EFFECT OF AN EXERCISE PROGRAM ON SELECTED VARIABLES IN PULMONARY REHABILITATION PATIENTS

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STILLWATER, OKLAHOMA

MAY, 1997

Submitted to the Faculty of the
Graduate College of
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
May, 1997

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REHABILITATION PATIENTS

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ACKNOWLEDGMENTS

I wish to express my sincere appreciation to my major advisor, Dr. Betty Edgley, for her supervision, knowledge and persistence in helping me to complete this graduate program. I would also like to thank Dr. Bert Jacobsen and Dr. Steve Edwards for serving on my graduate committee and helping me to get through the final study.

I would also like to express my sincere thanks to INTEGRIS Baptist Medical Center for offering the educational program that financially allowed me to pursue this degree. Hopefully, this final study will contribute to the information needed to progress within our business. I would also like to thank my boss, Don Schneider and many co-workers who kept me motivated to continue through this graduate program. My family members and many friends have also been a great support team to assist me in this endeavor.

A final thanks goes to my Golden Retriever, Shelby, for not eating all of the data that one morning while I was out running. Thanks also goes to Shelby for keeping my patience level tested every time I sat down to work on my final project.

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CHAPTER I

Introduction

The incidence of chronic lung diseases has continued to increase as our population has grown older. A history of cigarette smoking increases the chance that a patient with chronic airflow limitation will have chronic bronchitis or emphysema (Corbridge, Irvin, 1993). As insurance companies continue to make decisions on coverage for the long term care of these diseases, the concept of prevention as well as maintenance of these diseases has to be addressed.

Chronic obstructive pulmonary diseases (COPD) and related conditions are ranked as the fifth leading cause of death in the United States. As a major cause of morbidity and disability between 1979 and 1989, the number of deaths attributed to COPD and related conditions increased by 69% from 49,933 to 84,350 cases. The death rate from COPD increased by 52% from 22.3 to 34.0 per 100,000. Growth in the total population and increasing life expectancy are partly responsible for the increasing trends in death rates. This trend is projected to continue for some time and could lead to increasing numbers of patients in need of pulmonary rehabilitation (Higgins, 1993).

Due to increased incidence of COPD, it will be important to offer programs to help people maintain a reasonable quality of life. The primary goal of pulmonary rehabilitation is to restore the patient to the highest possible level of independent function. Successful programs can help patients to become better educated and more involved in their own care. In addition, patients may experience improved physical and psychological symptoms, improved exercise tolerance, fewer hospitalizations and physician visits, and obtain more gainful employment (Kaplin, Eakin, & Ries, 1993).

The design and supervision of an exercise training program for patients with respiratory disease depends on multiple factors, including staff availability, facilities for testing and training, and number of patients. Inpatient exercise-based rehabilitation programs should be considered for patients who have a very limited functional status and for those with unstable disease. Inpatient exercise sessions also provide an excellent setting for instruction of both the patient and family members (Mahler, Froelicher, Miller, York, 1995).

There is tremendous variability in current pulmonary outpatient programs. They vary from patients participating in supervised exercise sessions 5 days per week at a clinic, hospital, or community-based rehabilitation setting to one supervised session per week with additional unsupervised training in the patient's home, at a public facility, or fitness center. It is essential that program design and supervision be flexible and adapted to local conditions, opportunities, and constraints (Mahler, et. al, 1995).

Some programs have meshed the "unhealthy" (those with chronic disease processes) in with the "healthy" to provide a unique atmosphere for all types of clients. It is important for the pulmonary rehabilitation program to be run in congruence with a healthy population so that both groups of people can learn and interact with each other.

Patients with lung disease suffer from a progressive reduction in the level of physical activity (Clark, 1993). Since lung disease makes exertion unpleasant, patients become sedentary, which results in decreased strength in the muscles used to ambulate, which re-inforces inactivity and results in a downward spiral.

A primary goal of pulmonary rehabilitation is to interrupt the physical deterioration by enabling patients to tolerate a higher level of activity. During exercise patients can become accustomed to the fact that the shortness of breath they experience is not harmful. This may be a desensitization to the sensation of dyspnea (Casaburi, 1993). Another important benefit of a pulmonary rehabilitation program is an improved psychological outlook which typically occurs. This improved psychological outlook will positively affect the patient's ability to conduct daily living habits as well as their tolerance for exercise.

A decrease in exercise capacity results from a decrease in maximum oxygen consumption (Patessio, Ioli, Donner, 1993). The hypothesis that exercise training can improve pulmonary hemodynamics is still very controversial (Patessio, et al., 1993). A pulmonary rehabilitation program conducted by a qualified staff has the potential to help clients redefine the status of living with an improved quality of life in addition to improved endurance for daily activities (Patessio, et al., 1993).

Statement of the Problem

The problem of this study was to compare the results of a twelve week exercise rehabilitation program on the effect of blood pressure response, heart rate response, and oxygen desaturation between the pre and post tests of pulmonary patients in experimental and control groups.

Importance of the Study

Positive implications of an exercise program can assist physicians in advising pulmonary patients about the benefits of rehabilitation programs. The compilation of this data may further justify the necessity of continuing program implementation as clients prepare for and recuperate from life altering surgeries. As more physicians realize the importance of an exercise rehabilitation program, more patients with respiratory disease processes will be able to live their lives more productively and with an improved quality of life.

Limitations

1. There was no attempt to randomly select the subjects.
2. There was no control over the disease processes or the necessity for some patients to use oxygen during their exercise routine.

3. The study used existing staff who were already working with the program in the exercise facility.

4. There was no attempt made to control for negative (smoking) health behaviors by the participants.

Assumptions

1. All subjects in this study participated in the pulmonary exercise program for twelve weeks.

2. All the participants exercised to the best of their ability each day.

3. The nurses working with the program adapted the exercise routines for each client as the client progressed.

Delimitations

1. All subjects will have had a physician's consent and prescription to participate in the exercise program.

2. All exercise sessions were supervised by a registered nurse who specializes in cardiopulmonary diseases and exercise.

3. Only those patients who exercised 3 times per week were in the experimental group.

Hypotheses

The following null hypotheses will be tested at the .05 level of significance.

1. There will be no significant differences in the client's oxygen saturation (SaO_2) levels between the pre-test and posttest means following a 12 week exercise program.
2. There will be no significant differences in the client's blood pressure response between the pre and posttest means following a 12 week exercise program.
3. There will be no significant differences in the client's heart rate responses between the pre and posttest means following a 12 week exercise program.

Definition of Terms

Breathlessness - the feeling of not being able to breathe efficiently.

Chronic bronchitis - a disease of the lungs diagnosed clinically when a patient has a history of cough and sputum production for more than 3 months in each of 3 successive years. Other causes, such as cystic fibrosis, bronchiectisis, or chronic infection (including tuberculosis), should not be present (Saroea, 1993).

Chronic obstructive pulmonary disease (COPD) - a disorder characterized by abnormal tests of expiratory flow that do not change markedly over periods of several months of observation (Corbridge, & Irvin, 1993).

Cor Pulmonale - right sided heart failure in patients with COPD is due to pulmonary hypertension (Saroea, 1993).

Desaturation - arterial oxygen saturation that falls during exercise (Rao, Todd, Kuus, Buth, & Pearson, 1995).

Disease Processes - identifies any type of chronic disease that a patient may be experiencing.

Dyspnea - shortness of breath; difficult or labored breathing (Netter, 1992).

Emphysema - a pathological diagnosis. The disease is marked by destruction of alveolar walls with resultant loss of elastic recoil in the lung (Saoea, 1993).

FEV_1 - forced expiratory volume in the first second (Rao, et al, 1995).

Field test - a low level exercise tolerance test performed on each patient prior to the beginning of the exercise program Usually performed on a treadmill. Specifics explained in "Methods and Procedures".

Functional capacity - the volume of air in the lungs at the end of expiration during normal breathing (Netter, 1992).

Lung reduction surgery (pneumonectomy, pneumoplasty) - removal of approximately 20-30% of the volume of one lung; partial resection of the diseased lung (Benditt, & Albert, 1995).

Obstructive disease - airway (bronchi) obstruction; work to overcome flow resistance is increased; elastic work of breathing remains unchanged (Netter, 1992).

Oximetry - use of an instrument that provides continuous analysis of pulse rate and capillary oxygen saturation through a finger probe (Rao, et al., 1995).

Oxygen saturation percentage - $\frac{\text{oxygen combined with hemoglobin}}{\text{oxygen capacity}} \times 100$ (Netter, 1992).

Oxygen therapy - supplemental oxygen; considered a medicine; must be prescribed (Saroea, 1993).

Quality of life / quality of well being - a comprehensive measure of health related quality of life that measures three aspects of function: mobility, physical activity, and social activity (Manzettis, Hoffman, Sereika, Sciurba, & Griffith, 1994).

Restrictive disease - an increase of elastic work of breathing; work to overcome flow resistance is normal (Netter, 1992).

SaO_2 - arterial oxygen saturation - tested by using pulse oximetry (Cooper, 1993).

Total lung capacity - the volume of air in the lungs following a maximal inspiration (Netter, 1992).

Tuberculosis (TB) - a chronic infectious disease, primarily involving the lungs but capable of attacking most organs of the body (Blakiston, 1979).

Vital capacity - the maximal volume of air that can be exhaled from the lungs following a maximal inspiration (Netter, 1992).

CHAPTER II

Review Of The Literature

Chronic Obstructive Pulmonary Disease

Chronic Obstructive Pulmonary Disease (COPD) is defined by the American Thoracic Society as a "disorder characterized by abnormal tests of expiratory flow that do not change markedly over periods of several months of observation" (Corbridge, Irwin, 1994). It should be emphasized that the term COPD does not describe one disease but rather the state in which airway obstruction is the predominant functional abnormality. It encompasses a number of diseases, including emphysema, bronchitis, and asthma (Wasserman, 1993). In emphysema there is irreversible lung destruction particularly at the alveolar level; chronic bronchitis involves inflammation and chronic infection of the airways; and asthma is an inflammatory condition characterized by airway hyperactivity (Tiep, 1991).

Mechanisms limiting exercise tolerance in obstructive lung diseases:

1. increased work of breathing,
2. increased ventilatory drive,
3. impaired cardiac output increase
    a. decreased cardiac filling due to increased intrathoracic pressure during exhalation, and
    b. increased pulmonary vascular resistance during exhalation due to increased alveolar pressure and the loss of functional pulmonary vessels because of underlying lung disease (Wasserman, 1993).

A number of mechanisms that effect ventilation interact to reduce exercise tolerance and increase breathlessness during exercise in the COPD patient:

1. inefficiency of gas exchange,
2. arterial hypoxemia,
3. the development of lactic acidosis at exceptionally low work rates, and
4. the metabolic cost of work; the O_2 requirement is increased (Wasserman, 1993).

For inspiratory gas flow to occur during respiration, the inspiratory muscles (mainly the diaphragm) must generate enough negative pleural pressure to overcome the resident resistive and elastic pressures. In other words, strength must be greater than load.

In patients with severe chronic obstructive pulmonary disease, exercise capacity is usually severely impaired for ventilatory reasons. Ventilatory demand during exercise is increased due to excessive dead space ventilation, and ventilation capacity is reduced due to impaired respiratory system mechanics (Gibbons, Levine, Bryan, Segarra, Calhoon, Trinkle, & Jenkinson, 1991). These patients are sometimes candidates for single lung transplantation (SLT). The study by Gibbons, et al, (1991), documented that although exercise capacity is decreased following SLT for end-stage obstructive lung disease, it is more than sufficient for the performance of activities of daily living.

Non-COPD Chronic Lung Disease

The disability of non-COPD (respiratory impaired other than COPD) patients may have similar origins to that of COPD patients. For example, dyspnea is a prominent factor in the limitation of exercise. Fatigue, enforced periods of bed rest, and muscular deconditioning may also contribute to the overall debility in these patients. The patients may have behavioral and cognitive dysfunction which often causes a withdrawn and depressed state coupled with a sense of hopelessness (Novitch, Thomas, 1993).

Patients with significant interstitial lung disease (ILD) usually have impaired maximal exercise performance and reduced endurance time at submaximal work rates; their maximal oxygen uptake and maximal work rate are reduced when compared to age-matched and sex-matched normal subjects (Marciniuk, Gallagher, 1994).

Factors that may contribute to exercise limitation in interstitial lung disease:

1. ventilatory/respiratory muscle function,
2. arterial oxygen desaturation,
3. dyspnea,
4. cardiac function,
5. unfitness, and
6. other: e.g., peripheral vascular disease, motivation (Marciniuk, Gallagher, 1994).

Exercise limitation in ILD also might be due to cardiac dysfunction. The well documented increase in heart rate and reduction in stroke volume, as well as abnormal central hemodynamics demonstrated during exercise, may contribute to limiting the exercise performance in these patients (Marciniuk, Watts, & Gallagher, 1994).

Asthma

The American Thoracic Society defines asthma as a "clinical syndrome characterized by increased responsiveness of the tracheobronchial tree to a variety of stimuli." However, as is apparent in clinical practice, considerable overlap exists between asthma and COPD. Patients with chronic severe asthma may develop irreversible airflow limitation, and patients with COPD may have airway hyperresponsiveness and often exhibit significant improvement in airflow after the inhalation of a bronchodilator (Corbridge, Irvin, 1993).

Since there is a variety of stimuli both allergic and environmental that may affect asthma, there are two important implications for rehabilitation management of the resulting disability. First, there is a wide *interpatient* variability in disease severity that ranges from very mild asthma, which allows participation in athletic competition at the highest level, to severe disease which is characterized by irreversible airways obstruction despite optimal medication. Second, there is often a significant *intrapatient* variability in disease severity either in the form of illness exacerbations or background lability of airways obstruction (Clark, 1993).

In research performed by Clark (1993), he found that after training, breathlessness was found to be reduced at workloads equivalent to those required by a wide range of daily activities. It is observed that overall, patients with asthma may notice a reduction in symptoms after participating in an exercise program. While patients may feel less breathless due to a decrease in ventilation at submaximal workloads, a training effect may also positively affect this desensitization to feeling breathless (Clark, 1993).

Pulmonary Rehabilitation Programs

Pulmonary rehabilitation requires a comprehensive multifaceted team approach for integrating medical management, coping skills, self-management techniques, and exercise reconditioning (Tiep, 191). The primary goal of pulmonary rehabilitation is to restore the patient to the highest possible level of independent function. Successful programs can help patients to become better educated and more involved in their own care. In addition, patients may experience reduced physical and psychological symptoms, improved exercise tolerance, fewer hospitalizations and physician visits, and more gainful employment (Kaplan, Eakin, & Ries, 1993).

A major goal of pulmonary rehabilitation is to interrupt the downward spiral that develops through inactivity by enabling patients to tolerate a higher level of activity. Undoubtedly, much of the benefit of pulmonary rehabilitation is psychological. Patients often become convinced that the shortness of breath they experience is not harmful. They may, in fact, become *desensitized* to the sensation of dyspnea (Casaburi, 1993). The goals of education are to teach the patient which symptoms are life-threatening and which are not, to encourage compliance in following the prescribed therapeutic plan, and to increase the patient's ability to function independently (Saroea, 1993).

Many approaches have been used in rehabilitation to train the patient with chronic lung disease. To be successful, the program should be tailored to the individual patient's physical abilities, interests, resources, and environment. For general application, techniques should be simple and inexpensive. As in normal and patients with pathology, benefits from exercise are largely specific to the muscles and tasks involved in training. Patients tend to do best on activities and exercises for which they are trained (Ries, 1994). Neiderman, Clemente, Fein, Feinsilver, Robinson, Ilowite and Bernstein (1991), conclude that pulmonary rehabilitation can reasonably be offered to any patient with chronic lung disease with the expectation that improvement can occur, regardless of the severity of the underlying disease processes.

While evaluating the results of a pulmonary rehabilitation treatment, Clark (1993) states that "the paradigm of pulmonary rehabilitation has been defined as the art of medical practice where an individually tailored, multidisciplinary program is formulated which through accurate diagnosis, therapy, emotional support and education, stabilizes or reverses both the physio- and psycho-pathology of pulmonary diseases and attempts to return the patient to the highest possible functional capacity allowed by his pulmonary handicap and overall life situation." While rehabilitation programs were initially designed to help optimize the quality of pulmonary patients lives, they have also been beneficial to prepare patients for lung reduction and lung transplantation surgeries. This role in the care of lung transplantation patients has evolved significantly in the past five years. Initially, it was used only post operatively, but after the first recipient exhibited considerable muscle weakness and fatigability post operatively, a program of rehabilitation and muscle training was added preoperatively (Biggar, Malen, Trulock, & Cooper, 1993).

Dyspnea

Patients with COPD are generally limited in the performance of exercise to inappropriately low work rates. It is well documented that this decrease in exercise capacity is a result of a decrease in maximum oxygen consumption. The mechanism of reduced exercise capacity is multifactorial, but it can be conceptualized as an imbalance between an increased ventilatory requirement, which is caused by diminished gas exchange, and a decrease in ventilatory capacity, which is the result of altered pulmonary mechanics. Dyspnea is the end-point symptom responsible for the limitation of physical activity: patients enter a vicious circle of increasing inactivity, deconditioning, increased dyspnea for a lower level of activity, and further deconditioning (Patessio, et al, 1993). Improvements in functional capacity have been achieved without directly altering ventilatory demand or maximal ventilatory capacity. The most ideal intervention would blunt the patients awareness or perception of how difficult it is to breath (Belman, 1992). Dyspnea arises from the various sensory systems associated with respiration. The large body of research addressing the effect of physiologic cues on dyspnea, however, reveals that only 10% of the variance in chronic dyspnea can be accounted for by reduction in pulmonary function. Such physiologic factors as anxiety and depression have been shown to modulate the perception of dyspnea (Haas, Salazar-Schicchi, Axen, 1993).

Mahler (1992) discusses the measurement of dyspnea during exercise in patients with lung disease citing that the exercise intensity-dyspnea relationship appears to be the most appropriate stimulus-response relationship for quantifying dyspnea during exercise.

Oxygen Desaturation During Exercise

Patients with severe COPD often develop hypoxemia (arterial desaturation) during light exercise (Patessio, et al, 1993). The correct detection of oxygen desaturation is important because supplemental oxygen given to patients who desaturate during exercise is able to improve exercise tolerance, relieve exercise dyspnea, and increase the capacity to perform useful daytime activities (Patessio, et al, 1993). So far, supplemental oxygen therapy during exercise has been used more as a means to manage the "dyspnea symptoms" and to correct SaO_2 if it decreases below an essentially arbitrary level rather than as a pivotal component of a comprehensive strategy for the long-term management of severe chronic airway obstruction (Patessio, et al, 1993).

Spirometry remains a standard method of assessing patients risk prior to lung resection despite its poor sensitivity and specificity (Rao, Thomas, Todd, Kuus, Buth, & Pearson, 1995). Rao, et al. (1995) found that exercise oximetry more reliably predicted home oxygen requirements, need of admissions to the intensive care unit, prolonged hospital stay, and respiratory failure. Pulse oximetry employs the principle that light transmission through an adequately perfused ear lobe or through finger pulp is directly proportional to the oxygen saturation of perfusing blood (Cooper, 1993). Patessio (1993) states that some studies show that oximetry has major limitations in detecting exercise hypoxemia, particularly when SaO_2 is less than 85%. Another study demonstrated that oximetry is reliable in detecting desaturation, both in pulmonary patients and in normal subject. However, this study did not explore low SaO_2, which occasionally is observed during light exercise in COPD patients. It may be reasonable to simply use these devices to detect desaturation episodes and eliminate any concern about their reliability in detecting the lowest SaO_2 levels (Patessio, et al, 1993).

Gender Differences in Lung Diseases

Gender differences in men and women do exist for some lung diseases (Carter, Nicotra, & Huber, 1994). Carter, et al. (1994) also site that within the population with COPD, differences in mortality exist between men and women, with nearly a threefold greater mortality for men (28 and 10 deaths per 100, 000, respectively). Gender-specific differences in pulmonary function and exercise performance in normal individuals are recognized, with men achieving higher work performances, as measured by the maximal oxygen uptake (VO_2) in absolute (mL/min.) and relative (mL/kg•min.$^{-1}$) terms (Carter, et al., 1994). Men are also more likely to lead a restricted life-style at an equivalent degree of pulmonary disease than are women. This may imply that men are more debilitated than women when they first seek medical attention or that the physical work demands are greater for men than women, such that men experience more symptoms than women at the same relative levels of functional capacity. This, in part, would reflect differences in mean functional capacities known to exist between the sexes (Carter, et al., 1994). Carter, et al. (1994) site that their data suggest that men, but not women, significantly decrease their physical work capacity in the early stages of development of obstructive lung disease. Men with mild airway obstruction decreased their functional work capacity by 33%, compared to those without evidence of airway obstruction. Carter, et al (1994), also found that women with mild COPD, however, had work capacities almost identical to the control groups. Thereafter, both men and women decrease their functional work capacities as airway obstruction increased.

Cardiovascular Consequences of COPD

Cardiac function is impaired in COPD, but most of the direct impairment and the impairment that is of the greatest clinical significance occurs on the right side of the heart (Morrison, Zuckerman, 1993). Morrison and Zuckerman (1993) identified that patients with a chronic cough had an abnormal increase in pulmonary artery pressure when they exercised (which is a "load on the right ventricle"). Another study cited by Morrison and Zuckerman (1993), shows evidence that 10 of 17 autopsy cases with COPD had both right and left ventricular hypertrophy and right ventricular dilatation. Morrison and Zuckerman (1993) state that the literature reviewed supports the concept that there is a right ventricular dysfunction in COPD patients. This may be related to both abnormal pulmonary hemodynamics and hypoxemia. In contrast, those patients with COPD who do not have any cardiovascular complications usually do not appear to develop left ventricular dysfunction.

Summary

The primary goal of a pulmonary rehabilitation program is to restore the patient to the highest possible level of independent function. The disease processes seen in pulmonary exercise programs will vary from chronic obstructive diseases to interstitial or non-obstructive diseases. Dyspnea is typically the end-point symptom responsible for the beginning of a downward spiral that often results in severe deconditioning. After beginning an exercise rehabilitation program, patients usually become desensitized to dyspnea which results in an improved tolerance to exercise. In addition to improved exercise tolerance, the patient may experience reduced physical and psychological symptoms, fewer hospitalizations and physician visits, and more gainful employment. Pulmonary exercise programs will also offer the patient an opportunity to monitor their needs for oxygen supplementation through pulse oximetry. Developing a better comprehension about their oxygen desaturation, will also enable the patient to improve their exercise tolerance, and increase the capacity to perform useful daytime activities.

CHAPTER III

METHODS FOR RESEARCH

This research was a non-equivalent control group experimental study designed to investigate if exercise has an effect on oxygen saturation levels, heart rate, and blood pressure response for clients who have lung disease processes.

Population and Sampling

The sample consisted of a total of 89 participants; 42 females and 47 males. Age range was from 32 to 83 years old with a mean age of 65.56 years. The experimental male group had 27 participants and the experimental female group had 19 participants. All participants reported that they were non-exercisers prior to the start of their program. The various disease processes observed in these clients included: COPD, asthma, emphysema, restrictive disease, bronchiectisis, T.B., cancer, pre and post lung transplant recipients, and pre and post lung reduction candidates (Table I). Emphysema and asthma were the most common.

All participants completed medical information forms that included a release of liability. All subjects performed a "field test" prior to starting the exercise program..

Table I. Disease Processes Identified in Subject Population

Disease Processes*	Experimental Group	Control Group
Asthma	11	6
COPD	10	11
Emphysema	31	25
Restrictive Disease	2	
Chemical Induced Asthma		1
Pueumonia - Perm. Damage		1
Tuberculosis	1	
Pulmonary Fibrosis	1	
Interstitial Pulm. Fibrosis	1	1
Bullous Emphysema	1	
Cystic Fibrosis		1
Polymyalitis	1	
Legionella Bronch. Oblit.		1
Chronic Bronchitis	2	1
Bronchiectasis		1
Polycythemia		1

*Some patients had more than one disease process.

All participants had their O_2 saturation levels and heart rates measured pre, during, and post exercise. Blood pressure was taken once a week, before, during and after exercise. While all participants participated in an aerobic program, some clients also had a resistance training component included in their program. The impact of the strengthening program was not be considered in this study. The data collected on each client was recorded on an exercise card. Once the card was completed it was kept in the patient's file. Data collected for this study was taken from the initial exercise cards when the subjects began their exercise program. Of the entire group of pulmonary clients, only those who participated three times a week, regularly for the 12 week period were used as the experimental group. Those patients who attended only 30% or less of the expected 36 visits during the 12 week period, were evaluated as the control group. The subjects were compared within their gender type only.

Methods and Procedures

Prior to starting an exercise program, each participant performed a low level field test on a treadmill to determine exactly the intensity and duration they would begin their exercise program, based on ACSM guidelines. Each client was informed about the test and the purpose of the test. Each client had the Borg scale of rating of perceived exertion for effort level and shortness of breath explained to them. Oxygen saturation levels (SaO_2) and heart rates (HR) were measured by use of a Nelcor pulse oximeter. Blood pressures (BP) were measured by use of a manual blood pressure cuff and single lead EKGs were checked by telemetry at rest and then again as the client stood.

The field test consisted of four stages with each being three minutes in duration. The treadmill was set at zero elevation with a starting speed of 1.0 mph; stages two through four are, 1.5 mph, 2.0 mph, and 2.5 mph respectively. Every minute of each stage HR, BP, SaO_2, and single lead EKGs were monitored. The client responded with a rating of perceived exertion on effort as well as dyspnea. The test was concluded when the clinical data indicated that it was necessary to stop or when the client asked to stop the test.

Immediately at the conclusion of the test all parameters were measured again. After the client was taken off the treadmill and was sitting, all parameters were measured every minute for the following five minutes. The client was allowed to leave the building as soon as he/she had returned to his/her baseline measurements. The tester was looking for a normoadaptive response to the exercise.

The result of the field test identified the level at which the nursing staff would begin monitoring the patient's exercise program. Completion of Stage II or less of the was considered as poor exercise tolerance. 1) The client was then started on work/rest, 5 minutes each for 3 sets as tolerated. 2) An SaO_2 of 90% or better was expected to be maintained. 3) Stationary bicycles with no tension could be used for up to 20 minutes after the work/rest exercise. 4) Eventually the rest periods were taken out of the program.

Completion of Stage III or greater was considered as moderate exercise tolerance. 1) The client was started on the treadmill at a speed slightly below the speed of the field test prior to discontinuing. 2) A continuous walking time of up to 20 minutes was started on the treadmill. 3) An SaO_2 of 90% or better was expected to be maintained. 4) The speed and time was increased as tolerated by the client. 5) Additional aerobic exercise on the bicycle for an additional 20-25 minutes could be added to the program. 6) Upper body ergometry (UBE) was started for approximately 6 minutes with no tension. The time and tension were increased as tolerated.

The guidelines set to follow regarding heart rate and SaO_2 values were to reach 60% of estimated maximal effort using Karvonen's formula and to keep the $SaO_2 \geq 90\%$ at rest and $\geq 85\%$ at peak exercise. All data collected on each client each day was recorded on an exercise card, and it included any relevant symptoms. The exercise program that each participant followed was individually prescribed by the pulmonary nurse and was based on the patient's field test results.

Collection of the Data

The data was collected by college students who were completing their internships at the fitness center. All files were analyzed for completeness and if any of the parameters were not measured on a regular basis, the data was not utilized. The data was not utilized if the patient did not attend for a complete 12 week period. For the purpose of confidentiality all names were omitted from the exercise cards. Gender was identified on the exercise card by the nurse in charge of the program. The data was reported on a template designed on Microsoft Excel. This information was then analyzed using a statistical program (SPSS) available at Oklahoma State University.

Analysis of Data

The differences between the two groups' pre-test and posttest means were examined by a two-way repeated measures analysis of variance: groups x time. The dependent variables were:

1. the exercise heart rate value,
2. the exercise systolic blood pressure value,
3. the exercise diastolic blood pressure value, and
4. the exercise oxygen saturation level.

The data were analyzed as follows:

1. a comparison of pre-test and posttest heart rate, systolic and diastolic blood pressure, and oxygen saturation means within the exercise group,
2. a comparison of pre-test and posttest heart rate, systolic and diastolic blood pressure, and oxygen saturation means within the control group.

The level of significance was set at 0.05.

CHAPTER IV

RESULTS AND DISCUSSION

Introduction

The purpose of this study was to determine if a hospital based fitness center's pulmonary rehabilitation program had a positive impact on physiological factors; heart rate, blood pressure, and oxygen saturation. A two-way repeated measures ANOVA was used to analyze the data. The alpha level was set at .05.

Hypothesis Testing and Analysis

Three hypotheses were tested in this research study. The normative data is presented in Table I.

The first hypothesis stated that there will be no significant difference in the client's oxygen saturation levels between the pre-test and posttest means following a 12 week exercise program. There was virtually no difference in the oxygen saturation levels pre and post test for either males or females. Based on this data, the first hypothesis was accepted.

The second hypothesis stated that there will be no significant difference in the client's blood pressure response between the pre-test and posttest means following a 12 week exercise program. Although the statistically significant covariate age was included, there was no significant ($p < 0.5$) difference in the men's diastolic blood pressure. Based on this data, the second hypothesis was accepted.

The third hypothesis stated that there will be no significant differences in the client's heart rate responses between the pre-test and posttest means following a 12 week exercise program. Although the covariate age was statistically significant for males, there was no significant difference ($p < 0.1$) in heart rate for males or for females ($p < 0.5$). Based on this data, the third hypothesis was accepted.

As can be seen in Table II, the data indicate that there were no significant improvements, and any differences were non-significant. However, the experimental group was able to maintain their physical status with exercise.

Table III shows the analysis of variance results for heart rate for males. There was no significant difference ($p < .01$), in the means within the group of males.

TABLE II

NORMATIVE DATA FOR THE SAMPLE SUBJECTS

Variable	*Experimental Group Males*	*Control Group Males*	*Experimental Group Females*	*Control Group Females*
Number	27	20	19	23
	Mean / Stand. Dev.	Mean / Stand. Dev.	Mean / Stand. Dev.	Mean / Stand. Dev.
Age	67.9 ± 7.4	64.6 ± 8.9	66.1 ± 9.2	58.7 ± 11.3
Pretest				
Heart Rate	102.9 ± 14.2	107.8 ± 16.2	107.1 ± 16.5	109.7 ± 19.4
Systolic BP	139.4 ± 24.0	140.1 ± 18.8	129.2 ± 19.9	130.7 ± 18.3
Diastolic BP	77.8 ± 13.4	78.0 ± 10.1	74.2 ± 8.4	74.7 ± 11.5
SaO_2	90.5 ± 3.9	90.4 ± 4.2	93.0 ± 5.2	91.3 ± 5.6
Posttest				
Heart Rate	108.5 ± 14.7	107.4 ± 12.7	107.3 ± 15.3	113.9 ± 13.2
Systolic BP	138.4 ± 18.0	137.6 ± 15.8	124.2 ± 15.9	127.0 ± 19.7
Diastolic BP	75.3 ± 6.6	75.3 ± 7.3	73.3 ± 9.2	72.4 ± 10.0
SaO_2	89.6 ± 5.1	91.0 ± 4.2	91.6 ± 4.2	91.6 ± 3.8

TABLE III

ANALYSIS OF VARIANCE RESULTS FOR HEART RATE FOR MALES

Source	SS	df	MS	F
Covariate - age	2354.0	1	2354.0	11.83*
Group	1.1	1	1.1	0.01
Error	8752.2	44	198.9	
Time	154.9	1	154.9	0.89
Group X Time	206.3	1	206.3	1.19
Error	7832.7	45	174.1	
Total	19301.2	93		

*significant at the .01 level.

Table IV displays the results of analysis of variance for the variable heart rate for females. There was no significant difference ($p< 0.5$), within the group of females.

TABLE IV

ANALYSIS OF VARIANCE RESULTS FOR HEART RATE FOR FEMALES

Source	SS	df	MS	F
Covariate - age	1503.4	1	1503.4	4.45*
Group	46.0	1	46.0	0.14
Error	13180.3	39	338.0	
Time	100.0	1	100.0	0.61
Group X Time	81.7	1	81.7	0.50
Error	6527.2	40	163.2	
Total	21438.6	83		

*significant at the .05 level.

Table V displays the analysis of variance results for the systolic blood pressure for males. There was no significant difference between the means within the group of males for the dependent variable of systolic blood pressure.

TABLE V

ANALYSIS OF VARIANCE RESULTS FOR SYSTOLIC BLOOD PRESSURE FOR MALES

Source	SS	df	MS	F
Group	0.1	1	0.1	0.00
Error	24510.4	45	544.7	
Time	71.9	1	71.9	0.31
Group X Time	12.3	1	12.3	0.05
Error	10393.0	45	231.0	
Total	34987.7	93		

Table VI displays the analysis of variance results for systolic blood pressure for females. There was no significant difference between the means within the control group and the means for the experimental group.

TABLE VI

ANALYSIS OF VARIANCE RESULTS FOR SYSTOLIC BLOOD PRESSURE FOR FEMALES

Source	SS	df	MS	F
Group	95.5	1	95.5	0.19
Error	20146.8	40	503.7	
Time	392.6	1	392.6	2.12
Group X Time	7.6	1	7.6	0.04
Error	7394.7	40	184.1	
Total	28037.2	83		

Table VII shows the analysis of variance results for the diastolic blood pressure for males. There was no significant difference (p< .05), within the group of males for the dependent variable of diastolic blood pressure.

TABLE VII

ANALYSIS OF VARIANCE RESULTS FOR DIASTOLIC BLOOD PRESSURE FOR MALES

Source	SS	df	MS	F
Covariate - age	501.1	1	501.1	5.81*
Group	15.3	1	15.3	0.18
Error	3792.9	44	86.2	
Time	158.7	1	158.7	1.59
Group X Time	0.1	1	0.1	0.00
Error	4485.4	45	99.7	
Total	8953.5	93		

*significant at the .05 level

Table VIII shows the results of the analysis of variance for diastolic blood pressure for females. There was no significant difference between the means within the control and experimental group.

TABLE VIII

ANALYSIS OF VARIANCE RESULTS FOR DIASTOLIC BLOOD PRESSURE FOR FEMALES

Source	SS	df	MS	F
Group	0.6	1	0.6	0.00
Error	5911.0	40	147.8	
Time	53.2	1	53.2	1.05
Group X Time	10.3	1	10.3	0.20
Error	2024.3	40	50.6	
Total	7999.4	83		

Table IX shows the analysis of variance results for oxygen saturation for males. There was no significant difference between the means within the control and experimental group.

TABLE IX

ANALYSIS OF VARIANCE RESULTS FOR OXYGEN SATURATION FOR MALES

Source	SS	df	MS	F
Group	9.5	1	9.5	0.33
Error	1320.7	45	29.4	
Time	0.4	1	0.4	0.04
Group X Time	12.1	1	12.1	1.28
Error	425.1	45	9.4	
Total	1767.8	93		

Table X shows the results of the analysis of variance for oxygen saturation for females. There was no significant difference between the means within the control and the experimental group.

The means were evaluated for the dependent variable of oxygen saturation level combining both males and females in each of the pre test and post test groups. The values that were less than or equal to 90% SaO_2 were calculated for significant differences between the means. When using only these values, no significant differences between the means was found.

TABLE X

ANALYSIS OF VARIANCE RESULTS FOR OXYGEN SATURATION FOR FEMALES

Source	SS	df	MS	F
Group	14.6	1	14.6	0.40
Error	1444.7	40	36.1	
Time	6.4	1	6.4	0.66
Group X Time	13.8	1	13.8	1.44
Error	384.4	40	9.6	
Total	1863.9	83		

DISCUSSION OF FINDINGS

Effects of a Pulmonary Rehabilitation Program

Based on the data presented, the positive physiological effects of a pulmonary rehabilitation exercise program might be questioned. The exercise training responses of patients with chronic lung diseases differ from those observed in those without disease, athletes, or other patient populations (Ries, 1994). Aerobic exercise training results in changes in skeletal muscles specific to the muscles involved in training and in the cardiovascular response to exercise. In contrast to normals, exercise training responses in patients with COPD differ because the limitations to exercise are more likely to be due to ventilatory function, or pulmonary gas exchange, or both (Ries, 1994). Mechanisms of improved exercise tolerance after rehabilitation can include: improved mechanical skill (decrease in oxygen cost and ventilatory requirements for a given workload); improved ventilatory pattern (larger tidal volume, lower respiratory rate) during exercise; increased motivation; and desensitization to dyspnea. Changes in muscle or cardiovascular performance seen in subjects without disease after aerobic training may not occur (Ries, 1994). The patients in the control group of this study may have experienced some changes due to minimal participation in the exercise program.

In a disease process that can be as progressive as lung disease, it might be presumptive to assume that a patient would improve their cardiovascular responses to exercise. Many patients are not able to exercise at a level high enough to have a training effect and may not experience an increase in their exercise capacity. The patients in this study may have had difficulty exercising at a level that is intense enough (at least 60% of predicted VO_2 max.) to produce a training effect. While this may be true, it is also important to remember that some patients will become desensitized to the sensation of dyspnea (Casaburi, 1993). The reduction of this sensation of dyspnea may allow patients to participate in more "normal" daily activities compared to their daily activity level prior to the rehabilitation program.

The disease processes represented most often were; asthma (15% of total), COPD (19% of total), and emphysema (50% of total). These pulmonary patients are very often unable to walk any longer than one and a half to two minutes at less than one mile per hour when they first begin an exercise program. While the majority were obstructive diseases, some were non-obstructive and restrictive and each may respond differently to exercise.

A progressive decline in physiologic functions is evident in individuals as they get older. There is a distinct decrease in VO_2 max. that is associated with aging; thus, any absolute work rate represents a higher stress for the older individual (Patessio, et al, 1993).

A study performed by Carter, et al (1994), documents that numerous differences exist between the loss of functional work capacity in men and women with early COPD; men with mild COPD experienced a greater loss than their female counterparts. The exact underlying mechanisms responsible for the decline in functional capacity have yet to be identified, but they appear to be related primarily to a significant decrease in cardiac performance secondary to chronic deconditioning and airway obstruction (Carter, et al, 1994).

It is not surprising that most pulmonary patients need to be motivated and convinced that exercise will be helpful to them. Some of them fear that exercise may induce the fear of being breathless. In many instances, the dyspnea experienced at levels of exercise near maximum oxygen consumption is further aggravated by fear of the sensation, which in turn amplifies the breathlessness (Patessio, et al, 1993).

Haas, et al, (1993), cites that patients with severe COPD who performed progressive exercise in a well-supervised environment reduced their unrealistic fear of activity and dyspnea. Dyspnea has been described as one of the most common and distressing symptoms in COPD. Behavioral interventions may be valuable for helping patients to cope with dyspnea and depression (Kaplan, et al, 1993).

Patients may also find that the camaraderie of exercising with other patients in the same situation can be very helpful. A growing body of data suggests that social support may be an important determinant of health outcomes for adults with chronic illnesses (Kaplan, et al, 1993).

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter includes a brief summary of findings, conclusions, and recommendations for further research.

Summary of Findings

As insurance companies begin to look at preventative programs to lower costs, the importance of rehabilitation programs increases. Many hospital facilities are offering programs to help people who have had either cardiac or pulmonary disease processes. The purpose of this study evaluated the impact a hospital based fitness center's pulmonary rehabilitation program had on its clients.

The following hypotheses were tested at the .05 level:

Hypothesis #1 - There will be no significant difference in the client's oxygen saturation levels between the pre-test and posttest means following a 12 week exercise program. Hypothesis was accepted.

Hypothesis #2 - There will be no significant difference in the client's blood pressure response between the pre-test and posttest means following a 12 week exercise program. Hypothesis was accepted.

Hypothesis #3 - There will be no significant difference in the client's heart rate responses between the pre-test and posttest means following a 12 week exercise program. Hypothesis was accepted.

Conclusions

Based upon the findings of this study, the following conclusion was submitted: A 12 week exercise program assisted in maintaining patient's heart rate, blood pressure, and oxygen saturation responses, however, based on the data, the exercise did not help to improve these values significantly. It can be concluded that exercise rehabilitation programs do help to maintain physiological parameters and should be continued as a part of the complete rehabilitation program.

While this exercise program affected the physiological data slightly, another important aspect to evaluate are the psychological changes the patients experience. The camaraderie observed among the participants can be very positive. This camaraderie helps to keep the patients motivated to exercise on a consistent basis. When the patients exercise regularly they are able to improve their strength and when an improvement in overall strength occurs, it allows these patients an opportunity to live more productively.

It was considered that the data may have presented evidence that the typical drop of oxygen saturation during exercise may have improved. As shown, this level of improvement did not occur. The data did show, however, that there was not a <u>decline</u> in the patient's physiological variables that were evaluated. As such, this exercise program was successful in maintaining the patient's physiological status.

Recommendations for Further Research

The following are recommendations for future research in this area.

1. Document hospital visits made by patients who exercise 3 times a week on a regular basis to compare with the number of hospital visits with those who do not exercise regularly.
2. Perform quality of life surveys for all new clients and then retest the clients 12 weeks post start of program to document any changes that have taken place. This may help the client see some type of progress "on paper" since they do not see improvements in their physiological data documented.
3. Evaluate the effect the rehabilitation educational program has on its patients. This may help to determine if any positive changes are occurring within their patient population.
4. Perform follow up testing on clients to determine any changes occurring from which they can adapt their patients exercise programs if necessary.
5. Perform medical outcomes data to provide them with statistical information for marketing purposes to physicians and other potential clients.

6. Utilize more patient data for analysis such as; duration of exercise, effect of the use of weight equipment.
7. Compare dyspnea rating from field test to 12 weeks into exercise program.

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APPENDIX A

Oklahoma State University
Institutional Review Board Permission

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 07-22-96 **IRB#: ED-97-002**

Proposal Title: EFFECT OF AN EXERCISE PROGRAM ON SELECTED VARIABLES IN PULMONARY REHABILITATION PATIENTS.

Principal Investigator(s): Betty Edgley, Nancy J. Shidler

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR ONE CALENDAR YEAR AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature: [signature] Date: September 20, 1996

Chair of Institutional Review Board

APPENDIX B

Institutional Review Board of the
Medical and Dental Staff of
Baptist Medical Center of Oklahoma, Inc.
Permission

INTEGRIS
Baptist Medical Center

3300 Northwest Expressway
Oklahoma City, OK 73112-4481
(405) 949-3011

May 23, 1996

Nanc" Shidler
1041_ reystone Ave
OKC, OK 73120

Nancy Shidler, :

The Institutional Review Board of the Medical and Dental Staff of Baptist Medical Center of Oklahoma, Inc. met on Monday, **May 20, 1996,** at 12:30 p.m. in the Bennett Conference Room and reviewed the following protocol and consent form:

Effects of an Exercise Program on Selected Variables in Pulmonary Rehabilitation Patients. (#G9605125)

The Principal Investigator and sub-investigators were not present during the vote. The Board approves this protocol and patient consent form, as presented, and requests an annual report in one year or a final report in the event the study is closed prior to that time. A copy of the approved consent form (s) is enclosed. Proposed changes in the approved protocol or consent form must be submitted to the I.R.B. for review and approval. Unanticipated problems involving risks to subjects or others must be promptly reported to the I.R.B.

Approval from the board does not indicate financial support of this study by Baptist Medical Center. Separate administrative approval may be necessary to expend hospital funds either directly or indirectly to support your study.

The hospital department(s) impacted by this study will be notified of the I.R.B. approval. There may be a need to coordinate the study with the involved hospital department(s).

Sincerely,

R.C. Brown, M.D. Chairman
INSTITUTIONAL REVIEW BOARD

RCB:ehc

APPENDIX C

Informed Consent for Use of Medical Records

INTEGRIS HEALTH, INC.
PACER Fitness Center
INFORMED CONSENT

The undersigned hereby authorizes PACER Fitness Center to release copies of certain medical information as specified below:

Patient (client) Name______________________________ Birth Date________________
Social Security #_________________________________ Phone #__________________
Address____
(City) (State) (Zip)

Client Type: _____Outpatient Cardiac Rehab. _____Pulmonary Rehab.

_____PACER Fitness Center Member _____PACER Guest _____Outpt. Phys. Therapy

Information will be released to: ______________________________________
(Name)

____
(Address) (City) (State) (Zip)

Information Needed:
____Medical records ____Field test results ____Fitness test results
____Data written on exercise cards _____Nutritional records data
____Any other data collected that may be used for research purposes.

Purpose of need for this disclosure:_____________________________________

I understand this authorization is subject to revocation by me at any time except to the extent that action has already been taken in reliance on it. I understand that the information authorized for release may indicate the presence of a communicable or venereal disease which may include, but is not limited to, diseases such as hepatitis, syphillis, gonorrhea or the human immunodeficiency virus, also known as acquired immune deficiency syndrome (AIDS).

NOTICE TO RECIPIENT OF COPIES OF CERTAIN MEDICAL RECORDS

PROHIBITION ON REDISCLOSURE. This information has been disclosed to you from records whose confidentiality is protected by federal law. Federal regulation (42 CFR Part 2) prohibits you from making any further disclosure of this information except with the specific written consent of the person to whom it pertains. A general authorization for the release of medical or other information held by another party is not sufficient for this purpose. Federal regulations state that any person who violates any provision of this law shall be fined not more than $500 for the first offense and $5000 in the case of each subsequent offense.

With this knowledge, I give my consent to the release of all information in my medical records including any information concerning my identity and release Integris Health, Inc., its affiliates, agents and employees, from any liability in connection with the release of the information contained therein.

Client Name_____________________________________ Date________________
(Printed)

Signature_____________________________________

If client/patient is deceased, a minor, or mentally incapacitated, consent may be give may be given by a legally authorized representative, identified below:

______________________________ ______________________________
Reason unable to sign Signature - relationship

____
Date

VITA

Nancy J. Shidler

Candidate for the Degree of

Master of Science

Thesis: THE EFFECTS OF AN EXERCISE PROGRAM ON SELECTED VARIABLES IN PULMONARY REHABILITATION PATIENTS

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Professional Organizations: American College of Sports Medicine.

Professional Certifications: American College of Sports Medicine: Health Fitness Director, Exercise Test Technologist, and Health Fitness Instructor. American Heart Association: CPR Instructor. Baptist Medical Center: Supervisor and Manager Training; Basic Dysrhythmia; Code Blue Course. CONTACT Crisis Phone Line: Volunteer.