

**THE UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE
DEPARTMENT OF PHYSIOLOGY**

**EFFECTS OF ACTIVE CYCLE OF BREATHING
TECHNIQUES (ACBT) ON VENTILATORY
FUNCTION IN ADULT HEART FAILURE
PATIENTS AT THE UNIVERSITY TEACHING
HOSPITAL LUSAKA ZAMBIA.**

By

CHARITY KAPENDA MUSELEMA

(511600624)

**SUPERVISORS : DR FASTONE .M. GOMA
DR GERSHOM CHONGWE**

**A DISSERTATION SUBMITTED IN PARTIAL FULLFILLMENT OF THE
REQUIREMENT FOR THEAWARD OF THE DEGREE OF MASTER OF
SCIENCE IN HUMAN PHYSIOLOGY**

2015

Notice of Copyright

©2014 BY [CHARITY KAPENDA MUSELEMA] ALL RIGHTS RESERVED

DECLARATION

I declare that this dissertation (*physiological effects of active cycle of breathing techniques on ventilatory function in adult heart failure patients at the University Teaching Hospital, Lusaka*) presented for the degree of Master of Science in Human Physiology is my own work. It has never been submitted for any degree or examination at any other university. All the sources herein quoted have been acknowledged by complete references.

Full Name.....

Signed.....

Date

CERTIFICATE OF COMPLETION OF DISSERTATION

I, Dr **Fastone, M. Goma** having supervised and read this dissertation is satisfied that this is the original work of the author under whose name it is being presented. I confirm that the work has been completed satisfactorily and is ready for presentation to the examiners.

Signature.....

Date.....

Head of Department.....

Date.....

Department of Physiological Sciences, School of Medicine, University of Zambia

CERTIFICATE OF APPROVAL

The University of Zambia approves this Dissertation by **CHARITY KAPENDA. M** on **PHYSIOLOGICAL EFFECTS OF ACTIVE CYCLE OF BREATHING TECHNIQUES ON VENTILATORY FUNCTION IN ADULT HEART FAILURE PATIENT AT THE UNIVERSITY TEACHING HOSPITAL** in partial fulfillment of the requirements of a Master of Science in Human Physiology by the University of Zambia.

SIGNATURE: **DATE**.....

EXAMINER I

SIGNATURE: **DATE**

EXAMINER II

SIGNATURE: **DATE**.....

EXAMINER III

HEAD OF DEPARTMENT:

SIGNATURE: **DATE:**

ABSTRACT

BACKGROUND: Chronic heart failure patients experience mild, moderate to severe pulmonary dysfunction demonstrated in alterations of FEV₁, FVC and FEV₁/FVC ratio. About 50% of severe heart failure patients have restrictive lung disease resulting in dyspnea, exercise intolerance and poor quality of life. Active cycle for breathing techniques (ACBT) is a cycle of breathing exercises traditionally used by physiotherapists in the management of respiratory dysfunction. A study was undertaken to evaluate the physiological effects of ACBT on ventilatory function in stable heart failure (HF) patients following a 12 weeks training program.

METHOD: This was a prospective cohort study. Twenty three participants (16 female and 7 male) were recruited at baseline. The mean age was 54.0 years (range 25-77 years). Participants were taught and performed the ACBT on three days of the week for 12 weeks. FVC, FEV₁ FEV₁/FVC and quality of life were assessed at baseline, six and twelve weeks post intervention using a spirometer and the Minnesota questionnaire.

RESULTS: The data generated from spirometry and the questionnaire was statistically analyzed using analysis of variance (ANOVA). Although not statistically significant, there was an increase in the mean lung volume values which translated into improved quality of life at 6 and 12 weeks, FVC (p=0.70), FEV₁ (p=0.70) and FEV₁/FVC (p=0.43). The physical, emotional/ mental and socio-psychological factors of quality of life were statistically significant (p< 0.0001).

CONCLUSION: ACBT exercises can affect lung volume and quality of life in heart failure patients and can therefore be used as an additional therapy to pharmacological intervention in HF patients to manage HF respiratory related symptoms in order to improve lung volumes, exercise tolerance and quality of life.

KEY WORDS: Heart Failure, Active Cycle of Breathing Techniques, Spirometry, Ventilatory Function and Quality of Life

DEDICATION

I dedicate this work to my children Natasha, Chileshe, Diana and Chisanga for their patience and support, my husband Pascal Muselema who put up with the children in my absence. I also dedicate this work to my sister Ireen, brothers, Diana and Dr Gashongore for their support and encouragement and my parents for dedicating their lives to educating me and my siblings. There are no words that can express how I feel. May God bless you all.

ACKNOWLEDGEMENT

My sincere gratitude goes to my two supervisors Dr F. M. Goma and Dr G. Chongwe for their invaluable mentorship and encouragement, and also for their insistence in working hard and finishing my studies in time. The success of this study and compilation of the report was also dependent on many people who made various valuable contributions. I therefore, wish to express my gratitude to the following individuals: My parents Mr and Mrs Mukosayi and the entire family for their continued support and encouragement. Dr Ngambi former Provincial Medical Officer, Dr P. Mulenga and Dr Tshibangu for their support. I am deeply indebted to Dr I. Gashongore, Dr Oliver Mweemba and Chris Mweemba who made positive contributions to this study and shaped this dissertation through their positive and constructive criticisms. Great thanks go to Dr Mateo, Dr Mwiinga, Themba Banda and Sister Rose for their kindness and assistance in this work, Dr Kalichenko and sister Prisca for allowing me to work with their patients and other staff in the cardiac and respiratory clinics; Dr Nzala, Professor Michelo and Dr M. Banda for their continued encouragement and moral support; Professor Siziya for material support; my precious participants for their participation, dedication and commitment. I further want to thank friends and all those who contributed to this study directly or indirectly may God bless you all. Last but not the least I wish to thank my sponsors Ministry of Health and Ministry of Community Development Mother and Child, Medical Education Partnership Initiative (MEPI), Southern Africa Consortium for Research (SAORE) and Copperbelt University School of Medicine for making my dream come true.

TABLE OF CONTENTS

Copyright declaration	ii
Author's declaration.....	iii
Certificate of completion.....	iv
Certificate of approval.....	v
Abstract.....	vi
Dedication	vii
Acknowledgement.....	viii
Table of contents.....	ix
List of tables	xii
List of figures.....	xiii
Acronyms.....	xiv
Definitions	xv
1.0 CHAPTER ONE: INTRODUCTION.....	1
1.1 Background.....	1
1.2 Statement of the problem	3
1.3 Justification of the problem.....	3
1.4 Research Question(s).....	5
1.5 General Objectives.....	5
1.6 Specific Objectives.....	5
2.0 CHAPTER TWO: LITERATURE REVIEW.....	6
3.0 CHAPTER THREE: METHODOLOGY.....	10
3.1 Study design.....	10

3.2 Study Site.....	10
3.3 Target population.....	10
3.4 Study Population.....	10
3.5 Research study variables.....	10
3.6 Inclusion criteria.....	11
3.7 Exclusion criteria.....	11
3.8 Sample Size.....	11
3.9 Data collection.....	11
3.9.1 Material and methods.....	11
3.9.2 Pilot study.....	12
3.9.3 Preparation of patient for spirometry.....	13
3.9.4 ACBT exercise protocol.....	13
3.9.5 Breathing control.....	13
3.9.6 Thoracic expansion exercise.....	13
3.9.7 Forced expiratory techniques.....	13
3.9.8 Minnesota questionnaire.....	14
3.10 Data management and Analysis.....	14
3.11 Ethical Consideration.....	14
4.0 CHAPTER 4: RESULTS.....	16
4.0 Presentation of findings.....	16
4.1 Main Demographic information/ physical characteristics.....	16
4.2 Clinical function lung volumes.....	16
4.3 FVC, FEV1 and FEV ₁ /FVC ratio after ACBT.....	17
4.4 Quality of Life.....	18

5.0 CHAPTER 5: DISCUSSION.....	21
5.1 Demographic characteristics.....	22
5.2 Respiratory Function Parameters.....	23
5.2.1 Forced vital capacity.....	23
5.2.2 Forced expiratory volume in one second.....	24
5.2.3 FEV1/FVC Ratio.....	24
5.3 Quality of life.....	25
5.3.1 Physical Factors.....	25
5.3.2 Socio psychological Factors.....	26
5.3.3 Mental/ Emotional Factors.....	26
5.4 Limitations of study.....	27
5.5 Challenges.....	28
CHAPTER SIX:	29
6.0 Conclusion and recommendations.....	29
7.0. References.....	30
8.0 Appendices.....	36

LIST OF TABLES

Table 1: Demographic characteristics of patients at cardiac clinic (n=23) 16

Table 2: Summary of clinical characteristics of CHF patients..... 17

Table 3: lung function changes in twelve (12) weeks in ANOVA 17

Table 4: Percent change in FVC, FEV₁and FEV1/FVC at baseline, 6 and
12 weeks..... 18

Table 5: means and percent changes in quality of life..... 20

Table 6: Change in Quality of life dimension measurements from baseline to 12
weeks 21

LIST OF FIGURES

Figure1: Physical factors of Quality of life in HF	18
Figure 2: Emotional/mental scores of Quality of life in HF.....	19
Figure 3: Socio-psychological factors of Quality of life in HF.....	19

List of Acronyms

ACBT	-	Active cycle of breathing techniques
ANOVA	-	Analysis of variance
BC	-	Breathing control
CHF	-	Chronic heart failure
COPD	-	Chronic obstructive pulmonary disease
EPP	-	Equal pressure point
FEV₁	-	Forced expiratory volume in one second
FET	-	Forced expiratory training
FVC	-	Forced vital capacity
IMT	-	Inspiratory muscle training
MLHFQ	-	Minnesota living with heart failure questionnaire
NYHA	-	New York heart failure association
P_{pi}	-	Peri-bronchiole pressure during a forced expiration
P_{br}	-	Bronchial pressure
QoL	-	Quality of life
TEE	-	Thoracic expansion technique
TLC	-	Total lung capacity
UNZA	-	University of Zambia
UNZABREC	-	University of Zambia Biomedical Research Ethics Committee
UTH	-	University Teaching Hospital
VC	-	Vital capacity
VO₂	-	Peak oxygen consumption

Definitions

Spirometry: The measurement of how quickly air can be expelled from the Lungs.

Forced Expiratory Volume in 1 second (FEV1): Is the volume of air that the patient exhales in the first second of forced expiration.

Forced Vital Capacity (FVC): Is the total volume of air that the patient can forcibly exhale in one breath.

Quality of life: Is the multi-dimensional concept that includes domains related to physical, mental, emotional and social functioning. It is perceived quality of an individual's daily life i.e. an assessment of their well-being or lack thereof.

Active cycle of breathing exercises: A cycle of breathing techniques which includes breathing control, forced expiratory manoeuvres and huffing.

Exercise tolerance: Refers to the exercise capacity of an individual as measured by their ability to endure exercise and/or the maximum work load achieved during the exercise period.

Dyspnoea: breathlessness, a period when a person is aware of their breathing

New York Heart Association I: No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea (shortness of breath).

New York Heart Association II: Slight limitation of physical activity. Comfortable at rest but ordinary physical activity results in fatigue, palpitation and dyspnoea

New York Heart Association III: Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity results in fatigue, palpitation or dyspnoea

New York Heart Association IV: Unable to carry on any physical activity without discomfort. Symptoms of heart failure at rest. If any physical activity is undertaken, discomfort increases.

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

Chronic heart failure is associated with mild to moderate restrictive or obstructive changes in pulmonary function (Jonson et al., 2001). The lung function changes seen in heart failure (HF) are caused by structural, functional and biological changes due to cardiac disorder (Pina et al., 2003). Pulmonary function at rest is said to be normal in moderate HF while 50% of severe HF patients often show a restrictive respiratory pattern, secondary to heart enlargement and increased lung fluids, and impairment of alveolar-capillary gas diffusion (Agostoni et al., 2006). This contributes to a reduction in lung function volumes; such as vital capacity (VC), Forced vital capacity (FVC) and forced expiratory volume in one second (FEV₁). However, FEV₁/FVC ratio remains normal or increases (Kim et al., 2012). FVC and FEV₁ are strong indicators of lung function which differentiate obstructive from restrictive lung diseases; these can decline due to disease and sedentary life style (Jakes et al., 2002).

The cardinal pathophysiologic mechanisms responsible for the lung function volume changes is neurohormonal activation which is initially adaptive, trying to restore the balance in circulation, but in the long term, turns maladaptive (Kim et al., 2012), causing patients to experience dyspnea, cough, fatigue, reduced muscle mass and fluid retention (Brubaker and Omezek, 2010).

Dyspnea is the earliest symptom in heart failure, initially noted on exertion by change in the extent of physical activity (Mancini et al., 1995). As heart failure worsens, the intensity of exertion required decreases and the patient progressively develops paroxysmal nocturnal dyspnea, orthopnea, and eventually dyspnea at rest which limits physical performance (Bonow and Udelson, 1992). Breathlessness and fatigue on exertion are the dominant symptoms and primary determinants of the health-related quality of life in heart failure (Clark, 2006). Usually there is a 30-50% reduction of functional capacity in HF compared with age-matched healthy subjects (Myers, 2008). This long-term physical inactivity reduces pulmonary function

volumes and deteriorates health status (Kupari et al., 2000) causing wasting of respiratory muscles and a reduction in strength and endurance (Chua et al., 1996). The reduction in muscle mass may be associated with under perfusion of accessory respiratory muscles (Mancini et al., 1991). Skeletal muscle atrophy, pulmonary embolism, venous thrombosis, reduction in exercise tolerance and exacerbation in symptoms are some of the consequences of prolonged bed rest and physical inactivity (Papathasious et al., 2007).

Generally, Heart failure patients are often characterized by exercise intolerance associated with poor prognostic effects such as increase in mortality and poor quality of life despite advanced pharmacological intervention (Hagerman, Tyni-Lenne and Gordon, 2005). Medical intervention and pharmacological therapies improve symptoms and modify risk factor as well as the outcome for HF patients (Desai, 2004 and Collins, 2005). However, the global prevalence of HF is said to remain high (Young, 2000) and their survival is poor despite aggressive and effective treatment. In Africa case fatality rate ranges from 9% to 12.5% (Ntusi and Mayosi, 2009), with Zambia's mortality rate ranging from 30- 44% in the last ten years (Chansa et al., 2012). The increase in HF patients has been attributed to the increase in the aging population and improved survival rates of post myocardial infarction (Klein, 2004).

Medical advice towards physical activity over the years has been recommended in heart failure patients in order to improve quality of life and exercise tolerance (Tavazzi and Giannuzzi, 2001). Stable heart failure patients may tolerate an amount of exercise (Piepoli, 2003) which is said to lower disease progression if properly implemented (Vuori and Kesäniemi 2005). The impact of disease progression in chronic heart failure patient decreases with physical activity and improves quality of life (The Aging Technology Research Centre, 1998). Exercise is an important adjunct non-pharmacological treatment modality that has proven positive effects on exercise capacity, tolerance and quality of life in CHF patients (Mancini et al., 1991).

Active cycle of breathing techniques (ACBT) exercises are said to improve respiratory function and other symptoms of heart failure conditions (Mancini et al, 1995). ACBT exercise is a cycle of three techniques; breathing control (BC), thoracic expansion exercises (TEE) and the forced expiratory technique (FET). The

exercises aim at relaxing the airways, lung expansion through the use of collateral air channels of the lungs to dislodge and mobilize the secretions to the upper airways for easy coughing of secretions (Porter, 2003). They combine diaphragmatic breathing, active expiration and deep and slow breathing for the benefits of airway clearance, chest expansion and mobility, in order to reduce dyspnea, fatigue and improve quality of life (The Cystic Fibrosis Trust, 2002). ACBT increase exercise tolerance, build respiratory muscle mass, reduces hospital admissions, morbidity and mortality (Pantalo and Tavazzi, 2001).

While the benefits of these exercises have been documented elsewhere, there have been no known studies in the Zambian population. A positive result would be an added, cost- effective adjunct to current treatment modalities leading to shorter hospital stay of admitted patients and improvement in morbidity and mortality.

1.2 STATEMENT OF THE PROBLEM

Heart failure is still a major debilitating problem despite advances in pharmacological therapy. About 15 million patients are affected worldwide (Young, 2004). In Africa case fatality rate ranges from 9% to 12.5% (Ntusi and Mayosi, 2009). It is ranked sixth (6th) among the top ten causes of morbidity and mortality at UTH (UTH records, 2014); with an increase in the proportion of deaths from 30 to 44% in the last ten years (Chansa et al., 2012). Heart Failure is until now considered a condition best treated by bed rest in some areas including Zambia. Respiratory dysfunction is a common pathophysiological condition in HF; causing patients to have exercise intolerance, high morbidity, mortality and poor quality of life. There is overwhelming evidence that ACBT exercises improve respiratory dysfunction and quality of life in non-African populations. This study therefore purposed to replicate this and investigated the effects of ACBT exercise on lung function in the Zambia heart failure population at UTH, Lusaka.

1.3 JUSTIFICATION OF THE STUDY

The current management of heart failure patients at UTH is centered on pharmacological intervention, bed rest and dietary alterations, excluding any type of exercise. Many of these patients exhibit exercise intolerance and have poor quality of life. ACBT are a package of easy exercise which can be done by most HF patients

and have been shown to be of great benefits. The findings from this study will increase the utilization of respiratory Physiotherapy in the management of HF and greatly influence clinical practice in general.

1.4 RESEARCH QUESTION

What are the physiological effects of ACBT exercises on ventilatory function volumes in HF patients seen at UTH, Lusaka, Zambia?

1.5 GENERAL OBJECTIVE

To determine the effects of ACBT exercises on ventilatory function volume and quality of life in heart failure patients at the UTH, Lusaka, Zambia.

1.6 SPECIFIC OBJECTIVES

1. To determine the extent to which ACBT can increase FVC, FEV₁ and FEV₁/FVC ratio in Heart Failure patients
2. To establish whether the changes in lung volume have an impact on quality of life using the Minnesota questionnaire.

CHAPTER TWO

2.0 LITERATURE REVIEW

Respiratory dysfunction is a common problem associated with heart failure. Lung function abnormalities are frequently observed in patients with heart failure both at rest and during exercise, also in the absence of respiratory disease causing alterations of respiratory mechanics and of gas exchange capacity (Agostoni et al., 2006). This results in reduced ventilatory function, exercise intolerance and compromised quality of life (Nikolov et al., 2012). The changes occur as a consequence of the heart's inability to meet the demands of the body as the disease progresses (Pina et al., 2003). A limited increase in cardiac output and elevated intrapulmonary pressure, skeletal muscle changes, inactivity, under perfusion and increased levels of neurohormones are said to be the initial determinant of exercise intolerance and muscle fatigue in HF (Kupari et al., 2000 and Hobbs, 2000).

A reduction in static lung mechanics (i.e. reduced vital capacity- VC and forced expiratory volume in one second FEV₁) is a common finding in HF (Wasserman et al., 1997). Usually the occurrence of restrictive lung changes result from a lower rate of increase in tidal volume, higher respiratory rate, and dead space to tidal volume ratio for a given workload (Myers et al., 1997), causing an increase in ventilatory requirement during exercise mainly associated with abnormalities in alveolar gas membrane conductance along with ventilation/perfusion mismatch due to the combination of impaired regional lung perfusion and abnormal increase in pulmonary capillary pressure (Wada, 1993).

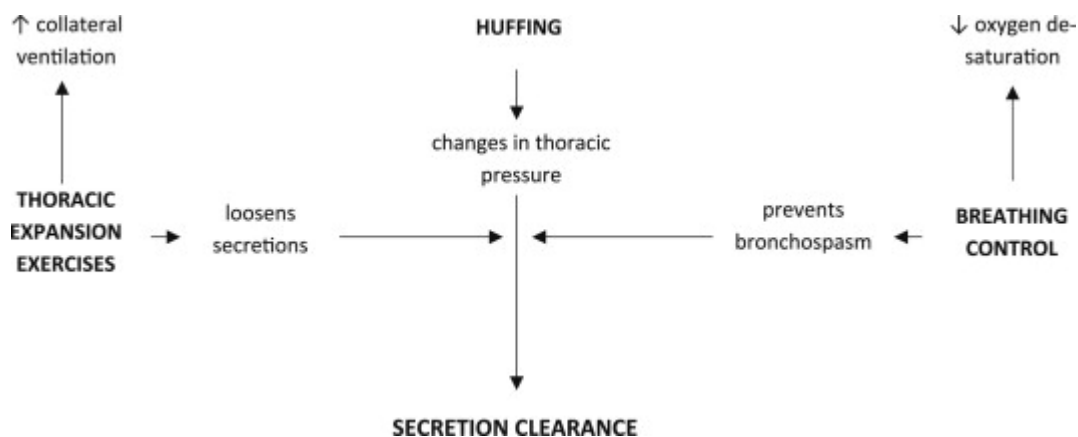
CHF was until the late 1980 described as a condition best treated by rest, and patients were excluded from exercise training because of what was perceived as safety concerns and beneficial effects in the failing or damaged myocardium (Larsen and Dickstein, 2005). However, the guidelines for diagnosis and treatment of CHF from the American Heart Association and European Heart journal (2001), recommend exercise training for all patients with stable CHF (Pina et al., 2003). Exercise training is well tolerated by stable CHF patients and results in improved lung volumes, functional capacity and health related quality of life (Belardeinelli et al., 1999). Evidence suggests that these benefits are mainly due to the effects of exercise

training on peripheral skeletal muscles and circulation rather than on the myocardium (Ventura- Clapier, 2007). Similarly, exercise training improves the ratio of type 1 and type 2 muscle fibers in skeletal muscle, partially reverse activation of the neurohormonal system, reduce levels of pro-inflammatory cytokines (Clark, 2006), improve skeletal muscle metabolism, and increase blood flow within the active skeletal muscles (Clark, 2006).

Breathing control is considered integral to the management of patients with respiratory disorders and its goals are said to optimize oxygen transport, improve ventilation-perfusion matching, increase lung volumes, reduce work of breathing, and enhance mucociliary clearance (Ciesla 1996, Stiller 2000 and Bott et al., 2001).

ACBT is a cycle of breathing control, thoracic expansion and forced expiratory techniques routinely used in respiratory disorders (Smith and Ball, 1998). The exercises are actively performed and involve active expiration, slow and deep breathing, inspiratory and expiratory muscle training and diaphragmatic breathing (Gosselink, 2003). Studies done on ACBT exercises have shown that these exercises improve lung function; exercise tolerance and quality of life (Hough, 2001).

Traditionally these exercises are used for clearance of bronchial secretions, lung function improvement and strengthening of the respiratory muscles (Porter, 2003). A number of mechanisms have been proposed as the means by which ACBT achieves enhanced secretion clearance. The forced expiratory maneuvers (low- and high-volume huffing) are thought to promote movement of secretions through changes in thoracic pressures and airway dynamics (Porter, 2003). Breathing control is reported to prevent bronchospasm and oxygen desaturation while the thoracic expansion exercises assist in the loosening and clearance of secretions, and the improvement of collateral ventilation (Lewis et al., 2005).



Proposed mechanism by which ACBT improves clearance of secretions (Lewis et al., 2005)

Several studies have shown that ACBT is effective in the management of respiratory disorders. It is an effective treatment which improves pulmonary function (Savci et al., 2000) and airway clearance (Pryor, 1999). It has been evaluated in stable patients with cystic fibrosis (Pryor and Webber, 1979), chronic obstructive pulmonary disease (Savci et al., 2000) and in patients with chronic heart failure (Collins, 2005).

Collins (2005) in her study on the effects of chest physiotherapy on lung volumes in heart failure patients concluded that the use of ACBT exercises in heart failure had a significant increase in lung volume such as FVC, FEV₁, peak expiratory flow, FEV₁/FVC and patient's quality of life.

In another crossover study to compare ACBT and conventional chest physical therapy on airway clearance in bronchiectasis; 35 adult bronchiectasis patients had measurement of PFT, weight and volume of sputum done. The study concluded that ACBT in postural drainage position was equally as effective as conventional chest physiotherapy in airway clearance of bronchiectasis patients. Patients in the study rated ACBT to be more comfortable than conventional therapy and hence, can be used as a preferred modality for airway clearance (Syed et al., 2009).

A comparative study done by Mohammad et al., (2012) in India on the efficacy of ACBT and postural drainage in 30 patients with bronchiectasis, found that ACBT

had better effects in airway clearance than postural drainage thereby improving pulmonary function in patients with bronchiectasis.

In another study by Patterson et al., (2004) ACBT and test of incremental respiratory endurance were used in 20 stable COPD patients mainly with bronchiectasis in a randomized crossover trial. In their conclusion ACBT was found to be a more effective method of airway clearance in bronchiectasis than incremental respiratory endurance during a single treatment session. The results of the study showed ACBT resulted in a significant increase in pulmonary functions FEV₁, FEV₁/FVC and a reduction in dyspnea.

Donrawee et al., (2009) studied acute benefits of chest wall stretching exercise on expired tidal volume, dyspnea and chest expansion in a patient with Chronic Obstructive Pulmonary Disease. The results of this study showed a significant clinical improvement of expired tidal volume, reduction in dyspnea level and increase in chest expansion. These study findings are supported by Goso et al., (2001).

Luciano et al., (1998) also studied the effects of breathing rate on oxygen saturation and exercise performance in heart failure and concluded that slowing respiratory rate reduces dyspnea and improves both resting pulmonary gas exchange and exercise performance, this is also supported by (Keteyian et al., (2000), Elaine et al., (2009) and McConnell et al., (2003) who concluded that exercise improves chest mobility, quality of life and submaximal exercise capacity and there was also a reduction in dyspnea and depression.

A similar study undertaken by Bernadi et al., (1998) at Parvia University on the effects of breathing rate on oxygen saturation and exercise performance in chronic heart failure concluded that slowing respiratory rate reduces dyspnea and improves both resting pulmonary gas exchange and exercise performance in patients with heart failure.

CHAPTER THREE

3.0 METHODOLOGY

3.1 STUDY DESIGN

The study was a hospital based prospective cohort. It was limited to stable New York Heart Association function class II and III patients who presented with dyspnoea. The investigator classified the known HF patients based on the clinical signs such as dyspnea, fatigue and palpitations in line with the NYHA function class criterion, as shown in the definition of terms (page; xiv)

3.2 STUDY SITE:

The study was conducted at the cardiac clinic at University Teaching Hospital in Lusaka, Zambia from May to October. Lusaka is the capital and largest city in Zambia with a population of 2,191,439 million (Zambia population and Demographic Projections for 2011-2035, 2014). UTH was selected purposively because it is the biggest tertiary, referral and teaching hospital which serves patients from Central, General, Specialized and private hospitals and has a high population of HF patients.

3.3 TARGET POPULATION

The population included all stable New York Heart Association class II and III heart failure patients referred to out-patient cardiac clinic during the study period.

3.4 STUDY POPULATION

At baseline the population composed of 30 NYHA function class II and III patients who consented to participate on the study.

3.5 RESEARCH STUDY VARIABLES

3.5.1 Dependent variables: Lung function volumes and quality of life

3.5.2 Independent variables: Teaching Active Cycle of Breathing Techniques

3.6 INCLUSION CRITERIA

Consenting Stable adult patients aged 18 years and above of either gender in NYHA function class II and III, who were available during the study period were invited to participate.

3.6 EXCLUSION CRITERIA

Unstable heart failure Patients and below the age of 18 years; those in NYHA class IV, with any severe neurological or musculoskeletal disorders, COPD, unstable angina (last four weeks before the study), anemia were excluded from the study.

3.8 SAMPLE SIZE CALCULATION

It was assumed that for the FEV₁/FVC ratio to increase from 0.77 to 0.8 % over a 12 weeks period at 5 percent significance level, recruiting 24 participants would give us 80 percent power to detect this difference of 0.03%. After accounting for a possible 25% loss to follow up, the final sample size was estimated to be 30 participants. STATA version 11 was used to calculate this sample size. This sample size compares well with similar studies by Mancini et al., 1995; Goso et al (2001), and Collins., 2005).

3.9 DATA COLLECTION

3.9.1 MATERIALS AND METHODS

The data collection tools included the spirometer (DATOSPIR-70, SN117-B696), which measured the FVC, FEV₁ and FEV₁/ FVC ratio, weighing scale measuring weight, a wall standiometer for measuring height (German model 220, SECA) and the Minnesota questionnaire was used to assess quality of life. The dependent variables in this study were lung function volumes and quality of life and independent variable was teaching the ACBT exercises

3.9.2 PILOT STUDY

The questionnaire was pre-tested on 5 randomly selected HF patients in the cardiac clinic in order to check for validity and reliability. The flow and understanding was good; hence no changes were made to the questionnaire.

3.9.3 PREPARATION OF PARTICIPANTS FOR SPIROMETRY

The participants who reported to the cardiac clinic at the University Teaching Hospital were screened based on the inclusion and exclusion criteria for eligibility to participate in the study. Recruitment of patients was conducted in May 2014 for three weeks after ethical clearance. The purpose of the study was explained and written informed consent was obtained from all participants. The participants who consented underwent 12 weeks ACBT exercise training. Participants were given 5 minutes rest for maximum relaxation of the respiratory muscles to ensure maximum air entry and expansion of the lungs before commencement of exercises. The nature of spirometry was explained to them and the mouth pieces fitted to the spirometer. The trained spirometry nurse demonstrated spirometry to the patients in order for them to familiarize with the equipment. The investigator with the help of a trained Spirometry nurse carried out lung function testing using portable Spirometer model (DATOSPIR-70, SN117-B696). Patient's information such as participant's identity (Id), age, sex, weight, height, ethnic origin and smoking status were entered in the machine using the standard operating procedure as recommended by the manufacturer. The reference normal value used for Spirometry testing was that of a normal person as per physiological standard where FEV_1 / FVC ratio was 80 per cent (Guyton, 2006). Lung function volume measurements (FEV_1 , FVC and FEV_1 / FVC) and Quality of life as outcome measures were taken in sitting position with predicted values calculated based on sex, age, weight in kilograms and height in centimeters at baseline. The participants were guided on the correct posture during breathing maneuvers to ensure maximum effort when they forcefully expired. Further instructions were given on how to breathe into the instrument that is, they were asked to expire in the absence of the instrument and then if it was done correctly into the instrument. Up to three (3) maneuvers were done on each participant and a forceful expiration for at least 6 seconds was recommended. Three readings of the lung function test were collected and the mean of the three scores was calculated and recorded during data entry. The primary outcomes were the changes in lung volume

(FEV₁, FVC and FEV₁/ FVC) and quality of life measured by the Minnesota questionnaire as secondary outcome.

3.9.4 ACBT EXERCISE PROTOCOL

Participants received 30 minutes of supervised ACBT exercise per session; this was done on 3 days of the week for a total of 12 weeks. ACBT were performed in an upright sitting position on a chair, the back at ninety degrees and feet resting flat on the floor.

3.9.5 BREATHING CONTROL

Participants were placed in a well-supported and relaxed sitting position with feet resting on the floor, participants were told to rest for 5 minutes before commencing the exercises. With hands placed on the abdomen, shoulders relaxed and dropped down; participants were instructed to take a gentle, quiet and relaxed breath using the lower abdomen while feeling the hand rising during inspiration and falling back during expiration. This was repeated 4-5 times.

3.9.6 THORACIC EXPANSION EXERCISES

The participants were placed in a comfortable sitting position; participants took deep breaths by placing hands over the chest when the movement was encouraged combined with a 3-4 seconds hold before passively exhaling. Thoracic expansion exercises were encouraged with proprioceptive stimulation. These techniques helped in the clearance of secretions. The exercise was repeated 4-5 times and was followed by the breathing control again.

3.9.7 FORCED EXPIRATION TECHNIQUE (HUFFING)

In the same position as above, the participants were asked to perform two forced expirations. The instruction given to the participants was that they should imagine they were fogging the mirror; this was also repeated 4-5 times and a period of breathing control followed later. Breathing control given for 2 to 3 seconds was followed by expiration with open glottis. Coughing or huffing was preferred according to the subject's comfort. When secretions have reached the more proximal

upper airways, a huff or cough from a high lung volume was used to clear the secretions. Breathing control between huffs was given to avoid breathlessness and those who felt like coughing were advised to do so.

3.9.8 MINNESOTA QUESTIONNAIRE

Quality of life was assessed by the Minnesota questionnaire which was a self-administered questionnaire. However, the researcher guided those who needed help at baseline. This questionnaire was administered at baseline, 6 weeks and 12 weeks. The questionnaire concerned how much the participant's heart condition prevented them from living as they wanted during the last month. Participants were first encouraged to understand the instructions and simply choose the response that best represented how their heart condition affected them during the last month from a scale of 6 scores ranging from zero to five. Zero representing no impairment and five representing very much impaired. The questionnaire had 21 self-assessment questions with a maximum of 105 scores. The higher one scored the poorer was their quality of life. The Minnesota questionnaire is attached as an appendix III.

3.10 DATA MANAGEMENT AND ANALYSIS

Raw data was first cleaned, sorted out and coded manually before analysis. This was to ensure all the incomplete, missing and inconsistent data were accounted for and excluded. Data was then entered into Microsoft Excel spread sheet containing the necessary formulae for calculating some indices. The spread sheet included participant identity code (ID,) age, sex, weight, height, BMI and lung volumes such as the FVC, FEV₁ and FEV₁/FVC ratio and scores from the Minnesota questionnaire. The data was exported and analyzed using STATA (version 11.0). The means and standard deviation of all measurements were calculated and appropriate normality of data was determined using the Shapiro Wilks test. Analysis of variance (ANOVA) was used to analyze FVC and FEV₁ and FEV₁/FVC ratio and quality of life at baseline, 6 weeks and 12 weeks values.

3.11 ETHICAL CONSIDERATIONS

The study was conducted under a research protocol which was reviewed and approved by University of Zambia Biomedical Research Ethics Committee (Annex

1). Written permission was obtained from UTH Senior Medical Superintendent and the Head of Department of Internal Medicine. ACBT exercises were simple, non-injurious, non-strenuous and easy to perform. Participation was voluntary and no penalty was to be given for withdrawing. The purpose and nature of the study was thoroughly explained and participants who declined to participate were not forced but were assured of their protected privilege. Written informed consent was obtained from all participants. Precautions were taken to ensure that patients were protected from any negative effects by working closely with the cardiac nurses and the cardiologist. The researcher's phone numbers were availed to the participants and family members for home contacts. Privacy and confidentiality were maintained by de-identification and serial numbers were allocated to each participant to be used by staff when collecting and reporting information. Once collected, data was kept in a lockable cupboard to promote confidentiality. Soft copies data was stored on the computer with the password known to the principle investigator alone to avoid breach in confidentiality. There was no interference to the participants beyond the general standard of clinical care offered by UTH. Transport refunds were given to assist with the movement. All research documents containing participant's responses will be destroyed after seven (7) years in line with ethical approval standards.

CHAPTER FOUR

4.0 PRESENTATION OF FINDINGS

4.1 Main Demographic Information and physical characteristics

The total sample size consisted of 23 cardiac patients who consented to participate with lung function volume parameters and QoL measured at baseline, 6 and 12 weeks. The mean age was 54.0 years (range 25-77years); 16 (69.6%) were females and 7 (30.4%) were males; majority of the men declined to participate. The mean BMI for males was 25.5 kg/m² and 26.1kg/m² for females which remained relatively unchanged at 6 weeks and 12 weeks (Table 1).

Table 1: Demographic characteristics of participants by sex (n=23)

Variable (n=23)	Male			Female		
Number	7 (30.4%)			16(69.6%)		
Mean age (range)	59.3(40- 76 years)			51.4(25- 77 years)		
Height(meter) (SD)	1.7 (0.1)			1.6 (0.1)		
Smoking						
Yes	1 (14%)			1 (6%)		
No	6 (86%)			15 (94%)		
Duration	Baseline	Week 6	Week12	Baseline	Week 6	Week12
Weight (kg)	72.6 (18)	75.4 (15.2)	75.0 (15.4)	65.4 (18.9)	66.0 (18.7)	65.7 (18.6)
BMI (kg/m ²)	24.0 (3.0)	24.4 (2.8)	24.2 (2.5)	26.1 (6.7)	26.2 (6.3)	26.1 (6.3)

4.2 CLINICAL LUNG FUNCTION VOLUMES

All participants showed a reduction in lung volumes at baseline, the mean FVC was 2.7± 1.1 liters, FEV₁ was 1.9± 0.7L, and FEV₁/FVC was 70.1 ±14.7%. There was no significant change in mean parameters at 6 weeks. However there was a slight insignificant increase in the means at 12 weeks; FVC was 2.8 ± 1.1L, FEV₁ was 2.0 ±

0.8 L and FEV₁/FVC was 73.0 ± 13.6%. One way repeated measure ANOVA computed to estimate the change from baseline to 12 weeks of ACBT showed no significant difference (Table 2).

Table 2: Summary of clinical characteristics for CHF patients

Variables	Units	Mean (SD)	Range	Mean (SD)	Range	Mean (SD)	Range	P Value
		baseline		6 weeks		12 weeks		
FVC	L	2.7 (1.1)	1.1-5.4	2.7 (1.0)	1.2-4.8	2.8 (1.1)	1.1-4.8	0.70
FEV ₁	L	1.9 (0.7)	0.6-3.8	1.9 (0.7)	1.0-3.6	2.0 (1.0)	0.8-3.4	0.43
FEV ₁ /FVC	%	70.1(14.7)	40.1-94.4	70.1 (12.0)	40-80	73.0 (13.6)	30.0-94.3	0.49

4.3 FVC, FEV₁ AND FEV₁/FVC RATIO AFTER ACBT EXERCISES

One way repeated measure ANOVA was computed to estimate the change in FVC, FEV₁ and FEV₁/FVC ratio from baseline, 6 weeks and 12 weeks. There was no significant difference in all parameters of FVC, FEV₁ and FEV₁/FVC form baseline to 12 weeks (Table 3).

Table 3: lung function changes in twelve (12) weeks in ANOVA

Variable	F statistic	Df	P value
FVC	0.35	(2,44)	0.70
FEV ₁	0.86	(2,44)	0.43
FEV ₁ /FVC	0.72	(2,44)	0.49

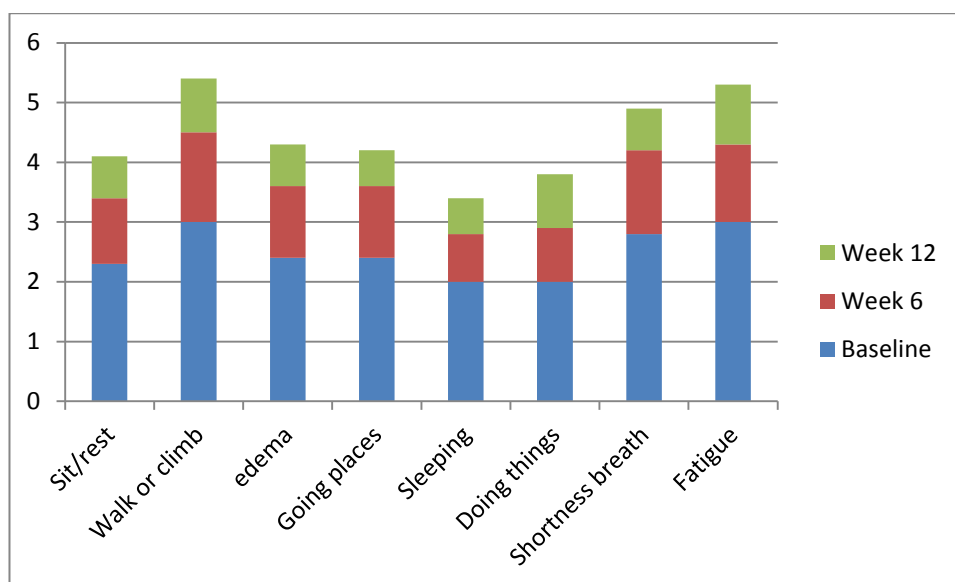
Table 4: shows the small insignificant percentage changes in lung volumes from baseline to 12 weeks, FVC was 3.6%, FEV₁ was 5.3% and FEV₁/FVC was 4.0% (Table 3).

Table 4: Percent change in FVC, FEV₁ and FEV₁/FVC

Variable	baseline	Week 6		Week 12	
		Measure (L)	% change	measure	% change
FVC (L)	2.70	2.74	2.1	2.80	3.6
FEV ₁ (L)	1.9	1.9	0.0	2.0	5.3
FEV ₁ /FVC %	70.1%	70.1%	0.0	73.0%	4.0

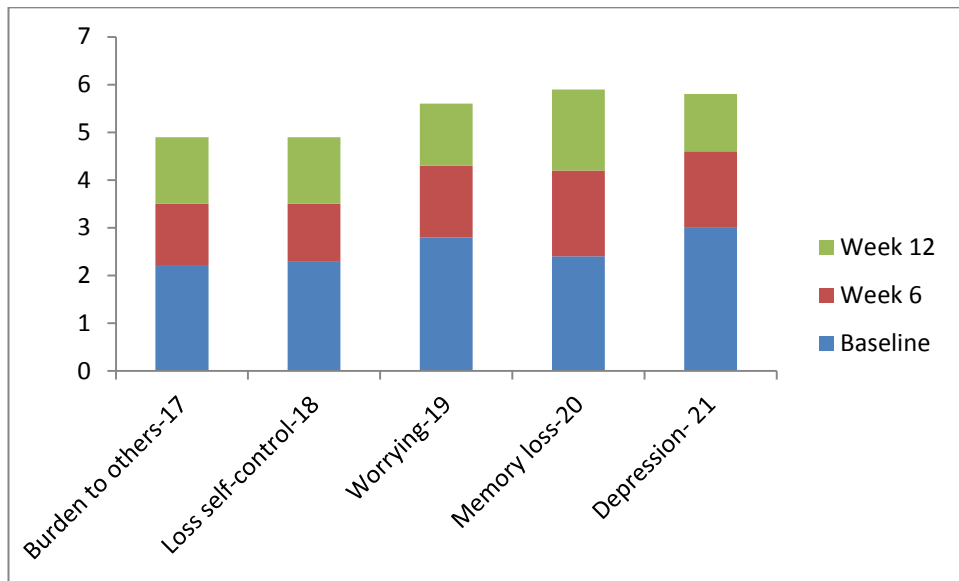
4.5 QUALITY OF LIFE

To calculate the changes in Quality of Life (QoL), 8 questions which relate to physical symptoms and socio-psychological factors ranged from 0-40 and 5 to emotional/mental factors from 0-25 were summed up (Figures 1, 2 and 3) below. The higher one scored the poorer was their health.

Figure 1: Physical factors of Quality of life in HF

By comparing pre and post quality of life measurements, there was a decrease in all variable scores of the physical dimension of quality of life for participants from baseline to 12 weeks (Figure 1). This was also reported verbally by the participants.

Figure 2: Emotional/ Mental dimension of Quality of Life



The emotional/mental dimension of quality of life showed improvement as shown in the reduction in the scores from baseline to 12 weeks (Figure 2).

Figure 3: Socio-psychological factors of Quality of life in HF

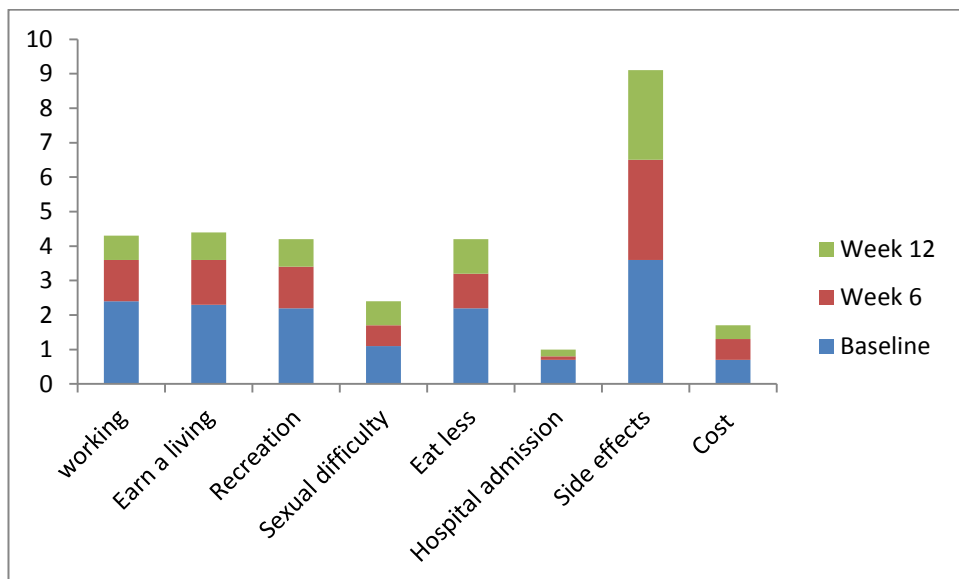


Figure 3 showed a reduction in the socio-psychological scores from baseline to 12 weeks; indicating improved socio-psychological dimension of quality of life

Table 5: means and percent changes in quality of life

variable	baseline	6 weeks	12 weeks
physical	17.9 (45%)	9.4 (24%)	6.1 (15%)
Mental/emotional	12.7 (51%)	7.4 (30%)	7.0 (18%)
Socio-psychological	14.1 (35%)	8.5 (21%)	7.2 (18%)

All mean variables for each dimension were summed up and their % change calculated at baseline, week 6 and week 12. The reduction in the scores and percentages show improvement in all areas of quality of life (table 5).

4.6 The various dimensions of quality of life were statistically compared at different points using analysis of variance (ANOVA). There was significant difference in all dimensions of quality of life (physical factors $P < 0.001$, emotion/mental; $P < 0.0002$ and Socio-psychological $P < 0.001$) (Table 6).

Table 6: Change in Quality of Life dimension measurements from baseline to 12 weeks

Factor	variables	F- Statistic	P -Value
Physical	Sit or rest, walk or climb, house work, going to places, sleeping at night, doing things with friends, shortness of breath	53.45	P< 0.001
Emotional/ mental	Burden to others, loss of self- control, worrying, memory loss and depression	10.17	P< 0.0002
Socio- psychological	Swelling, earning a living, recreation, sexual difficulty, eating less food, hospital admission, side effects and cost	46.33	P< 0.001

CHAPTER FIVE

5.0 DISCUSSION

The study has demonstrated that ACBT exercises have a modest effect of lung volumes but have an appreciable effect of the quality of life. ACBT is a cycle of breathing control, thoracic expansion and forced expiratory technique routinely used in respiratory disorders (Smith and Ball, 1998). Traditionally these exercises are said to be used for clearance of bronchial secretions, lung function improvement and strengthening of the respiratory muscles (Porter, 2003). ACBT also facilitate improvement in cardiorespiratory symptoms in conditions such as heart failure (Collins, 2005). Physiologically these exercises are said to promote maximum air entry by reducing bronchospasms and utilizing collateral ventilation to promote alveoli expansion. This exerts force on adjacent collapsed alveoli for re-expansion (Porter, 2003), and moves secretions through changes in thoracic pressures and airway dynamics by the use of forced expiratory maneuvers (Pryor, 1999). Diaphragmatic breathing fills up the majority of the lungs with air, creating a negative pressure which drives air into the lungs thereby improving ventilation perfusion and quality of life (Bless et al., 2014). When air reaches the small air sacs such as the pores of Khon, bronchiolar channels of Martin, bronchiole-alveolar canals of Lambert it loosens the secretions which are consequently coughed out hence decongesting the lungs (Pryor, 1999; Porter, (2003). In addition, the use of thoracic expansion and inspiratory holds result in redistribution of gas between the lung segments and improved ventilatory function (Porter, 2003). The increase in lung compliance and reduction in lung resistance are also said to result from the release of prostaglandins and surfactant in the alveolar space during maximum deflation of the lungs (Blessy et al, 2014).

5.1 Demographic Characteristics

The mean age of participants in this study was 54.0 years (age range 25-77 years) similar to that reported in two studies done in Tanzania (Spencer and Makene, 1972 and Mohamed, 2011). These reported that the age related prevalence of heart failure in Africa tends to occur at around the 5th and 6th decade in contrast to developed countries where the prevalence of heart failure peaks much later. The probable

reasons for the difference include prevalence of rheumatic heart disease (RHD) and hypertension which occur at a tender age among blacks (Wright et al, 2009 and Mohamed, 2011) and the low life expectancy which currently stands at 54 years in Zambia (World Health Organization Statistic, 2014), with very few people surviving beyond the 7th decade. It is further reported that 40-50 years is the age when the pulmonary function starts declining anatomically, physiologically and immunologically including structural changes of the chest wall and thoracic spine deformities (Babb and Rodarte, 2000; James, 2004).

Heart Failure is until now considered a condition best treated by bed rest in some areas including Zambia (Larsen and Dickstein, 2005). The perception of risk during exercise is said to be high (Meyer, 2008) and the beneficial effects of exercise remain unappreciated (Larsen & Dickstein, 2005). However, the benefits of exercise in HF are well documented (The European Heart journal, 2001; Pina et al., 2003). The benefits of exercise by stable HF patients have included improved lung volumes, functional capacity and health related quality of life. Evidence suggests that these benefits are mainly due to the effects of exercise training on peripheral skeletal muscles and circulation rather than on the myocardium (Ventura- Clapier, 2007).

5.2 Respiratory Function parameters

HF patients are said to have dysfunctional respiratory capacity which is compounded by the amount of pulmonary fluid congestion due to oedema. West in 2008 showed a reduction in compliance of the lungs or chest wall, edema of the bronchial walls or secretions within the airways and weakness of inspiration muscles in HF patients (West, 2008).

5.2.1 Forced Vital Capacity (FVC)

In our study the baseline FVC averaged 2.7L from the predicted 5L demonstrating impairment of the compliance of lungs and the chest wall (Guyton and Hall, 1996). This is supported by Kupari et al (2000) who reported that respiratory muscle weakness reduces pulmonary function volumes, a reduction mainly seen in FVC. Cahalin et al., (1997) also reported poor ventilatory muscle strength and diminished endurance which leads to dyspnea in HF patients during daily activities.

At six weeks post ACBT intervention the FVC remained the same on average (2.7L), a finding which could have been precipitated by variations in height, weight and age of participants. There was a marginal average increase of FVC of 0.1L at 12 weeks of ACBT. This change was statistically insignificant. However this small increase in mean FVC values may be attributed to the effects of ACBT which enhance strength of respiratory muscles, reduce air trapping, improve lung compliance, reduce airway resistance and improve lactate uptake (Sayed et al., 2014). Guyton and Hall (1996) in support of ACBT exercises state that breathing exercises increase the rate and depth of respiration to improve FVC and rate of oxygen diffusion. These are said to be mechanisms responsible for reducing dyspnea and improving quality of life (Mancini et al., 1995).

5.2.2 Forced Expiratory Volume in One Second (FEV₁)

The FEV₁, the volume of air that the patient exhales in the first second of forced expiration, was recorded at an average of 1.9L. The predicted FEV₁ for this patient population was 4.0- 4.2 L. This suggested an increase in airway resistance or a reduction in elastic lung recoil (West, 2008). The interstitial pulmonary oedema due to high Left Ventricular filling pressure and respiratory muscle weakness are said to lead to reduced lung volumes and decreased lung compliance; contributing to reduced capacity to increase air flow and lung volume in heart failure. The decreased FEV₁ observed in this study may also have been due to air trapping because of increased airway resistance in exhalation and the low vital capacity. However the mean FEV₁ marginally increased to 2.0 L at 12 weeks (p=0.43). The breathing exercises may have helped in loosening secretions by allowing air to reach the small airways such as the pores of kohns and bronchiolar of Lambart moving the secretions to the upper airways to be coughed out (Pryor, 1999) thus reducing the airway resistance.

5.2.3 FEV₁/FVC Ratio

The FEV₁/FVC ratio, the proportion of the vital capacity exhaled in the first second, was 70% at baseline (predicted was 70-80%) demonstrating a normal ratio. In this study FVC and FEV₁ decreased in parallel while the ratio remained normal, suggesting a restrictive pathophysiological mechanism. This result is supported by Agostoni et al., (2006) who reported that approximately 50% of severe HF patients

have pulmonary restrictiveness. At 12 weeks post intervention the ratio increased to 73.0%. The increase in this study was small and statistically insignificant. However this trend to increase the lung volume parameters showed the potential of ACBT exercises to increase ventilatory function thus reducing dyspnea, and easy fatigability hence improving quality of life; this is supported by Hough (Hough, 2001).

The patients reported a reduction in HF symptoms such as dyspnoea, swelling, fatigue and improved exercise capacity after undergoing ACBT sessions. This supports the finding of Mancini et al., (1995) who found no significant differences in FVC, FEV1 and FEV1/FVC between baseline measurements and those obtained after completion of the 3 months period of the study; however they found significant improvement in the perceived dyspnea, fatigue and swelling during sustained ventilatory capacity.

5.3 QUALITY OF LIFE

Quality of life was also considered in this study as a way of assessing the impact of ACBT on the individual's day to day activities. This was in line with the numerous studies that have evaluated the effects of various interventions on health related quality of life in the HF population (French, 2005). The Minnesota Living with Heart Failure Questionnaire was used in this study and is said to be a reliable and valid tool (Rector and Kubo, 1987 and Morgan and McGee, 2007). The parameters measured within the 3 domains; Physical, Psycho-social and emotional/mental were good determinants of QoL in this population.

5.3.1 Physical Factors

At baseline, most of the patients had considerable physical impairment needing to sit to rest during activity, swelling, difficulty to walk or climb stairs and/or to do house chores. They had difficulties going places and doing things with friends, had paroxysmal nocturnal dyspnoea which disturbed their sleep and had shortness of breath on mild exertion. There was improvement in these symptoms noted at 6 weeks of ACBT and this was more marked at 12 weeks at which time they reported ability to better endure physical activity thus interacted better with friends, slept much better at night and did not experience dyspnoea on mild exertion. The magnitude of these changes attained statistical significance ($p < 0.001$). Similar findings were reported in

previous studies (Mancini et al., 1995; Rich, 2005 and Cecily and Alotaibi 2013). These findings are worth noting as they occur in the presence of small insignificant increases in the lung volumes reported in this study. Collins (2005) and Hough (2001) also reported an improvement in patient's quality of life after eight (8) weeks of ACBT but this was in the presence of significant differences in lung volume such as FVC, FEV₁, peak expiratory flow and FEV₁/FVC. However, these study findings show that breathing exercises done regularly with maximum compliance can improve lung volumes and enhance pulmonary performance (Sayed et al., (2014)) suggesting that probably our patients may not have been adequately exercise dosed because the majority had poor compliance to treatment.

5.3.2 Psycho-social Factors

In the psycho-social domain, the patients were evaluated for their perception working with friends, ability to earn a living, recreation, sexual difficulty, eating less food, frequency of hospital admissions, medication side effects and hospital costs. Improvement in these parameters was noted at 6 weeks as well when the patients reported an increase in food uptake, improved sexual activities, a reduction in hospital admissions and most importantly was the improved ability to do various activities to earn a living. The improvement was marked at 12 weeks as well, similar to what was reported by Keteyian et al., (2010) who also investigated the clinical role of exercise in the management of patients with heart failure. The study showed improvement in the health status of participants and they reported a 15% reduction of hospital admissions. Similar findings have been also reported in other studies (Berlardinelli et al., 2000, Austin et al, 2005).

5.3.3 Mental/Emotional Factors

Heart failure is accompanied by significant emotional/mental symptoms which include the perception of being a burden to others, loss of self- control, worrying, memory loss and depression. These are considerable determinants of one's quality of life. Depression especially is a serious medical condition which interferes with a person's ability to perform other activities of daily living (American Psychiatry Association, 1994). In heart failure the prevalence of depression is said to range from 13 to 48% among heart failure out- patients (Gottlieb et al 2004). At baseline, a considerable number of patients showed emotional/mental symptoms. These were

noted to improve at 6 weeks of ACBT intervention and were marked at 12 weeks of the intervention at which time the patients reported change in their perception of being a burden to the family as they were able to perform certain tasks independently. They also reported an improvement in control of one's self, a reduction in worries which also improved their ability to recall things. These findings are similar to those by Li (2000) who reported a great improvement in the depression and anxiety (mental and emotional scores).

Substantial amount of research has shown that ACBT exercises can be of benefit to heart failure patients in overcoming HF related symptoms such as dyspnea, fatigue, and chest congestion through its physiological mechanisms. Progressive ACBT exercises for 30 minutes on a daily basis are recommended for heart failure patients (Collins, 2005). Indeed ACBT given consistently is said to cause improvement by 3rd week of the intervention and can continue up to 6 months if compliance with training program continues (Meyer et al., 2000). Exercises are therefore encouraged for stable heart failure patients in order to minimize Government expenditure through hospital admissions and drugs. However, the current management of heart failure patient still includes traditionally medication, bed rest and dietary alteration with little emphasis on exercise. Significant benefit from ACBT exercises is said to result from consistent use, thus requiring good compliance from the patients (Meyer et al, 2000). Our patients to a large extent were very cautious in their exercising, still concerned with the health effects and this may have impacted on the outcome due to under dosing. This does invite further investigation.

5.4 LIMITATIONS OF THE STUDY

The confounder component of the multidisciplinary management of disease such as optimization of HF medications, increased social interactions and other treatment effects may have played a part. Although drugs have an effect on lung function volume, we would say much of the improvement was caused by the effects of ACBT because these patients had poor quality of life at baseline despite being on pharmacological intervention for a very long time. Significant improvement in quality of life was seen during and after ACBT intervention.

The study was limited to NYHA II and III HF patients. Only heart failure patients who came for review during the recruitment period were enrolled while those not attending review may have been missed

The study only explored lung function volumes and quality of life and did not explore the levels of functional activity. Six minutes' walk to assess function would have increased the significance of ACBT effects.

5.5 CHALLENGES

The myths and beliefs that HF patients are not supposed to exercise made it difficult to enrol participants on this study. This also contributed to the low treatment doses as participants were afraid of exercising outside the safe hospital environment.

Some participants lacked family support, because they were suspected of having affairs at the hospital; making compliance and adherence to treatment difficult.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

Although active cycle of breathing techniques is a major non- pharmacological treatment modality in respiratory related abnormalities, it has not been included in the management of heart failure patient population in Zambia.

This study has shown the importance of ACBT exercise in the treatment of heart failure. The benefits are seen even in mild exercises such as the ACBT which can be easily performed in HF. While the improvements in pulmonary function parameters may be small, the accompanying changes in quality of life are considerably significant.

ACBT exercises should therefore be recommended as additional therapy to pharmacological intervention in HF patients to improve lung volumes, exercise tolerance and overall quality of life. Future studies to be done on confined patients.

Health education is key to enhancing and improving utilization of exercise. More patients and families will only become free and courageous to use exercise if they are equipped with the right and correct information on the benefits of exercise in heart failure.

Clinicians are therefore challenged to carry out research in this area in order to increase utilization of physiotherapy services and bridge the gap that exists between pharmacological and non- pharmacological intervention. A holistic approach in the management of heart failure patients will help reduce patient hospital stay, morbidity, mortality and improve quality of life.

Therefore this study recommends that ACBT be included in HF patient management. It is also recommends that UTH sets appropriate management guidelines for heart failure patients. Physiotherapists being the custodians of ACBT must be among the team involved in the management of these patients for a holistic approach and comprehensive care provision.

REFERENCES

Agostoni, P. Bussotti, P. and Cattadori. G. et al., "Gas diffusion and alveolar-capillary unit in chronic heart failure," *European Heart Journal*, vol. 27, no. 21, pp. 2538–2543, 2006.

American Psychiatric Association. *Diagnostic and Statistical Manual Mental Disorders*. 4th edition. Washington DC: American Psychiatric association; 1994

Austin J, Williams R, Ross L, Moseley L, Hutchison S. Randomised controlled trial of cardiac rehabilitation in elderly patients with heart failure. *Eur opean Journal of Heart Failure* 2005; 7:411-17

Babb, T.G.& Rodarte, J.R. (2000). Mechanism of reduced maximal expiratory flow with aging. *Journal of Applied Physiology*, 89, 505-511

Belardnelli, R.Geogiou, D.Ganci, G. and Parcaro, A. (1999) randomized controlled trial of long term moderate training in chronic heart failure patients. *Circulation* 99; 1133- 1183

Belardnelli, R. Cianci,G. and Parcaro, A.; Exercise training for patients with CHF reduced mortality, cardiac events and quality of life. *West Journal of Medicine*. 2000; 172(1): 28

Bernadi, L. Parta, C. Spicuzza, L. Sanderson, J.E. Pedrtti, R. and Tramarin, R. (2002) slow breathing increases arterial baroreflex sensitivity in patients with chronic heart failure. *Circulation* 105, 143-145.

Blessy, V. Saya, R. Yadav, P.K.Kar, K.S. (2014) Effects of breathing exercises on pulmonary tests in healthy individuals. *Journal medical and biomedical sciences*, India.

Bonow, R.O. and Udelson, J.E. Left ventricular diastolic dysfunction as a cause of congestive heart failure.Mechanisms and management.*Annals of internal medicine* 117: 502-510, 1992.

Bott, J.Carrol,l M.P. Conway, J.H.Keilty, S.E.J. Ward, E.M. Brown, A.M. Paul, E.A. Elliot, M.W. Godfrey, R.C.Wedzicha, J.A and Moxham, J. (1993): Randomised controlled trial of nasal ventilation in acute ventilatory failure due to chronic obstructive airways disease. *Lancet* 341: 1555–1557.

Brubaker, P.H. and Ozemek, C. Exercise therapy for the failing heart: Harmful or helpful? *ACSM's Health and Fitness Journal*.14:9-15, 2010.

Cahalin, L.P.Sermigram, M.J. and Dec,G.W. (1997) Inspiratory muscle training in patients with chronic heart failure, *Physical Therapy*, 72, 8, 830-838

Cecily, H.S.J and Alotaibi. Effectiveness of Breathing Exercises on Pulmonary Function parameters and quality of life of patients with COPD. *IJHSR*; 2013 3(11): 80- 85

Chansa, P.Lakhi, S. Andrews, B.Khalichenko, S.Sakr, R. (2012) Factors Associated with Mortality in Adults Admitted with heart failure at the University Teaching Hospital in Zambia, University of Zambia, Vanderbilt Institute for Global Health

Ciesla, N.D. (1996): Chest physical therapy for patients in the intensive care unit. *Physical Therapy* 76: 609–625.

Clark, A.L. Origin of symptoms in chronic heart failure. *Heart (British Cardiac Society)* 92: 12-16, 2006

Collins, S. (2005) can Physiotherapy breathing exercise improve lung function

Chua, T. Clark, A.Amadi, A. Coats, A: relationship between chemosensitivity and ventilator response to exercise in chronic heart failure; *J AM CollCardiol* 27: 650-1, 1996

Chua, T.P and Coats, A. J. S. “The lungs in chronic heart failure,” *European Heart Journal*, vol. 16, no. 7, pp. 882–887, 1995. View at Scopus

Desai, S. (2004) the role of internist and primary care physicians practices guidelines 88; 1369- 1380

Donrawee, L. et al. Acute effects of chest wall stretching exercise on expired tidal volume, dyspnea, and chest expansion in a COPD patient. *Journal of body work and movement therapy*. 2009; 13(4)

Elaine, P. Antonio, F.B.Celso, R.F.D. Effects of a physical exercise program designed to increase thoracic expansion in chronic obstructive pulmonary disease patients. *J.Pneumologia* vol.29 no.5 São Paulo Sept/Oct. 2003

French, D.P.Lewin, R.J. Watson, N. Thompson, D. R. Do illness perceptions predict attendance at cardiac rehabilitation and quality of life following myocardial infarction? *J Psychosom Res*. 2005; 59(5):315-22.

Goso, Y. Asanoi, H. Ishse, H. Kamenyama, T. et al., (2001) respiratory modulation sympathetic nervous activity in patients with heart failure *circul* 104: 418- 426

Gosselink, R. (2003) controlled breathing and dyspnea in patients with chronic obstructive diseases. *Journal of rehabilitation research and development* 40, 5, 25, 34

Gottlieb, S.S. Kop, W.J. Elis, S.J et al. relation of depression to severity of illness in heart failure. From heart failure and a controlled trial investigating outcomes of exercise training (HF ACTION). *AM J Cardiol* 2009; 103:1285-9

Hagermann, I.TyniLenne, R. and Gordon, A. (2005) outcome of exercise training on long term burden of hospitalization in chronic heart failure patients. *International journal of cardiology* 98, 1209- 1235

Hobbs, R.D.F (2000) Management of Heart Failure; Evidence verses Practice; Does current prescribing provide optimal treatment for heart failure patients; University of Birmingham *British Journal of General practice*

Hough. (2001) *Physiotherapy in Respiratory Care*.3rd edition

Jakes, R.W. Day, N.E. Patel, B.Khaw. K.T. Oakes, S.Luben, R. et al,. Physical inactivity is associated with lower forced expiratory volume in 1 second: European Prospective Investigation into Cancer-Norfolk Prospective Population Study. *Am J Epidemiol*2002; 156 (2): 139- 47. Investigation into Cancer-Norfolk Prospective Population

James, B. C. (2004) A comparison of the pulmonary function of Older endurance Athletes and Age matched sedentary controls. University of New Orleans

Jonson, B.D. Beck, K.C. O'malley, K. Alison, T.G. Squires, R.W. Gau, G.T; Pulmonary function in patients with reduced left ventricular function: influence of smoking and cardiac chest 2001; 120: 1869-1879

Keteyian, S.J. Levine, A.B. Brawner, C.A. Kataoka, T. Rogers, F.J. Schairer, J.R. Stein, D. Levine, T.B. Goldstein, S. Exercise training in patients with heart failure. A randomized,controlled trial.*Ann Intern Med* 2010; 124:1051-7.

Kim, E.B et al (2012) Ganong's Review of Medical Physiology. 24thedithion, New Delhi

Kupari, M.Lommi, J.Kokkonen, J. Sydämen vajaatoiminnan patofysiologia (Pathophysiology of heart failure). In Heikkilä J, Huikuri H, Luomanmäki K, Nieminen MS, Peuhkurinen K (eds) *Kardiologia*. 1st edition.Jyväskylä: Duodecim, 2000:295-312.

Larsen, A.I. Dickstein, K. Exercise training in congestive heart failure. A review of the current status.*Minerva Cardioangiol*2005;53:275-86.

Lewis, L. K. William, T.M. Olds, T. S; The active cycle of breathing technique: a systematic review and meta-analysis, 2005.

Li, Y. L.(2002) Nutritional Supplementation of Respiratory gymnastics in Patients with COPD; 6: 1260-2

- Luciano, B.Giamario, S. Jery, B.Ramic, H.Helmat, R. Alex, W. F; Effects of breathing rate on O₂ saturation and exercise performance in chrironic heart failure; The lancet Vol 351, issue 9112; page 1308 -1311, 2nd May 1998
- Mancini, D. Ferraro, N. Nazarro, D. Chance, B. Wilson, J. Respiratory muscle deoxygenation during exercise in patients with heart failure demonstrated with near-infrared spectorscopy. J Am Coll Cardiol 18: 492-8, 1991
- Mancini, D. M. Pulmonary factors limiting exercise capacity in patients with heart failure. ProgCardiovasc Dis 37: 347-70, 1995
- McConell, T. R. Mandak, P.D. Jeffery, S.eta.l, Training for Heart Failure patients improve respiratory endurance, exercise tolerance, breathlessness and quality of life. Journal of cardiopulmonary rehabilitation24 (1) 2003: 10-16
- Mohamed, H. M. (2011) Outcomes and their associated factors in patients admitted with clinical Diagnosis of Heart Failure at Muhimbili national Hospital.
- Mohammed, F. Efficacy of active cycle of breathing techniques an d postural drainage in patients with bronchiectasis- A comparative study; innovative Journal of medical and Health sciences 2;6 Nov- Dec (2012) 129- 132. India
- Morgan, K. McGee, H. Shelley, E. Quality of life assessment in heart failure interventions: a 10-year (1996-2005) review. *Eur J CardiovascPrevRehabil* 2007;14: 589-607.
- Myers. J; Principles of Exercise Prescription for patients with Chronic Heart Failure; Heart Fail Rev 2008; 13:61-8
- Nikolov, Fedya, P. Papathanasious, G. Jannis, V.llieva, Elena, M. Exercise training modes in Rehabilitation of Patients with chronic Heart failure.2012 Folia medica journal article volume 54 issue 4
- Ntusi, N. B and Mayosi, B .M; Epidemiology of Heart Failure in Sub Saharan Africa; Expert Rev CardiovascTher. 2009Feb, 7(2): 169-80. Doi: 10.1586/19779072.7.2 169.
- Pantalo, G. and Tavazzi, L. Recommendation for Exercises training in Chronic Heart Failure Patients. European Heart Journal (2001) 22: 125-35
- Papathasious, G. Tsamis, N. Georgiadou, P. and Admapodilos, S; beneficial effects of physical training and methodlogy of exercise prescription in patients with heart failure. Anthens Greece (2007).Helenic journal of cardiology.
- Peterson, J. E etal., airway clearance in bronchiectasis. A randomized crossover trial of ACBT(incoperating postural drainage and vibration) versus test of incremental respiratory endurance Chronic Respire Dis. 2004;1(3): 123-4

Piepoli, M. F. Davos, C. F. Francis, D. P. Coats, A.J; Exercise training meta-analysis of trials in patients with chronic heart failure (exercise training MATCH) 2004; 328: 189-196

Pina, I.L. et al.,; Exercise and heart failure: A statement from the American Heart Association Committee on exercise, rehabilitation, and prevention. *Circulation* 107:1210-1225, 2003.

Porter, S. B (2003) Tidy's Physiotherapy. 13th edition. Butterworth Heinemann. London

Pryor, J. (1999) Physiotherapy for air clearance in Adults. *European Journal*, 14: 1418-1424

Pryor, J. A and Webber, B. A. An evaluation of the forced expiration technique as an adjunct to postural drainage. *Physiotherapy* 1979; 65:304-307

Rich, D. (2000) Exercises and Heart Failure www-bcs.com/cgi-bin/item.cgi

Savci, S.Inal–Ince, D. and Arikan, H. (2000): A comparison of autogenic drainage and the active cycle of breathing techniques in patients with chronic obstructive pulmonary diseases. *Journal of Cardiopulmonary Rehabilitation* 20: 37–43.

Sayed S. F, Rehana. R, Saifullah, Yumna. K (2014) Physical activity and its effect on forced expiratory volume; Karachi

Smith, M. and Ball, V. (1998) Cardiovascular/ Respiratory Physiotherapy London; Mosby

Spencer, S.Makene, W. Rheumatic heart disease in Tanzania. *East African Medical Journal*.1972; 49: 909-920.

Stiller, K. (2000): Physiotherapy in intensive care: Towards an evidence-based practice. *Chest* 118: 1801–1813

Syed, N. Arun, G.Siyakumar, T; Active cycle of breathing technique versus conventional chest physiotherapy on airway clearance in bronchiectasis. *Across over trial* 2009 vol 1No 4. Pages 193-198

The Aging Technology Research Center (1995)

The Cystic fibrosis Trust (2002) Airway clearance Technique. www.cft.org.uk/scope/documentlibrary/cftrust/physiotherapy

The Zambia population and Demographic Projections for 2011-2035, 2014

The European Heart Journal (2001)

Ventura-Clapier, R.Mettauer, B.Bigard, X. Beneficial effects of endurance training on Cardiac and skeletal muscle energy metabolism in heart failure. *Cardiovasc Res* 2007;73:10-8.

Vuori, I.Kesäniemi, A. Sepelvaltimotauti,jasydämen vajaatoiminta (Coronary artery disease and heart failure). In Vuori I, Taimela S, Kujala U, (eds) Liikuntalääketiede. 3rd edition.Hämeenlinna: Karisto O y, 2005:348-69Interpretationed, Lippincott Williams & Wilkins, Baltimore, Md, USA, 3rd edition, 1999

Wada O, Asanoi H, Miyagi K, Ishizaka S, Kameyama T, Seto H, Sasayama Importance of abnormal lung perfusion in excessive exercise ventilation in chronic heart failure. *Am Heart J* 1993; 125: 790–798

Wasserman, K. Zhang, Y.Y.Gitt, A. Belardinelli. R. Koike, A.Lubarsky, L.Agostoni, P.G. Lung function and exercise gas exchange in chronic heart failure. *Circulation* 1997; 96: 2221–2227

World Health Organization Statistic (2014)

Wright, S .P.Verouhis, D. Gamble, G.Swedberg, K. Sharpe, N. and Doughty, R.N. Factors influencing the length of hospital stay of patients with heart failure. *European Journal of Heart Failure*.2003; 5(2):201-209.

Young, J. B. (2004) the global epidemiology of heart failure, *Medical clinics of North America*; 88: 1135-1143



REPUBLIC OF ZAMBIA
MINISTRY OF HEALTH
University Teaching Hospital

P/Bag Rw 1X
Lusaka - Zambia

Fax: +260 211 250305
e-mail: mduth@yahoo.com

Tel: +260 211 253947 (Switch Board)
+260 211 251451

OFFICE OF THE SENIOR MEDICAL SUPERINTENDENT

Our Ref: **UTH/HCC/9/8**
Your Ref:

10th March, 2014

The Head of Department
The University of Zambia
School of Medicine
Department of
P.O. Box 50110
LUSAKA

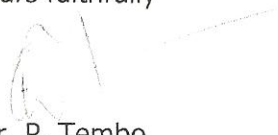
Dear Sir/Madam

RE: RESEARCH PROJECT FOR CHARITY KAPENDA MUSELEMA

Reference is made to your letter of 7th March, 2014.

I wish to inform you that permission has been granted for the student to conduct research at University Teaching Hospital. She is advised to liaise with the Head of Department – Medicine and Health Information Systems.

Yours faithfully


Dr. P. Tembo
A/Head Clinical Care
For Senior Medical Superintendent
UNIVERSITY TEACHING HOSPITAL

cc. HOD – Physiotherapy

LC/mchk



THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: unzarec@unza.zm

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

Assurance No. FWA00000338
IRB00001131 of IORG0000774

8th May, 2014.

Our Ref: 014-03-14.

Ms. Charity K. Muselema,
University of Zambia,
School of Medicine,
Department of Physiological Sciences,
P.O Box 50110,
Lusaka.

Dear Ms. Muselema,

RE: RESUBMITTED RESEARCH PROPOSAL: "PHYSIOLOGICAL EFFECTS OF ACTIVE CYCLE OF BREATHING TECHNIQUES (ACBT) ON VENTILATORY FUNCTIONS IN HEART FAILURE PATIENTS AT THE UNIVERSITY TEACHING HOSPITAL, LUSAKA, ZAMBIA"
(REF. No. 014-03-14)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 6th May, 2014. The proposal is approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat).
- **Ensure that a final copy of the results is submitted to this Committee.**

Yours sincerely,


Dr. J.C. Munthali
CHAIRPERSON

Date of approval: 8th May, 2014.

Date of expiry: 7th May, 2015.



THE UNIVERSITY OF ZAMBIA
SCHOOL OF MEDICINE

Telephone: 252641
Telegram: UNZA, Lusaka
Telex: UNZALU ZA 44370
Email: shnzala@unza.zm

P.O. Box 50110
Lusaka, Zambia

=====

4th March, 2014

Ms Charity K Muselema
Department of Physiological Sciences
School of Medicine
LUSAKA

Dear Ms Muselema,

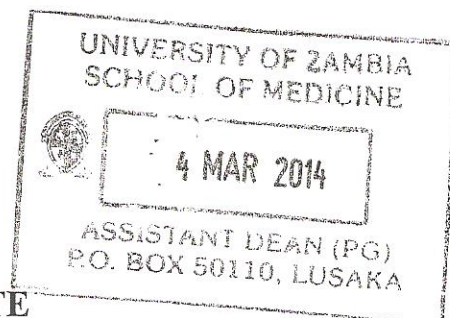
RE: GRADUATES PROPOSAL PRESENTATION FORUM (GPPF)

Having assessed your dissertation entitled “Effects of Active Cycle of Breathing Techniques (ACBT) on Ventilatory Function in Heart Failure Patients at the University Teaching Hospital; Lusaka, Zambia”, we are satisfied that all the corrections to your research proposal have been done. The proposal meets the standards as laid down by the Board of Graduate Studies.

You can proceed and present to the Research Ethics.

Yours faithfully,

Dr. S. H. Nzala
ASSISTANT DEAN, POSTGRADUATE



CC: HOD – Physiological Sciences