, the layout of the track may influence the 6MWD.

Peruzza et al. (2003) investigated the impact of COPD on HRQOL and functional status in elderly. 60 COPD patients and 58 healthy controls over 65 years old were assessed for pulmonary function tests, 6MWD for exercise tolerance, the Barthal Index and Mini Mental State Examination (MMSE) for functional status, the Geriatric Depression Scale (GDS) for mood and SGRQ for HRQOL. FEV₁ and PaO₂ were reduced in COPD patients. Also the distance walked during 6MWD was significantly shorter for patients than controls (283 ± 90 vs. 333 ± 95m, P < 0.01). Moreover, COPD patients had significantly worse outcome for the Barthal Index, GDS and SGRQ. In conclusion elderly COPD patients show a substantial impairment in HRQOL depending on the severity of airway obstruction, symptoms related to the disease may be exaggerated by mood deflection.

Brooks et al. (2003) compared between an indoor and an outdoor 6MWD among individuals with COPD. An experimental repeated measures
crossover design was used. Patients were studied two separate days in the same week. Two 6MWTs one indoor and the other outdoor were performed on each study day, with a rest in between. 18 patients with COPD were selected for the test. There was no significant effect of setting (indoors Vs outdoors) on distance walked (394 ± 86m Vs 398 ± 84m, p < 0.4), duration of rest, or change in rate of perceived dyspnoea. Testing day had no significant effect on walk test performance (all p > 0.1). The results indicated that the 6MWT performed outdoors within reasonable climatic parameters may be reflective of 6MWT performance indoors.

Pinto-Plata et al. (2004) conducted a prospective study to find out the value of the 6 MWD as a predictor of mortality in COPD patients. 198 patients with COPD and 41 age-matched controls were followed for 2 years. The anthropometrics, spirometry, 6 MWD and co-morbidities were measured. The 6MWD decreased in the COPD group from 238 ± 107m to 218 ± 112m, and increased in the control group from 532 ± 82m to 549 ± 86m. In both groups, there was a poor correlation with changes in FEV₁. The 6MWD independently predicted survival, after accounting for age, body mass index and co-morbidities. In severe COPD, the 6MWD predicts mortality better than other traditional markers of disease severity. Its measurement was useful in comprehensive evaluation of patients with severe disease.

2.7 HEALTH RELATED QUALITY OF LIFE

The term 'Quality Of Life ' (QOL) is widely used in clinical research and clinical care. In its broadest definition, QOL of an individual is strongly influenced by factors such as health status, financial status, housing, employment, social support etc. Hence medical researchers favour a more restrictive term 'Health Related Quality of Life ' (HRQOL). In general
HRQOL measures the impact of an individual's health on his or her activities of daily life, emotional and social functioning and ability to enjoy activities.

Several researchers attempted to assess the HRQOL of patients with COPD. Few studies correlated the HRQOL score to the physical measures on health status.

2.7.1 HRQOL Tool Development Related Studies

Guyatt et al. (1987) framed a self-report questionnaire to determine the effect of treatment on HRQOL in clinical trials of patients with chronic airflow limitation. The items in the questionnaire were constructed to evaluate the following four dimensions namely dyspnoea, fatigue, emotional function and the patients feeling of control over the disease. Repeatability was observed to be excellent with the coefficient of variation less than 12% for all four dimensions. Responsiveness (sensitivity to change) was tested by administering the questionnaire to 13 patients before and after optionisation of their drug treatment and to another 28 before and after participation in a respiratory rehabilitation programme. In both cases large, statistically significant improvements in all four dimensions were noted, changes in questionnaire score were correlated with changes in spirometric values, exercise capacity of patients and physicians global ratings. Thus it has been shown that the questionnaire is precise, responsive, and valid.

Jones et al. (1992) formulated a fixed format self-complete questionnaire for measuring health status in chronic airflow limitation. A 76-item questionnaire was developed and named as St. George Respiratory Questionnaire (SGRQ). Repeatability was tested over 2 weeks in 40 stable asthmatic patients and 20 patients with stable COPD. The coefficient of variation for the SGRQ total score was 19%. SGRQ scores correlated with
appropriate comparison measures. For example symptom score versus frequency of wheeze ($r^2 = 0.32$, $P<0.0001$), activity versus 6 MWD, ($r^2 = 0.5$, $P<0.0001$). Changes in SGRQ scores and other measures were studied over 1 year in 133 patients, significant correlation’s were found between changes in SGRQ scores and the comparison measures.

Maille et al. (1994) constructed a disease specific HRQOL questionnaire for patients with Asthma and COPD. The questionnaire consisted of 55 items divided into seven sub sections. The construct validity was found to be good. A strong relationship between the HRQOL subclass and several indicators of illness severity was also found.

Maille et al. (1997) developed a disease specific HRQOL questionnaire for patients with mild to moderate chronic non specific lung disease. The developed HRQOL questionnaire consisted of 55 items divided into seven domain subscales; breathing problems, physical problems, emotions, situations triggering or enhancing breathing problems, general activities, daily domestic activities and social activities, relationship and sexuality. Reliability estimates of the constructed questionnaire varied from 0.68 to 0.89.

Hajiro et al. (1999) developed a novel short and simple questionnaire, the Airway questionnaire 20 (AQ20) to measure and quantity disturbances in HRQOL of patients with asthma or COPD. To assess the discriminative properties ad responsiveness of the AQ 20. They conducted a cross sectional study among 165 patients with mild to severe COPD. All the patients have completed the AQ20, SGRQ, CRQ, Pulmonary function tests, progressive cycle ergometer exercise test dyspnoea and anxiety. All these measures showed significant improvements in their scores over a 3 months period after initiating medical intervention. In conclusion, the AQ20 may
have discriminative properties and responsiveness that are similar to more complex questionnaires such as the SGRQ and CRQ. Because it is short and can be quickly answered and scored, the AQ20 in useful in studies with limited time for HRQOL assessments.

Yohannes et al. (1998, 2000) developed the Manchester Respiratory ADL questionnaire (MRADL) and to assess its validity in older patients with chronic obstructive pulmonary disease (COPD). The MRADL is a composite of the most discriminative questions from the Nottingham Extended ADL Questionnaire (NEADL) and the Breathing Problems Questionnaire (BPQ). 188 (104 men) COPD were enrolled as subjects. All subjects completed MRADL and NEADL scales, and 15 COPD subjects (11 men) completed an 8-week PR program. MRADL responded to changes during PR: pre versus post mean (SE) score 11.2 (1.1) vs. 13.4 (1.1); (t = 3.09; p = 0.008), but NEADL was unchanged. MRADL showed high consistency (Cronbach alpha 0.91). 95% confidence limits of repeatability were -0.63 to +0.26 (p = 0.42) for MRADL and -0.53 to +0.26 (p = 0.50) for NEADL. They concluded that MRADL is a reliable and valid self-report scale for assessment of physical disability in older COPD patients. It is responsive to pulmonary rehabilitation.

Morimoto et al. (2003) developed the Chronic obstructive pulmonary disease Activity Rating Scale (CARS) to measure life related activity in patients with COPD, and to confirm its reliability and constructive validity in a factorial structure model. 88 items life related activity list, generated previously from a literature review, was administered to 114 patients of COPD. The secondary structural model consisted of 4 factors with 12 items. The internal consistency of the 12 items was highly reliable (Cronbach’s alpha = 0.924). The CARS score was correlated with pulmonary function tests, breathlessness, and HRQOL scales in Pearson correlation
The results revealed that the COPD Activity Rating Scale is a valid scale for the assessment of life related activity in patients with COPD.

Corless et al. (2001) reviewed the literature on cross cultured QOL using the Cumulative Index to Nursing & Allied Health literature (CINAHL), 1982 to February 2000, and Medline, 1966 to May 2000, databases. The authors explored that the use of research instruments beyond the samples with which they were initially tested, particularly if the new samples are cross cultural, presents considerable challenges. The findings of the reviews indicated the importance of knowing the following consideration of the problems, phenomenon of interest, cross cultural vs. cross national, salience, conceptual equivalence, cultural hegemony versus cultural validity, cultural equivalence vs. verbal equivalence, fidelity vs. appropriateness privacy vs. disclosure, appropriateness of format, and resource utilization for translation. Many issues about cross cultural QOL were identified. By addressing the above-mentioned issues researcher can develop appropriately translated and validated QOL instruments to advance knowledge about cross cultural QOL.

2.7.2 HRQOL Reliability and Validity Related Studies

Wijkstra et al. (1994a) assessed the reliability and validity of the chronic respiratory questionnaire (CRQ). The CRQ was administered on two consecutive days to 40 patients with COPD. Internal consistency reliability of each dimension was investigated by Cronbach’s $\alpha$ reliability coefficient and content validity by Pearson’s correlation coefficient between the CRQ and the symptom checklist. Items of the dimensions fatigue, emotions and mastery of the CRQ were found to be valid and can be used to assess HRQOL in patients with chronic airflow limitations. Items of the dyspnoea dimension were less reliable and should not be included in the overall score of the CRQ in comparative research.
Guell et al. (1998) translated the CRQ into Spanish and to test its measurement properties. The study was performed in 60 patients (30 rehabilitation group and 30 standard community care only). A rigorous process of forward and back translation and review produced an easily comprehensible questionnaire, which was administered together with measures of pulmonary function and exercise capacity. Only low correlations were found between the changes in CRQ and the changes in pulmonary function and exercise capacity. Scores remained stable in patients who were deemed clinically stable and showed large statistically significant improvement p < 0.001 in patients of rehabilitation group. The index of responsiveness was 0.92 for fatigue, 0.91 for dyspnoea, emotional function and mastery. In conclusion, the Spanish translation of the CRQ is likely to be useful for measuring differences between patients, particularly for measuring the effects of intervention on quality of life in chronic respiratory disease.

Hajiro et al. (1998) compared the three disease specific HRQOL questionnaires (SGRQ, BPQ and CRQ) their discriminative properties and to clarify the characteristics of each questionnaire. 143 patients with mild to severe COPD completed pulmonary function tests, progressive cycle ergometer testing for exercise capacity, assessment of dyspnoea, anxiety and depression and HRQOL. Dyspnoea and psychological status impacted the HRQOL in patients with COPD. Although on substantial differences between the SGRQ, BPQ and the CRQ were evident in the correlation with physiologic parameters and the influential factors. The BPQ was found to be less discriminatory than the SGRQ and CRQ in cross sectional evaluation of HRQOL.

Bestal et al. (1999) examined the validity of the Medical Research Council (MRC) dyspnoea scale. 100 patients with COPD were recruited from an outpatient PR programme. Assessment included the MRC dyspnoea scale,
spirometric tests, blood gastensions, a shuttle walk test, and a Borg scores for perceived breathlessness before and after exercise. Health status was assessed using the SGRQ and CRQ. The Nottingham Extended Activities of Daily Living (NEADL) score and Hospital Anxiety and Depression HAD score were also measured. There was a significant association between MRC grade and shuttle distance, SGRQ and CRQ stores, mood state and NEADL. In conclusion 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 FEV$_1$, in the classification of COPD severity.

Eakin et al. (1998) examined the reliability and validity of a new version of the University of California, San Diego Shortness of Breath Questionnaire (SOBQ), a 24-item measure that assesses self reported shortness of breath while performing a variety of activities of daily living. Patients enrolled in a PR program were asked to complete the SOBQ, the Quality of Well Being Scale, the Center for Epidemiological Studies Depression Scale, and a 6MWT with modified Borg scale ratings of perceived breathlessness following the walk. 32 male subjects and 22 female subjects with a variety of pulmonary diagnoses, COPD (n = 28), cystic fibrosis (n = 9), and post lung transplant (n = 17). The current version of the SOBQ was compared with the previous version, the format of which often resulted in a significant number of "not applicable" answers. The results demonstrated that the SOBQ had excellent internal consistency (alpha = 0.96). The SOBQ was also significantly correlated with all validity criteria. The SOBQ is a valuable assessment tool in both clinical practice and research in patients with moderate to severe lung disease.

Benzo (2000) examined the effect of usage of Medical Outcomes Survey Short Form 36 items questionnaire (SF-36), a generic QOL measure, to detect changes in QOL in COPD patients after completion of PR. Patients
with COPD who participated in a PR program completed the QOL questionnaire before and after completion of PR. Exercise tolerance was assessed by the 6MWT. Quality of life was assessed by the SF-36; the authors calculated its eight dimensions as well as mental (MCS) and physical (PCS) component summary scores. The patients realized a significant improvement in exercise tolerance; 6MWD increased from 470 ± 104 m to 536 ±133 m (p = 0.0006) after PR. Quality of life also improved in nearly all dimensions and in both summary scores; PCS improved from 26.1 ± 8.0 to 30.5 ± 9.0 (p = 0.008) and MCS improved from 27.9 ± 7.0 to 34.1 ± 5.0 (p = 0.0002). The SF-36 and its summary scores are sensitive instruments to detect improvement in HRQOL in COPD patients after PR.

Nishiyama (2000) examined the validity and responsiveness of the Visual Analog Scale 8 (VAS8), consisting of eight linear scales, has been developed to measure HRQOL in COPD patients. First, HRQOL was assessed in a cross-sectional study with the VAS8 and the SGRQ in 46 COPD patients. Relationships between the VAS8 and various physiological parameters were analysed. Second, in a longitudinal study, changes in HRQOL scores after pulmonary rehabilitation were evaluated in 29 COPD patients. The total VAS8 scores showed a weak correlation with vital capacity and maximal inspiratory pressure and a moderately strong correlation with 6MWD and dyspnoea rating. The total VAS8 score showed a significant correlation with each SGRQ score. Furthermore, almost every VAS8 and SGRQ score improved significantly after PR. The change in the total VAS8 value showed a strong correlation with that of the SGRQ. The VAS8 was a well suited measure to assess HRQOL in COPD patients. VAS8 is particularly beneficial because of its ease of use.

Barr et al. (2000) assessed the reliability, validity, and sensitivity to change of the modified version of the St. George's Respiratory Questionnaire
SGRQ was translated into American English (SGRQ-A). Based on input from American patients with COPD and health professionals, the SGRQ was translated into American English (SGRQ-A) and then translated back to British English. For SGRQ-A reliability and validity studies, patients were asked to report symptoms experienced over 1 year (reporting period in the original SGRQ) and one month (modification made to SGRQ-A). They evaluated 102 patients with COPD (50% female) forced expiratory volume in one second (FEV\(_1\)= 1.01 L) at an administrative session before and after completion of a pulmonary rehabilitation program. The SGRQ-A showed good agreement with the original SGRQ when translated back to British English. Internal reliability (Cronbach alpha) was > 0.70 for all SGRQ-A components except the 1-year symptom reporting component. Test retest intra class correlations were 0.8 to 0.9. Construct validity was strengthened when all SGRQ-A components (except 1 year symptoms and most 1 month symptoms) correlated (p < or = 0.01) with the MRC Dyspnoea scale, 6MWD, all SF-36 concept scores, and 80% of CRQ domains (r = 0.30 - 0.72). Discriminate validity was demonstrated when all components of the SGRQ-A with the modified 1 month symptom reporting period were shown to discriminate better between disease severity groups (based on patient self reports of disease severity) than did pulmonary function tests and the 6MWD. Responsiveness of the SGRQ-A to change in health status was demonstrated when scores on the Symptoms 1 month and Total 1 month components detected significant improvements in patients' health status (p = 0.02 and p = 0.04, respectively). The SGRQ-A with a modified 1 month symptom-reporting period demonstrated reliability and validity in this sample of patients with COPD.

Engstrom et al. (2001) identified the need to use both disease specific and generic measures should be used in patients with COPD as an outcome measures. The patients (n = 68) were stratified by forced expiratory
volume in one second (FEV₁) to represent a wide range of disease severity. Pulmonary function, blood gases and 6MWD were assessed. HRQL instruments included St George Respiratory Questionnaire (SGRQ), Sickness Impact Profile (SIP), Hospital Anxiety and Depression Scale and Mood Adjusted Check list. The strength of the impact of COPD on HRQL was represented along a continuum ranging from lung function, functional status (physical and psychosocial) to well being. Although correlations between FEV₁ versus SGRQ total and SIP overall scores (r - 0.42 and -0.32) were stronger than previously reported, multiple regression analyses showed that lung function contributed little to the variance when dyspnoea related limitation, depression scores and 6MWD were included in the models. The three factors (dyspnoea, depression and 6MWD) were important to varying degrees along the whole range of HRQL. Physiological, functional and psychosocial consequences of COPD are only poorly to moderately related to each other. The authors concluded that a comprehensive assessment of the effects of COPD requires a battery of instruments that not only tap the disease specific effects, but also the overall burden of the disease on everyday functioning and emotional well being.

Garrod et al. (2002) investigated the reliability and sensitivity of the London Chest Activity of Daily Living Scale (LCADL). The Reliability was assessed in 19 patients with stable severe COPD, by test - retest 4 weeks apart. Responsiveness was assessed in 59 patients, who had undergone at least 6 weeks of pulmonary rehabilitation. Test - retest scores of the LCADL showed a strong relationship with the another, Intra class correlation coefficient is 0.93. All domains of the LCADL showed a statistically significant reduction in dyspnoea during ADL after PR. There was a statistically significant improvement in the total LCADL score. The analyzed data support the use of the LCADL as an outcome measure in COPD, which is valid, reliable and responsive to change.
Alemayehu et al. (2002) performed a comparative analysis of two quality of life instruments. A more concise instrument, the Airways questionnaire (AQ) was developed to measure HRQOL among patients with Asthma and COPD. The shorter version of that instrument has 20 items (AQ20) and longer version 30 items (AQ30). The authors found out the relationship between HRQOL scores measured by the AQ20 / 30 or the SGRQ scale among 303 patients of COPD. In conclusion both AQ20 and the AQ30 were highly correlated with the overall SGR score and with symptoms, activity and impact component scores. AQ20/30 and the SGRQ scores are comparable in terms of measuring HRQOL in COPD patients and are equally useful in determining the association between utilization of health care services and HRQOL.

van Stel (2002, 2003) stated that the quality of life for respiratory illness questionnaire (QOLRIQ) is an outcome measure for patients with asthma or COPD. They assessed the longitudinal validity, reliability of the change score and the interpretation of changes on the QOLRIQ in inpatient PR, completed by 108 patients with moderate to severe asthma (39) or COPD (69). Domains and total score of the QOLRIQ changed significant (all \( p < 0.0002 \)) with standardized response means from 0.46 to 0.90. All QOLRIQ change scores were significantly correlated with self rated change in health and in disease symptoms and with change in self assessed health status (r from 0.2 to 0.61). There were several significant correlations between QOLRIQ change scores and change in experienced invalidity, emotional well being, anxiety, depressive symptoms and Rand 36domains (r from 0.2 to 0.68). The intra class correlation coefficient of change was 0.90. Author concluded that the QOLRIQ is sensitive to change, longitudinally valid and reliable. The results enable the use of the QOLRIQ as an outcome measure in clinical trials with patients with moderate to severe asthma or COPD. The
longitudinal measurement properties in less severe patients still need to be studied.

Katsura et al. (2003) examined the validity, discriminatory ability and responsiveness of HRQOL questionnaire using a linear analog scale for COPD patients. A cross sectional and longitudinal study was conducted among 102 elderly COPD patients. Scores on the QOL scale, SGRQ and SF – 36 and various clinical parameters were recorded and the correlations between all three QOL questionnaires and various clinical parameters were examined. The responses of 31 elderly COPD patients to QOL scale and the SGRQ before and 3 months after the completion of a comprehensive PR program were compared longitudinally. In conclusion the authors revealed that the QOL scale was similar to complex questionnaires such as the SGRQ in terms of validity and responsiveness for evaluating disease specific HRQOL in elderly COPD patients. QOL scale is a simple questionnaire that may be used easily in clinical settings to assess COPD patients.

Doll et al. (2003) compared a generic and a specific QOL instrument in the assessment of patients with chronic bronchitis. Data from 320 patients were collected at actual exacerbation if chronic bronchitis (AECB) and 230 patients during a subsequent stable phase (non AECB) utilizing both SGRQ and generic Nottingham health profile (NHP). Patients (maximum n = 200) reported significantly poor QOL at AECB than at non AECB for all domains except the SGRQ symptom domain. The SGRQ was more sensitive than the NHP to QOL differences between patients. In conclusion the authors suggested that the condition specific SGRQ and particularly its symptom domain was less responsive than generic NHP to QOL change accompanying AECB. That reflected the construct of the symptom domain, which measures chronic bronchitis symptoms over the previous year.
Williams et al. (2001, 2003) explored the sensitivity of both the self report CRQ (CRQ – SR) and the conventional interviewer led CRQ (CRQ – IL) in patients undergoing pulmonary rehabilitation. 80 patients with stable COPD who had been referred for pulmonary rehabilitation completed the CRQ – SR at initial assessment and at the end of the 7 weeks program. A further 35 patients completed both the CRQ – SR and the CRQ – IL, administered 1 week apart, before starting rehabilitation and again at the end of the programme. Similar results were found in the comparison of the sensitivity of the CRQ – SR and the CRQ – IL, with large changes in mean score per dimension following rehabilitation for both versions of the questionnaire (p< 0.005). No significant differences were seen in the magnitude of change between the two formats of the questionnaire (p>0.05). In conclusion the author revealed that the self reported CRQ is as sensitive to change as the interviewer led CRQ in patients undergoing pulmonary rehabilitation but has the advantage of being less time consuming to administer.

Kaplan et al. (2004) and Ries et al. (2005) evaluated two generic medical outcome study short form (SF- 36), quality of well being (QWB) and the two disease specific measures (SOBQ & SGRQ) of HRQOL in the National Emphysema Treatment Trail (NETT). The data was collected from the 1,218 subjects who were randomized in the NETT. Patients completed evaluation before and after completion of the pre randomization phase of the NETT pulmonary rehabilitation program, HRQOL measures were evaluated against physiologic and functional criteria using correlation analysis. The significant improvements in HRQOL were correlated with improvements in 6MWD. The disease specific and general HRQOL measures used in the NETT were correlated. However the disease specific measures were more sensitive to clinical changes than the generic measures. Based on those
evaluation they recommended either the SGRQ or SOBQ as COPD specific outcome measures.

Names and Bumbacea (2005) stated that the HRQOL has been an important field of research for the last 10 years, the result being several questionnaires used to measure it. Measuring HRQOL is important in order to evaluate the impact if the disease on patient life, it can also be used to measure the therapeutic effect of pharmacological or non pharmacological therapies. The generic questionnaires and questionnaire specific to chronic respiratory diseases were used. The authors described the ways of administration domains, scores, minimally clinical important difference (MCID), characteristics of a good questionnaire and basic information regarding the main standardized respiratory questionnaires AQLQ, CRQ and SGRQ, they finally focused on the Romanian Version of SGRQ (SGRQ – RO).

Damato et al. (2005) validated the Italian version of Clinical Chronic Obstructive Pulmonary Disease Questionnaire (CCQ), in specific pulmonary disease clinical practice. The CCQ is the first questionnaire that incorporates both clinician and patient guideline goals in the clinical control evaluation of patients with COPD in general clinical practice. Validity was tested in a population of healthy subjects and patients with COPD (55 healthy; 40 mild-moderate, 50 severe and 30 very severe COPD) using the Italian validated version of the Short Form Health Survey (SF-36) and guideline recommended routine measurement in COPD patients (FEV$_1$, FVC, BMI and functional dyspnoea). Test-retest reliability was tested by re administering the CCQ after 2 weeks. Responsiveness of the tool was assessed by re administering the CCQ after three weeks of hospital pulmonary rehabilitation. Distance walked and Borg breathlessness ratings were measured at the end of the six-minute walking test (6 MWT), before and after rehabilitation.
Significant correlations were found between the CCQ total score and domains of the SF-36, CCQ and FEV$_1$% predicted, CCQ and MRC. Test-retest reliability was determined in 112 subjects over a period of two weeks (Intra Class Coefficient = 0.99). 46 patients with COPD showed significant improvement in CCQ scores, distance walked and Borg breathlessness rating after 3 weeks of pulmonary rehabilitation, indicating CCQ responsiveness. The CCQ is self administered and has been specially developed to measure clinical control in patients with COPD. Data support its validity, reliability and responsiveness in Italian and in specific pulmonary disease clinical practice.

2.7.3 Effects of PR on HRQOL Related Studies

Wijkstra et al. (1994b) investigated the effect of PR on HRQOL, lung function and exercise tolerance on patients with COPD. 28 patients were randomly allocated in a home rehabilitation programme for 12 weeks. HRQOL was assessed in four dimensions namely dyspnoea, fatigue, emotion and control over the disease. After the rehabilitation, the exercise tolerance and HRQOL significantly improved whereas lung function showed no significant changes.

Wijkstra et al. (1994c) studied the relation of both objective and subjective measurements with exercise capacity in patients with COPD. Spirometric values and maximal inspiratory pressure were modestly correlated with 6 MWD ($\gamma=0.55$). QOL showed no correlation with exercise capacity, whereas there was a correlation between dyspnoea and 6 MWD. ($\gamma = -0.41$).

Camp (2000) selected both quantitative and qualitative research methods to evaluate HRQOL changes in patients with COPD after PR.
29 patients with COPD were assessed before and after a 5 weeks control phase and after a 5 weeks rehabilitation phase using the CRQ, SF-36, and spirometry. Their qualitative research was based on a sub sample of 7 subjects who were interviewed after PR. PR improved HRQOL, as demonstrated by increases of 22% and 14% in the physical function categories of the CRQ and the SF-36, respectively, and by an increase of 10% in the CRQ's emotional function category. The qualitative data indicated how PR influenced HRQOL. The use of both quantitative and qualitative methods illustrated the nature of improvement in HRQOL after PR. Improved physical function, less dyspnoea, and a heightened sense of control over the subjects' COPD resulted in increased confidence and improvement in emotional well being.

Singh et al. (2001) observed the relative sensitivity of the 3 disease specific measures and 2 generic measures in health status assessment of the 7 weeks PR of patients with stable COPD. They completed a shuttle walking test and 3 disease specific questionnaires: the CRQ, SGRQ and the Breathing Problems Questionnaire (BPQ). Patients also completed 2 generic questionnaires: a global quality of life scale and an activity checklist. 97 patients completed the course over 12 months period. The shuttle walking test and the treadmill endurance test increased significantly after rehabilitation ($p < 0.001$). All 3 disease specific questionnaires improved significantly (the CRQ and SGRQ improved beyond minimal clinically important difference). The global score improved significantly. All 3 disease-specific measures were responsive to PR. However the operator led CRQ appears to be the most sensitive short term outcome measure.

Lisboa (2001) observed the impact of COPD on HRQOL and the effect of 10 weeks of exercise training on exercise performance and on QOL. The Spanish version of the CRQ was applied to 55 COPD patients ($\text{FEV}_1$ is $37 \pm 13\%$ pred) for the assessment of HRQOL. 30 of them submitted to
exercise training for 10 weeks. Exercise performance was evaluated by measuring: 6MWD, maximal workload (Wmax), maximal O₂ consumption (VO₂max) as well as endurance time, blood lactic acid, dyspnoea and leg fatigue during a submaximal exercise. Trained patients were evaluated before and after training. Exercise training significantly improved the four domains of HRQOL (p < 0.0001), Wmax (p < 0.05), VO₂max (p < 0.02) and endurance time (p < 0.001). Isometric exercises, measurements of dyspnoea, leg fatigue and lactic acid decreased after training (p < 0.001, each). The study results demonstrated that HRQOL is seriously impaired in patients with COPD and confirm: (a) the lack of relationship of HRQOL to the usually measured physiological parameters, and (b) the beneficial effect of exercise training on HRQOL through the reduction of symptoms. Study findings stress the need of measuring HRQOL in COPD patients to evaluate the impact of therapeutic procedures on well being from the patients' perspective.

Fuchs Climent (2001) identified the relationships between HRQOL and the clinical state using factor analysis of pre and post rehabilitation among patients with COPD. Comprehensive rehabilitative programs, including exercise training, have beneficial effects on exercise tolerance and HRQOL for these patients. Factor analysis (n = 6) was conducted using the data of 32 patients with COPD. Patients had been evaluated for HRQOL using the Nottingham Health Profile (NHP), spirometric values, dyspnoea, and the variables assessed by an incremental exercise test at three levels of activity. All measurements were obtained pre and post rehabilitation. Factor analysis showed that the following two factors characterize the pathophysiologic condition of patients with COPD: (1) the specific cardiorespiratory responses to incremental exercise test and the spirometric values; and (2) the HRQOL results. The factor analysis results differed with the testing time (pre & post) and the level of activity. Study results reinforce the usefulness of different types of evaluation, especially pre and post
rehabilitation, because they reflect independent benefits used to understand the success and follow up of rehabilitative programs.

Shafazand et al. (2001) performed a longitudinal analysis of changes in HRQOL and 6MWD for the first group of 6 patients with stable severe COPD completed the newly formed 8 weeks outpatient PR program. Patients completed the CRQ immediately before and 1 year after the PRP. 4 patients completed the PR, 6MWT both before and after the program. They found improvement in all CRQ domains at follow up. The interval improvements in all HRQOL domains were statistically significant (p < 0.02 for all comparisons). There was a trend toward improvement in exercise tolerance: 231 ± 213 ft before PR vs. 353 ± 66 ft at the 1 year follow up (p = 0.2). PR can result in sustained improvement in the HRQOL of patients with severe COPD, even when the complex, interdisciplinary service is delivered by a newly formed and inexperienced PR Personnel.

Boueri et al. (2001) evaluated the effects of comprehensive PR program on QOL as measured by the SF – 36 in 37 patients with COPD. Rehabilitation consisted of 3 weeks PR incorporating 12 exercise sessions, each of which included bicycle ergometer exercise, upper extremity exercise, strength and stretching exercises, along with psychosocial counseling and education. The SF–36 and 6MWD were completed before and after rehabilitation. Although there was an improvement in functional capacity as measured by 6MWD, there was no correlation between improvement in HRQOL and improvement in functional capacity. There was no correlation between FEV₁ and improvement in 6MWD, but there was a correlation between FEV₁ and improvement in SF – 36 physical function and energy / fatigue subscales. In conclusion HRQOL assessed by the SF – 36 improved following an intensive 3 weeks PR. Use of the SF – 36 allows comparison of
the results of PR to therapeutic interventions in patients with other medical disorder.

Curtis et al. (2002) conducted a prospective cohort study to determine whether a brief, Self administered COPD specific HRQOL measure, the Seattle Obstructive Lung Disease Questionnaire (SOLDQ) could accurately predict hospitalization and death. Totally 3,282 patients with COPD who completed the baseline SOLDQ were followed for 12 months. The findings revealed that 601 patients (18.3%) were hospitalized, 141 (4.3%) for COPD exacerbations and 167 patients (5.1%) died. However HRQOL is a powerful predictor of hospitalization and all-cause mortality. Brief Self administered instruments such as the SOLDQ provide an opportunity to identify patients who could benefit from preventive interventions.

Peruzza et al. (2003) investigated the impact of COPD and HRQOL and functional status in the elderly. 60 COPD patients and 58 healthy controls over 65 years old were administered Pulmonary function tests, 6MWD, for functional status, the Geriatric Depression Scale (GDS) for mood, SGRQ for HRQOL and PaO₂ were reduced in COPD patients. The 6MWD was significantly less; moreover, COPD patients had significantly worse outcomes for the Barthel Index, GDS and SGRQ. In conclusion, elderly COPD patients show a substantial improvement in HRQOL depending on the severity of airway obstruction symptoms related to the disease may be exaggerated by mood deflection.

Bestall (2003) examined whether the initial benefits gained in exercise tolerance and health status may be maintained after a 1 year follow up programme. 66 patients with COPD were assessed with the MRC Dyspnoea scale and found that the patients were moderately disabled due to dyspnoea (MRC Grades 3 and 4). Those patients were then randomised to
8 weeks outpatient programme of either, exercise training and education (exercise group) or to education alone (control group). Exercise performance was assessed with the shuttle walking test and health status assessed with 2 disease specific measures, the SGRQ and the CRQ. After PR, all patients were invited to attend monthly follow up sessions for one year. 56 patients were available for follow up immediately after the programme and were assessed at 6 months and 1 year. The study results revealed that the patients in the exercise group maintained improvements in exercise capacity and health status up to 6 months after an 8 weeks programme. At 1 year there was a significant difference between the exercise and control 1 year groups in terms of exercise tolerance due to a considerable decline experienced by the control group. However, neither group had maintained improvements in health status at 1 year. Further study is required to assess whether benefit may be sustained for a longer period using alternative follow up strategies.

Kapella et al. (2006) conducted a cross sectional descriptive study and analysed the theoretical and empirical model of the relationships among subjective fatigue, dyspnoea, functional performance, anxious and depressed moods, and sleep quality in people with COPD. 130 people with moderate to severe COPD were assessed for the following measures: a Numerical Rating Scale (NRS) for frequency, intensity, and distress of fatigue and dyspnoea, Fatigue Assessment Instrument (FAI), CRQ, Profile of Mood States (POMS), Pittsburgh Sleep Quality Index (PSQI), Functional Performance Inventory (FPI), and Spirometry. Path analysis was used to examine the relationships among variables. Participants reported moderate amounts of fatigue, which was described as situation-specific, had considerable consequences, and was responsive to rest and sleep. Dyspnoea was slightly greater than fatigue, as measured by the NRSs (p < 0.001), and there was a strong relationship between fatigue and dyspnoea (r =.74, p < 0.001). Dyspnoea, depressed mood, and sleep quality accounted for 42% of the variance in subjective
Fatigue, dyspnoea, airflow obstruction, and anxious mood accounted for 36% of the variance in functional performance. Fatigue is an important problem that affects performance of daily activities in people with COPD. The relationships or interactions that exist among fatigue and other symptoms are complex.

Garrido et al. (2006) assessed the HRQOL of patients with stable COPD followed in primary care and to identify possible predictors of disease. It was a multicentre, epidemiological, observational, descriptive study. Subjects of both sexes, older than 40 years and diagnosed of COPD at least 12 months before starting the study were included. Socio demographic data, severity of disease, co-morbidity, and use of health resources in the previous 12 months were collected. All patients were administered a generic QOL questionnaire, the SF-12, that enables to calculate two scores, the physical (PCS-12) and the mental (MCS-12) component summary scores. 10,711 patients were evaluated (76% men, 24% women), with a mean age of 67 years, the mean PCS-12 and MCS-12 scores (SD 9.66). The correlation with FEV\textsubscript{1} was higher for PCS-12 (r=0.38) than for MCS-12 (r=0.12). Predictors for both HRQOL components were sex, FEV\textsubscript{1}, use of oxygen therapy, and number of visits to emergency rooms and hospital admissions. Other independent predictors of PCS-12 were age, body mass index and educational level. The factors that determine the HRQOL were the sex, FEV\textsubscript{1}, use of oxygen therapy, and number of visits to emergency rooms and hospital admissions.

**2.8 CONCEPTUAL FRAME WORK**

**2.8.1 Self Care**

Self care is the deliberate use of valid means to control or regulate internal and external factors that affect the smooth activity of a person's own
functional and development processes or contribute to a person's personal well being. Self care is the practice of activities that individuals initiate and perform on their own behalf in maintaining life, health, and well being. The ill or disabled person requires partial or total care from others (education or guidance) depending on his or her health status and immediate or future requirements for self care.

Self care is an adult's continuous contribution to his or her own continued existence, health, and well being. Care of others is an adult's contribution to the health and well being of dependent members of the adult's social group. Adult persons require assistance from persons in social services of health care services whenever they are unable to obtain needed resources and maintain conditions necessary for the preservation of life and promotion of health for themselves or their dependents; assistance may be needed for the accomplishment or supervision of care of self and care of dependents.

2.8.2 Self care, a Regulatory Function

Self care is a human regulatory function. It differs from other regulatory functions, for example, neuroendocrine regulations, in that it is action deliberately performed by persons to regulate their own functioning and development or that of their dependents. Performed actions supply or ensure the supply of materials (air, water, food) needed for continued life, for growth and development, and for maintenance of human integrity. Performed actions also are directed to bring about or maintain internal and external conditions needed to maintain and promote health, as well as growth and development. Actions, at times, also focus on the prevention, alleviation, cure, or control of untoward human conditions that are affecting or can affect life, health, or well being. This includes, when indicated, seeking and participating
in medical care in its various modalities, as well as nursing and other forms of health care.

### 2.8.3 Therapeutic Self Care Demand

Therapeutic self care demand is a conceptual construct that stands for the operations, the action sequence necessary to meet not just one formalized and particularized self care requisites of a person but all requisites to be met by or for a person during a specific time period. The development of the concept, as well as a search for understanding the concept, therapeutic self care demand, moves from having the knowledge that person's self care requisites are identified to knowledge that methods and means for meeting them have been selected; the effort then proceeds to identify the action sequences, unit acts, or care measures necessary to use the selected means to meet each of the formalized, particularized requisites. The summation of actions or care measures to meet outstanding requisites is the self care demand. The adjunctive therapeutic is attached to the term self care, the self care demand to indicate the process, the action sequences, or the care measures through which requisites are to be met have actual or presumed validity in effecting the desired regulations of human functioning or development.

In the foregoing frame of reference the term therapeutic self care demand stands for humanly constructed concept with it basis in nurses' knowledge of what action sequences or care measures must be performed if each self care requisites of an individual is to be met such a concept stand in distinction conceptualizations of naturally existence entities, for example, the existent powers and capabilities of persons to produce self care (self care agencies). In a sense, the formulation of therapeutic self care demand for an individual is short, Practical way of expressing the care measures person should elect to form (or have performed for them) to meet their outstanding
Self care requisites. Nurses use their knowledge about individuals under nursing care to arrive at judgments about how and to what degree involve them in the formulation of their own therapeutic self care demands (or those of their dependents).

Self care and care of dependents may be well intentioned but not therapeutic. It is necessary to determine the therapeutic value of practices prescribed by general culture and even by health professionals. A single self care practice or a whole system of self care therapeutic to the degree it actually contributes to the achievement of the following results: 1) Support of life process and promotion of normal functioning; 2) Maintenance of normal growth, development, and maturation; 3) Prevention, control, or secure of disease process and injuries; 4) Prevention of or compensation for disability; and 5) Promotion of well being. Some of the above mentioned results are applicable to few persons in each stage of life cycle, but others are required only in the event of disease or injury.

2.8.4 Self Care Requisites

Health deviation self care requisites are associated with generic and constitutional defects and human structural and functional deviations and with their effects and with medical diagnostic and treatment measures and their effects. When these three types of requisites are effectively met, they are productive of human and environmental conditions that (1) support life processes, (2) maintain human structures and human functioning within a normal range, (3) support development in accord with the human potential, (4) prevent injury and pathologic states, (5) contribute to the regulation or control of the effects of injury and pathology, (6) contribute to the cure or regulation of pathologic process, and (7) promote general well being. From the perspective of preventive health care, effectively meeting universal and
development self care requisites in healthy individuals is ideally in the nature of primary prevention of disease and ill health. Meeting health deviation requisites may aid in the control of pathology in its early stages (secondary prevention) and in the prevention of defect and disability (tertiary prevention). Effectively meeting the universal and development self care requisites is essential when there is pathology in order to maintain human structure and functioning and to promote development and thereby continue to rehabilitation. Rehabilitation focuses on development and other self care requisites associated with conditions resulting from pathology, medical diagnoses or treatment procedures, or the results of inadequate nursing or dependent care.

Self care requisites are expressions of the purposes that individuals should have when they engage self care. Formalized requisites that have been validated by the successful use in aiding individuals to manage their health and well being become elements of the general culture or remain within the domains of the health care professions. Self care requisites must be known before they can serve as the purpose of self care. Universal self care requisites should become know by all educable adults. Ideally, this also holds for development self care requisites. For both type of requisites, however, reliable knowledge is always effectively selected and adequately organized for public dissemination. Health deviation / Self care requisites are usually become known by those who have genetic or constitutional defects or health deviations or whose family members or associates have such defects or health deviations.

2.9 NURSING MODEL OF THE PRESENT STUDY

The conceptual framework for this study was based on Dorothea Orem’s self care nursing model. This model focuses on identifying patients
self care requisites (or) needs and nursing actions to meet the patients’
requisites. Orem’s model is based on three major constructs. Self care
requisites, self care and nursing systems. The Orem’s model is based on the
belief that individuals function and maintain life, health and well being by
caring for themselves. When an individual or group is unable to meet their
needs (self care requisites), self care deficits occur and therapeutic self care
demand arise, which lead to nursing assistance, the three self care requisites
are universal, developmental and health deviation (Orem et al., 2001).

For the present study on patients with COPD, the health deviation
self care requisites are found to be predominant. These requisites were
associated with individuals who had a pathological condition that resulted in
pulmonary impairment and were receiving medical care. The self care
requisites for the present study was formulated based on a previous study on
asthma (Mayo Foundation, 1996). The identified self care requisites for the
selected pulmonary impaired patients of the present study were

1. Seeking and securing appropriate therapeutic assistance.
2. Recognizing and taking care of pulmonary impairment.
3. Implementing prescribed physical and breathing exercises
   regularly along with medications.
4. Recognizing and regulating the effects of exercises on
   pulmonary function, exercise capacity and health related quality
   of life.
5. Modifying the self concept on impairment.

Self care deficit occurs when an individual is unable to perform the
necessary actions to meet one’s self care requisites. The subjects of this study
were economically poor and educationally inadequate in health concepts.
Hence they could not meet the above listed self care requisites on their own
and there occurred self care deficit. There was a need for assistance
particularly from health care personnel such as a nurse or respiratory therapist
to fulfill their requisites. Then the function of nursing system in this situation obviously became educative and supportive.

The goal of nursing intervention is guiding patients to perform their own self care. The supportive and educative nursing system assists patients who are able or can learn to perform therapeutic self care, yet require assistance in decision making, behaviour control, or acquiring knowledge or skills. The nurse may assist the patient through guidance, support, teaching, or environmental change (Wilson et al., 2003).

In this study the subjects were assessed for their pulmonary impairment and self care deficits. Practicable physical and breathing exercise programme was prepared and taught to the patients with necessary instructional guide and demonstration. The subjects were motivated to perform breathing exercises regularly through suitable psychosocial support and the change in pulmonary functional parameters and work capacity were monitored. The subjective feelings of the patients were also assessed and thus in the present study, nursing system functioned as supportive and educative process.

Orem’s model is widely used in nursing practice. It is a comprehensive model for assessment, analysis and management of an individual or group especially in the physiological, social and developmental areas. As thinking process, substruction enables the researcher to delineate the foundational elements of studies. Creating the figure during substruction helps researcher in improving their knowledge of the theoretical, empirical or descriptive links between the conceptual and operational components of the studies (Wolf and Heinzer, 1999). Orem’s model is very useful for chronically ill patients in the hospital or in other settings (Burks, 1999; Taylor, 1990; Morales and Jiang, 1993). Hence this model ideally suited the present study on patients with COPD. The substruction of Orem’s conceptual framework of the present study is depicted in Fig. 2.1.
Fig. 2.1 Conceptual Framework Based on Dorothea Orem’s Self Care Nursing Model for the Study on Effect of Multi Dimensional Pulmonary Rehabilitation of Patients with COPD